Atmos Energy Corporation
Natural Gas-Fueled Explosion
Dallas, Texas
February 23, 2018
Managing Director’s Introduction

Sara Lyons  Investigator-in-Charge*
Rachael Gunaratnam  Emergency Response
Steve Jenner  Human Performance
Nancy McAtee  Fire and Explosion
Frank Zakar  Materials Laboratory
Michael Hoepf  System Safety
Gena Evans  Writer / Editor
Christy Spangler  Graphics

* The on-site Investigators-in-Charge were Ravi Chhatre and Roger Evans.
## Managing Director’s Introduction

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
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<tr>
<td>Michael Hiller</td>
<td>Deputy Director, Office of Railroad, Pipeline and Hazardous Materials Investigations</td>
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<tr>
<td>Sean Lynum</td>
<td>Chief, Pipeline and Hazardous Materials Division</td>
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<td>Dolline Hatchett</td>
<td>Director, Office of Safety Recommendations and Communications</td>
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<td>Jim Ritter</td>
<td>Director, Office of Research and Engineering</td>
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<td>Kathy Silbaugh</td>
<td>General Counsel</td>
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<td>Scott Rainey</td>
<td>Safety Recommendations</td>
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# Support Staff for Virtual Board Meeting

<table>
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<th>Name</th>
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<tr>
<td>James Anderson</td>
<td>SRC-60</td>
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<tr>
<td>Michael Anthony</td>
<td>CIO-1</td>
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<tr>
<td>Deidra Esters</td>
<td>AD-10</td>
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<td>Carl Perkins</td>
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<td>Kelley Romeo</td>
<td>CIO-60</td>
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<td>Rahiq Syed</td>
<td>CIO-60</td>
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<tr>
<td>Brian Young</td>
<td>MS-10</td>
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Investigation Overview
Dallas, Texas
February 23, 2018

Sara Lyons
Investigator-in-Charge
Explosion at 3534 Espanola Drive

Photograph courtesy of DFR
Timeline

**Event 1**
February 21, 2018 – 5:49 a.m.
Explosion and fire reported
3527 Durango Drive
One injury - second-degree burns

**Event 2**
February 22, 2018 – 10:21 a.m.
Fire reported
3515 Durango Drive
One injury - second-degree burns

**Event 3**
February 23, 2018 – 6:38 a.m.
Explosion reported
3534 Espanola Drive
Five injuries - one fatal

Photographs courtesy of DFR
Weather Conditions

- Significant rainfall observed prior to the explosion
- Temperature ranged between 34-52°F
Note: thick white outline indicates if technician indicated conditions will not permit bar test.
Cracked Gas Main

- Gas main leaking below sewer lateral
- Sandy embedment surrounded sewer lateral

Photograph courtesy of Atmos, taken March 6, 2018
Gas Migration

- Gas indicated
  - between cracked main and explosion home
  - over sewer main
- Accumulated within home
- Ignited by an unknown source
Parties to the Investigation

- Pipeline and Hazardous Materials Safety Administration
- Railroad Commission of Texas
- Dallas Fire-Rescue Department
- Atmos Energy Corporation
Safety Issues

- Incident investigation
- Leak investigations and repairs
- Methane detection
- Incident reporting
- Integrity management
Examination of Gas Main

Frank Zakar
Gas Main

• API 5L Grade C seamless pipe
• Protected against corrosion
  • Exterior coating: coal-tar enamel spiral wrap
  • Cathodic protection: sacrificial anode
Gas Main

- Calcareous deposit
- External coating
- Gas Leak
- Dent
- Crack

Side Profile

Internal View

↑ Up

East

West

Dent
As-received

Post-cleaning
Gas Main

Dent and gouges

- Typical of damage from digging operation
- Consistent with those caused by excavation equipment (not from a shovel)
- Most likely resulted when sanitary sewer lateral was replaced in 1995
Pressure Testing at NTSB Materials Laboratory

Cracked gas main
• Operating pressure: 17-45 psig
• Leak rate: 8 - 14 CFM

Service tee assembly
• Started to leak at: 55 psig
• Leak rate: 0.2 CFM

The maximum allowable operating pressure (MAOP) was 55 psig.
Gas Main Fracture Sequence of Events

Outside diameter

S1

S2

DENT

End of crack

Laboratory fracture

Longitudinal saw cut

End of crack

Laboratory fracture

0.1 inch
Timing of Through-wall Crack

- Fracture surface contained corrosion and calcareous deposits
- Through-wall crack was present for an extended period of time
- Fracture preceded all three fire/explosion events
Fire and Explosion Evaluation

Nancy McAtee
Overview of Incidents

• 3527 Durango Drive

• 3515 Durango Drive
3527 Durango Drive (Incident 1)

Photographs courtesy of DFR
3527 Durango Drive (Incident 1)
3527 Durango Drive (Incident 1)
3527 Durango Drive  (Incident 1)

- Damage consistent with a fuel gas/air mixture explosion
- Gas entered the structure through the new addition and spread up into the attic
- Most likely source of gas was Atmos-owned gas lines
  - Gas range, hot water heater, customer piping excluded
- HVAC the most likely ignition source
3515 Durango Drive  (Incident 2)

