National Transportation Safety Board
Washington, D.C. 20594

Office of Railroad, Pipeline and Hazardous Materials Investigations

Pipeline Operations

Group Chairman's Factual Report of the Investigation

Atmos Energy Corporation

Natural Gas-Fueled Explosion During Routine Maintenance

Farmersville, Texas

June 28, 2021

NTSB Investigation No.:

PLD21FR002

Report Date: February 3, 2022

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B. Accident Summary

For a summary of the accident, refer to the *Accident Summary* report within this docket.

C. Location of the Accident

The accident occurred in Atmos Energy Corporation's (Atmos's) Line D17, Line D17-9, Line O13-3 Junction Lot (junction lot), about 5 miles northwest of Farmersville, Texas (Figure 1). The junction lot was gated and fenced, with three active pipelines, and three pig launchers.[1] The junction lot was in a Class 1 location that was preliminarily identified as a potential moderate consequence area (MCA) and did not fall within a high consequence area (HCA).[2] The launcher involved in this accident is shown in Figure 2.

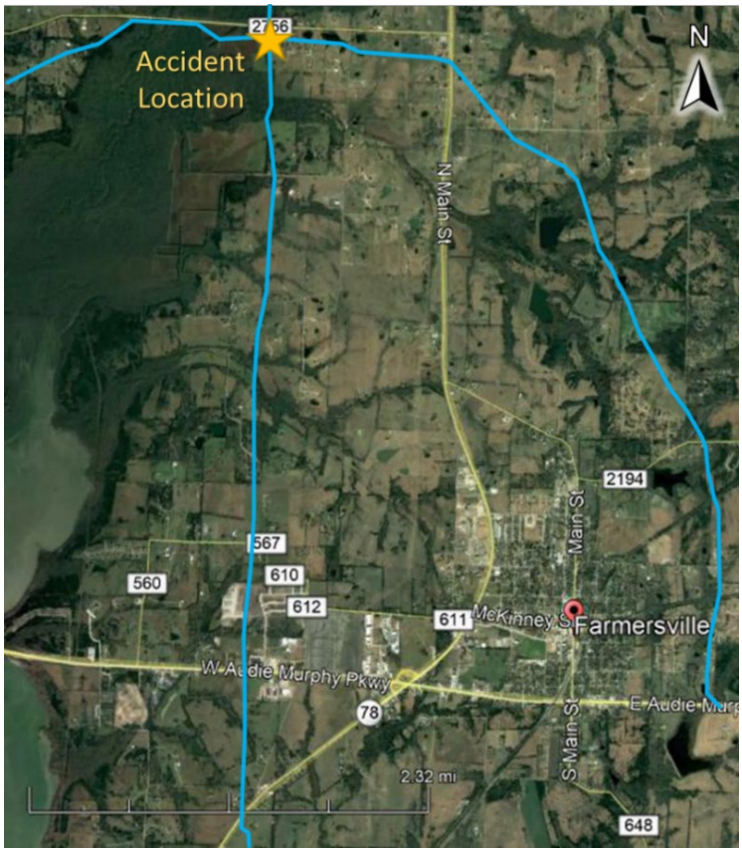

Figure 1. Accident location with nearby gas transmission pipelines shown in blue (Source: Google Earth and NPMS Public Viewer)

[1] A *launcher* is the portion of the pipeline facility used to insert in-line inspection tools, commonly referred to as pigs, into a pipeline.

[2] Pipeline safety regulations for gas transmission pipelines define areas that have higher potential consequences to health and safety as *high consequence areas* or *moderate consequence areas*.

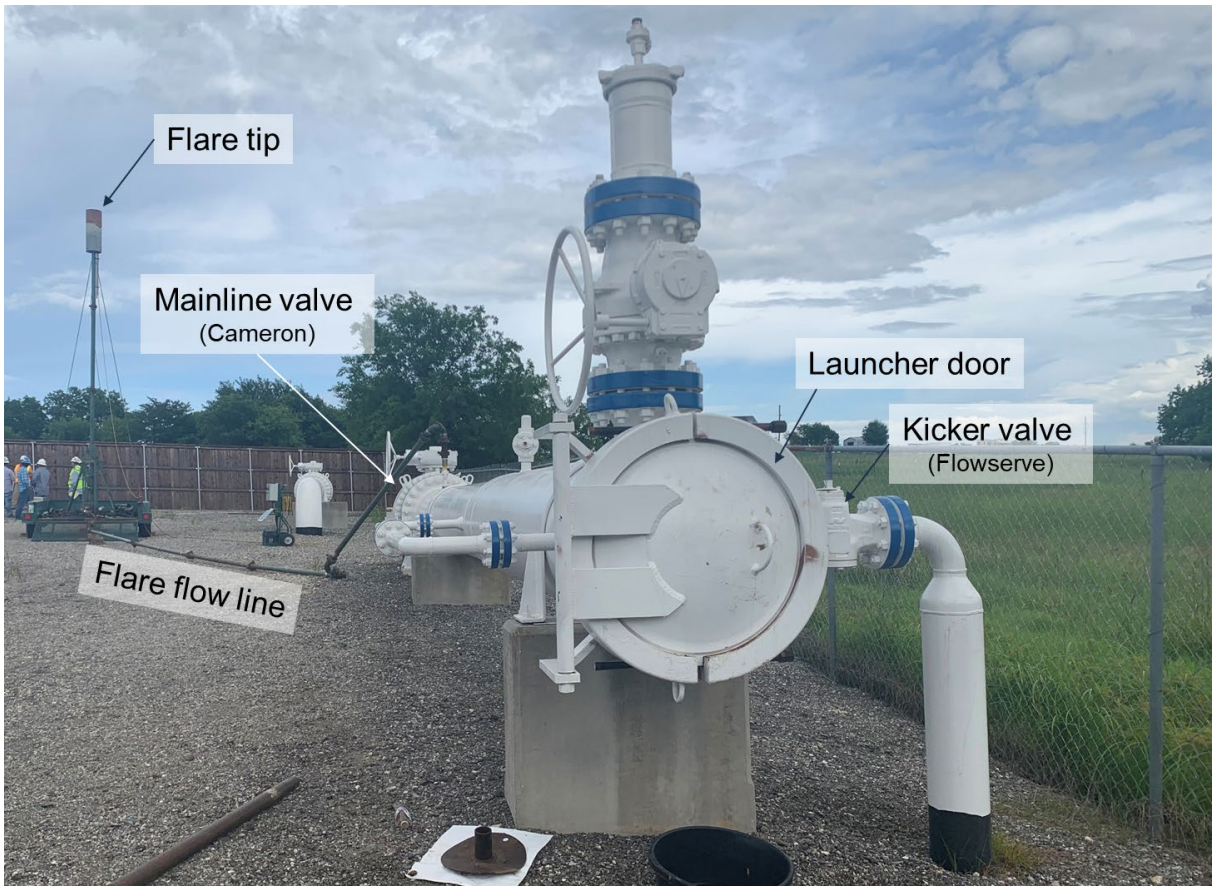

Figure 2. Front View of Pig Launcher Involved in the Accident

D. Description of the Operator and Contractors

When the accident occurred, employees from Atmos, Bobcat Contracting L.L.C. (Bobcat), and FESCO, Ltd. (FESCO) were onsite.

D.1 Atmos

As of June 2021, Atmos had about 6,733 miles of intrastate gas transmission pipelines, primarily in Texas, but also in Kansas, Louisiana, Mississippi, Tennessee, Virginia, and Kentucky; about 386 miles were in HCAs. Atmos Pipeline - Texas (APT; PHMSA Operator Identification #31978), headquartered in Dallas, TX, was a regulated intrastate natural gas transmission pipeline network and storage company. APT owned and operated about 5,750 miles of intrastate natural gas transmission pipelines. APT provided transportation and storage services to local distribution companies, including Atmos's Mid-Tex Division, and transportation services to industrial and power generation customers, gas marketers and producers.

Atmos staff were onsite to perform in-line inspection activities and oversee contractor personnel when the accident occurred.

D.2 Bobcat

As of June 2021, Bobcat, headquartered in Hillsboro, Texas, provided pipeline and fabrication, crane, and electrical and instrumentation services. Bobcat was providing pig loading services to Atmos when the accident occurred.

According to Master Service Agreement No. SA16-08234, Bobcat's assignable scope of work included:

> "General pipeline construction, maintenance, repairs and related services for Atmos Energy's natural gas facilities, including, but not limited to excavation, coating, hydrotesting, fabrication, trucking and hazmat emergency response for both transmission and distribution systems."[3]

D.3 FESCO, Ltd.

As of June 2021, FESCO, headquartered in Alice, Texas, with the Pipeline Services division in El Campo, TX, was a national oilfield service company. FESCO was providing flaring services to Atmos.

According to Master Service Agreement No. CW2225263, FESCO's assignable scope of work included:

> "Provide support to company's pigging operations, separation of effluents from pipeline, flaring of natural gas; design / professional recommendations on flare stack and separator sizing and metering for flared volumes."[4]

FESCO was assisting Bobcat in pig loading when the accident occurred.

E. Personnel Information

At the time of the accident, seven workers were on-site, including:

- Atmos Senior Field Construction Coordinator A (Atmos Sr. FCC A)
- Atmos Senior Field Construction Coordinator B (Atmos Sr. FCC B)
- Bobcat Foreman
- Bobcat Skilled Laborer
- Bobcat General Laborer
- FESCO Project Manager
- FESCO Pipeline Technician

[3]Atmos-Bobcat Master Services Agreement Excerpt and Task Rate Sheet
[4]Atmos-FESCO Master Services Agreement Excerpt and Task Rate Sheet

Additional information about these workers' experience, training, and qualifications is provided in the *Human Performance Group Chairman's Factual Report* within this docket.

F. Atmos and Contractor Roles and Responsibilities

Atmos documented the work being performed at the time of the accident in Compliance Management Plus (CM+) Pig Survey Work Order for project 423.[5] Project 423 included pigging about 21 miles of 24-inch outer diameter pipe on line D17 from the junction lot to Rockwall between June 21, 2021 and July 2, 2021. A Pigging Form was used to collect data about the pig run, including data needed to complete the CM+ work order. At the conclusion of the project, Atmos planned to close out the CM+ work order and maintain the record in CM+.[6]

As indicated on Atmos's Technical Questionnaire for this project, project number 180.47094, the desired in-line inspection tools included the gauge pig involved in this accident, a caliper pig (XGP) for geometry, and a high-resolution magnetic flux leakage (MFL) pig for wall loss detection.

On June 21, 2021, Atmos provided a schedule of activities to project stakeholders; the schedule was updated on June 24, 2021. The updated schedule indicated that the following activities were planned:[7]

- Monday, June 21: Setup Day
- Tuesday, June 22: Foam Pig Cleaning
- Wednesday, June 23: Brush Mandrel Cleaning
- Thursday, June 24: Cleaning Run
- Friday, June 25: Cleaning Run
- Monday, June 28: Open
- Tuesday, June 29: Gauge Plate Tool
- Wednesday, June 30: Caliper Tool
- Thursday, July 1: Smart Tool
- Friday, July 2: Open

Atmos contracted Bobcat and FESCO to support this project. Atmos communicated its expectations of its contractors through Master Service Agreements and related task request forms, verbally during a June 15, 2021 Stakeholders Meeting, and verbally on-site.[8,9,10]

[5] (a) Ops - Atmos Work Order and Related Documentation
(b) CM+ is a compliance and work management system used by Atmos.
[6] Atmos-NTSB IIC Email Statements
[7] Adjustments were later made to this schedule (see Section I)
[8] Although the Stakeholder Meeting Notes indicated that the push bar would be provided by Atmos's supplier, Entegra, it was instead provided by Bobcat. (Atmos Stakeholder Meeting Notes)
[9] Atmos Sr. FCCs A and B interviews
[10] A *task request form* is a written document that identifies and authorizes work to be performed; it may contain work instructions, specifications, and specific billing advice.

