Incident Title	**Natural Gas Transmission Pipeline Rupture**	
Incident Type	Explosion and Fire	
Date	15th June 2021	
Country	USA	
Location	Coolidge, AZ	
Fatalities	**Injuries**	**Cost**
2	1	US$ 5.5 m (2023) – Ref. 1

Incident Description

Credit: Coolidge Fire Department

In the early hours of 15-Jun-21, an underground DN 750 (30" NS) natural gas transmission pipeline operating at around 59.5 barg (863 psig) ruptured in a rural location. The resulting loss of primary containment (LOPC) caused a release of natural gas. The escaping gas ignited and caused an explosion which generated a blast wave and a gas-fed fire. The control panel operator for the pipeline was located ~ 1240 km (770 miles) away and only received abnormal pressure rate-of-change alarms about 7 minutes after the rupture. The emergency response procedure was initiated and 3 manually operated main line valves (MLVs) were closed to isolate the affected section of the pipeline. The fire was finally extinguished approx. 3 hours after the rupture.

The explosion and fire destroyed a single-storey wood-framed farmhouse located approximately 137 m (450 ft) away and a 14.3 m (47 ft) section of pipe was ejected 268 m (878 ft) from the centre of the rupture crater. Two of the three occupants of the farmhouse died; the third was seriously injured. Several farm animals were killed or injured by sustained heat exposure from the fire and a 0.13 km^2 (33 acre) area of vegetation was damaged.

Incident Analysis

Basic cause was rupture of a DN 750 (30" NS) section of carbon steel (API 5L Gr. X-70) pipe caused by localised loss of wall thickness due to low pH stress corrosion cracking (SCC) on the pipe OD at a longitudinal seam weld.

Critical factors included: 1) The pipe was fabricated from rolled steel plate with double submerged arc-welded longitudinal seams, 2) Corrosion protection was provided by coating the pipe with 2 layers of plastic spiral-wrap tape and supplemented with an impressed current cathodic protection system, 3) The tape coating had become disbonded from the pipe along the longitudinal weld seams due to “tenting” of the tape wrap (“tenting” creates a gap where the weld meets the OD of the pipe), 4) Isolation of the affected section of line required manual closure of main line valves (MLVs).

Root causes included: 1) Inadequate design (not using high integrity fusion-bonded coating for corrosion protection), 2) Inadequate documentation (coating type for affected section incorrectly recorded as epoxy rather than tape), 3) Inadequate risk assessment of potential for stress corrosion cracking (assumed use of epoxy coating), 4) Inadequate normative design standard (calculation method for potential impact radius [PIR] of pipeline rupture), 5) Inadequate hazard awareness (PIR and SCC risk underestimated), 6) Inadequate inspection (location not designated a high consequence area).

Lessons Learned

1) Designers should assess risk of internal and external corrosion of pipelines (especially if buried or repurposed), 2) “Tenting” of tape wrap coatings on seam-welded pipe can prevent cathodic protection current reaching the resulting exposed pipe wall, hence enabling corrosion of its external surface, 3) The PIR calculation methodology in the design standard was updated.

More Information

1) “Kinder Morgan Natural Gas-Fuelled Explosion – Coolidge, Arizona 15th August 2021”, US National Transportation Safety Board (NTSB), Pipeline Investigation Report No. PIR-23/01 (2023): NTSB Report.
2) UK Statutory Instrument No. 825 “The Pipelines Safety Regulations 1996”: UK Pipeline Safety Regulations.
3) “Steel Pipelines for High Pressure Gas Transmission”, Institution of Gas Engineers and Managers, IGEM/TD/1 Ed. 6 with amendments, May 2024.

Industry Sector	Process Type	Incident Type
Oil & Gas	Gas Transmission	Explosion & Fire
Equipment Category	**Equipment Class**	**Equipment Type**
Mechanical	Piping	Pipe

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