DOT	US Department of Transportation
PHMSA	Pipeline and Hazardous Materials Safety Administration
OPS	Office of Pipeline Safety – Accident Investigation Division

Principal Investigator	Wesley Mathews
Acting Accident Investigation Director	Chris Ruhl
Date of Report	May 26, 2022
Subject	Failure Investigation Report - Denbury Gulf Coast Pipelines, LLC – Pipeline Rupture/ Natural Force Damage

Operator, Location, & Consequences

Date of Failure	February 22, 2020
Commodity Released	Carbon Dioxide
City, County and State	Satartia, Yazoo County, MS
OpID and Operator Name	32545, Denbury Gulf Coast Pipelines, LLC
Unit # and Unit Name	75379 – MS-2
WMS Activity ID	20-176125
Milepost (MP) / Location	MP 6.6 / Pipeline Stationing 348+63
Type of Failure	Natural Force Damage
Fatalities	None
Injuries	None
Description of Area Impacted	Rural, "Could Affect" High Consequence Area (HCA) - Other Populated Area
Total Costs	$ 3,947,009

Key Points

- On February 22, 2020, a carbon dioxide (CO_2) pipeline operated by Denbury Gulf Coast Pipelines LLC (Denbury) ruptured in proximity to the community of Satartia, Mississippi. The rupture followed heavy rains that resulted in a landslide, creating excessive axial strain on a pipeline weld.
- Carbon dioxide is considered minimally toxic by inhalation and is classified as an asphyxiant, displacing the oxygen in air. Symptoms of CO_2 exposure may include headache and drowsiness. Individuals exposed to higher concentrations may experience rapid breathing, confusion, increased cardiac output, elevated blood pressure, and increased arrhythmias. Extreme CO_2 concentrations can lead to death by asphyxiation.
- When CO_2 in a super-critical phase (which is common for CO_2 pipelines) releases into open air, it naturally vaporizes into a heavier than air gas and dissipates. During the February 22 event, atmospheric conditions and unique topographical features of the accident site significantly delayed dissipation of the heavier-than-air vapor cloud. Pipeline operators are required to establish atmospheric models to prepare for emergencies—Denbury's model did not contemplate a release that could affect the Village of Satartia.
- Local emergency responders were not informed by Denbury of the rupture and the nature of the unique safety risks of the CO_2 pipeline. As a result, responders had to guess the nature of the risk, in part making assumptions based on reports of a "green gas" and "rotten egg smell" and had to contemplate appropriate mitigative actions. Fortunately, responders decided to quickly isolate the affected area by shutting down local highways and evacuating people in proximity to the release. Denbury reported on its PHMSA F 7000.1 accident report that 200 residents surrounding the rupture location were evacuated, and forty-five people were taken to the hospital. Denbury also reported that to the company's knowledge, one individual was admitted to the hospital for reasons unrelated to the pipeline failure. No fatalities were reported.
- This event demonstrated the need for:
    - Pipeline company awareness and mitigation efforts directed at addressing integrity threats due to changing climate, geohazards, and soil stability issues.
    - Improved public engagement efforts to ensure public and emergency responder awareness of nearby CO_2 pipeline and pipeline facilities and what to do if a CO_2 release occurs. This is especially important for communities in low-lying areas, with certain topographical features such as rivers and valleys.

Failure Investigation Report – Denbury Gulf Coast Pipelines LLC
Pipeline Rupture/Natural Force Damage
February 22, 2020

Executive Summary

On February 22, 2020, at 7:06 p.m. Central Standard Time (CST[1]), Denbury's 24-inch Delhi (Delhi) Pipeline ruptured, releasing liquid CO_2 that immediately began to vaporize at atmospheric conditions. The site of the rupture was on the northeast side of Highway 433 (HWY 433), approximately one mile southeast of Satartia, Mississippi. Denbury subsequently reported the rupture released an estimated total of 31,405[2] barrels of CO_2. Following the accident, investigators from the Pipeline and Hazardous Material Safety Administration's (PHMSA's) Accident Investigation Division (AID) and Southwest Regional Office, conducted an investigation, including an onsite investigation.

Liquid CO_2 vaporizes when released to the atmosphere. Carbon dioxide vapor is 1.53 times heavier than air, and displaces oxygen, so it can act as an asphyxiant to humans and animals. The National Institute for Occupational Safety and Health has established that concentrations of 40,000 parts per million (ppm) are immediately dangerous to life and health. The Occupational Safety and Health Administration has established 5000 ppm as a permissible exposure limit, which is an 8-hour time-weighted average. The weather conditions and unique topography of the accident site prevented the CO_2 vapor from rapidly dispersing and allowing a plume to form that migrated toward Satartia. Upon learning of the pipeline rupture, Yazoo County Office of Emergency Management (Yazoo County OEM) shut down HWY 433 to all traffic and evacuated the area. Local authorities evacuated approximately 200 people near the rupture, including the entire town of Satartia (around 50 residents), and three homes across the Yazoo River. According to Denbury's PHMSA F 7000.1 accident report, forty-five people sought medical attention at local hospitals, including individuals who were caught in the vapor cloud while driving a vehicle. One individual was admitted to the hospital for reasons unrelated to the pipeline failure. There were no fatalities.

The pipeline failed on a steep embankment adjacent to HWY 433, which had recently subsided. Heavy rains are believed to have led to a landslide, which created axial strain on the pipeline and resulted in a full circumferential girth weld failure. After the accident, Denbury, under PHMSA's oversight, cut out the failed sections of pipe and sent them to Det Norske Veritas' (DNV) Columbus, Ohio laboratory for metallurgical analysis. DNV confirmed the initial onsite observations of a girth weld failure.

PHMSA's investigation also revealed several contributing factors to the accident, including but not limited to, Denbury not addressing the risks of geohazards in its plans and procedures, underestimating the potential affected areas that could be impacted by a release in its CO_2 dispersion model, and not notifying local responders to advise them of a potential failure.

System Details

Denbury's Delhi Pipeline, on which the failure occurred, consists of 77 miles of 24-inch diameter pipeline, the majority of which is located within Mississippi. The entire Delhi Pipeline system flows east to west, beginning at the Jackson Dome in Mississippi and terminating in Delhi, Louisiana. Denbury primarily uses the CO_2 for enhanced oil recovery (EOR) for Denbury Resources Inc. onshore oil wells. The pipeline is controlled from the Denbury control room located in Plano, Texas.

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[1] All times are reported in CST unless otherwise noted.

[2] Denbury reported a total release volume of 31,405 barrels in Form PHMSA F-7000.1, Accident Report – Hazardous Liquid Pipeline Systems, dated November 25, 2020. The actual release volume likely exceeded this amount due to a valve operation error, however, Denbury has not confirmed and reported any new release volume to PHMSA.

Following the Delhi Pipeline rupture, two of Denbury's local oilfields were cut off from its CO_2 supply and assumed non-EOR operation while the pipeline remained out of service. One oilfield returned to full EOR operation before repairs were made to the Delhi Pipeline as the oilfield had an alternate supply of CO_2. The other oilfield conducted non-EOR operations until the pipeline was repaired and returned to service in October 2020.

Stupp Corporation manufactured the pipe in 2007 and Denbury installed it in 2009. The pipe was manufactured to API 5L X80 grade, with an electric resistance welded (ERW) longitudinal weld seam, a 0.469-inch wall thickness on the mainline pipe, 0.540-inch wall thickness on the bored pipe section under roads, which was 240 feet in length and more than 30 feet below HWY 433. The pipe is coated with fusion bonded epoxy (FBE) and was installed by horizontal directional drill. During construction, Denbury welded the pipe joints using an API 1104 qualified welding procedure. The procedure specified using an E6010 electrode root pass, followed by an E9018 electrode hot pass, then E10045 electrode for subsequent passes.

The maximum operating pressure of the Delhi Pipeline is 2160 pounds per square inch gauge (psig). At the time of the rupture, Denbury was operating the Delhi Pipeline at an estimated pressure of 1400 psig, which was above the 1070 psig needed to maintain CO_2 in a supercritical state.

Denbury's control room isolated the failed pipeline section by remotely operating the mainline block valves (MLBVs) at Redwood, Satartia, and Tinsley. There is approximately 9.55 miles of pipe between the Tinsley and Satartia MLBVs, which are the two MLBVs closest to the rupture.

Events Leading up to the Failure

According to the National Weather Service (NWS), accumulated rainfall data between January 1, 2020, through February 29, 2020 (60 days) for each of the cities of Greenville, Greenwood, Vicksburg, and Jackson, Mississippi – which form a relative square (Figure 1) around Satartia and Yazoo County[3] – was 17.43 inches, 19.41 inches, 23.2 inches, and 23.36 inches of rain, respectively. The amount of rain recorded in these four cities was between 7.44 and 13.63 inches above the annual historical average for the same 60-day timespan. Significant variations in environmental/climate conditions such as ambient temperatures and rainfall can impact soil stability and erosion patterns. Landslides are typically associated with periods of heavy rain, particularly in susceptible areas with the right combination of slope and soil-type. On May 26, 2022, PHMSA issued an updated Advisory Bulletin to remind operators of gas and hazardous liquid pipelines of the importance of identifying and mitigating risks caused by changes in environmental and geological conditions on their pipeline facilities.

[3] Neither Yazoo City, Satartia, nor Yazoo County had historic NWS data for the desired date range.