The task request forms for both Bobcat and FESCO did not describe the specific work that was to be performed on the day and site of the accident. It instead served as a rate sheet for all work requested by Atmos between October 1, 2020 and September 30, 2021.[11]

According to the Stakeholder Meeting notes, many Atmos employees (including Atmos Sr. FCCs A and B) attended, as did one representative from Bobcat and one representative from FESCO; neither the Bobcat nor the FESCO representative were on-site at the time of the accident.[12] At the Stakeholder's meeting, Atmos Sr. FCC A recalled that the team went over what equipment was needed at the launching point (track hoe and portable flare), where those points were located, as well as any safety issues or safety concerns. The safety issues or concerns noted on the Stakeholder Meeting Notes included personal protective equipment, COVID-19 protocols, and responsible staff for safety meetings at the launcher and receiver.

Some items on the Stakeholder's Meeting Template did not have notes next to them, including: "Atmos PIM Plan Appendix R procedures review" and "Launcher compliant with 192.750 to prevent opening pressurized vessels (pressure gauges, equalizing connections, and/or devices to prevent opening pressurized vessels)."[13]

The responsibilities of Bobcat, FESCO, and Atmos workers who were onsite on the day of the accident were delineated as follows:

- Bobcat's responsibilities included: [14]
    - Collecting information on each pig run in the Pigging Form Pig Run Log
    - Collecting site photos of the work being performed
    - Ensuring access to the launcher to load pigs and providing the push bar
    - Installing new batteries in the transmitter and installing the transmitter in the pig
    - Opening the launcher door
    - Loading the pig using the excavator
    - Pushing the pig into the reduced section of the launcher using the push bar and excavator
    - Closing the launcher door
- FESCO's responsibilities included the flaring operation:[15]

[11] (a) Atmos-Bobcat Master Services Agreement Excerpt and Task Rate Sheet
(b) Atmos-FESCO Master Services Agreement Excerpt and Task Rate Sheet

[12] According to Atmos Sr. FCC A, Atmos Stakeholders Meetings provide an opportunity for all parties meet to discuss the entire process (issues, tasks, schedule). It allows local operations, engineers, management, and contractors to get on the same page. Usually, the engineer leads the conversation.

[13] The requirements of 49 CFR 192.750 were published October 1, 2019, effective July 1, 2020, and applicable July 1, 2021 (84 FR 52180). 49 CFR 192.750 was not required by any regulatory authority at the time of the accident.

[14] (a) Atmos Stakeholder Meeting Notes
(b) Bobcat Scope of Work with Email Clarification
(c) Bobcat was not contracted to perform any evaluations to determine whether the configuration as installed would adequately depressurize or remove natural gas from the launcher prior to opening the launcher door.

[15] (a) Atmos Stakeholder Meeting Notes
(b) Atmos was responsible for obtaining city and county permits necessary to operate flare.
(c) FESCO Scope of Work Email Clarification
(d) FESCO was not contracted to perform any evaluations to determine whether the configuration as installed would adequately depressurize or remove natural gas from the launcher prior to opening the launcher door.

    - Determining the flaring system/configuration to be used
    - Installation of temporary piping to allow the trap to be blown down to the flare stack
    - Installing and operating the flaring system
- Atmos's responsibilities included:
    - Verifying operator qualifications
    - Leading the safety meeting at the launcher
    - Verifying the valve configuration
    - Overseeing work of contractor employees
    - Determining when contractor employees could begin opening the launcher door
    - Confirming when the pig is in the correct position
    - Purging the launcher with natural gas in preparation for the pig launch scheduled on the following day[16]

All three organizations also had responsibilities at the receiving end of the project. For example, Bobcat was responsible for providing a fire-retardant chemical (3% ANSUL) and pressure sprayer on location to spray pigs if iron sulfide was present at the receiver.

G. Meteorological Information

At the time of the accident, light to heavy rain showers and a temperature of about 75°F were reported. The total precipitation reported on June 28, 2021, was 0.51 inches. No cloud-to-ground lightning strikes were recorded within 15 miles of the accident site. The *Meteorology Specialist's Factual Report* within this docket provides additional information.

H. The Natural Gas Transmission Pipeline System

This accident occurred on a launcher which connected to Atmos's 24-inch nominal diameter Delta-17 (D17) underground natural gas transmission pipeline. Line D17 ran from Mesquite, Texas, north through Rockwall, Texas, and terminated in Bells, Texas. The wall thickness of the D17 pipeline ranged from 0.281-inches to 0.5-inches on the mainline, the majority of which is API 5L grade X52. Line D17 served intrastate natural gas distribution and transmission pipelines in multiple areas. The gas in Line D17 was odorized.

The junction lot was a mixed-purpose valve and pigging facility that had been completed and placed into service on September 22, 2008 (Figure 3). The junction lot contained three pig launchers (Launcher 1, 2, and 3). Launcher 1 was used to send pigs north through Line D17, and Launcher 2 (the launcher involved in this accident) was used to send pigs south through Line D17. Launcher 3 was used to send pigs west through Atmos's Line D17-9.[17]

[16] This step was to occur after the pig was loaded and the launcher door was secure.
[17] Junction Lot Drawings

The ten-mile section of Line D17 south of the junction lot was last hydrostatically tested on May 22, 2019.[18] D17 was in full operation at about 628-pounds-per-square-inch-gauge (psig) at the time of the accident.[19]

The section of D17 within the D17/17-9 junction lot had an MAOP of 800 psig. Its highest recorded operating pressure in the 5 previous years was 731 psig based on the upstream pressure transmitter.[20]

The junction lot also contained regulator station equipment serving Atmos's O13-3 underground transmission pipeline, which ran east from the facility. The west-running portion of the pipeline had been abandoned prior to the accident.

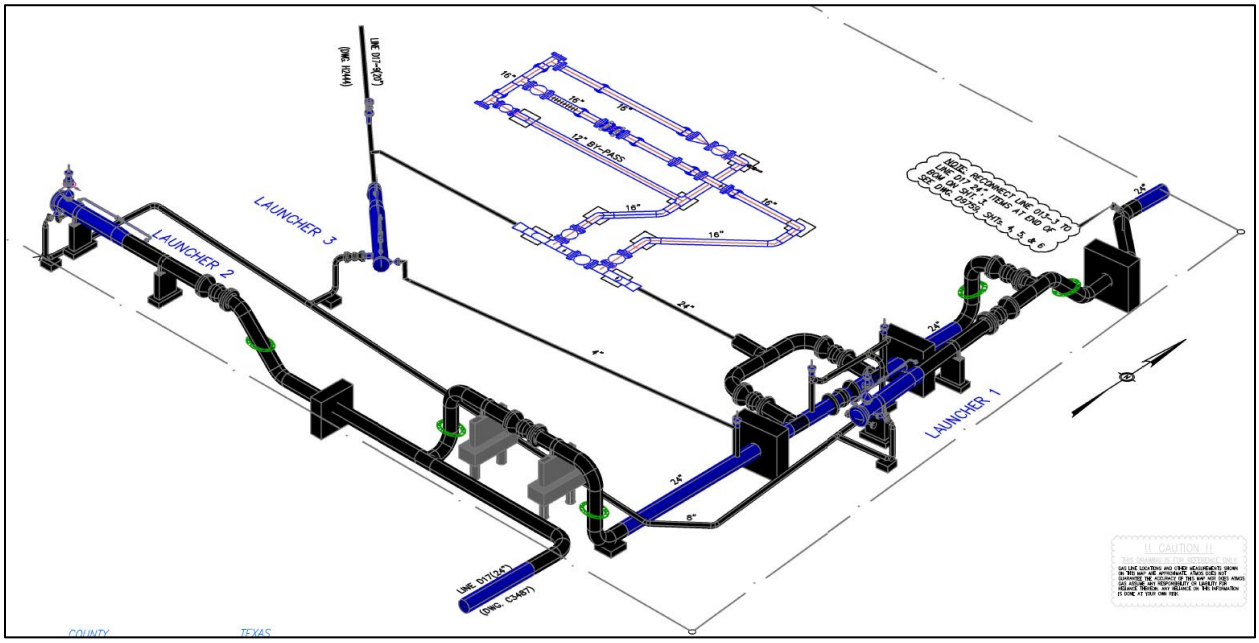

Figure 3. Junction Lot with Launchers Indicated (Courtesy of Atmos)[21]

H.1 Launcher

The launcher involved in this accident (Launcher 2) was assembled from parts brought from other locations to the accident site in 2008. The launcher included a 26-inch Tube Turn hinged closure door (model 400-H), purchased on April 15, 1967, which is no longer manufactured.[22] This closure door did not have a separate device to prevent opening of the

[18] 2019 Pressure Test Report
[19] Gas Transmission System Pressure at Time of Explosion
[20] Atmos-NTSB IIC Email Statements
[21] Junction Lot Drawings
[22] Launcher Door Purchase Requisition

closure if pressure had not been relieved.[23] The distance from the ground to the top of the launcher barrel was about 5 feet.

The launcher barrel included 26-inch and 24-inch diameter sections, an equalizer that connected these sections, and seven valves (Figure 4). Valve 1 was a 24-inch mainline valve, manufactured by Cameron (a Schlumberger company), which connected to the gas transmission pipeline system immediately downstream of the launcher barrel.[24] Valve 2 was a 4-inch kicker valve, manufactured by Flowserve, which connected to the gas transmission pipeline system near the closure door. Valve 3 was a 2-inch ball valve that could isolate the equalizer. Valves 4, 5, and 6 were connected to the top of the launcher barrel and could be used to vent the launcher barrel. Valve 7 was connected between the launcher barrel and Valve 4.

At the time of the accident, Valve 5 was inoperable and had been inoperable since 2020 (possibly earlier).[25] Valve 6 was connected to the flare flow line.

[23] Atmos-NTSB IIC Email Statements
[24] Flow direction in the launcher barrel is defined by the normal direction of travel of the pig, from the kicker valve to the mainline valve.
[25] Atmos-NTSB IIC Email Statements

