National Transportation Safety Board

Pipeline Accident Brief

Gasoline Transmission Pipeline Explosion/Fire

Helena, Alabama

October 31, 2016

The Accident

On October 31, 2016, at 2:47 p.m., local time, while excavating, a contractor damaged the Colonial Pipeline Company's (Colonial) 36-inch diameter refined liquid petroleum transmission pipeline, known as Line 1, near Helena, Alabama. The damage resulted in a release of gasoline from the pipeline, which ignited and burned for several days. Two excavation crew workers died, and four other workers were injured. The photographs in Figures 1 and 2 show the equipment and environmental damage that resulted from the fire. Figure 1 is a ground-level view of the ongoing fire and equipment damage that occurred from the gasoline release. Figure 2 is an aerial view of the excavated Line 1 pipeline and accident-related environmental damage taken during the postaccident investigation.[1]

Figure 1. Ground-level view of active fire. (Source first responders.)

[1] For more detailed information about this accident investigation, see the the public docket at https://www.ntsb.gov/investigations/dms.html and search for accident number DCA17FP002.

Figure 2. Aerial view of environmental damage. (Source: ESI, a Colonial technical contractor.)

Background

Colonial is an interstate common carrier that delivers refined liquid petroleum products, including gasoline, kerosene, home-heating oil, and jet fuel, throughout the southeastern, mid-Atlantic, and northeastern United States. Colonial's pipeline system extends from Houston, Texas, to Linden, New Jersey, crossing 13 states.[2] The company transports about 2.4 million barrels of refined products per day. There were two Colonial contractors involved in this accident. One contractor was L.E. Bell Construction Company, Inc. (L.E. Bell), which performed excavation and maintenance activities at the accident site.[3] The second contractor was Superior Land Designs, LLC (Superior Land Designs), which performed project inspection services at the accident site.[4]

Line 1 Pipeline

The accident occurred on Colonial's Line 1, which extends from Houston, Texas, to Greensboro, North Carolina. When the accident occurred, Line 1 was transporting gasoline eastward at a maximum flow rate of 58,000 barrels per hour, with a maximum operating pressure

[2] For further information, see the Colonial Pipeline website at http://www.colpipe.com/.

[3] For further information, see the L.E. Bell Construction Company Pipeline Stations and Terminals website at https://www.lebellconstruction.com/.

[4] For further information, see the Superior Land Designs website at https://www.superiorlanddesigns.com/.

at the accident site of 539 pounds per square inch, gauge. Line 1 at the accident site was a 36-inch diameter pipe with a 0.281-inch wall thickness. The pipe was manufactured in 1960 by National Tube, using double submerged arc welding to comply with American Petroleum Institute (API) 5L X52 grade pipe specification.

Colonial uses THREAD-O-RING (TOR) fittings welded to the pipe for maintenance work. (See figure 3.) TORs consist of a short length of pipe that contains mechanical components such as a pipe cap, an O-ring, and a pipe plug. The outward end is threaded for the attachment of a hose line, which can be used during field maintenance or testing (nitrogen injection/pressure testing of the pipeline). The TOR fittings at the accident site were fabricated from NPS 2 pipe and were about 5 inches long.[5] There were four TOR fittings positioned along the top of the Line 1 pipeline at the accident site, spaced about 20 inches apart.

[5] *Nominal Pipe Size (NPS*) is a North American standard for specifying the size of pipe in nominal or dimensionless units for the diameter of the hole. For example, NPS 2 pipe has a 2.375-inch outside diameter. Also see American Society of Mechanical Engineers B36.10M – 2018: Welded and Seamless Wrought Steel Pipe, October 2018, for other pipe sizes.