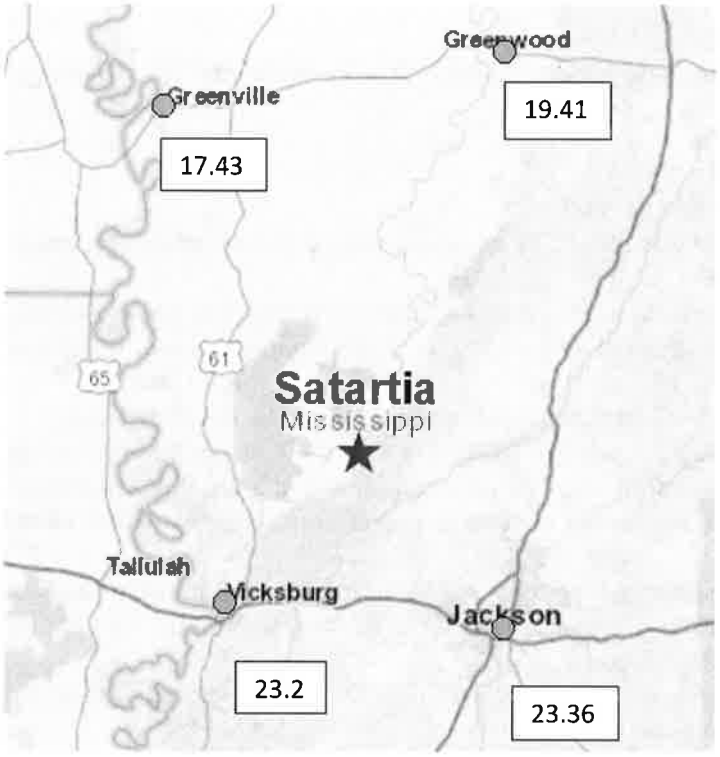

Figure 1: Map of Cities Relative to Satartia and Their Respective Rain Totals Between January 1, 2020, and February 29, 2020

On November 9, 2018, the Delhi Pipeline experienced a girth weld rupture at a valve location during pipeline reloading activities, and not attributed to natural force damage. Laboratory analysis indicated the release was the result of large thermal differential stresses being exerted on the pipeline from CO_2 loading at two different locations at the same time. The pipe between the two loading points shrank due to chilling from the CO_2, causing the girth weld connecting the pipeline to the valve body to rupture. The report found no evidence of inadequate mechanical properties or chemical composition anomalies in the ruptured weld. Denbury updated their procedure to prevent similar occurrences.

Prior to the accident, on November 8, 2019, Yazoo County first responders practiced a full-scale county response during a drill for a rail accident, however Denbury was not a participant in the drill. Local responders believe that the drill prepared them to respond to this event. Denbury had not conducted any drills with local responders since Denbury's modeling had not identified that Satartia would be impacted by a rupture of the pipeline.

Emergency Response

The Delhi Pipeline was operating normally prior to the February 22, 2020 accident.

Approximated Timeline

The following timeline was developed utilizing information provided by the Yazoo County OEM, [4] Denbury, and PHMSA investigator notes.

On February 22, 2020:

- 7:06 p.m. – Denbury's 24-inch pipeline ruptured.
- 7:07 p.m. – Denbury's control room was alerted by its supervisory control and data acquisition (SCADA) system of a pressure drop.
- 7:14 p.m. – Denbury control room remotely closed three MLBVs (one MLBV at Tinsley Station, which is upstream of the rupture site, and two MLBVs at Satartia and Redwood, which are downstream of the rupture).
- 7:15 p.m. – Denbury control room received SCADA confirmation that the MLBVs were closed.
- 7:15 p.m. – Yazoo County OEM dispatcher received an initial report of a "foul smell and green fog across the highway." Based on that information, responders responded under the assumption there was a possible chlorine leak and began contacting people from the local water utility company.
- 7:17 p.m. – Yazoo County OEM dispatcher received a call regarding a person possibly having a seizure. Responders began contacting personnel responsible for a nearby water well as the description of the report indicated chlorine gas.
- 7:19 p.m. – Denbury dispatched personnel to attempt to confirm MLBVs were closed successfully and to identify the location of the release.
- 7:26 p.m. – HWY 433 was ordered closed by local officials due to belief a chlorine leak was occurring.
- 7:30 p.m. – A responder commented that it sounded like a gas line had erupted. It was around this same time that another responder fielded a call from someone in the area who could hear a loud roar. This led the responders to believe that the accident was not chlorine gas related. First responders redirected their efforts to a possible CO_2 and hydrogen sulfide release, based on the initial first-hand reports from community members.
- 7:30 p.m. – First responders accessed a plume model generated by the NWS correlating local meteorological data with product type which indicated the CO_2 would move from the release site directly toward Satartia. Responders then called for the evacuation of Satartia. The scope of the response expanded as the CO_2 cloud dispersed, requiring an Incident Command (IC), commanded by the Chief of the District Three Volunteer Fire Department.
- 7:39 p.m. – Yazoo County OEM closed Highway 3 to traffic (intersection with HWY 433 is about 2/3-mile northwest of the rupture site).
- 7:43 p.m. – IC confirmed Denbury's CO_2 pipeline had ruptured; however, no one could get close to the release site due to the ongoing release of CO_2.
- 7:48 p.m. – Denbury's Tinsley Station Manager was contacted by IC and informed that Denbury's pipeline had ruptured. IC made Denbury aware of the response measures being taken. Denbury informed the IC that the Jackson Dome formation was shut down and that company personnel had been dispatched to check that the MLBVs were closed.

[4] The events entered in the Yazoo County OEM recording system are time stamped upon entry and may be delayed by seconds or minutes from the actual time of the event.

- 7:57 p.m. – Yazoo County OEM blocked off Mechanicsburg Road (around two miles southeast of the rupture site; intersects with HWY 433).
- 7:58 p.m. – According to Yazoo County OEM records, the Mississippi Department of Environmental Quality (MDEQ) contacted the Center for Toxicology & Environmental Health (CTEH) requesting technicians be dispatched to the rupture site with air monitoring equipment.
- 8:06 p.m. – The first Denbury representative arrived near the rupture site after confirming MLBV closures.
- 8:24 p.m. – Yazoo County OEM dispatch confirmed the second Denbury representative arrived near the rupture site.
- 9:06 p.m. – A Denbury representative from the Plano, Texas office called the National Response Center (NRC) to report their Delhi Pipeline had ruptured, releasing an estimated 222 barrels of liquid carbon dioxide (Report No. 1271847).
- 9:25 p.m. – Representatives from the CTEH and Denbury's environmental contractor E3 Environmental (E3) arrived on scene to conduct air monitoring to support the IC.
- 10:25 p.m. – Tinsley MLBV was completely closed.[5]
- 10:30 p.m. – CTEH initiated real-time air monitoring.

On February 23, 2020:

- 1:49 a.m. – The IC established a warming shelter at a local middle school for evacuees.
- 8:00 a.m. – Evacuees were allowed to return home. Air monitoring services were extended to anyone who requested the service. Evacuees were encouraged to vent their homes by opening doors and windows. The closure of HWY 433 was lifted after heavy equipment was used to clear mud that was deposited by the rupture.
- 11:34 a.m. – Real-time air monitoring concluded.

On February 24, 2020:

- 6:56 p.m., Denbury called the NRC and made the PHMSA required 48-hour update (Report No. 1272001). The update stated 21,873 barrels of liquid CO_2 had been released.[5]

Personnel from the Vicksburg Fire Department, including paramedics, District Three Volunteer Fire Department, Pafford EMS, Mississippi Emergency Management Agency, CF Industries, MDEQ, Madison County Fire Department, Warren County Fire Department, NWS, Local Police Departments, Yazoo County OEM, CTEH, E3, and Denbury participated in the emergency response efforts.

Local emergency responders utilized regular media, social media posts, phone calls, and door-to-door checks to notify homeowners and affected individuals of the CO_2 release.

A total of approximately 200 people were evacuated, which included those who were evacuated out of the area and those who were not allowed to pass through the area. During post-accident interviews, PHMSA learned that individuals on HWY 433 and in the area nearest to the migrating CO_2 vapor cloud experienced vehicle engine issues. This included individuals in a vehicle off of HWY 433, who succumbed to the effects of exposure to the released CO_2 and required emergency assistance to be evacuated. PHMSA also learned that one of two residents living in a dwelling in closest proximity to the pipeline rupture

[5] Denbury reported an updated estimate of 31,405 barrels to PHMSA on November 25, 2020.

passed out upon investigating the cloud. She later came-to and was able to evacuate to safety with her partner. Denbury reported a total of forty-five people sought medical attention at local hospitals.

Emergency Response Air Monitoring Plan

CTEH (Denbury's third-party contractor) in consultation with the IC developed an air monitoring plan to ensure the safety of response personnel, the community, and site characterization. CTEH implemented the plan to monitor for concentrations of CO_2, hydrogen-sulfide (H_2S), and oxygen (O_2) using handheld real-time instrumentation throughout the community and within homes of residents who requested monitoring. Air monitoring was conducted from 10:30 p.m. on February 22, 2020, until approximately 11:30 a.m. on February 23, 2020. Monitoring was performed using calibrated RAE Systems instruments made by Honeywell.

Carbon dioxide is considered minimally toxic by inhalation, unless in higher concentrations. CO_2 is classified as an asphyxiant, displacing the oxygen in breathing air. Symptoms of CO_2 exposure may include headache and drowsiness. Those exposed to higher concentrations may experience rapid breathing, confusion, increased cardiac output, elevated blood pressure, and increased arrhythmias. Extreme CO_2 concentrations can lead to death by asphyxiation.

In the hours after the rupture, after outdoor ambient air CO_2 levels continuously measured below 5,000 ppm, responders performed initial indoor assessment monitoring within residences and church buildings potentially impacted by the accident. During initial indoor assessments, CO_2 concentrations ranged from 200 through 28,000 ppm, with six detections exceeding 5,000 ppm. In these instances, occupants of these structures were advised to open doors and windows to allow ventilation to dissipate the concentration of CO_2 and not to enter prior to re-assessment. No subsequent CO_2 readings in the hours after the accident were recorded above 3,500 ppm during re-assessments.