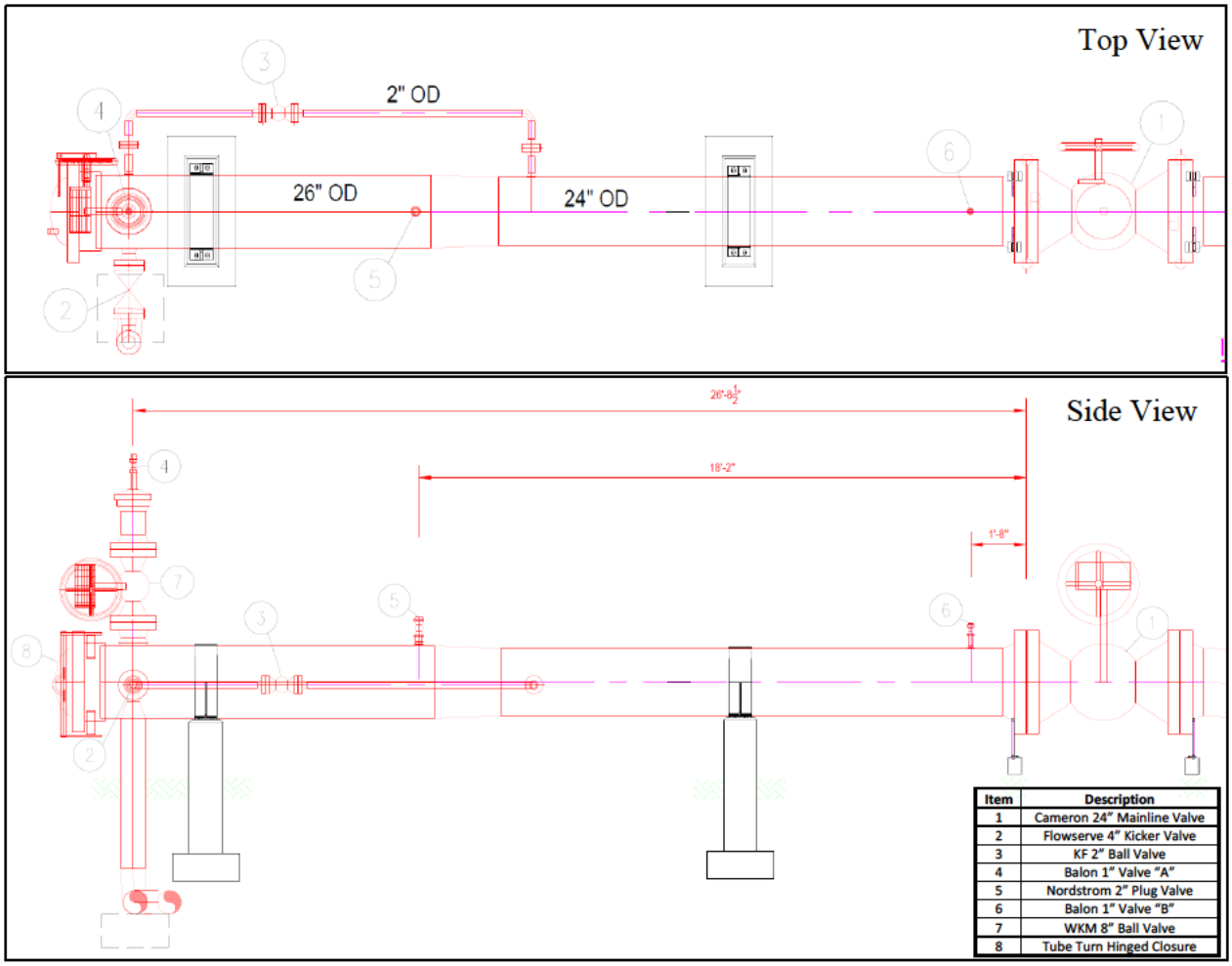

Figure 4. Launcher Configuration with Valves Indicated (Courtesy of Atmos)[26]

H.2 Mainline Valve

One of the two valves that was needed to separate the launcher from the gas transmission system was a 24-inch Grove Side-Entry Ball Valve, Type B5, manufactured by Cameron (mainline valve or Valve 1). This valve had included two redundant seals, one on the pipeline side and one on the launcher side. Each seal was hydrostatically tested to withhold full pressure by the manufacturer during original fabrication. Each seal required two O-rings to function. Additional information about this valve is provided in *Materials Laboratory Factual Report No. 21-094*.

H.3 Kicker Valve

The other valve that was needed to separate the launcher from the gas transmission system was a 4-inch Dynamic Balance Valve, manufactured by Flowserve (kicker valve or Valve 2).

[26] Atmos Drawing of Launcher

Additional information about this valve is provided in *Materials Laboratory Factual Report No. 21-093*.

H.4 Portable Flare System

Atmos indicated that they began using flaring systems to support pig loading and launching activities in February 2021, about four months prior to this accident. They indicated that this change was made to reduce methane emissions, consistent with the *Protecting our Infrastructure of Pipelines and Enhancing Safety Act of 2020* (PIPES Act of 2020), signed December 27, 2020, and a PHMSA Advisory Bulletin, *Pipeline Safety: Statutory Mandate to Update Inspection and Maintenance Plans to Address Eliminating Hazardous Leaks and Minimizing Releases of Natural Gas from Pipeline Facilities*, published on June 10, 2021.[27]

To evaluate the potential risks of this change, Atmos indicated that they relied on their experience safely flaring for other pipeline applications. Atmos stated that, "Our evaluation of potential risks in any operation is ongoing, and in this specific instance, the formal Stakeholder Meeting allowed participating members to thoroughly discuss all aspects of the pigging operation, including flaring of gas from the launcher." For work performed on the day of the accident, Atmos stated that their risk evaluations included both the Stakeholder Meeting and the employees' stop work authority. No procedures were updated to document the change, nor were qualification or training requirements revised to reflect the change.[28]

Atmos Sr. FCC A indicated that the new direction is to blow down launchers with a flare or to use a compressor (e.g., Zero Emission Vacuum and Compressor, or ZEVAC) which can take gas and compress it into another pipe to reduce the launcher pressure to zero.

At the accident site, a FESCO portable flare system (model FS-128-3) was connected to Launcher 2 at Valve 6. The flare system included temporary piping to allow the launcher to be blown down to the flare stack.[8,29]

H.5 Gauge Pig

A 24-inch gauge pig (model 2CC-SM – 24"), manufactured by S.U.N. Engineering, Inc., was being loaded into the launcher at the time of the accident. The gauge pig had two aluminum gauge plates attached.[30]

A tracking transmitter with batteries, provided by Atmos, was inserted into the gauge pig prior to loading.

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[27] (a) Atmos-NTSB IIC Email Statements
(b) The PIPES Act of 2020 contained a self-executing mandate requiring operators to update their Operations and Maintenance plans by December 27, 2021 to adequately consider "…(ii) … minimizing releases of natural gas from pipeline facilities; and (iii) the protection of the environment." (https://www.congress.gov/116/bills/s2299/BILLS-116s2299es.pdf)
(c) This Advisory Bulletin was provided by PHMSA to remind each owner and operator of a pipeline facility of the self-executing mandate. (https://www.govinfo.gov/content/pkg/FR-2021-06-10/pdf/2021-12155.pdf)
[28] Atmos-NTSB IIC Email Statements
[29] On Figure 2, this piping is labeled "flare flow line."
[30] Gauge Pig Specifications Provided by Atmos

H.6 Push Pole

The push pole, provided by Bobcat, was a tool used to insert the pig into the launcher.[31] It included two metal pipes connected by a bolt. An oversized cupped head was welded on the end that was used to push the pig. The push pole was completely straight prior to the accident.[32]

I. Events Leading up to the Accident

One week prior to the accident, on June 21, 2021, FESCO installed a portable flaring system at the junction lot. The flaring system remained onsite for the duration of the project, which included the activities indicated in Table 1. Representatives from Atmos, Bobcat, and FESCO were present each time a pig was loaded.[33]

To accommodate expected customer needs, the target completion time for each run was between 9:00AM and 9:30AM. To support this timeline, the pigs were preloaded the afternoon prior to each run.

Table 1. Activities performed at accident site the week prior to the accident[34]

Date	**Early Morning** *(start time range 3:00 - 3:30 AM)*	**Afternoon** *(time varied from 1PM - 5PM)*
June 21, 2021		Loaded foam bullet nose brush pig
June 22, 2021	Launched foam bullet nose brush pig (Run 1)	Loaded brush mandrel pig
June 23, 2021	Launched brush mandrel pig (Run 2)	Loaded brush mandrel pig
June 24, 2021	Launched brush mandrel pig (Run 3)	Loaded brush mandrel pig
June 25, 2021	Launched brush mandrel pig (Run 4)	
June 26, 2021		
June 27, 2021		Loaded brush mandrel pig
June 28, 2021	Launched brush mandrel pig (Run 5)	Load gauge pig[35]

[31] Atmos Stakeholder Meeting Notes
[32] Atmos Sr. FCCs A and B interviews
[33] (a) Atmos Timeline June 21-28
(b) Photographs of Previous Runs
[34] Pre- and post-run photographs are in Appendix A: Previous Run Photographs
[35] The accident occurred while loading the gauge pig. Additional details of this pig loading activity are discussed below.

On Monday, June 21, 2021, the workers noticed that the mainline valve was leaking, and the flare did not extinguish as expected. They adjusted the position of the valve and were able to find a position where the leak stopped or reduced to the point that the flare extinguished. They marked that position and did not have any issues with the flare extinguishing during subsequent runs, including on the day of the accident.[36]

Gas sometimes bleeds by in-service valves (see Section O). To mitigate this issue, Atmos Sr. FCC A indicated that they leave a valve open so that the gas can vent if it is leaking. He also noted that other actions may be taken, depending on the severity of the leak. Atmos Sr. FCC A indicated that he would gauge the severity of a leak by: (1) relying on Bobcat personnel at the open launcher door to tell him there's a leak, or (2) when there is an accessible vent open to atmosphere, he may hear the leak or put his hand over the valve to feel it.

Atmos Sr. FCC B indicated that, had there been gas leaking out of the launcher door, the fumes should have been visible and the odorant noticeable. He further indicated that, when Valve 6 (the valve connected to the flare flow line) was open to atmosphere, gas leaking from the mainline valve would go up and out of the flare stack.

Atmos told NTSB investigators that it "expects its employees to rely on their experience, training, qualifications and judgment to determine when reporting potential issues with valves is necessary." Atmos indicated that it was not aware of any written or verbal reports of potential issues with either the mainline or kicker valve in the 10 years prior to the accident.[37]

According to the Atmos Sr. FCC B and Bobcat Foreman, on previous runs, the Atmos employees used a pressure gauge attached to Valve 4 to monitor the pressure in the launcher barrel. The Atmos Sr. FCC B noted that, when the pressure gauge was installed, the launcher door was only opened when it indicated zero pressure. Bobcat Laborer also recalled seeing pressure gauges being used the week before but didn't see them on the day of the accident.

Atmos Sr. FCC B indicated that attaching the gauge at Valve 4 required climbing on top of the launcher and he didn't feel it was safe enough to continue doing that. He indicated that when loading pigs for the first couple runs, they did watch the pressure drop on the pressure gauge until it equalized.[38]

Atmos Sr. FCC A indicated that they were limited by the number of ports available on the launcher (3 ports), two of which were unavailable (Valve 5 was inoperable and Valve 6 was connected to the flare system).[39] This left only one available port for a pressure gauge, Valve 4. Atmos Sr. FCC A indicated that Valve 4 could not be used when it was raining because someone would have had to climb on top of the launcher to reach it. He indicated that he didn't think you'd be able to see the gauge from the ground even if it had been connected. He also noted that this limitation did not cause him concern because they were "still able to use the flare as a purge." He indicated that the only concern he had was that the flare stack

[36] Atmos Sr. FCC B and Bobcat Foreman interviews
[37] Atmos-NTSB IIC Email Statements
[38] The pressure gauge *equalizes*, or measures 0 psig, when the pressure within the launcher is equal to the atmospheric pressure (~14.7 psi) outside the launcher.
[39] Atmos Sr. FCC A indicated that that he couldn't remove the cap on Valve 5 without turning the whole assembly. He spoke with Bobcat about changing the valve once they had the appropriate paperwork to make sure all the components had the correct pressure rating.

was up high, and he did not have visual or audible confirmation of what was happening at that location.

Atmos Sr. FCC B also indicated that the location of inoperable Valve 5 could have been a port for a pressure gauge, but he had previously used Valve 6.

Atmos Sr. FCC A stated that after being told that Valve 4 had been used as an extra purge point on the first few runs, he recommended instead using only the flare stack due to the elevated release point.

Atmos Sr. FCC A stated that this was the second project he'd worked on which used a portable flare to depressurize a launcher. He had previously performed many pig loading, launching, and receiving assignments, but they had involved venting directly from the launcher to the atmosphere.

Atmos Sr. FCC B also stated that using the portable flare system on the launcher was new. He indicated that he had normally opened Valve 6 to blow the gas to atmosphere. He also indicated that the blow off cap on Valve 7 would be used to depressurize the launcher.

A timeline of the activities performed on the day of the accident, leading up to the accident, is provided in the *Human Performance Group Chairman's Factual Report* within this docket. The below subsections provide additional details about the work that was done prior to the accident.

I.1 Control and Monitor for Natural Gas

No gas monitors were used by any of the workers on the day and site of the accident, either before or after the accident occurred.[40] FESCO Pipeline Technician indicated that he wore a gas monitor when required for previous jobs, but it wasn't required on the day of the accident. Atmos Sr. FCC B indicated that he had a 4-gas monitor in his vehicle but was not wearing it on the day of the accident.[41] Atmos Sr. FCC A stated that he had a combustible gas indicator in his truck but did not use it on the day of the accident.[42] Atmos Sr. FCC A indicated that he had seen Bobcat employees use gas detectors near the launcher door on other jobs, but did not recall seeing any used on the day of the accident.