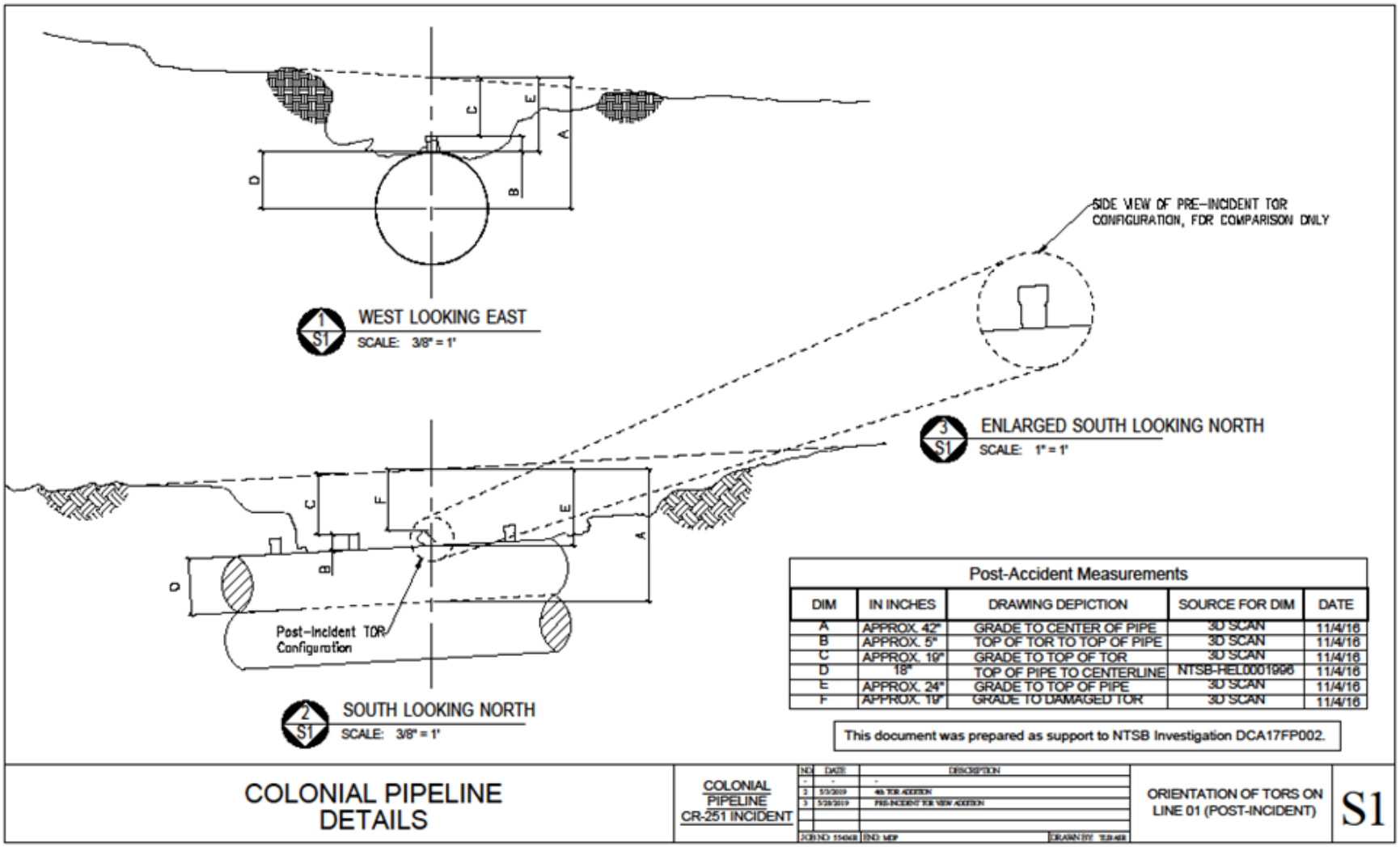

Figure 3. Postaccident Illustration of TORs on Line 1 at the accident site**.** (Source: Colonial.)