According to firsthand accounts, as well as secondhand accounts from first responders, there was a "rotten eggs" odor associated with the CO_2 release and gas plume. A rotten eggs odor can be attributed to the presence of H_2S, which is naturally occurring in the geologic formation that serves as a source of the CO_2 in the pipeline. PHMSA reviewed the CTEH air monitoring results and did not identify any observed readings of H_2S by monitoring equipment. The monitoring equipment's detection limit for H_2S was 0.1 ppm.

Summary of Return-to-Service

Prior to repairing the pipeline, Denbury contracted an engineering firm to develop plans to cutout the failed section of pipe and to mitigate potential future land movement. Denbury installed soil shoring along HWY 433 to stabilize the area. PHMSA evaluated the repair plan and monitored its execution.

On September 1, 2020, Denbury began replacing the failed pipe section, and on September 26, Denbury welded the new sections of pipe into the pipeline at the accident location. Mannesmann Line Pipe manufactured the newly installed 80-foot section of 24-inch nominal diameter pipe in 2019. The pipe is API 5L X70 grade, has 0.562-inch wall thickness and an ERW longitudinal weld seam, and is coated with FBE.

Denbury restarted the pipeline on October 26, 2020. Prior to the restart of the pipeline, Denbury provided PHMSA with a proposed restart plan for review and approval. Concurrently with Denbury's repair and restart efforts, PHMSA conducted an inspection of Denbury's pipeline operations, which resulted in the

issuance of various enforcement actions, including a Notice of Probable Violation in connection with this accident.[6]

Investigation Details

On February 23, 2020, at 10:09 a.m., a PHMSA AID investigator from Oklahoma City arrived at the intersection of HWY 433 and Highway 3 to meet with Denbury representatives and emergency response organizations. The group then proceeded to the site of the rupture (Figure 2). By that time, the IC had demobilized, and roadblocks had been removed. Denbury crews were in the process of setting up caution fencing and slowing traffic on HWY 433 for public and worker safety. The rupture crater was on the northeast side of HWY 433 (Figure 2).

Figure 2: Vehicle is Parked on HWY 433 - The White is Ice Generated by the Release of CO_2 - The Blue Arrow Points North (Aerial Drone Photograph Courtesy of the Mississippi Emergency Management Agency)

[6] CPF 4-2022-017-NOPV, dated May 26, 2022.

The topography along the pipeline right-of-way (ROW) in this area is a steep hill that rises from the valley containing the Big Black River to the east, goes relatively flat across the crest of the hill containing HWY 433, and then slopes downward toward the valley containing the Yazoo River to the west.

Figure 3: Crater Created by the Rupture Containing Fallen Debris (dry ice, and the failed pipe sections) (Blue Arrow is Pointing at the Pipeline Separation)

The pipeline separated at a girth weld. The pipeline self-excavated due to the discharge of CO_2. The auto refrigeration generated by the CO_2 discharge and accompanying chance in phase covered the area with a thick layer of ice (Figures 2, 3, and 4). The upstream section of pipe was not covered in ice, and a slightly jagged edge was observed on the rupture edge (Figure 4). The crater was an estimated 40-feet-deep on the downstream (HWY 433) side and about four-feet-deep on the upstream side.

Figure 4: The failed pipe sections shown separated by a few inches.

Upon release, the CO_2 transitioned from a liquid to a gaseous phase resulting in a refrigeration effect. Although the pipeline was shut down by 7:15 pm, the remaining contents of the pipe continued to vent to the atmosphere for several hours. The CO_2 was heavier than air[7] and followed a path downhill. CO_2 moved down the slope to the east and remained in the bowl of the crater. As the discharged volume increased, and without significant winds to disperse the CO_2, the CO_2 moved over the crest of the hill then west into the valley, reaching Satartia.

Plume Model

First responders utilized a plume model generated by the NWS to base the decision to evacuate Satartia (Figure 5).

[7] CO_2 has a density approximately 1.53 times that of air in standard atmospheric conditions.

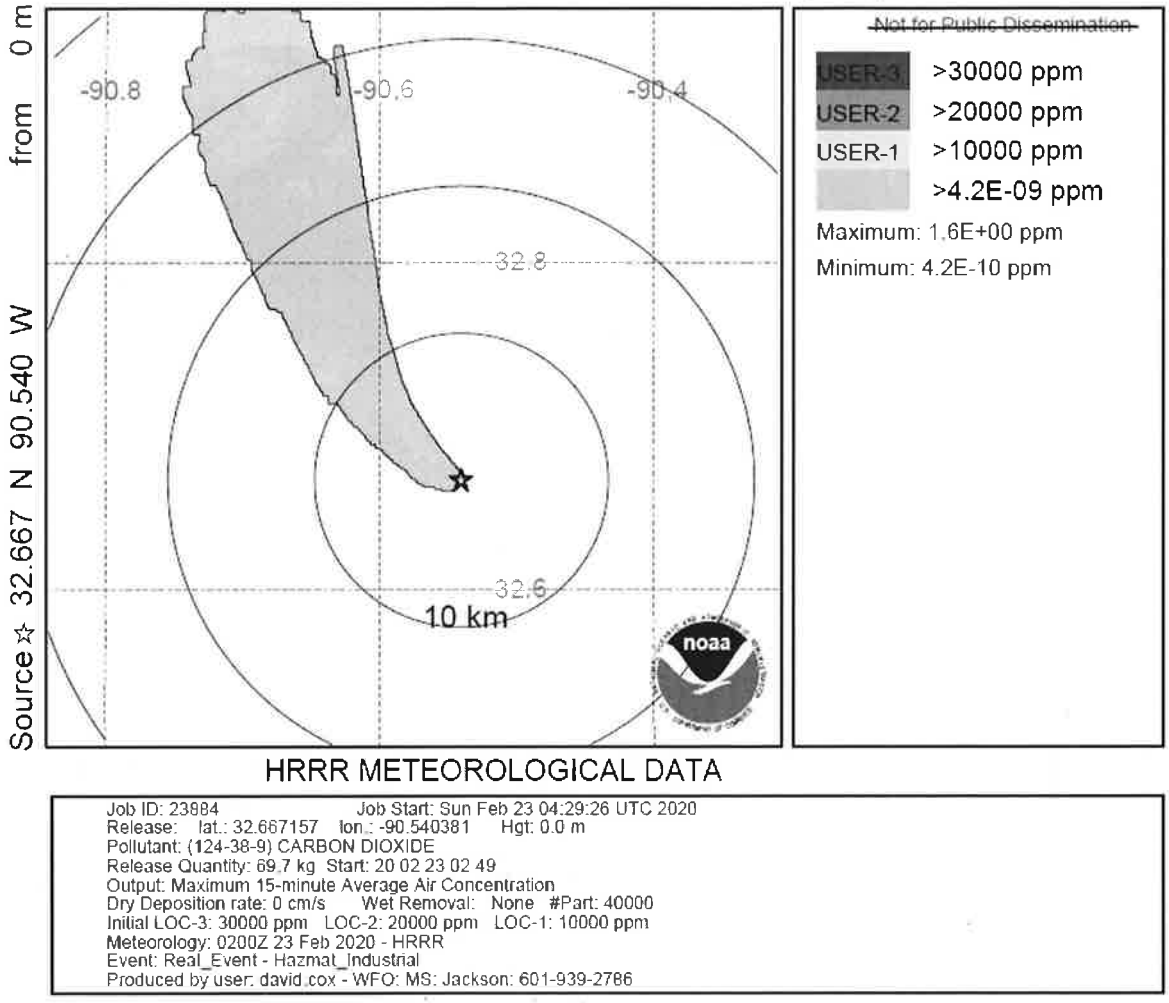

Figure 5: This Chart Shows the Plume Model Data Generated by the National Weather Service/NOAA - The Model Indicates the Direction a Plume or Cloud of CO_2 Would Have Followed from Ground Level While Dissipating, According to Atmospheric Data at the Time of the Release - Each Ring is 10 Kilometers (Satartia is Less Than Two Kilometers Northwest of Release Site, Indicated by the Star)[8]

Prior to the accident in 2011, Denbury had contracted a third-party company to generate an affected radius model for a potential CO_2 release. Denbury used the model to generate a zone along the pipeline ROW to identify pipeline segments which were within or "could affect" an HCA and to develop its Public Awareness Program (PAP).[9] The model established a zone for the Delhi Pipeline (Figure 6) that left Satartia outside of the affected radius, and therefore the pipeline segment was not identified by Denbury as a "could affect" HCA. Additionally, Satartia was not included in Denbury's PAP or considered in any local

[8] The NWS approved inclusion of the chart within this report and clarified that "Not for Public Dissemination" (in the upper right-hand corner) pertains to real-time emergency response utilization, due to inherent uncertainties with several variables.
[9] Required by 49 CFR § 195.440.

emergency response plans. The rupture location was one mile from the center of Satartia, where the entire town was evacuated.