Although the gas in Line D17 was odorized, none of the workers smelled natural gas odorant that concerned them. FESCO Pipeline Technician indicated it always smells different when a launcher door is opened, so it's hard to tell if gas is leaking or not by the smell. Bobcat Skilled Laborer stated that he typically smells a light odor when a launcher door is opened but didn't recall whether he smelled the odor on the day of the accident. Neither Atmos Sr. FCCs nor Bobcat Foreman recalled smelling natural gas odorant.

[40] All five surviving workers indicated that they did not monitor for gas and no gas monitors were found after the accident.

[41] Multi-gas monitors, or *4-gas monitors*, can detect dangerous levels of various toxic or combustible gases in confined spaces.

[42] *Combustible gas indicators* can be used to pinpoint the location of a natural gas leak.

I.2 Depressurize Launcher

When workers arrived, the launcher was pressurized from the early morning pig launch and had to be depressurized prior to opening the launcher door. The pressure in the launcher was not measured but was expected to be about the same as the natural gas transmission system pressure at the time of the pig launch if there were no leaks.[43]

The portable flare system was used to depressurize the launcher. After Atmos Sr. FCCs gave approval to begin flaring, FESCO Project Manager operated the igniter and FESCO Pipeline Technician operated Valve 6 (the valve connected to the flare flow line). Valve 6 was the only valve opened at this time. Valve 6 was opened to allow natural gas from the launcher to flow through the flare flow line and up the flare stack where it successfully ignited.[44] While the flame at the flare tip continued to burn, FESCO Pipeline Technician manned Valve 6 to incrementally open the valve until it was completely opened. After the valve was completely opened, it was left opened. As the natural gas pressure in the launcher decreased and less natural gas flowed to the flare tip, the flame died down and extinguished.

No device was used to indicate that pressure in the barrel had been relieved; no pressure gauge was used during pig loading activities.

I.3 Purge Natural Gas from Launcher

No additional steps were taken to purge natural gas from the launcher or confirm that the launcher was free of natural gas.

Atmos Sr. FCC A indicated his understanding that the flare was used as a purge and that the open launcher door would have been a secondary check. He explained that any leaking gas would have gone up and out the flare stack.

Bobcat Foreman also indicated his understanding that the flare extinguishing is confirmation that everything is sealed off and no gas is seeping through anywhere.

I.4 Obtain and Assemble Gauge Pig for Loading

Bobcat employees were responsible for picking up the gauge pig from Atmos's McKinney Service Center and bringing it to the junction lot. Three Bobcat employees on-site prior to the accident loaded a transmitter into the pig. Bobcat Foreman took a photograph of the pig with his cell phone at 3:28 PM on June 28, 2021, prior to opening the launcher door (Figure 5).

Atmos Sr. FCC B recalled that Bobcat employees worked on rebuilding the pig under their umbrella while FESCO flared down the launcher.

[43] The launcher is exposed to system pressure during pig launching activities and was not vented after the pig launch was complete.

[44] FESCO Pipeline Technician indicated that the flaring system worked the way it was supposed to, and they had no issues with it. Atmos Sr. FCCs A and B and Bobcat Skilled Laborer observed the flare ignite after some complications.

Figure 5. Photograph of gauge pig under umbrella prior to loading into the launcher. Taken 6/28/2021 at 3:28 PM. (Courtesy of Bobcat)

I.5 Open Launcher Door

None of the surviving workers observed any indication of pressure on the launcher door when it was opened. Bobcat Foreman recalled that, after getting approval from Atmos, he and the Bobcat Skilled Laborer opened the launcher door.

Bobcat Skilled Laborer recalled Atmos announcing that it was safe to open the launcher door but could not recall if he assisted in opening it. He did not recall any audible sound or indication that gas was still present in the launcher when the door was opened.

FESCO Pipeline Technician indicated that he was right near the door while it was being opened, assisting two Bobcat employees. He did not notice any pressure pushing on the door as it was being opened.

I.6 Load Pig in Launcher

Bobcat Foreman recalled going to the excavator to lift the pig as soon as the launcher door was opened. Bobcat Skilled Laborer said he put the strap on the pig so that the excavator could lift and carry it over to the launcher. Once it was loaded, FESCO Pipeline Technician removed the strap and Bobcat Foreman reversed the excavator.

Bobcat Skilled Laborer was responsible for the grounding cable. He indicated that he attached one end on the launcher's white painted exterior and the other end on the push pole. Bobcat Skilled Laborer indicated that the grounding cable was attached the entire time and that he held it to make sure it was bonded.

Neither Atmos Sr. FCCs nor FESCO Pipeline Technician recalled seeing the specific location where the grounding cable attached to the launcher. Atmos Sr. FCC A indicated that he would expect it to attach to the face of the flange where the door is so that there is bare metal contact.

The workers pushed the pig in as far as they could manually with the push pole. Atmos FCC B indicated that it was probably close to the reducer.

The workers then used the excavator and push pole to insert the pig further into the launcher. Atmos Sr. FCC A recalled that they held the push pole and guided the excavator in. The excavator then put its bucket on the bar and began to push. Atmos Sr. FCCs monitored the pig's position as the excavator was used to further insert the pig.[45] Atmos Sr. FCC A monitored the pig's position by visually observing the open end of the launcher. Atmos Sr. FCC B monitored the pig's position by listening for a sound as the pig contacted the reducer. Atmos Sr. FCC B recalled that he was by the equalizer and Atmos Sr. FCC A was by the Bobcat truck during this activity. When the excavator started backing up, Atmos Sr. FCC B was walking back towards the truck. Atmos Sr. FCC B recalled hearing the pig rubbing against the inside of the launcher.

After the pig was inserted to the correct location as determined by the Atmos Sr. FCCs, the push pole was manually removed from the launcher. As the push pole was pulled away from the pig, it fell to the bottom of the launcher barrel. Atmos Sr. FCC A indicated that he heard it hit the bottom of the launcher.

The FESCO Pipeline Technician indicated that he had the lifting strap in his hand, took one step to put the strap on the ground and the explosion occurred. He indicated that he blacked out when he hit the ground and did not see how far the push pole had been pulled out.

Bobcat Skilled Laborer indicated that he observed that the push pole was on the very edge of the launcher, about to be pulled off. He indicated that he still held onto the bonding cable as he was pushed up into the air before landing face down on the ground.

Atmos Sr. FCC A indicated that he had turned to start walking away as soon as they started to extract the pole and he saw them moving the grounding cable.

Atmos Sr. FCC B recalled that the push pole had been about halfway out when the flash occurred and blew the pig back out. He stated that he saw a flash and heard a loud boom; the sound and flash were nearly simultaneous.

The explosion resulted in fatal injuries to the FESCO Project Manager and the Bobcat General Laborer. It also resulted in injuries to the Bobcat Skilled Laborer and FESCO Pipeline Technician.

[45] Atmos Sr. FCC A indicated that they were monitoring the pig's position to make sure that it didn't over seat and block the equalizer.

J. Emergency Response

The post-accident response actions taken by the Collin County Sheriff's Office, Farmersville Police Department, RRC, Atmos, Bobcat, and other responding organizations are provided in the *Emergency Response Group Chairman's Factual Report* within this docket. Atmos Sr. FCC B called 9-1-1 to request assistance at about 3:35 PM.

K. Post-Accident Examinations

K.1 Odorization Tests

Following the accident, Atmos performed and RRC observed an odorant test on nearby aboveground piping at County Rd 574 in Blue Ridge, Texas at aerial line marker 35. The odorant test met regulatory criteria.[46]

K.2 Site Assessment and Evidence Removal

After conducting a site safety review (including a leak survey) prior to entry, the NTSB's initial site visit was completed on the afternoon of June 29, 2021. Several participants smelled natural gas odorant upon entering the junction lot. The FESCO flare system was found connected to Launcher 2 at valve 6. The S.U.N. Engineering Inc. gauge pig, push pole, grounding cable, and two hardhats were found in the southwest corner of the lot, all damaged. All valves were found in the closed position, except Valves 3, 6, and 7. The launcher door was found in the closed position.

Following the initial site visit, the Pipeline Operations Group identified the following additional work to be completed onsite:

1) Confirm the presence of natural gas at the flare tip with RMLD
2) Confirm full closure of launcher door
3) Take measurements and photographs of the site
4) NTSB to take work notes/ Job Safety Analyses (JSAs) that are onsite as evidence
5) Leak survey flare connection at Valve 6, along 2-inch flare flow line, and flare stack to flare tip.
6) Inspect pig internals
7) Measure flow rate through the flare line from closed pig launcher cavity
8) Visually inspect flare tip
9) Test flare system
10) Remove 24-inch mainline valve for visual examination and future testing
11) Remove 4-inch kicker valve for visual examination and future testing
12) Visually inspect launcher cavity and door
13) Remove launcher for future examination

[46] Post-Explosion Odorization Test of D-17 Provided by RRC

Prior to beginning work at the site, protocols were developed, outlining the agreed upon steps that would be followed. Items (1) through (9) were completed in accordance with the Site Assessment Protocol (See Appendix B: Site Assessment Protocol). Items (10) through (12) will be completed in accordance with the Valve Removal and Remaining Examinations Protocol (Appendix C: Valve Removal and Remaining Examinations Protocol). Item (13) was completed in accordance with the Launcher Removal Protocol (Appendix D: Launcher Removal Protocol).

Prior to the Site Assessment on July 2, 2021, Atmos completed a leak survey which a RRC inspector oversaw. The results confirmed safe entry for the investigative team and natural gas at the flare tip. The investigative team smelled gas upon entry to the junction lot. The team also took measurements and photographs (Figure 6) and made the following observations:

- The launcher door was fully closed and secure.
- No work notes or job safety analyses were found onsite.
- No gas was leaking from the flare connection at Valve 6, along the 2-inch flare flow line, or from the flare stack except at the flare tip.[47]
- The excavator undercarriage had a circular mark consistent in size and shape to the push pole.
- Hair and what appeared to be blood was present on the excavator.
- The welded connection between the push pole head and pole was broken.
- The plate that was welded to the push pole head was deformed (concave, not flat).
- The push pole was bent, and the connecting bolt was sheared off.
- The end of the push pole that did not have the head attached was deformed.
- The pig's rear gauge plate was bent forward in two areas, about 180 degrees apart.
- The blind flange on the back of the pig was deformed on one side.
- Insulation on the grounding cable was damaged in several locations.
- Valve 1 had scribe marks nearly in the center of the "SHUT" location.
- One hardhat was found south of the southern fence line.

Site Assessment activities continued on July 5, 2021. Prior to entering the junction lot, Atmos completed another leak survey which a RRC inspector oversaw. The results confirmed safe entry for the investigative team and natural gas at the flare tip. The investigative team smelled gas upon entry to the junction lot.

The team visually inspected the pig, completed orifice flow testing, visually inspected the flare tip, and ignited the flare with natural gas that was venting from the pig launcher. The team took photographs (Figure 7) and made the following observations:

- Visual inspection of pig
    - Four fins on the larger gauge plate were bent forward on one side and three on the other.
    - One fin on the smaller gauge plate was bent backwards.
    - Packing inside pig no visible evidence of ignition, burning, or soot.