Purpose of Excavation

The accident occurred near milepost 573.7, which was 306 feet northeast of River Road (County Road 251).[6] Colonial refers to this location as the CR-251 jobsite. The right-of-way in this area had a slight downhill slope to the southwest, which is in the direction of River Road. The top of the Line 1 pipeline was buried with a depth of cover of about 24 inches in this area. The soil was dry and rocky. According to the Colonial project manager, the geology did not present any significant challenges for the excavation work.

At the time of the accident, the excavation being performed was to expose a series of TOR fittings on Line 1 in preparation for upcoming maintenance work to inject nitrogen into Line 1 during the removal of a temporary bypass pipe used to repair a previous leak.[7] The Colonial project manager indicated that, by Colonial pipeline documentation alone, they were unable to confirm the number of TORs on that segment of Line 1 (at the accident location) and that the number of TORs could only be verified by excavating the pipe.[8] The excavation would also permit the installation of additional TORs for nitrogen injection if they were deemed necessary.

There were two concrete slabs positioned over the TORs on Line 1 at the CR-251 accident site. The concrete slabs each measured 3 feet wide and 4 feet long, and they were situated in an end-to-end orientation (the 3-foot end of one slab abutted the 3-foot end of the other slab) so that the slabs extended for 8 feet above the pipeline. The concrete slabs are intended to protect the pipeline from unintended strikes during excavation work.

According to National Transportation Safety Board (NTSB) interviews of L.E. Bell and Colonial personnel, neither the L.E. Bell crew nor Colonial had knowledge of the two concrete slabs above the TOR fittings. There was no documentation available that indicated the dimensions, depth, or position of the concrete slabs. The alignment sheets available to the work crew did not indicate the concrete pads over the TOR fittings and indicated only three of the four TOR fittings. Although the depiction of appurtenances such as TOR fittings was required at the time of the accident, there was no requirement that the concrete pads be indicated on the alignment sheets.

The Investigation

About 2:15 p.m. on October 31, 2016, the L.E. Bell excavation crew arrived at the River Road jobsite to excavate soil from above the pipe to allow access to the TOR fittings. As part of this process, the L.E. Bell crew also had to remove any known nonsoil materials such as concrete slabs. The Superior Land Designs project inspector arrived at the River Road site about 2:30 p.m. According to the Superior Land Designs project inspector, seven L.E. Bell crewmembers were at

[6] Milepost references in a pipeline system refer to the linear distance, in miles, along the length of the pipeline, relative to a designated origin point. Here the Colonial Line 1 origin point is located in Houston, Texas (to the west of the accident site).

[7] The previous leak on Line 1 occurred September 9, 2016, at a location about 5.5 miles downstream (northeast) of the accident site.

[8] In-line inspection data confirmed the presence of four branch connections; three of the TOR fittings had been previously located. This data, as well as the alignment sheets, can be found in the public docket.

the CR-251 site, including two spotters, a track-hoe operator, a superintendent, and a foreman.[9] The Superior Land Designs project inspector told NTSB investigators that he had mentioned to the L.E. Bell crew that the excavation site likely would have some protections for the TORs. The L.E. Bell superintendent represented in an NTSB interview that the presence of concrete slabs was infrequent but possible.

The Superior Land Designs project inspector told NTSB investigators that he was informed by the L.E. Bell foreman about 2:35 p.m. that two of the L.E. Bell crewmembers had located Line 1 at the River Road excavation site using a line locator and probing. The L.E. Bell foreman stated that when Line 1 was located with the electronic line locator, the locator indicated that the center of the pipe was at a depth of about 3.5 feet. According to the Superior Land Designs project inspector, the L.E. Bell crew probed, located, and confirmed that the depth of Line 1 was the same (3 1/2 feet) as the line finder reading before excavation activities were initiated and that the L.E. Bell crew had hand probed both sides of Line 1 before undertaking any excavation work.