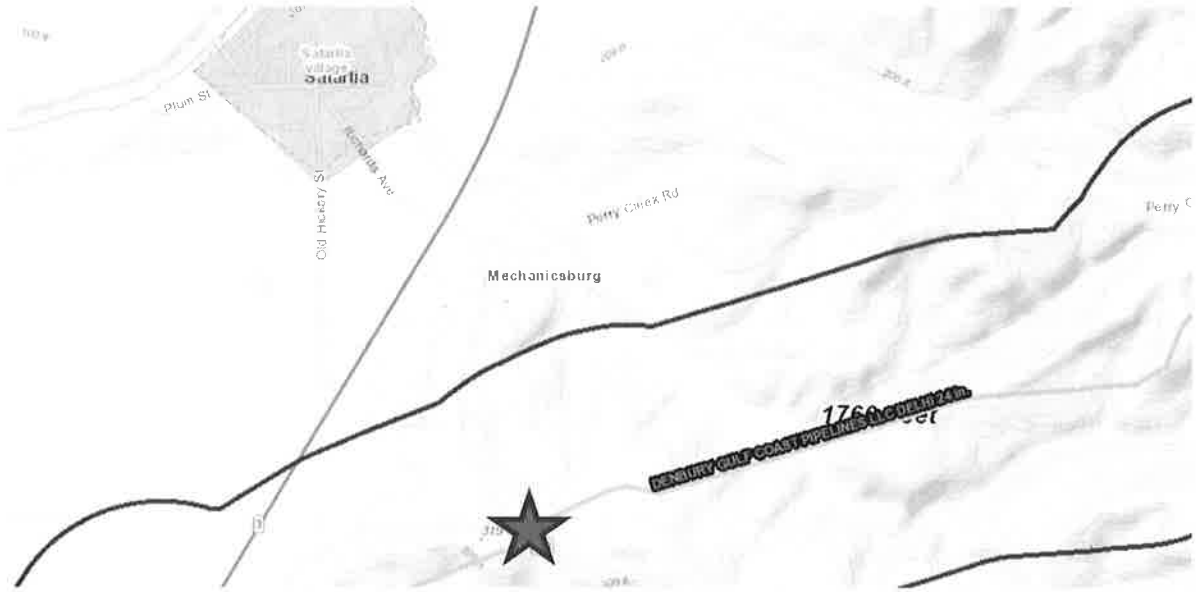

Figure 6: Topographical Map Showing the Delhi Pipeline (Green) and Denbury's Buffer Zone (Red) on Either Side of the Pipeline and the Proximity to Satartia (Blue Star Indicates the Rupture Site)

Soil and Geohazards

The soil at the failure location is identified as a loess soil typical to the area and was relatively saturated due to the recent heavy rainfall. Dry patches of the soil observed later were powdery, confirming the loess to be silty and clayey, indicating the soil would be prone to absorb water as well as collapse or slump under the right conditions.[10] Vertical erosion of the steeply sloped hillside, made heavier by water saturation, produced enough axial loading on the pipeline to cause the girth weld to fail.

On February 23, 2020, representatives from the Mississippi Department of Transportation assessed the condition of the crater's edge along HWY 433. They determined the highway was at risk of further land movement due to current and future soil saturation from rainfall, the weight of the trees at the edge of the crater, and the HWY 433 ROW was impinged upon by the rupture. Crews were dispatched to cut down the trees and mitigate the risk of additional land movement. Soil instability along roads is not unusual in the region. The PHMSA AID investigator observed road damage from unstable soil slumping away from a road along roadways leading to the accident site. Denbury representatives mentioned that, along the Delhi pipeline, they experience two to three issues per year involving land movement. Denbury's Integrity Management Program (IMP)[11] identified "geo-technical hazards" (geohazards) as a potential risk to its pipelines but lacked additional details concerning threat assessment or preventative/mitigative measures for its operational pipelines such as: using in-line inspection tools with inertial measurement unit sensors, conducting bending strain analysis, or conducting geohazard assessments. Denbury's operations and

[10] Loess soil has a relatively high porosity (typically around 50-55%) and often contains vertical capillaries that allow the sediment to fracture and form vertical bluffs. The loess bluffs tend to erode vertically.
[11] Required by 49 CFR § 195.452.

maintenance (O&M) procedures also lacked substantive information regarding geohazard identification, assessment, remediation, and training for employees. Additionally, Denbury's pipeline patrolling program to address federal regulations[12] was commonly performed by aerial patrol. Records indicate that patrols were made at regular intervals, but no geohazards were identified at the rupture location.

In response to this rupture, PHMSA initiated a specialized review of Denbury's IMP and O&M activities. PHMSA's investigation identified that Denbury did not address the risk of geohazards to the pipeline and take adequate preventive and mitigative measures prior to the accident. PHMSA has made specific recommendations for the development of the company's geohazards program, which the company has initiated.

Welding Procedure

Denbury hired DNV prior to the construction of the pipeline to develop its welding procedure. The welding procedure was developed to API 1104, 20th edition and was qualified. The procedure utilized an E6010 electrode root pass, an E9018G electrode hot pass and E10045 electrode filler and cap pass. In 2009, a welding procedure utilizing an E10045 electrode was a pipeline construction industry leading development. Prior industry practice was to utilize cellulosic-type electrodes.

Laboratory and Root Cause Analyses

Once shoring was installed at the rupture site, the upstream pipe was excavated, and two failed pipe sections were cut out. On March 11, 2020, the two failure samples were secured and shipped to DNV's laboratory in Columbus, Ohio for metallurgical analysis. Denbury worked with Mears to provide DNV with a testing protocol to facilitate analysis. Mott MacDonald performed a site-specific soil movement analysis to estimate soil loading on the pipeline and perform a stress analysis. Mears performed a Root Cause Analysis utilizing the above information, coupled with information from original construction documentation, site observations, operating and maintenance records, and related information.

Denbury reported the results of the metallurgical findings and stress evaluations in a written accident report on the PHMSA Form 7000.1 and indicated soil movement upstream of the failure location induced axial stresses sufficient to cause an overload condition, and the soil movement was promoted by unusually heavy rainfall. There were no material defects observed with the pipe or the failed weld which could have contributed to the failure.

PHMSA notes the failed girth weld exhibited both ductile and brittle fracture appearances. A typical overload condition in these circumstances is expected to be ductile, unless the grain structure of the steel is susceptible to brittle failure, or the material has been chilled below its transition temperature from ductile to brittle behavior. A failure scenario whereby a leak initiates, and the refrigeration effect associated with vaporization of the liquid CO_2 results in a brittle failure is plausible, although a distinct failure origin within the girth weld was not identified.

Findings and Contributing Factors

PHMSA has determined that the failure of the Delhi Pipeline was a result of soil movement which caused excessive axial loading leading to failure at the girth weld. Area topography, soil type, and large amounts of rain over the preceding months saturated and vertically eroded the loess soil on the side of the hill above the pipeline. It is unclear whether prevalent warmer temperatures in the two months preceding the heavy rainfall could have contributed to the soil instability as well.

[12] Required by 49 CFR § 195.412.

Contributing factors include:

- Denbury's O&M procedures did not appear to address the potential for pipeline damage due to soil instability despite having prior experience with and knowledge of land movement risks.
- Denbury's IMP did not appear to address integrity threat identification and/or assessment for geohazards or preventative or mitigative measures.
- Denbury's aerial patrols did not identify a geohazard at the failure location prior to the accident.
- Denbury's CO_2 dispersion model underestimated the potential affected area that could be impacted by a release. As a result, the pipeline segment was not identified as a "could affect" HCA, and Satartia was not included in Denbury's PAP.
- Denbury did not notify local responders advising them of a potential failure. Local responders contacted Denbury approximately 40-minutes after the rupture. This led to confusion in understanding circumstances associated with the emergency and hindered the ability of first responders and community members to safely navigate the emergency.

Appendices

Appendix A	Map
Appendix B	NRC Reports Nos. 1271847 and 1272001
Appendix C	PHMSA 7000.1 Final Report
Appendix D	Mears Metallurgical and Root Cause Failure Analysis
Appendix E	CTEH Air Monitoring Summary Report

Appendix A Map

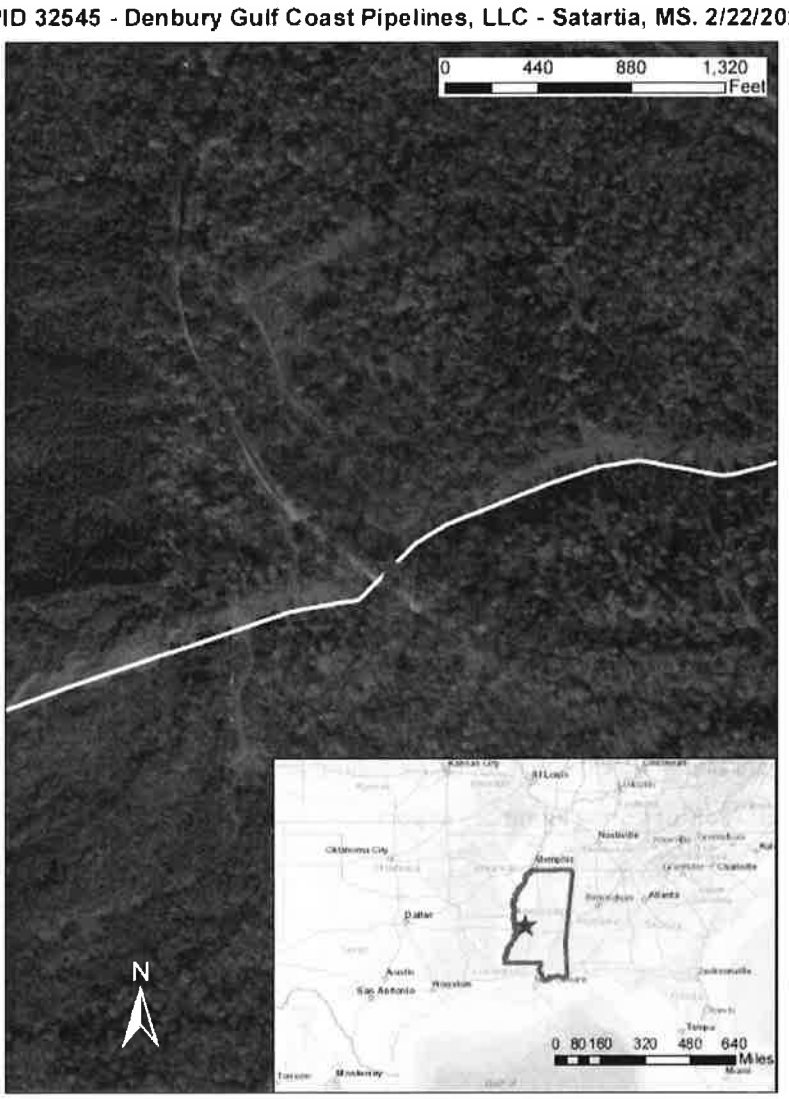

Figure 7: An ArcGIS-generated Satellite Map with the Site of the Rupture Marked by the Red Star (the Insert Map on the Bottom Right Shows the Rupture Site Location Within the State of Mississippi)