[47] Post-Explosion Leak Survey

    - Forward, chamfered edge of pig appeared to have been locally heated.
    - No significant damage to transmitter case was apparent.
- Orifice flow testing[48]
    - Prior to orifice flow testing, pressure in the launcher was measured at Valve 4 and recorded as 0.2 psig. This measurement was taken with the flare flow line venting from through Valve 6 and to the flare flow line to the flare tip.
    - Steady state flow was observed through a 1/8-inch diameter orifice plate at a pressure of 9 inches water column. This corresponds to an estimated natural gas flow rate of 1590 cubic feet per day.
- Visual inspection of flare tip
    - Nothing unusual observed.
    - Some corrosion and heat affect areas were observed.
- Flare system ignition[49]
    - Flare ignited without difficulty
    - Igniter was powered off after initial ignition
    - Flames were visible throughout 20-minute hold

Between July 9, 2021 and July 13, 2021, the mainline and kicker valves were removed from the junction lot and transported to a secure storage location (Figure 9). These activities were completed by Atmos and their contractors with oversight by RRC (in-person) and NTSB (remotely). The RRC pipeline safety inspector made the following observations: [50]

- The kicker valve appeared to be in the completely closed position, and the internal portion of the valve appeared to be in good condition.
- The mainline valve appeared to be in the completely closed position with three possible grooves visible on the ball.
- The interior of the launcher contained a dark colored film, but the film was missing in two areas at the approximate 6 o'clock position of the barrel.
- Borescope inspection inside the launcher provided a low-quality view and was not able to distinguish any surface abnormalities.
- A pressure release sound was heard when the pig transmitter was removed from its case. An O-ring seal, which was installed between the transmitter cap and transmitter body, appeared to be extruding on one side. There was no indication of pressure within the transmitter's battery compartment.

Photographs of the launcher door's mating surfaces taken on July 13, 2021 indicate that the surfaces were corroded (Figure 8).

[48] (a) Atmos's natural gas transmission system near Launcher 2 was pressurized to 660-670 psig during this testing. The test concluded at 12:35 PM.
(b) The orifice flow testing was performed from a location on the flare flow line upstream of the flare stack (the flare flow line was disconnected from the flare stack for testing).
[49] Atmos's natural gas transmission system near Launcher 2 was pressurized to 660-670 psig during this testing.
[50] Stopple Installation and Valve Removal Project Timeline provided by RRC

On July 23, 2021, the launcher was removed from the junction lot and transported to a secure storage location (Figure 10). The launcher removal was completed by Atmos and their contractors with oversight by RRC (in-person) and NTSB (remotely).

Figure 6. Site Assessment, July 2, 2021

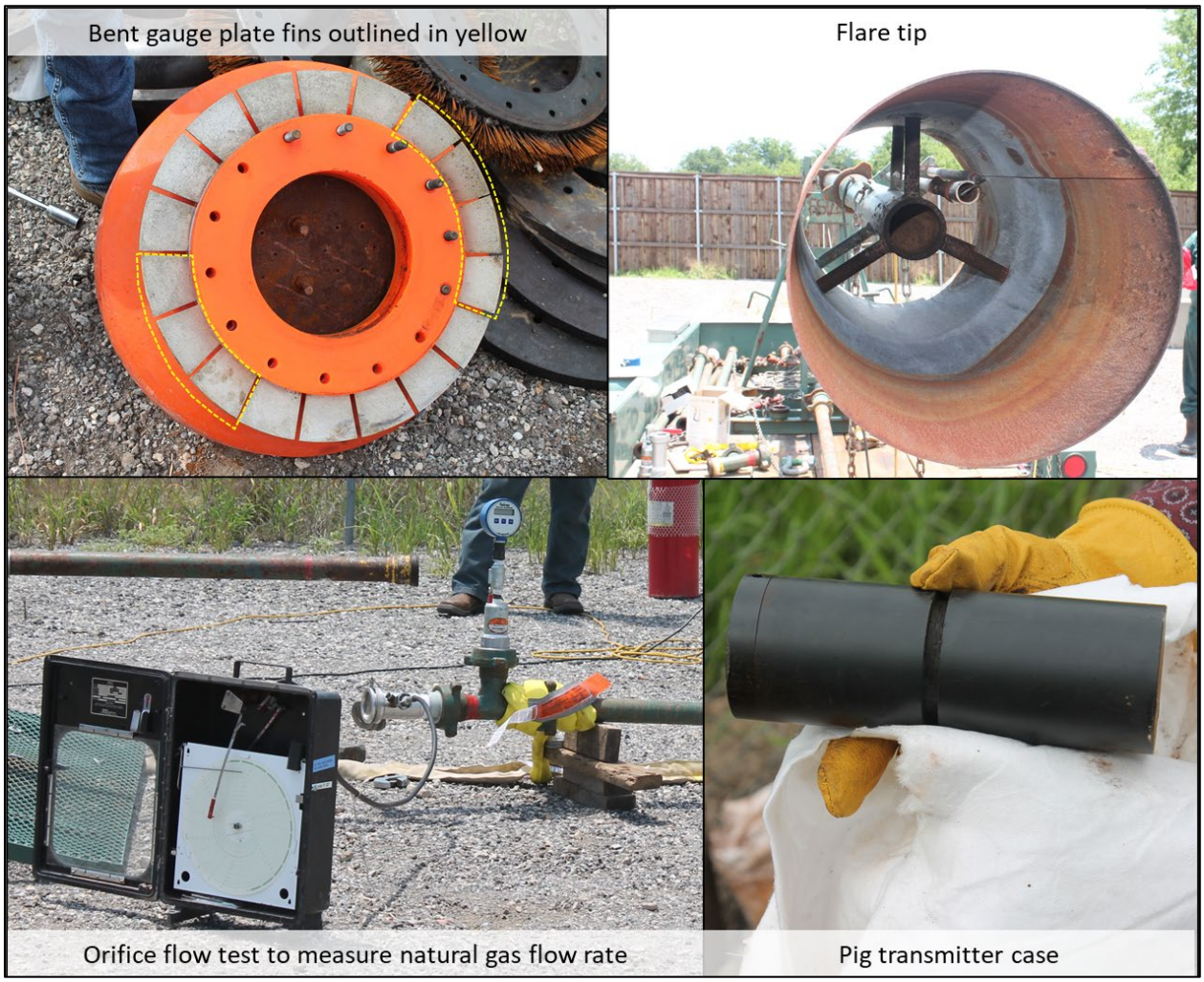

Figure 7. Site Assessment, July 5, 2021

Figure 8. Corrosion on launcher door mating surfaces, July 13, 2021 (Courtesy of RRC)

Figure 9. Evidence Removal, July 13, 2021 (Courtesy of RRC)

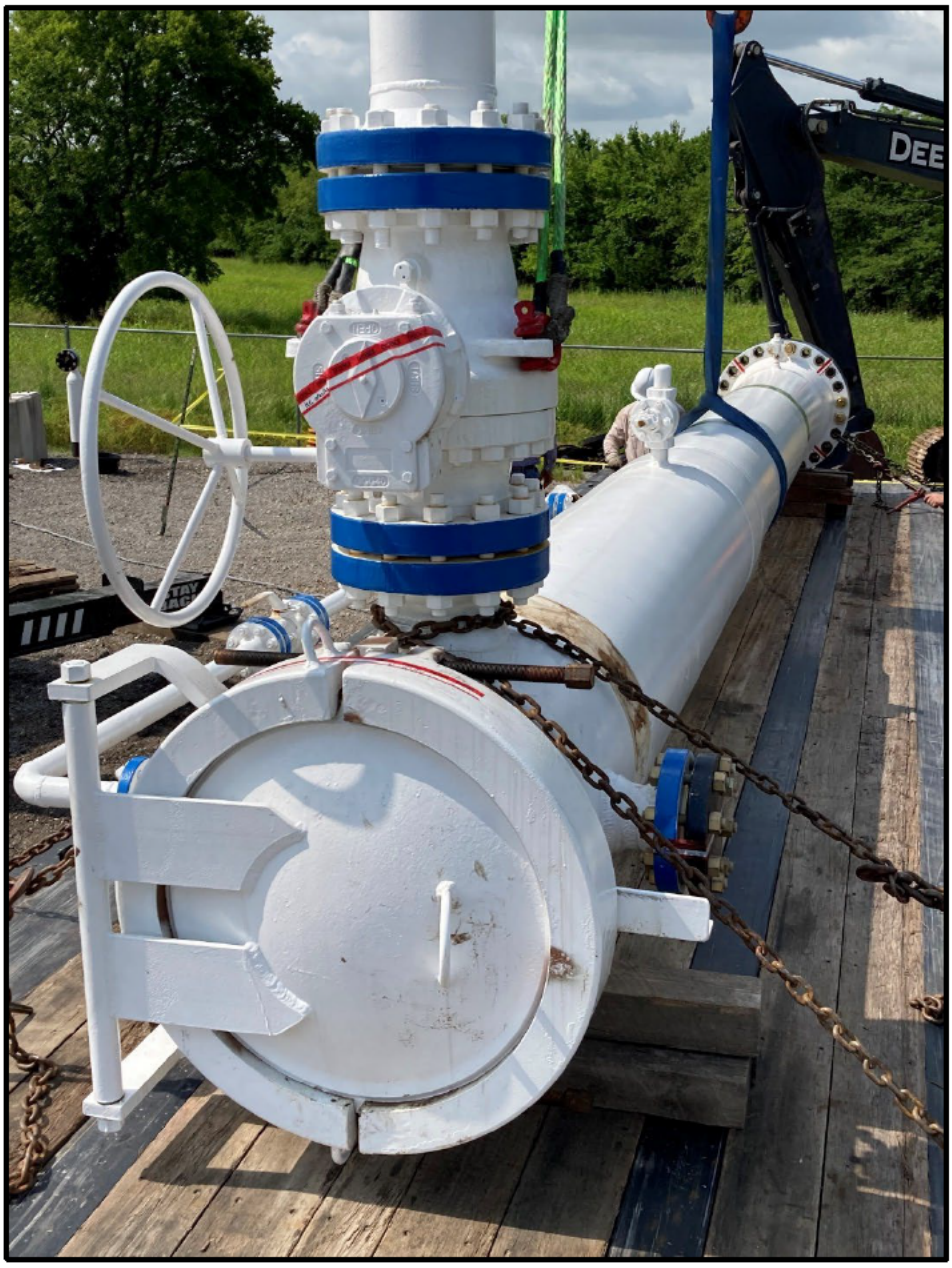

Figure 10. Launcher Removal, July 23, 2021 (Courtesy of RRC)

L. Post-Accident Tests and Research

L.1 24-inch Mainline Valve Testing and Disassembly

As described in the *Materials Laboratory Report No. 21-094* within this docket, the mainline valve was leak tested and disassembled after the accident. This testing indicated that the mainline valve was leaking, and seals were damaged on both the launcher and pipeline ends of the valve.

L.2 4-inch Kicker Valve Testing

As described in the *Materials Laboratory Report No. 21-093* within this docket, the kicker valve was leak tested after the accident. This testing indicated that the kicker valve was not leaking.

L.3 Pig Transmitter

As described in the *Materials Laboratory Report No. 21-097* within this docket, the pig transmitter (transducer) was visually examined after the accident. This evaluation indicated that the batteries did not exhibit any signs of thermal distress.

L.4 Flammability Conditions

As described in the *Materials Laboratory Report No. 21-098* within this docket, the flammability conditions within the launcher prior to the explosion were examined using a computational fluid dynamics software package developed by the National Institute of Standards and Technology called Fire Dynamics Simulator (FDS). This study provides a qualitative understanding of the flow paths and overall conditions within the launcher prior to the explosion.

M. Operator Policies and Procedures

M.1 Procedures Used on the Day of the Accident

M.1.1 Atmos and Bobcat

The following procedures were applicable to the pig loading activities performed by Atmos employees on the day and site of the accident:

- Pipeline Integrity Management Plan, Appendix R, R.1 Loading and Launching a Pig[51]
- Operation and Maintenance Manual
    - Chapter 2: Pipeline Integrity Management, Section 2.5.1, Launcher and Receiver Safety
    - Chapter 18: Transmission, Section 18.1.2
    - Chapter 27: Emergency Operating Procedures[52]
- Safety Manual

Bobcat indicated that their employees were following Atmos procedures for sending and receiving pigs on the day and site of the accident; they were not following Bobcat specific procedures. Bobcat indicated that its employees were following Atmos's Pipeline Integrity Management Plan, Appendix R, R.1 Loading and Launching a Pig.