However, according to one of the two spotters, the track-hoe operator instructed him to probe for the pipe where the orange ground markings identifying the pipe location were located. The spotter also told NTSB that he could only get the probe down about 3 inches into the ground, which was contrary to what the Superior Land Designs project inspector stated, and accordingly he could not confirm the depth of the pipe. The spotter stated that he tried to hammer the probe down into the ground, but it "jumped back" because, based on his experience, he assumed that the probe was hitting rocky material. In the industry, the typical next step would have been for another employee to hold the probe at its bottom and for the spotter to either hammer the probe or, alternatively, move incrementally 2 inches away and reattempt probing under direction of the Superior Land Designs project inspector. In addition, the spotter told NTSB that neither he nor anyone else performed additional probing prior to the accident.

The spotter told NTSB investigators that after he was unable to insert the probe more than 3 inches into the ground; the track-hoe operator informed him that he was going to "clean up" first, by scratching the surface of the ground with the teeth of the track-hoe bucket. The purpose of the scratching was to remove the rock from the excavation area so that the probe could be properly inserted. The spotter also said that the Superior Land Designs project inspector remained silent while the scratching occurred.

The Superior Land Designs project inspector told NTSB that, about 2:40 p.m., the track-hoe operator gently scratched the ground with the track-hoe bucket teeth to loosen the hardened earth. The spotter described in an NTSB interview that the track-hoe operator's pace of excavation was faster than the work performed at another jobsite earlier that day and mentioned that the excavation proceeded quickly.

The spotter stated in an NTSB interview that during the scratching process, the track-hoe operator was scratching directly over the pipe and that he visually signaled to the track-hoe operator that he was prepared to use the probe rod to locate the depth of the pipeline. The track-hoe operator did not allow him to probe. Also, the spotter said that on the fourth swipe the track-hoe

[9] A *spotter* is an employee who assists the operator in maneuvering equipment into position to prevent injuries or property damage.

bucket scratched what he believed to be a rock, but the bucket did not pick up any rocks. The spotter said the track-hoe operator then made a fifth swipe. At that point, the TOR fitting was impacted, allowing gasoline to be released. During his interview, the spotter told NTSB investigators that he had not witnessed site work where the dirt over the pipeline has been excavated before probing.

Additionally, the spotter estimated that after the final swipe, the track-hoe operator had dug down a total depth of between 18 inches and 2 feet. Colonial personnel, during postaccident examination, determined the top of the TORs to be 19 inches below grade, and the top of the pipeline was 2 feet below grade.[10] The spotter indicated that he did not hear the Superior Land Designs project inspector say anything while the digs occurred. The spotter also stated that if Colonial inspectors had been on-site, they would not have allowed mechanical excavation with the track-hoe excavator directly over the pipe.

Colonial's Maintenance Procedure for Excavation and Backfill, CM-102, Revision 5, January 30, 2015, states that hand excavation is required for the following conditions:

- Excavation closer than 2 feet from top or bottom of pipeline until pipeline has been exposed.
- Excavation closer than 2 feet from sides of pipeline until pipeline has been exposed.
- Excavation closer than 1 foot from top or sides after pipeline has been exposed. This means that after the pipe has been exposed, no mechanical excavation is permitted within 1 foot around the pipe.
- Complex excavation involving tight quarters.

At 2:47 p.m., according to the Superior Land Designs project inspector, he heard what he thought at the time was the bucket of the track-hoe scratching rock on the third scratch of the track-hoe bucket and then "a wall of gasoline" struck him in the face, spraying from the excavation site. He also stated that upon seeing the released gasoline, he was concerned that a fire would start. He stated that he screamed at the L.E. Bell crewmembers to run, and he turned and ran toward the nearby wooded area. The L.E. Bell superintendent told NTSB investigators that he saw the track-hoe operator walking away from the spraying gasoline, but then he saw him turn around and walk back toward the spray when the fire ignited. The L.E. Bell superintendent told NTSB investigators that he saw sparks close to a nearby power line just prior to ignition. There were also several internal combustion engines operating at the time of the fire ignition.