Appendix B NRC Report No. 1271847

Mathews, Wesley (PHMSA)

From: HQS-SMB-NRC@uscg.mil
Sent: Thursday, May 21, 2020 12:28 PM
To: Mathews, Wesley (PHMSA)
Subject: NRC#1271847

NATIONAL RESPONSE CENTER 1-800-424-8802
*** For Public Use ***
Information released to a third party shall comply with any
applicable federal and/or state Freedom of Information and Privacy Laws

Incident Report # 1271847

INCIDENT DESCRIPTION

*Report taken by NRC on 22-FEB-20 at 22:06 ET.
Incident Type: PIPELINE
Incident Cause: UNKNOWN
Affected Area:
Incident was discovered on 22-FEB-20 at 19:07 local incident time.
Affected Medium: AIR / ATMOSPHERE

SUSPECTED RESPONSIBLE PARTY

Organization: DENBURY GULF COAST PIPELINE

PLANO, TX 75024

Type of Organization: PRIVATE ENTERPRISE

INCIDENT LOCATION
32.658 County: YAZOO
-90.537
City: SATARTIA State: MS
Distance from City: 1 MILES
Direction from City: SE
OFF HWY 433

RELEASED MATERIAL(S)
CHRIS Code: CDO Official Material Name: CARBON DIOXIDE
Also Known As:
Qty Released: 222 BARREL(S)

DESCRIPTION OF INCIDENT
CARBON DIOXIDE RELEASED FROM A 24 INCH PIPELINE DUE TO AN UNKNOWN CAUSE AT THIS TIME. CALLER STATES THE CONTROL ROOM NOTICED A PRESSURE DROP AT 1907 AND PERSONNEL VERIFIED LEAK AT 2046. CALLER ALSO STATES THERE WERE EMERGENCY RESPONDERS ONSITE AS WELL WHEN THEIR PERSONNEL ARRIVED ONSCENE.

INCIDENT DETAILS

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

IMPACT

Fire Involved: NO Fire Extinguished: UNKNOWN

INJURIES: NO Sent to Hospital: Empl/Crew: Passenger:
FATALITIES: NO Empl/Crew: Passenger: Occupant:
EVACUATIONS:NO Who Evacuated: Radius/Area:

Damages: UNKNOWN

Closure Type	Description of Closure	Hours Closed	Direction of Closure

Air: NO

Road: YES HWY 3; HWY 433; EAGLE BEND RD; PERRY CREEK RD — Major Artery:YES
Waterway:NO

Track: NO

Passengers Transferred: NO
Environmental Impact: UNKNOWN
Media Interest: NONE

REMEDIAL ACTIONS

VALVES WERE IMMEDIATELY SHUT AFTER IDENTIFICATION OF PRESSURE DROP.
Release Secured: YES
Release Rate:
Estimated Release Duration:

WEATHER

ADDITIONAL AGENCIES NOTIFIED

Federal:
State/Local:
State/Local On Scene:
State Agency Number:

NOTIFICATIONS BY NRC

CENTERS FOR DISEASE CONTROL (GRASP)
22-FEB-20 22:14

DEPT OF HEALTH AND HUMAN SERVICES (SECRETARY'S OPERATION CENTER (SOC))
22-FEB-20 22:14
AZ OFFIC OF INTEL AND ANALYSIS (FIELD INTELLIGENCE AND INTEGRATION DIVISION)
22-FEB-20 22:14
DHS DEFENSE THREAT REDUCTION AGENCY (CHEMICAL AND BIOLOGICAL TECHNOLOGIES DEPARTMENT)
22-FEB-20 22:14
MS DEPT OF HOMELAND SECURITY (I&A FIELD OPS)
22-FEB-20 22:14
DOT CRISIS MANAGEMENT CENTER (MAIN OFFICE)
22-FEB-20 22:14
U.S. EPA IV (MAIN OFFICE)
22-FEB-20 22:17
U.S. EPA IV (EPA RRT4)
22-FEB-20 22:14
GULF STRIKE TEAM (MAIN OFFICE)
22-FEB-20 22:14
JFO-LA (COMMAND CENTER)
22-FEB-20 22:14
MS ANALYSIS AND INFORMATION CENTER (FUSION CENTER)
22-FEB-20 22:14
NATIONAL INFRASTRUCTURE COORD CTR (MAIN OFFICE)
22-FEB-20 22:14
NOAA RPTS FOR MS (MAIN OFFICE)
22-FEB-20 22:14
NTSB PIPELINE (MAIN OFFICE)
22-FEB-20 22:14
PIPELINE & HAZMAT SAFETY ADMIN (OFFICE OF PIPELINE SAFETY (AUTO))
22-FEB-20 22:14
PIPELINE & HAZMAT SAFETY ADMIN (HAZARDOUS MATERIAL ACCIDENT INVESTIGATION)
22-FEB-20 22:14
DOI FOR REGION 4 (MAIN OFFICE)
22-FEB-20 22:14
REPORTING PARTY (RP SUBMITTER)
22-FEB-20 22:14
SECTOR LOWER MISSISSIPPI RIVER (AUTO NRC NOTIFICATIONS)
22-FEB-20 22:14
SHELBY SHERIFF'S OFFICE (CRIMINAL INTELLIGENCE UNIT)
22-FEB-20 22:14
MS EMERGENCY MANAGEMENT AGENCY (MAIN OFFICE)
22-FEB-20 22:14
TEXAS FUSION CENTER (COUNTER TERRORISM)
22-FEB-20 22:14
USCG DISTRICT 8 (MAIN OFFICE)
22-FEB-20 22:14
USCG DISTRICT 8 (PLANNING)
22-FEB-20 22:14

ADDITIONAL INFORMATION

THE ROAD CLOSURES ARE STILL ONGOING.

*** END INCIDENT REPORT #1271847 ***

Report any problems by calling 1-800-424-8802
PLEASE VISIT OUR WEB SITE AT
https://gcc01.safelinks.protection.outlook.com/?url=http%3A%2F%2Fnrc.uscg.mil%2F&data=02%7C01%7Cwesley.mathews%40dot.gov%7Cb811754707c84b89d3e308d7fdabecad%7Cc4cd245b44f04395a1aa3848d258f78b%7C0%7C0%7C637256787161489692&sdata=MzcfYqeN1ZIbmwqa6VXKF9L%2FqieIW0kTmcl30E8JTvk%3D&reserved=0

Appendix B NRC Report No. 1272001

Mathews, Wesley (PHMSA)

From: HQS-SMB-NRC@uscg.mil
Sent: Thursday, May 21, 2020 12:30 PM
To: Mathews, Wesley (PHMSA)
Subject: NRC#1272001

NATIONAL RESPONSE CENTER 1-800-424-8802
*** For Public Use ***
Information released to a third party shall comply with any
applicable federal and/or state Freedom of Information and Privacy Laws

Incident Report # 1272001

INCIDENT DESCRIPTION

*Report taken by NRC on 24-FEB-20 at 19:56 ET.
Incident Type: PIPELINE
Incident Cause: UNKNOWN
Affected Area:
Incident was discovered on 22-FEB-20 at 22:06 local incident time.
Affected Medium: AIR / ATMOSPHERE

SUSPECTED RESPONSIBLE PARTY

Organization: DENBURY GULF COAST PIPELINE

PLANO, TX 75024

Type of Organization: PRIVATE ENTERPRISE

INCIDENT LOCATION
OFF HWY 433 County: YAZOO
City: SATARTIA State: MS
Distance from City: 1 MILES
Direction from City: Latitude: 32° 39' 28" N

Longitude: 090° 32' 13" W

RELEASED MATERIAL(S)
CHRIS Code: CDO Official Material Name: CARBON DIOXIDE
Also Known As:
Qty Released: 21873 BARREL(S)

DESCRIPTION OF INCIDENT
///THIS IS A PHMSA 48HR UPDATE TO NRC REPORT 1271847///

UPDATE: THE CORRECT LAT/LONG FOR THE INCIDENT IS 32.65785 NORTH AND
-90.53695 WEST.
TWO HUNDRED PRIVATE CITIZENS WERE EVACUATED FROM THEIR HOMES IN THE

AREA OF THE RELEASE.
FORTY FIVE PEOPLE WERE TAKEN TO A HOSPITAL. THE NUMBER OF PEOPLE TAKEN TO A HOSPITAL DUE TO INJURIES IS UNKNOWN
TWO PEOPLE ARE STILL AT THE HOSPITAL AS OF 24-FEB-20. THE RELEASE WAS COMPLETELY SECURED AT 23:08HRS ON SATURDAY THE 22-FEB-20. ROAD CLOSURES AND EVACUATION ORDER WAS LIFTED AT 08:00AM ON SUNDAY FEBRUARY 23RD. THE TOTAL AMOUNT OF THE RELEASE WAS DETERMINED TO BE 21,873 BARRELS OF CARBON DIOXIDE GAS. THE EVACUATION RADIUS WAS .25 MILES. TV NEWS AND POSSIBLY NEWSPAPERS IN THE LOCAL AREA AS WELL AS NATIONAL NEWS REPORTED THE INCIDENT. RELEASE DURATION WAS 4 HOURS. PHMSA, MS OIL AND GAS, MS DEQ WERE NOTIFIED. MS DEQ, STATE POLICE, LOCAL FD, LOCAL PD, EMS AND HWY PATROL WERE ALL ON SCENE.