This procedure had an "Important Safety Notice" at the beginning which stated:

> "Any launcher or receiver used after July 1, 2021, must be equipped with a device capable of safely relieving pressure in the barrel before removal or opening of the launcher or receiver barrel closure or flange and insertion or removal of in-line inspection tools, scrapers, or spheres. A device must be use to either: indicate that pressure has been relieved in the barrel; or alternatively prevent opening of the barrel closure or flange when pressurized, or insertion or removal of in-line devices (e.g. inspection tools, scrapers, or spheres), if pressure has not been relieved. Refer to 192.750."

This procedure, in part,

- warned that "Pigging a line can be dangerous. Be aware of risk and surroundings."
- instructed personnel to
    - hold a safety meeting prior to pigging operations
    - eliminate all sources of ignition (i.e., cell phones) during loading
    - monitor for oxygen, hydrocarbons, H_2S, and NORM
    - stay clear of gas release (in case of ignition)
    - ensure closure door with pressure alert valve installed and functioning properly
    - verify a pressure gauge and purge point has been installed to monitor and relieve pressure inside the barrel
    - never stand directly in front of the pig launcher/receiver door
    - man Class D fire extinguishers to manage pyrophoric material during loading and launching
- highlighted potential hazards, including
    - flammability

[51] The original version of Atmos's PIM Plan was based on the framework developed by the Northeast Gas Association, acquired by Atmos in January 2005. However, Appendix R was developed independently by Atmos and was not part of the original Northeast Gas Association framework. (Atmos-NTSB IIC Email Statements)

[52] Atmos's Emergency Response Procedures are discussed in more detail in the *Emergency Response Group Chairman's Factual Report* within this docket.

- flying projectiles
- pressure inside barrel prior to beginning work

This procedure included a pig loading procedure that served as "a guide for loading a pig under ideal situations and configurations." It noted that many pig receivers are configured differently, and valves may be in different locations or not there at all and required "Operations" to adjust the procedure as needed to ensure that loading and launching are performed in a safe and controlled manner. The pig loading procedure was based on the configuration shown in Figure 11.

This procedure required all valves to be opened when depressurizing the launcher, except the launcher mainline valve, kicker valve, and vent valve (2, 3, and 11 in Figure 11). The procedure did not mention the use of a flare system.

This procedure also required a grounding cable be connected "between the push bar and the launcher" when a push bar is used to load the pig. The materials of construction for the push pole were not specified. Abnormal operating conditions specific to pig loading were not indicated in this or any Atmos procedure.

Atmos indicated that it periodically updates the Pipeline Integrity Management Plan on an as-needed basis.[53]

[53] Atmos-NTSB IIC Email Statements

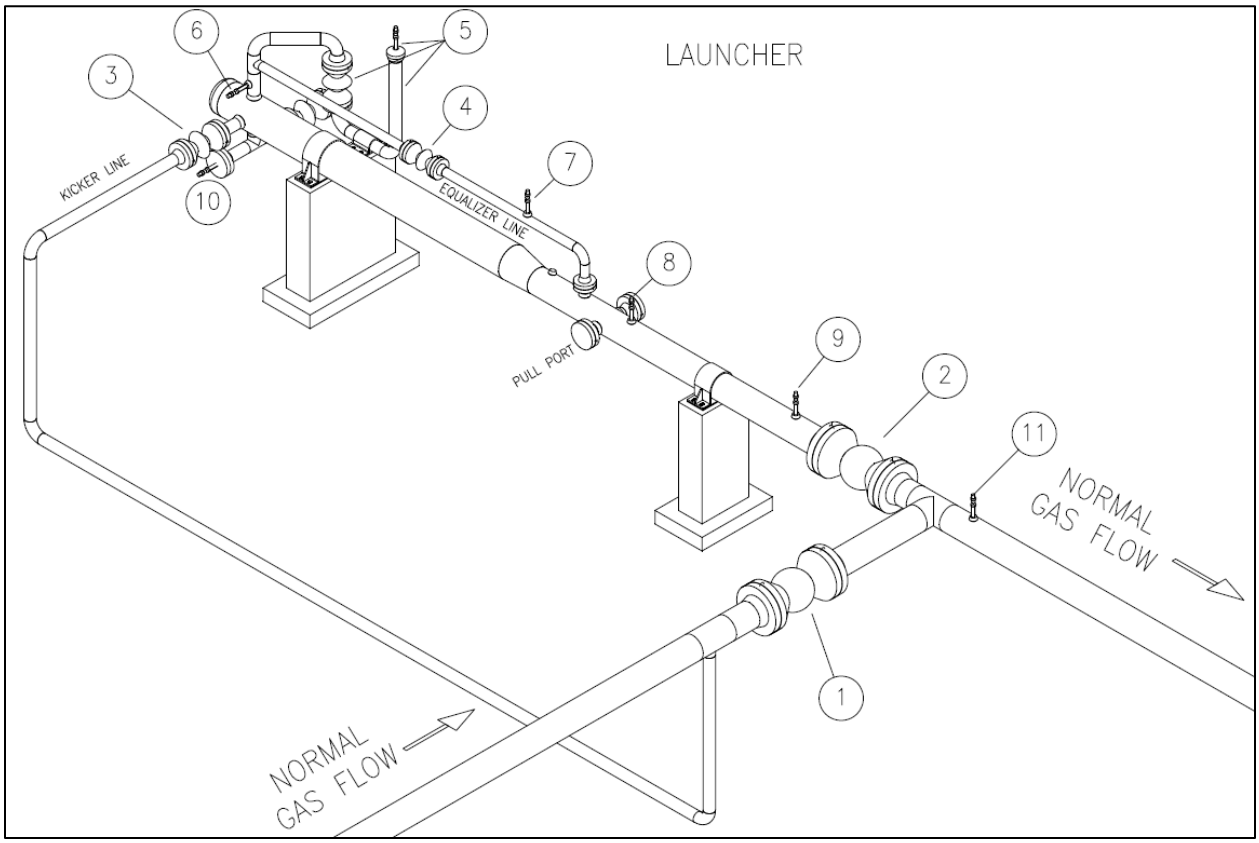

Figure 11. Example pig launcher configuration used in Atmos procedure (Courtesy of Atmos)[54]

M.1.2 FESCO

FESCO's Standard Operating Procedure (SOP) 10.0, *Flare Stack Operation*, was applicable to the flaring activities performed by FESCO employees on the day and site of the accident.

M.2 Operator Qualifications

Required operator qualification and training requirements are discussed in the *Human Performance Group Chairman's Factual Report* within this docket.

N. Safety Oversight

N.1 Regulatory Requirements

The following regulations are applicable to the activities that were being performed at the junction lot prior to the accident:

- 49 CFR Part 192, Subpart I, *Requirements for Corrosion Control*

[54] Atmos Pigging Procedures

- 192.493, *In-line inspection of pipelines.*

- 49 CFR Part 192, Subpart L, *Operations*
  - 192.605, *Procedural manual for operations, maintenance, and emergencies.*[55]
    - 192.605(a) requires operators to prepare and follow a manual of written procedures for conducting operations and maintenance activities and for emergency response. For transmission lines, the manual must include procedures for handling abnormal operations.
    - 192.605(c) requires, in part, that the manual required by 192.605(a) includes procedures for responding to, investigating, and correcting the cause of any foreseeable malfunction of a component which may result in a hazard to persons or property.
- 49 CFR Part 192, Subpart M, *Maintenance*
  - 192.750, *Launcher and receiver safety* (see Section N.2)[56]
- 49 CFR Part 192, Subpart N, *Qualification of Pipeline Personnel*
  - 192.801 indicates that 192 CFR Subpart N prescribes minimum requirements for operator qualification of individuals performing covered tasks on a pipeline facility.[57]
  - 192.805, *Qualification program*, requires, in part, that operators have and follow a written qualification program that identifies covered tasks, ensures through evaluation that individuals performing covered tasks are qualified, and communicates changes that affect covered tasks to individuals performing those covered tasks.[58]

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[55] The American National Standards Institute (ANSI) / Gas Piping Technology Committee (GPTC) Standard Z380, *Guide for Gas Transmission, Distribution, and Gathering Piping Systems,* indicated that "Operators should consider including written procedures in their procedural manual for operations, maintenance, and emergencies to protect maintenance workers from the unexpected movement or release of energy when working on electrical, pressurized fluid, or mechanical systems where the inadvertent actuation or release of energy could be dangerous (e.g., launchers)."

[56] The requirements of 49 CFR 192.750 were published October 1, 2019, effective July 1, 2020, and applicable July 1, 2021 (84 FR 52180). 49 CFR 192.750 was not required by any regulatory authority at the time of the accident.

[57] (a) A *covered task* is an activity that: is performed on a pipeline facility, is an operations or maintenance task, is performed as a requirement of Part 192, and affects the operation or integrity of the pipeline. (49 CFR 192.801(b))

(b) Atmos did not designate in-line inspection as a covered task. Atmos indicated that training specifically related to pigging operations was provided through on-the-job training. However, some operator qualifications were required for the work being performed, as discussed in the *Human Performance Group Chairman's Factual Report* within this docket. (Atmos-NTSB IIC Email Statements)

(c) In discussions with the NTSB IIC, PHMSA staff indicated that in-line inspection is considered a covered task by many operators and provided covered task lists from two industry groups, both of which identified *launching in-line inspection devices* as a covered task.

(d) Although operators are responsible for identifying covered tasks for which individuals must be qualified, regulators remain responsible for reviewing operator qualification programs and ensuring that federal regulatory standards are applied and met nationwide. Regulators may question an operator's inclusion and exclusion of particular activities as covered tasks. Regulators may require modifications to programs that fail to meet the requirements of the rule. (https://www.govinfo.gov/content/pkg/FR-1999-08-27/pdf/99-22208.pdf)

[58] (a) *Qualified* means that an individual has been evaluated and can perform assigned covered tasks and recognize and react to abnormal operating conditions. (49 CFR 192.803).

- 49 CFR Part 192, Subpart O, *Gas Transmission Pipeline Integrity Management*
  - 192.911(o) requires that procedures for ensuring that each integrity assessment is being conducted in a manner that minimizes environmental and safety risks.[59]

N.2 Launcher and Receiver Safety (49 CFR 192.750)

On January 3, 1983, the Associate Director for Operations and Enforcement at the Research and Special Programs Administration (PHMSA's predecessor) recommended a new regulation be established for 49 CFR Part 192 relating to the use of pipeline pig launchers and receivers. He indicated that several accidents had occurred because operators have used procedures that were inconsistent with company guidelines or sound operating practices. The recommendation was to require that the barrel closure cover of a launcher or receiver be designed so that it would be impossible to open while there is pressure in the barrel, consistent with an existing rule in section VIII of the ASME Boiler and Pressure Vessel Code Part UG-35.

On January 26, 1983, the Associate Director for Pipeline Safety Regulation responded, indicating that the operating requirements of 49 CFR 192.603(b) and 605(a) may be applied to scraper traps, ASME B31.8 Code does not have specific design or operating requirements for scraper traps, and 10 of 6,588 gas transmission accidents reported between 1970 and 1982 involved scraper traps. This response suggested that the compressible properties of gas, rather than the lack of regulations, was the reason for the greater hazard and identified two reasons that the proposed regulations would not likely be justified. The first reason was because RSPA is not authorized to impose a design regulation retroactively. The second was that since about 1960, most scraper traps have incorporated the safety features of the ASME Boiler and Pressure Vessel Code.[60]

In 84 FR 52252, issued on October 1, 2019, PHMSA promulgated 49 CFR 192.750, which states:

> Any launcher or receiver used after July 1, 2021, must be equipped with a device capable of safely relieving pressure in the barrel before removal or opening of the launcher or receiver barrel closure or flange and insertion or removal of in-line inspection tools, scrapers, or spheres. An operator must use a device to either: Indicate that pressure has been relieved in the barrel; or alternatively prevent opening of the barrel closure or flange when pressurized,

(b) *Abnormal operating condition* means a condition identified by the operator that may indicate a malfunction of a component or deviation from normal operations that may indicate a condition exceeding design limits or result in a hazard(s) to persons, property, of the environment. (49 CFR 192.803)

[59] GPTC Guide Material in Appendix G-192-14 indicates that safety considerations may include: using qualified personnel, installing tags on valves and listing the sequence of valve operation, ensuring there is a locking device on quick opening closures that provides a warning or prevents opening if the trap is pressurized, and determining personal protective equipment that will be needed by those involved with the pigging operations.