Photographs courtesy of DFR
3515 Durango Drive (Incident 2)

- Gas range sooted and exhibited thermal damage
- Although not tested, no obvious signs of failure or malfunction found during visual examination
- Neighbor reported similar incident
3515 Durango Drive (Incident 2)

- Kitchen most likely origin of fire
- Damage not consistent with structure fire
  - Firefighting efforts not ruled out
- Exact cause of the incident could not be determined
  - Evidence that natural gas existed within the structure
  - Not all accidental causes could be excluded
Incidents and Explosion Likely Related

- Natural gas was involved in both incident homes
- Insufficient evidence to exclude Atmos’s system as the source
- Leaks on Atmos’s system present prior to first two incidents
- Low likelihood of multiple structure fires/explosions occurring independently on the same block during the same week
Emergency Response

Rachael Gunaratnam
Emergency Response on February 21-23

- Dallas Fire-Rescue (DFR) and Atmos responded to February 21-23 incidents
- Firefighters requested utility companies and arson investigators on-scene
- Firefighters response was timely and effective
Emergency Response on February 21-23

• DFR did not conduct gas monitoring
• Relied on Atmos to conduct gas monitoring
• DFR Hazardous Materials Response Team (HMRT) was not requested
• DFR procedures not consistent for gas-related events
DFR Fire Investigation

- On-scene work
  - Take photos and interview witnesses
- Fire Investigation Reports
  - Classified as “undetermined”
  - Concluded both Durango home fires were related to a gas-fueled appliance

Photograph courtesy of DFR
DFR Fire Investigation Report Conclusions

- Initially identified the wrong appliance for February 21 incident
- February 21 and February 22 reports drew conclusions before pressure testing the gas piping
- Lacked awareness and understanding of natural gas operations and hazards
Atmos’s Investigation of the First Two Incidents

- Atmos technicians responded on February 21 and 22
- Bar hole made in ground
- Atmosphere in the bar hole sampled for gas

Figure courtesy of PHMSA
Atmos’s Investigation of the First Two Incidents

First Incident (3527 Durango Dr.)

- One bar hole test
- Surveyed for gas over the top of the soil
- DFR arson investigator indicated gas-related fire from inside the house
- Customer piping not tested
Atmos’s Investigation of the First Two Incidents

Second Incident (3515 Durango Dr.)

• Multiple bar hole tests
• Modified measurement technique
• Bubbles observed near meter
• Customer piping not tested

Photograph courtesy of DFR
Atmos’s Investigation of the First Two Incidents

- Atmos excluded its system from the February 21 and 22 incidents
- Atmos’s investigations of the Durango homes were insufficient
Methane Detection

- None of the residents smelled gas
- Previous NTSB pipeline investigations found that soil can deplete gas odorant
- A methane alarm would alert residents to a gas release

Photograph courtesy of Atmos, taken February 24, 2018
Operator Incident Reporting

- Gas distribution incidents are reportable to PHMSA and the NRC under 49 CFR 191.3
- Atmos did not immediately report the first two incidents
- Lack of official reporting delayed a timely response by the RRC, PHMSA, and the NTSB
Operator Incident Reporting

- PHMSA does not specify investigation requirements for gas-related events
- GPTC guidance lists items for operators to “consider” to determine if a gas event is reportable (explosion, fire, evacuation, etc.)
- Atmos relied on its leak investigation data
DFR Incident Reporting

- DFR fire investigation reports can be elevated and reported informally
- No formal policy in place to report unusual circumstances
- Timely reporting prompts further investigation and oversight
Operations and Integrity Management

Sara Lyons
Leak Investigation Equipment

**Remote Methane Leak Detector**
- Used to detect gas above ground
- Not recommended in wet weather

**Combustible Gas Indicator**
- Used to pinpoint the location of a gas leak
- Not recommended in wet weather
- Used in bar hole test
Leak Surveys

- 26 Grade 1 or 2 leaks
  - 13 found before explosion
  - 13 found after explosion
- Disconnected natural gas service to 2,800 homes
Geotechnical Evaluations

Atmos

• Large number of leaks was “abnormal, sudden, and unexplained”
• Rain caused unanticipated external loading

US Army Corps of Engineers

• Wet/dry cycles cause clay to shrink and swell, distressing buried piping
• No evidence of unanticipated external loading
High Plasticity Clay Soils

- US Army Corps of Engineers indicated that soil loading can distress buried piping
- Similar observations
  - Previous NTSB investigation
  - Foundation inspection at 3534 Espanola Drive
Integrity Management Requirements

- DOT Inspector General recommended PHMSA require pipeline integrity management for the gas distribution sector in 2004
- Requirements promulgated in 2009, effective August 2011
- Purpose was to enhance safety by identifying and reducing pipeline integrity risks
Integrity Management

- Threats must be identified and understood
- Safety resources are to be applied commensurate with the importance of each threat
- Leak survey methodology and frequency did not identify the degraded condition