ORIGINAL REPORT: CARBON DIOXIDE RELEASED FROM A 24 INCH PIPELINE DUE TO AN UNKNOWN CAUSE AT THIS TIME. CALLER STATES THE CONTROL ROOM NOTICED A PRESSURE DROP AT 1907 AND PERSONNEL VERIFIED LEAK AT 2046. CALLER ALSO STATES THERE WERE EMERGENCY RESPONDERS ONSITE AS WELL WHEN THEIR PERSONNEL ARRIVED ONSCENE.

INCIDENT DETAILS

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

IMPACT

Fire Involved: NO Fire Extinguished: UNKNOWN

INJURIES: YES 45 Sent to Hospital:45 Empl/Crew: Passenger:
FATALITIES: NO Empl/Crew: Passenger: Occupant:
EVACUATIONS:YES 200 Who Evacuated: EVERYONE Radius/Area:.25 Mile(s)

Damages: NO

Closure Type	Description of Closure	Hours Closed	Direction of Closure

Air: NO

Road: YES HWY 3; HWY 433; EAGLE BEND RD; PERRY CREEK RD — Major Artery:YES
Waterway:NO

Track: NO

Passengers Transferred: NO
Environmental Impact: UNKNOWN
Media Interest: HIGH

REMEDIAL ACTIONS

VALVES WERE IMMEDIATELY SHUT AFTER IDENTIFICATION OF PRESSURE DROP
Release Secured: YES
Release Rate:
Estimated Release Duration:

WEATHER

ADDITIONAL AGENCIES NOTIFIED

Federal: PHMSA
State/Local: MS DEQ, MS OIL AND GAS, SATATE POLICE
State/Local On Scene: MS DEQ, STATE POLICE, PD, FD, EMS
State Agency Number:

NOTIFICATIONS BY NRC

AGCY TOXIC SUBST & DISEASE REGISTRY (HHS)
24-FEB-20 20:22
CENTERS FOR DISEASE CONTROL (GRASP)
24-FEB-20 20:22
DEPT OF HEALTH AND HUMAN SERVICES (SECRETARY'S OPERATION CENTER (SOC))
24-FEB-20 20:22
AZ OFFIC OF INTEL AND ANALYSIS (FIELD INTELLIGENCE AND INTEGRATION DIVISION)
24-FEB-20 20:22
DHS DEFENSE THREAT REDUCTION AGENCY (CHEMICAL AND BIOLOGICAL TECHNOLOGIES DEPARTMENT)
24-FEB-20 20:22
MS DEPT OF HOMELAND SECURITY (I&A FIELD OPS)
24-FEB-20 20:22
DOT CRISIS MANAGEMENT CENTER (MAIN OFFICE)
24-FEB-20 20:22
EPA HQ EMERGENCY OPERATIONS CENTER (MAIN OFFICE (AUTO))
24-FEB-20 20:22
EPA HQ EMERGENCY OPERATIONS CENTER (AFTER HOURS SECONDARY)
24-FEB-20 20:36
U.S. EPA IV (MAIN OFFICE)
24-FEB-20 20:32
U.S. EPA IV (EPA RRT4)
24-FEB-20 20:22
GULF STRIKE TEAM (MAIN OFFICE)
24-FEB-20 20:22
INFO ANALYSIS AND INFRA PROTECTION (MAIN OFFICE)
24-FEB-20 20:22
JFO-LA (COMMAND CENTER)
24-FEB-20 20:22
MS ANALYSIS AND INFORMATION CENTER (FUSION CENTER)
24-FEB-20 20:22
NATIONAL INFRASTRUCTURE COORD CTR (MAIN OFFICE)
24-FEB-20 20:22
NOAA RPTS FOR MS (MAIN OFFICE)
24-FEB-20 20:22
NRC COMMAND DUTY OFFICER (MAIN OFFICE)

24-FEB-20 20:50
NTSB PIPELINE (MAIN OFFICE)
24-FEB-20 20:22
OCCUPATIONAL SAFETY & HEALTH ADMIN (MAIN OFFICE)
24-FEB-20 20:22
PIPELINE & HAZMAT SAFETY ADMIN (OFFICE OF PIPELINE SAFETY (AUTO))
24-FEB-20 20:22
PIPELINE & HAZMAT SAFETY ADMIN (OFFICE OF PIPELINE SAFETY WEEKDAYS (VERBAL))
24-FEB-20 20:34
PIPELINE & HAZMAT SAFETY ADMIN (HAZARDOUS MATERIAL ACCIDENT INVESTIGATION)
24-FEB-20 20:22
DOI FOR REGION 4 (MAIN OFFICE)
24-FEB-20 20:22
REPORTING PARTY (RP SUBMITTER)
24-FEB-20 20:22
SECTOR LOWER MISSISSIPPI RIVER (AUTO NRC NOTIFICATIONS)
24-FEB-20 20:22
SHELBY SHERIFF'S OFFICE (CRIMINAL INTELLIGENCE UNIT)
24-FEB-20 20:22
MS EMERGENCY MANAGEMENT AGENCY (MAIN OFFICE)
24-FEB-20 20:22
TEXAS FUSION CENTER (COUNTER TERRORISM)
24-FEB-20 20:22
USCG DISTRICT 8 (MAIN OFFICE)
24-FEB-20 20:22
USCG DISTRICT 8 (PLANNING)
24-FEB-20 20:22

ADDITIONAL INFORMATION
///THIS IS A PHMSA 48HR UPDATE TO NRC REPORT 1271847///

*** END INCIDENT REPORT #1272001 ***
Report any problems by calling 1-800-424-8802
PLEASE VISIT OUR WEB SITE AT
https://gcc01.safelinks.protection.outlook.com/?url=http%3A%2F%2Fnrc.uscg.mil%2F&data=02%7C01%7Cwesley.mathews%40dot.gov%7Cb126276307c640ca447f08d7fdab7b17%7Cc4cd245b44f04395a1aa3848d258f78b%7C0%7C0%7C637256785273758601&sdata=wEB2Wbm6RWfQw9nm5l8g20CXFahn0HprioWivv3i1Uo%3D&reserved=0

Appendix C PHMSA 7000.1 Final Report

NOTICE: This report is required by 49 CFR Part 195. Failure to report can result in a civil penalty not to exceed $100,000 for each violation for each day that such violation persists except that the maximum civil penalty shall not exceed $1,000,000 as provided in 49 USC 60122.		OMB NO: 2137-0047 EXPIRATION DATE: 8/31/2020
U.S Department of Transportation Pipeline and Hazardous Materials Safety Administration	**Original Report Date:**	03/21/2020
	No.	20200087 - 34574 (DOT Use Only)

ACCIDENT REPORT - HAZARDOUS LIQUID PIPELINE SYSTEMS

A federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with a collection of information subject to the requirements of the Paperwork Reduction Act unless that collection of information displays a current valid OMB Control Number. The OMB Control Number for this information collection is 2137-0047. All responses to the collection of information are mandatory. Send comments regarding this burden or any other aspect of this collection of information, including suggestions for reducing the burden to: Information Collection Clearance Officer, PHMSA, Office of Pipeline Safety (PHP-30) 1200 New Jersey Avenue, SE, Washington, D.C. 20590.

INSTRUCTIONS

Important: *Please read the separate instructions for completing this form before you begin. They clarify the information requested and provide specific examples. If you do not have a copy of the instructions, you can obtain one from the PHMSA Pipeline Safety Community Web Page at http://www.phmsa.dot.gov/pipeline/library/forms.*

PART A - KEY REPORT INFORMATION

Report Type: *(select all that apply)*	**Original:**	**Supplemental:**	**Final:**
		Yes	**Yes**
Last Revision Date:	11/25/2020		
1. Operator's OPS-issued Operator Identification Number (OPID):	32545		
2. Name of Operator	DENBURY GULF COAST PIPELINES, LLC		
3. Address of Operator:			
3a. Street Address	5851 LEGACY CIRCLE SUITE 1200		
3b. City	PLANO		
3c. State	Texas		
3d. Zip Code	75024		
4. Local time *(24-hr clock)* and date of the Accident:	02/22/2020 19:07		
5. Location of Accident:			
Latitude / Longitude	32.65785, -90.53695		
6. National Response Center Report Number (if applicable):	1271847		
7. Local time *(24-hr clock)* and date of initial telephonic report to the National Response Center (if applicable):	02/22/2020 20:51		
8. Commodity released: *(select only one, based on predominant volume released)*	CO2 (Carbon Dioxide)		
- Specify Commodity Subtype:			
- If "Other" Subtype, Describe:			
- If Biofuel/Alternative Fuel and Commodity Subtype is Ethanol Blend, then % Ethanol Blend:			
- If Biofuel/Alternative Fuel and Commodity Subtype is Biodiesel, then Biodiesel Blend e.g. B2, B20, B100			
9. Estimated volume of commodity released unintentionally (Barrels):	9,532.00		
10. Estimated volume of intentional and/or controlled release/blowdown (Barrels):	21,873.00		
11. Estimated volume of commodity recovered (Barrels):			
12. Were there fatalities?	No		
- If Yes, specify the number in each category:			
12a. Operator employees			
12b. Contractor employees working for the Operator			
12c. Non-Operator emergency responders			
12d. Workers working on the right-of-way, but NOT associated with this Operator			
12e. General public			
12f. Total fatalities (sum of above)			
13. Were there injuries requiring inpatient hospitalization?	No		
- If Yes, specify the number in each category:			
13a. Operator employees			
13b. Contractor employees working for the Operator			
13c. Non-Operator emergency responders			
13d. Workers working on the right-of-way, but NOT associated with this Operator			
13e. General public			
13f. Total injuries (sum of above)			