[60] g83-01-26_Paullin_192.603-msfx.pdf (dot.gov) (Accessed July 17, 2021)

> or insertion or removal of in-line devices (e.g., inspection tools, scrapers, or spheres), if pressure has not been relieved. (84 FR 52252))

In the Federal Register Notice, PHMSA explained that the current regulations for hazardous liquid pipelines under 49 CFR Part 195 have, since 1981, contained safety requirements for scraper and sphere facilities. However, the current regulations for natural gas transmission pipelines do not similarly require controls or instrumentation to protect against an inadvertent breach of system integrity due to the incorrect operation of launchers and receivers for ILI tools, or scraper and sphere facilities. As a result, PHMSA proposed to add a new section to the Federal Pipeline Safety Regulations to require ILI launchers and receivers include a suitable means to relieve pressure in the barrel and either a means to indicate the pressure in the barrel or a means to prevent opening if pressure has not been relieved.

N.3 Pipeline Safety Management Systems

According to Atmos, it began working with a third-party expert to examine its practices in the context of Pipeline Safety Management Systems (PSMS) in 2016 and then conducted a PSMS self-assessment and gap analysis for its Virginia operations. Atmos indicated that it engaged the third-party expert again in 2019 to perform an enterprise wide PSMS assessment and gap analysis.[61] From this, Atmos indicated that it developed a high-level roadmap to guide its continued implementation of PSMS. Atmos also indicated that it conducts annual PSMS maturity self-assessments using the API PSMS Maturity Tool. In October 2019, Atmos indicated that it had added a director level resource to support accelerated implementation of PSMS.[62]

The NTSB reviewed Atmos's third-party contractor's report (also referred to as the PSMS assessment and gap analysis or roadmap). The report documented findings of the third-party contractor's four and a half-day assessment. The third-party contractor reviewed Atmos's programs, policies, procedures, and practices against the requirements of PSMS. The review team identified strengths and opportunities for improvement. The review team's evaluation considered all ten essential PSMS elements defined in ANSI/API Recommended Practice 1173.

Atmos also provided the most recent results of its annual PSMS maturity self-assessment to the NTSB for review. The maturity self-assessment provides an overall implementation level between 0 and 4 based on responses to several questions. The implementation levels are described as follows: 0 – Learning; 1 – Planning; 2 – Developing; 3 – Implemented; 4 – Established. Atmos's most recent self-assessment indicated it was between the "planning" and "developing" implementation levels.

Atmos indicated that the following are examples of the improvements resulting from their PSMS activities:

[61] https://www.atmosenergy.com/newsroom/supplemental-materials-related-ntsbs-jan-2021-meeting (Accessed November 5, 2021)
[62] Atmos-NTSB IIC Email Statements

- "We conducted additional stakeholder meetings with various workgroups across all operating divisions to discuss PSMS and continue our focus on identifying and mitigating potential risks while continually assessing and improving processes and procedures."
- "We established new process controls for work being performed on portions [of] our distribution operating system, specifically around Management of Change (MOC) and constructability reviews, that will result in work stoppage when deviations from key elements are discovered."
- "We have enhanced language in our Safety Manual regarding Stop Work Authority and Hazard Analysis and reinforced these concepts through refresher training and safety huddles. In addition, we are emphasizing these concepts, along with other PSMS elements, in technical training curriculum and new hire training."
- "We conduct annual PSMS maturity self-assessments using the API PSMS Maturity Tool."
- "We have formalized sharing and lessons learned processes, including information gathered from NTSB reports and significant internal and external events. We have also continued our involvement in industry activities by serving on the AGA PSMS Executive Committee and participating in industry workshops and virtual conferences. We continue to meet with peer companies to discuss PSMS program activities and practices."
- "These and other efforts in support of PSMS are supported at the highest levels of the organization, with a corporate officer primarily responsible for the design, adoption, and implementation of PSMS. The Corporate Risk Management and Compliance Committee is responsible for ongoing governance and reporting to the Company's Management Committee."[63]

Atmos also explained that the pipeline industry does not have legal protections regarding public disclosure of report produced for the purposes of developing and implementing PSMS which parallel the aviation industry (see 49 U.S.C. §44735, *Limitation on disclosure of safety information*).[64]

O. Previous Accidents and Incidents

O.1 Atmos

Two previous gas transmission incidents that involved pigging operations were reported by Atmos to PHMSA. A summary of each reported incident is provided below.[65]

- **Waco, TX, June 10, 2011**. A pipeline failure occurred 759 feet from River Junction Station while company and contract personnel were on-site performing pigging operations. Examination of the pipeline indicated that the pipe had been

[63] Atmos-NTSB IIC Email Statements
[64] Atmos-NTSB IIC Email Statements
[65] Incident data reported by operators to PHMSA is publicly available at https://www.phmsa.dot.gov/data-and-statistics/pipeline/pipeline-incident-flagged-files. See PHMSA Reports 20110231 and 20120041.

longitudinally gouged by outside forces consistent with a backhoe or similar equipment.

- **Riesel, TX, March 27, 2012**. A pipeline failure occurred 6,695 feet downstream from Riesel Junction Station while company and contract personnel were on-site performing pigging operations. The failure was caused by the impact of the pig at the misalignment on a girth weld on the upstream side.

Prior to this accident, no fatalities or injuries were reported by Atmos to PHMSA involving their gas transmission system.

O.2 Other Gas Transmission Operators

Several previous accidents and incidents involving pig launching and receiving activities have been experienced by other gas transmission system operators. A summary of selected accident and incident reports is provided below.[66]

- **Ft. Cobb, OK, May 16, 1988**. This incident reportedly occurred at about 8:05 PM and resulted in 1 fatality and 2 injuries. The pipeline was being depressurized during pigging operation in a controlled and monitored procedure. An accumulation of natural gas was ignited by an unknown source, resulting in a flash fire and subsequent explosion.
- **McClain County, OK, December 2, 1998**. This incident reportedly occurred at about 1:40 PM and resulted in 1 injury. An employee was injured by a 20-inch pipeline cleaning pig that rapidly exited a 20-inch receiver barrel. After they pulled the pig into the receiver and opened the closure door, the pig shot out of the end of the receiver. The receiver valve was found to have minimal leakage but was determined to be operating properly to effectively control gas flow for the purposes of pigging pipelines. The blowoff valve was completely open. The operator performed an investigation to determine the cause of the incident but was unable to determine the cause.
- **Garland, AR, November 5, 2001**. This incident reportedly occurred at about 10:00 AM and resulted in 2 injuries. One company and two contract employees were going to insert and run a cleaning pig in the company's pipeline. After completing a blowdown of the launcher, the company employee noticed unrelated leakage from a 4-inch kicker line valve, and using a high-pressure grease gun, greased the valve. The company employee and the two contract employees opened the launcher door and inserted the pig. Before the launcher door could be shut, the pig was ejected from the open end of the launcher, striking both contract employees.
- **San Juan County, NM, February 26, 2004**. This incident reportedly occurred at about 12:30 PM and resulted in 1 injury. The employee attempted to open a 12-inch pig launcher at the Thompson Compressor Station without first relieving the pressure. Employee sustained injuries to the jawbone, ribs, and multiple lacerations. The operator attributed this incident to a failure to follow procedures.
- **Slaughters, KY, October 29, 2007**. This incident reportedly occurred at about 8:40 AM and resulted in 1 injury. This incident occurred during launch of pig after

[66] Previous Accidents and Incidents Experienced by Other Gas Transmission Operators

blowing down piping and opening pig trap door to check position of pig. The pig dislodged and broke off door while exiting launcher, pinning an employee between door and backhoe located about 4 feet behind launcher. The pig trap valve was leaking causing build-up of pressure behind pig.

- **Gulf of Mexico, October 23, 2008.** This accident reportedly occurred when pipeline system pressure slowly leaked through two closed isolation valves, allowing pressure to build up inside the launcher after the pig had been loaded. The Minerals Management Service indicated that the employee failed to ensure the pig launcher remained depressurized while isolated from all pressure sources.
- **Meade, KS, March 26, 2020**. This incident reportedly occurred at about 2:00 PM and resulted in 1 fatality. An employee was receiving a cleaning pig on the 10-inch east line at Borchers Station when the pig became lodged in the receiver. The door to the receiver was opened. The employee had positioned himself in front of the pig receiver in an attempt to dislodge the stuck pig. Suddenly, the pig became dislodged and discharged out of the barrel, striking the employee and resulting in fatal injuries. The operator indicated that a site-specific pigging procedure was required, but not located. The operator attributed this incident to incorrect operation and indicated that although the trap door was open, the employee positioned himself in front of the open receiver in the projected path of the pig without verifying that the pressure behind the pig had been relieved.

P. Post-Accident Actions

P.1 Occupational Safety and Health Administration (OSHA)

OSHA opened inspections of Bobcat, FESCO, and Atmos on June 29, 2021 in response to this accident. OSHA issued citations to both FESCO and Bobcat. The case with FESCO was settled and the case with Bobcat is still in litigation. Additional information is available on OSHA's website.[67]

P.2 RRC

As of February 2022, no enforcement actions have been taken related to the accident.

P.3 Atmos

Atmos told NTSB investigators that it suspended all pigging operations on in-service pipelines immediately following the accident and initiated a review of its related processes and procedures.[68]

Atmos drafted a revised pigging procedure which it indicated is subject to field testing and refinement before final adoption. The draft procedure and associated checklists, forms and drawings were provided to the NTSB for review; if implemented, they would require:

- A JSA meeting prior to every pigging run to identify basic job steps, potential hazards, and steps to mitigate hazards.
- Use of personal gas monitors by all onsite personnel.
- Use of a gradient control mat or grounding rod to ground all launchers, receivers, vessels, and equipment.
- All launchers and receivers to have an uncoated lug connection brazed onto the trap to allow connection for grounding (grounding stud).
- Pig pushing equipment (push poles) to be made from non-sparking material. Metallic push poles must have a welded or mechanical connection to a cable that is grounded to the grounding stud (magnetic connections are prohibited).
- Standardized design features
    - All launchers and receivers placed into service on or after January 1, 2022 shall conform to the standard launcher and receiver design drawings.
    - All launchers and receivers placed in service prior to January 1, 2022, shall have predetermined features that are fully operational or Corrective Actions

[67] (a) https://www.osha.gov/pls/imis/establishment.inspection_detail?id=1539666.015
(b) https://www.osha.gov/pls/imis/establishment.inspection_detail?id=1539651.015
(c) https://www.osha.gov/pls/imis/establishment.inspection_detail?id=1539646.015

[68] (a) Pigging out-of-service pipelines continued as needed, and may have involved water, air, or nitrogen, not natural gas.
(b) Atmos Post-Accident Actions

must be completed prior to performing launching/receiving activities.[69] The predetermined features include: 3 ports upstream of reducer, 3 ports downstream of reducer, minimum barrel length, drain on barrel near closure, equalizing line across reducer, grounding stud on launcher and receiver, grounding grid/mat, and pressure alert on closure door.