During the investigation of this accident, an area of the accident site was excavated by hand, which exposed a segment of the pipeline and the four TOR fittings that were attached to the top surface of the pipe. The examination revealed that one of the TOR fittings had been damaged

[10] Measurements were made in the field after soil levels may have been disturbed; thus, dimensions may differ by a few inches as compared to the actual dimensions at the time of the accident.

in the accident. Figure 4 shows a close-up view of the base of the damaged TOR fitting and the breach in the pipe at the point of the TOR attachment to the pipe surface.

Figure 4. Close-up photo of base of damaged TOR fitting and breach in pipe at point of TOR attachment to pipe. (Source: Colonial.)

Postaccident Actions

Following the accident, Colonial and L.E. Bell took action to improve the safety of their work activities, as summarized below.

Colonial

- Executed a safety stand-down to review existing policies and procedures, including the Excavation and Backfill Procedure, CM-102.

- Implemented a safety management system (SMS) based on the American National Standards Institute/American Petroleum Institue (ANSI/API) Recommended Practice 1173 and created the full-time positions of manager of SMS, vice president of operations services, and chief risk officer, who oversees SMS. [11]

- Implemented an annual review of procedures, including excavation and backfill procedures, encompassing review of CM-102 by district project leaders and

[11] For further information see ANSI/API Recommended Practice 1173 Pipeline Safety Management Systems, First edition, July 2015, API, https://www.api.org/~/media/files/publications/whats%20new/1173_e1%20pa.pdf.

management personnel, where formal revisions, if any, are published and reviewed annually with the projects team (including project managers and inspectors) during their annual training.

- Implemented contract inspector operator qualification, in which**,** as a new requirement, contract inspectors must now be operator qualified for any covered task they inspect, and general contractor operator qualification requirements are unchanged.

- Implemented credential and qualification verifications in which contract inspector credentials/qualifications must be verified prior to assignment and periodically thereafter.

- Improved contractor communications by creating a website as the primary source for Colonial communications to contractors.

- Colonial's Health and Safety Council developed a field visits brochure to provide insight for employees preparing to visit the field, with a reference guide issued to each new hire, corporate office staff members, and external visitors who tour facilities and jobsites.

- Increased the number of safety specialists who perform random safety audits and conduct behavior-based safety observations at jobsites.

- Instituted safety calls and meetings, where the company conducts monthly safety calls with contractors and convenes annual face-to-face safety meetings with contractors.

L.E. Bell

- Implemented SMS, which captured the elements of the ANSI/API 1173.

- Examined the company's policies, procedures, and practices applicable to its overall operations and the specific work being performed at the time of the accident. The company concentrated on (1) refocused annual training and enhanced supervisor training and (2) field training enhancements and additional management presence in the field.

- Refocused annual training and enhanced supervisor training, which emphasizes its stop-work authority policy, emergency action planning, the contents of its excavation and back-fill policy and procedure, and abnormal operating conditions. The enhanced supervisory training addresses hazard recognition and elimination, leadership, accident/incident/near-miss investigation, and field-safety auditing.

- Increased field job aides and additional safety and leadership presence in the field, which further augmented and ingrained the company's performance-based classroom and computer-based training throughout the year with several improvements to its job site planning, assessment, and enforcement, in which it modified its job safety analysis

procedure (requiring a new one whenever there is a change in (1) job location, (2) scope of work, (3) job task, or (4) a new potential hazard is identified).

- Developed several job aides, checklists, and visual tools (safe work cards for supervisors to use on every job) for use in the field to serve as a daily reminder for employees to assess the job and potential hazards before and during their work or when changes occur in the job location or scope of work or a new potential hazard arises.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the explosion was the excavation crew's inadequate planning, coordination, and communication during the excavation and failure to adhere to company policy requiring hand excavation if closer than 2 feet from the top or bottom of the pipeline until the pipeline has been exposed, which allowed the track-hoe to damage the pipeline.

For more details about this accident, visit www.ntsb.gov/investigations/dms.html and search for NTSB accident identification number DCA17FP002.

Report Date: December 10, 2019