14. Was the pipeline/facility shut down due to the Accident?	Yes
- If No, Explain:	
- If Yes, complete Questions 14a and 14b: *(use local time, 24-hr clock)*	
14a. Local time and date of shutdown:	02/22/2020 19:15
14b. Local time pipeline/facility restarted:	10/26/2020 12:30
- Still shut down? (* Supplemental Report Required)	
15. Did the commodity ignite?	No
16. Did the commodity explode?	No
17. Number of general public evacuated:	200
18. Time sequence *(use local time, 24-hour clock)*:	
18a. Local time Operator identified Accident - effective 7- 2014 changed to "Local time Operator identified failure":	02/22/2020 20:20
18b. Local time Operator resources arrived on site:	02/22/2020 20:20

PART B - ADDITIONAL LOCATION INFORMATION

1. Was the origin of the Accident onshore?	Yes
If Yes, Complete Questions (2-12)	
If No, Complete Questions (13-15)	
- If Onshore:	
2. State:	Mississippi
3. Zip Code:	39194
4. City	Not Within a Municipality
5. County or Parish	Yazoo County
6. Operator-designated location:	Milepost/Valve Station
Specify:	6.6
7. Pipeline/Facility name:	Delhi
8. Segment name/ID:	Delhi
9. Was Accident on Federal land, other than the Outer Continental Shelf (OCS)?	No
10. Location of Accident:	Pipeline Right-of-way
11. Area of Accident (as found):	Underground
Specify:	Under soil
- If Other, Describe:	
Depth-of-Cover (in):	360
12. Did Accident occur in a crossing?	No
- If Yes, specify type below:	
- If Bridge crossing –	
Cased/ Uncased:	
- If Railroad crossing –	
Cased/ Uncased/ Bored/drilled	
- If Road crossing –	
Cased/ Uncased/ Bored/drilled	
- If Water crossing –	
Cased/ Uncased	
- Name of body of water, if commonly known:	
- Approx. water depth (ft) at the point of the Accident:	
- Select:	
- If Offshore:	
13. Approximate water depth (ft) at the point of the Accident:	
14. Origin of Accident:	
- In State waters - Specify:	
- State:	
- Area:	
- Block/Tract #:	
- Nearest County/Parish:	
- On the Outer Continental Shelf (OCS) - Specify:	
- Area:	
- Block #:	
15. Area of Accident:	

PART C - ADDITIONAL FACILITY INFORMATION

1. Is the pipeline or facility:	Interstate
2. Part of system involved in Accident:	Onshore Pipeline, Including Valve Sites
- If Onshore Breakout Tank or Storage Vessel, Including Attached Appurtenances, specify:	
3. Item involved in Accident:	Weld, including heat-affected zone
- If Pipe, specify:	
3a. Nominal diameter of pipe (in):	24
3b. Wall thickness (in):	.540

3c. SMYS (Specified Minimum Yield Strength) of pipe (psi):	80,000
3d. Pipe specification:	API 5L
3e. Pipe Seam , specify:	Longitudinal ERW - High Frequency
- If Other, Describe:	
3f. Pipe manufacturer:	Stupp Corporation
3g. Year of manufacture:	2007
3h. Pipeline coating type at point of Accident, specify:	Field Applied Epoxy
- If Other, Describe:	
- If Weld, including heat-affected zone, specify. If Pipe Girth Weld, 3a through 3h above are required:	Pipe Girth Weld
- If Other, Describe:	
- If Valve, specify:	
- If Mainline, specify:	
- If Other, Describe:	
3i. Manufactured by:	
3j. Year of manufacture:	
- If Tank/Vessel, specify:	
- If Other - Describe:	
- If Other, describe:	
4. Year item involved in Accident was installed:	2009
5. Material involved in Accident:	Carbon Steel
- If Material other than Carbon Steel, specify:	
6. Type of Accident Involved:	Other
- If Mechanical Puncture – Specify Approx. size:	
in. (axial) by	
in. (circumferential)	
- If Leak - Select Type:	
- If Other, Describe:	
- If Rupture - Select Orientation:	
- If Other, Describe:	
Approx. size: in. (widest opening) by	
in. (length circumferentially or axially)	
- If Other – Describe:	Guillotine Type Failure
PART D - ADDITIONAL CONSEQUENCE INFORMATION	
1. Wildlife impact:	No
1a. If Yes, specify all that apply:	
- Fish/aquatic	
- Birds	
- Terrestrial	
2. Soil contamination:	No
3. Long term impact assessment performed or planned:	No
4. Anticipated remediation:	No
4a. If Yes, specify all that apply:	
- Surface water	
- Groundwater	
- Soil	
- Vegetation	
- Wildlife	
5. Water contamination:	No
5a. If Yes, specify all that apply:	
- Ocean/Seawater	
- Surface	
- Groundwater	
- Drinking water: *(Select one or both)*	
- Private Well	
- Public Water Intake	
5b. Estimated amount released in or reaching water (Barrels):	
5c. Name of body of water, if commonly known:	
6. At the location of this Accident, had the pipeline segment or facility been identified as one that "could affect" a High Consequence Area (HCA) as determined in the Operator's Integrity Management Program?	No
7. Did the released commodity reach or occur in one or more High Consequence Area (HCA)?	Yes
7a. If Yes, specify HCA type(s): *(Select all that apply)*	
- Commercially Navigable Waterway:	
Was this HCA identified in the "could affect" determination for this Accident site in the Operator's Integrity Management Program?	

- High Population Area:	
Was this HCA identified in the "could affect" determination for this Accident site in the Operator's Integrity Management Program?	
- Other Populated Area	Yes
Was this HCA identified in the "could affect" determination for this Accident site in the Operator's Integrity Management Program?	No
- Unusually Sensitive Area (USA) - Drinking Water	
Was this HCA identified in the "could affect" determination for this Accident site in the Operator's Integrity Management Program?	
- Unusually Sensitive Area (USA) - Ecological	
Was this HCA identified in the "could affect" determination for this Accident site in the Operator's Integrity Management Program?	
8. Estimated cost to Operator – effective 12-2012, changed to "Estimated Property Damage":	
8a. Estimated cost of public and non-Operator private property damage paid/reimbursed by the Operator – effective 12-2012, "paid/reimbursed by the Operator" removed	$ 225,899
8b. Estimated cost of commodity lost	$ 11,130
8c. Estimated cost of Operator's property damage & repairs	$ 3,504,518
8d. Estimated cost of Operator's emergency response	$ 205,462
8e. Estimated cost of Operator's environmental remediation	$ 0
8f. Estimated other costs	$ 0
Describe:	
8g. Estimated total costs (sum of above) – effective 12-2012, changed to "Total estimated property damage (sum of above)"	$ 3,947,009
PART E - ADDITIONAL OPERATING INFORMATION	
1. Estimated pressure at the point and time of the Accident (psig):	1,402.00
2. Maximum Operating Pressure (MOP) at the point and time of the Accident (psig):	2,160.00
3. Describe the pressure on the system or facility relating to the Accident (psig):	Pressure did not exceed MOP
4. Not including pressure reductions required by PHMSA regulations (such as for repairs and pipe movement), was the system or facility relating to the Accident operating under an established pressure restriction with pressure limits below those normally allowed by the MOP?	No
- If Yes, Complete 4.a and 4.b below:	
4a. Did the pressure exceed this established pressure restriction?	
4b. Was this pressure restriction mandated by PHMSA or the State?	
5. Was "Onshore Pipeline, Including Valve Sites" OR "Offshore Pipeline, Including Riser and Riser Bend" selected in PART C, Question 2?	Yes
- If Yes - (*Complete 5a. – 5f below)* effective 12-2012, changed to *"(Complete 5.a – 5.e below)"*	
5a. Type of upstream valve used to initially isolate release source:	Remotely Controlled
5b. Type of downstream valve used to initially isolate release source:	Remotely Controlled
5c. Length of segment isolated between valves (ft):	50,406
5d. Is the pipeline configured to accommodate internal inspection tools?	Yes
- If No, Which physical features limit tool accommodation? (*select all that apply)*	
- Changes in line pipe diameter	
- Presence of unsuitable mainline valves	
- Tight or mitered pipe bends	
- Other passage restrictions (i.e. unbarred tee's, projecting instrumentation, etc.)	
- Extra thick pipe wall (applicable only for magnetic flux leakage internal inspection tools)	
- Other -	
- If Other, Describe:	
5e. For this pipeline, are there operational factors which significantly complicate the execution of an internal inspection tool run?	Yes
- If Yes, Which operational factors complicate execution? (*select all that apply)*	
- Excessive debris or scale, wax, or other wall buildup	