- Lockout/Tagout of launcher mainline valve and kicker valve during launcher depressurization and pig loading, and of the receiver mainline valve and kicker valve during receiving and unloading.
- Purging the launcher with nitrogen prior to opening the launcher door and during pig loading. Purging the receiver with nitrogen prior to opening the receiver door and during pig unloading.
- Monitoring pressure at two locations on the launcher during launcher depressurization, purging, and pig loading. Monitoring pressure at two locations on the receiver during pig receiving, receiver depressurization, purging, and pig unloading.
- Monitoring gas concentration at two locations on the launcher during launcher depressurization, purging, and pig loading. Measuring gas concentration at two locations on the receiver prior to pig receiving and monitoring gas concentrations during receiver purging and pig unloading.
- A third-party inspector who shall:
    - Complete the JSA form prior to each pigging run and at every shift change.
    - Complete a launching checklist as part of every pig launch.
    - Complete a receiving checklist as part of every pig receiving job.
- An Atmos Job Site Leader who shall:
    - Complete the pre-job checklist and ensure that Corrective Actions are completed prior to performing pigging operations when needed.
    - Document any Corrective Actions on a Corrective Action form.
    - Oversee launching and receiving activities.
    - Complete the post-run form which documents the work performed and possible follow-up activities.

Atmos also drafted a new MOC Procedure which, if implemented, would:

- Define those "changes" that are subject to the procedures to include both permanent and temporary additions, modifications, or substitutions (person or item) that are not considered to be a replacement in kind and have not been approved in the Capital Improvement Planning Process.[70]
- Identify the process by which changes will be evaluated, approved, and implemented, including identification of impacted processes and stakeholders, completion of a risk assessment, and incorporation of risk mitigation strategies where needed.

[69] Corrective Actions are used to conform with standard pigging processes and procedures (e.g., adding a valve to meet standard design criteria or replacing broken or non-functioning equipment). Deviations from written procedures or the design standard cannot be approved through a Corrective Action and are instead addressed as a "change" under the MOC procedure.

[70] Emergency changes would undergo the MOC process after the emergency event was mitigated.

Additionally, Atmos indicated that:

- Training materials for the new pigging procedures are under development and will become a part of a new pigging specific OQ requirement.
- The new MOC procedure and associated training will be rolled out company-wide in 2022.
- The launcher involved in this accident has been replaced and will be retrofitted to comply with the new standard design and grounding requirements.

Appendix A: Previous Run Photographs

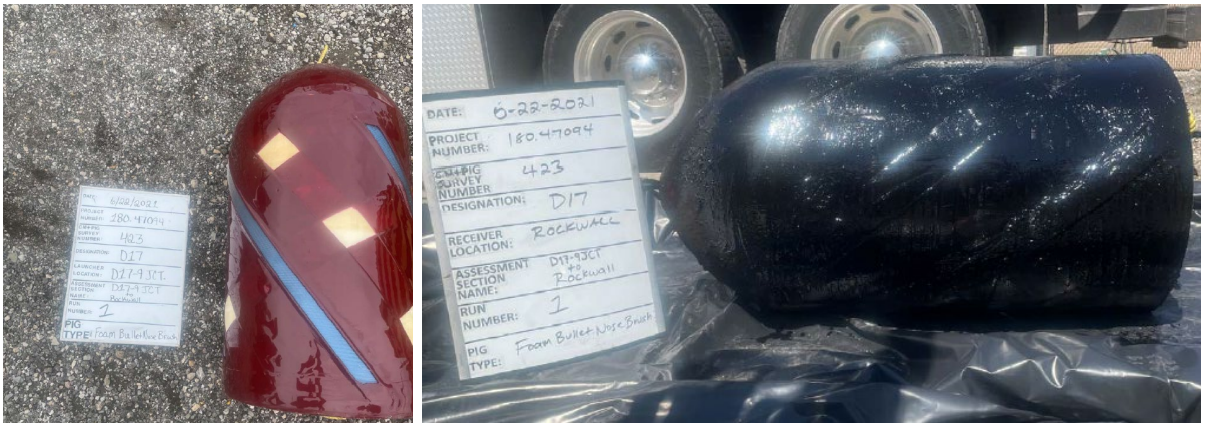

Figure 12. Run 1 Pre- and Post- Run Photographs (Courtesy of Atmos and Bobcat)

Figure 13. Run 2 Pre- and Post- Run Photographs (Courtesy of Atmos and Bobcat)

Figure 14. Run 3 Pre- and Post- Run Photographs (Courtesy of Atmos and Bobcat)

Figure 15. Run 4 Pre- and Post- Run Photographs (Courtesy of Atmos and Bobcat)

Appendix B: Site Assessment Protocol

All site work will be performed in accordance with Atmos' safety and qualification requirements.

** Exit procedure immediately and open Valve 4 if pressure is rising and causing a safety concern. **

1. Confirm the presence of natural gas at the flare tip with RMLD.
2. Confirm closure of launcher door.
3. Take measurements and photographs, as needed.
4. NTSB to take work notes/JSAs that are onsite as evidence.
5. Leak survey - flare connection at Valve 6, along the flare flow line to the flare stack, and the flare stack. Document results.
6. Measure flow rate from closed pig launcher cavity by completing the following steps:
    a) Check pressure at Valve 4 using pressure gauge
    b) Remove pressure gauge
    c) Begin venting from Valve 4
    d) Close Valve 6 going to flare stack
    e) Wait 10 minutes to ensure gas has escaped
    f) Break flow line union near flare trailer to tie-in orifice flow tester to flare flow line
    g) Install safety restraint on flare flow line
    h) Open Valve 6
    i) Reconnect pressure gauge at Valve 4 and begin pressure monitoring, capturing pressure data over time
    j) Begin testing with orifice flow tester
    k) Once steady state flow is reached, continue recording for a minimum of 30 minutes
    l) Close Valve 4
    m) Remove gauge on Valve 4
    n) Open Valve 4 to begin venting
    o) Close Valve 6
    p) Remove orifice flow tester connections
    q) Visually inspect flare tip (see item 8)
    r) Reconnect flare flow line
    s) Open Valve 6 and begin venting to flare stack
    t) Ignite flare and disconnect power to the igniter
    u) Allow flare to remain lit for 20 minutes
    v) Return accident site to original configuration
7. Inspect pig internals:
    a) Inspect and photograph throughout inspection

b) Remove cover plate, note any observations
c) Remove transmitter, note any observations
d) Replace transmitter, cover plate

8. Visually inspect flare tip
    a) While flare system is isolated at Valve 6, fold down flare stack
    b) Visually inspect flare tip and upper portion of flare stack, note any observations
    c) Return flare stack to its original configuration

Appendix C: Valve Removal and Remaining Examinations Protocol

All site work will be performed in accordance with Atmos's safety and qualification requirements.

A RRC inspector will witness all work performed on site and confirm receipt of both valves and the pig at the secure storage location. *Each step will be carefully documented and photographed by the RRC inspector.*

Valve Removal

After piping downstream of mainline valve has been purged of natural gas, the mainline valve and kicker valve will be removed and retained as evidence under NTSB evidence control procedures.

- Confirm completion of locate request.
- Install caution tape from the launcher area extending around the excavator as restricted area within the site.
- The portable light plant will be removed by Atmos's contractor.
- Follow steps to remove flare:
    - Confirm closure of launcher door.
    - Confirm continued gas venting at flare tip.
    - Confirm launcher internal pressure at Valve 4 using pressure gauge.
    - Remove pressure gauge at Valve 4.
    - Begin venting from Valve 4.
    - Close Valve 6 going to flare stack
    - Break flow line union above Valve 6 and disconnect flare stack piping
    - Install 2" vent extension onto Valve 6 in order to vent gas at least 8' above ground level or as otherwise required for safety of the work area.
    - Open Valve 6
    - Reconnect pressure gauge at Valve 4 to allow pressure monitoring during construction.
- Hot tap will be placed between stopple and mainline valve to purge the pipeline and launcher piping.
- If pressure is still on the kicker line, address the isolation/blowdown of kicker line before blowing down the launcher.
- Place pressure gauge at Valve 4 to verify at 0 psi reading.
- Once 0 psi reading is obtained, use same port for CGI reading to ensure atmospheric conditions are clear of any combustible gas readings.
- Remove mainline valve (check CGI reading up and downstream of mainline valve)
    - Mark position of wheel handle prior to work.
    - Mark top center of valve flange and launcher/piping direction
    - Frame or otherwise protect handle from movement.

    - Lay a tarp under the mainline valve prior to removal.
    - Align lifting crane in position to hold the mainline valve.
    - Remove all bolts from the flanges of the valve.
    - Any debris or external paint coating that comes from the external surface of the valve can be removed from the tarp.
    - Cover both flange ends of the mainline valve to retain any inner particles of valve packing or debris.
- If practical, mount mainline valve on wooden skid. Alternatively, place tarp under valve.
- Install blind flange on stopple side of mainline line where valve was removed
- Visually inspect mainline valve
    - Photograph the launcher side first, then the inlet side of the valve
    - Document conditions of the valve, including valve alignment, valve condition, its inner packing condition, and any possible debris
    - Cover and seal both flange sides of the valve to preserve present condition.
- Remove kicker valve by following steps similar to those used to remove the mainline valve, as appropriate, to remove the kicker valve.
- Install blind flange on inlet side of kicker line to isolate all energy sources from the launcher assembly.
- Visually inspect kicker valve
    - Photograph the launcher side first, then photograph exit side of valve
    - Document conditions of the valve, including valve alignment, valve condition, its inner packing condition, and any possible debris
    - Cover and seal both flange sides of the valve with plastic caps or covering to preserve the present condition of the valve.
- Inspect launcher after isolating and confirming all energy sources have been isolated from the launcher assembly.
- Open launcher door when conditions are safe, and the launcher has been adequately ventilated. Take pictures of the door surface area and inside the barrel of launcher looking for indications of arc burns.
- Use a borescope to review and record any arc burns or pig/push pole markings from the launcher entrance to the mainline valve to determine where the pig was seated, any signs of debris or misalignment in the surface area of the mainline valve.
- Build wooden crate (mainline valve) or use appropriate package to protect and secure valves during storage and transport.
- Transport valve to previously determined indoor storage facility secured by Atmos. Entry will be available only with prior NTSB IIC permission. All entries must be recorded with sign-in/sign-out log.

Retain Pig as Evidence

Pig and internal transmitter will be removed and retained as evidence under NTSB evidence control procedures.

- Carefully remove transmitter from pig and package to protect it during storage and transportation.
- Replace cover plate, returning pig to as-found condition without transmitter
- Package pig to protect it during storage and transportation.
- Transport pig and transmitter to previously determined indoor storage facility secured by Atmos. Entry will be available only with prior NTSB IIC permission. All entries must be recorded with sign-in/sign-out log.

Appendix D: Launcher Removal Protocol

All site work will be performed in accordance with Atmos's safety and qualification requirements.

A RRC inspector will witness all work performed on the site and confirm receipt of the launcher at the secure storage location. *Each step will be carefully documented and photographed by the RRC inspector.*

Launcher will be removed and retained as evidence under NTSB evidence control procedures. NTSB evidence identification number for the launcher is PLD21FR002-OPS-004.

Launcher Removal

Confirm that the launcher door has been secured.

RRC inspector will:

- place tamper evident tape where the blind flanges are attached to outlet of the launcher, and over the launcher door closure
- initial and date each piece of tamper evident tape

Place straps around launcher to safely secure launcher while unbolting launcher from concrete footings.

Unbolt the launcher from its concrete footings.

Safely lift the launcher from its footings in order to place the launcher on a trailer for transport.

Secure the launcher on the trailer for transport to the previously determined storage facility secured by Atmos.

RRC inspector will confirm condition of tamper evident tape after launcher is placed in storage.

Entry will be available only with prior NTSB IIC permission and recorded in the sign-in/sign-out log.

The launcher will be held in the storage facility until released by the NTSB IIC.