- Low operating pressure(s)	
- Low flow or absence of flow	Yes
- Incompatible commodity	
- Other -	
- If Other, Describe:	
5f. Function of pipeline system:	> 20% SMYS Regulated Trunkline/Transmission
6. Was a Supervisory Control and Data Acquisition (SCADA)-based system in place on the pipeline or facility involved in the Accident?	Yes
If Yes -	
6a. Was it operating at the time of the Accident?	Yes
6b. Was it fully functional at the time of the Accident?	Yes
6c. Did SCADA-based information (such as alarm(s), alert(s), event(s), and/or volume calculations) assist with the detection of the Accident?	Yes
6d. Did SCADA-based information (such as alarm(s), alert(s), event(s), and/or volume calculations) assist with the confirmation of the Accident?	Yes
7. Was a CPM leak detection system in place on the pipeline or facility involved in the Accident?	No
- If Yes:	
7a. Was it operating at the time of the Accident?	
7b. Was it fully functional at the time of the Accident?	
7c. Did CPM leak detection system information (such as alarm (s), alert(s), event(s), and/or volume calculations) assist with the detection of the Accident?	
7d. Did CPM leak detection system information (such as alarm (s), alert(s), event(s), and/or volume calculations) assist with the confirmation of the Accident?	
8. How was the Accident initially identified for the Operator?	CPM leak detection system or SCADA-based information (such as alarm(s), alert(s), event(s), and/or volume calculations)
- If Other, Specify:	
8a. If "Controller", "Local Operating Personnel", including contractors", "Air Patrol", or "Ground Patrol by Operator or its contractor" is selected in Question 8, specify:	
9. Was an investigation initiated into whether or not the controller(s) or control room issues were the cause of or a contributing factor to the Accident?	Yes, specify investigation result(s): (select all that apply)
- If No, the Operator did not find that an investigation of the controller(s) actions or control room issues was necessary due to: *(provide an explanation for why the operator did not investigate)*	
- If Yes, specify investigation result(s): *(select all that apply)*	
- Investigation reviewed work schedule rotations, continuous hours of service (while working for the Operator), and other factors associated with fatigue	Yes
- Investigation did NOT review work schedule rotations, continuous hours of service (while working for the Operator), and other factors associated with fatigue	
Provide an explanation for why not:	
- Investigation identified no control room issues	Yes
- Investigation identified no controller issues	Yes
- Investigation identified incorrect controller action or controller error	
- Investigation identified that fatigue may have affected the controller(s) involved or impacted the involved controller(s) response	
- Investigation identified incorrect procedures	
- Investigation identified incorrect control room equipment operation	
- Investigation identified maintenance activities that affected control room operations, procedures, and/or controller response	
- Investigation identified areas other than those above:	
Describe:	
PART F - DRUG & ALCOHOL TESTING INFORMATION	
1. As a result of this Accident, were any Operator employees tested under the post-accident drug and alcohol testing requirements of DOT's Drug & Alcohol Testing regulations?	No
- If Yes:	
1a. Specify how many were tested:	

1b. Specify how many failed:	
2. As a result of this Accident, were any Operator contractor employees tested under the post-accident drug and alcohol testing requirements of DOT's Drug & Alcohol Testing regulations?	No
- If Yes:	
2a. Specify how many were tested:	
2b. Specify how many failed:	

PART G – APPARENT CAUSE

Select only one box from PART G in shaded column on left representing the APPARENT Cause of the Accident, and answer the questions on the right. Describe secondary, contributing or root causes of the Accident in the narrative (PART H).

Apparent Cause:	G2 - Natural Force Damage
G1 - Corrosion Failure - only one **sub-cause** can be picked from shaded left-hand column	
Corrosion Failure – Sub-Cause:	
- If External Corrosion:	
1. Results of visual examination:	
- If Other, Describe:	
2. Type of corrosion: *(select all that apply)*	
- Galvanic	
- Atmospheric	
- Stray Current	
- Microbiological	
- Selective Seam	
- Other:	
- If Other, Describe:	
3. The type(s) of corrosion selected in Question 2 is based on the following: *(select all that apply)*	
- Field examination	
- Determined by metallurgical analysis	
- Other:	
- If Other, Describe:	
4. Was the failed item buried under the ground?	
- If Yes :	
□4a. Was failed item considered to be under cathodic protection at the time of the Accident?	
If Yes - Year protection started:	
4b. Was shielding, tenting, or disbonding of coating evident at the point of the Accident?	
4c. Has one or more Cathodic Protection Survey been conducted at the point of the Accident?	
If "Yes, CP Annual Survey" – Most recent year conducted:	
If "Yes, Close Interval Survey" – Most recent year conducted:	
If "Yes, Other CP Survey" – Most recent year conducted:	
- If No:	
4d. Was the failed item externally coated or painted?	
5. Was there observable damage to the coating or paint in the vicinity of the corrosion?	
- If Internal Corrosion:	
6. Results of visual examination:	
- Other:	
7. Type of corrosion *(select all that apply)*: -	
- Corrosive Commodity	
- Water drop-out/Acid	
- Microbiological	
- Erosion	
- Other:	
- If Other, Describe:	
8. The cause(s) of corrosion selected in Question 7 is based on the following *(select all that apply)*: -	
- Field examination	
- Determined by metallurgical analysis	
- Other:	
- If Other, Describe:	
9. Location of corrosion *(select all that apply)*: -	
- Low point in pipe	
- Elbow	
- Other:	

- If Other, Describe:	
10. Was the commodity treated with corrosion inhibitors or biocides?	
11. Was the interior coated or lined with protective coating?	
12. Were cleaning/dewatering pigs (or other operations) routinely utilized?	
13. Were corrosion coupons routinely utilized?	
Complete the following if any Corrosion Failure sub-cause is selected AND the "Item Involved in Accident" (from PART C, Question 3) is Tank/Vessel.	
14. List the year of the most recent inspections:	
14a. API Std 653 Out-of-Service Inspection	
- No Out-of-Service Inspection completed	
14b. API Std 653 In-Service Inspection	
- No In-Service Inspection completed	
Complete the following if any Corrosion Failure sub-cause is selected AND the "Item Involved in Accident" (from PART C, Question 3) is Pipe or Weld.	
15. Has one or more internal inspection tool collected data at the point of the Accident?	
15a. If Yes, for each tool used, select type of internal inspection tool and indicate most recent year run: -	
- Magnetic Flux Leakage Tool	
Most recent year:	
- Ultrasonic	
Most recent year:	
- Geometry	
Most recent year:	
- Caliper	
Most recent year:	
- Crack	
Most recent year:	
- Hard Spot	
Most recent year:	
- Combination Tool	
Most recent year:	
- Transverse Field/Triaxial	
Most recent year:	
- Other	
Most recent year:	
Describe:	
16. Has one or more hydrotest or other pressure test been conducted since original construction at the point of the Accident?	
If Yes -	
Most recent year tested:	
Test pressure:	
17. Has one or more Direct Assessment been conducted on this segment?	
- If Yes, and an investigative dig was conducted at the point of the Accident::	
Most recent year conducted:	
- If Yes, but the point of the Accident was not identified as a dig site:	
Most recent year conducted:	
18. Has one or more non-destructive examination been conducted at the point of the Accident since January 1, 2002?	
18a. If Yes, for each examination conducted since January 1, 2002, select type of non-destructive examination and indicate most recent year the examination was conducted:	
- Radiography	
Most recent year conducted:	
- Guided Wave Ultrasonic	
Most recent year conducted:	
- Handheld Ultrasonic Tool	
Most recent year conducted:	
- Wet Magnetic Particle Test	
Most recent year conducted:	
- Dry Magnetic Particle Test	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
G2 - Natural Force Damage - only one **sub-cause** can be picked from shaded left-handed column	
Natural Force Damage – Sub-Cause:	Heavy Rains/Floods
- If Earth Movement, NOT due to Heavy Rains/Floods:	
1. Specify:	

- If Other, Describe:	
- If Heavy Rains/Floods:	
2. Specify:	Other
- If Other, Describe:	,Soil movement, promoted by unusually high rainfall averages and not a singular event, induced axial stresses sufficient to cause an overload condition.,,
- If Lightning:	
3. Specify:	
- If Temperature:	
4. Specify:	
- If Other, Describe:	
- If Other Natural Force Damage:	
5. Describe:	
Complete the following if any Natural Force Damage sub-cause is selected.	
6. Were the natural forces causing the Accident generated in conjunction with an extreme weather event?	No
6a. If Yes, specify: *(select all that apply)*	
- Hurricane	
- Tropical Storm	
- Tornado	
- Other	
- If Other, Describe:	
G3 - Excavation Damage - only one **sub-cause** can be picked from shaded left-hand column	
Excavation Damage – Sub-Cause:	
- If Previous Damage due to Excavation Activity: Complete Questions 1-5 ONLY IF the "Item Involved in Accident" (from PART C, Question 3) is Pipe or Weld.	
1. Has one or more internal inspection tool collected data at the point of the Accident?	
1a. If Yes, for each tool used, select type of internal inspection tool and indicate most recent year run: -	
- Magnetic Flux Leakage	
Most recent year conducted:	
- Ultrasonic	
Most recent year conducted:	
- Geometry	
Most recent year conducted:	
- Caliper	
Most recent year conducted:	
- Crack	
Most recent year conducted:	
- Hard Spot	
Most recent year conducted:	
- Combination Tool	
Most recent year conducted:	
- Transverse Field/Triaxial	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
2. Do you have reason to believe that the internal inspection was completed BEFORE the damage was sustained?	
3. Has one or more hydrotest or other pressure test been conducted since original construction at the point of the Accident?	
- If Yes:	
Most recent year tested:	
Test pressure (psig):	
4. Has one or more Direct Assessment been conducted on the pipeline segment?	
- If Yes, and an investigative dig was conducted at the point of the Accident:	
Most recent year conducted:	
- If Yes, but the point of the Accident was not identified as a dig site:	
Most recent year conducted:	
5. Has one or more non-destructive examination been conducted at the point of the Accident since January 1, 2002?	
5a. If Yes, for each examination, conducted since January 1, 2002, select type of non-destructive examination and indicate most recent year the examination was conducted:	
- Radiography	
Most recent year conducted:	
- Guided Wave Ultrasonic	

Most recent year conducted:	
- Handheld Ultrasonic Tool	
Most recent year conducted:	
- Wet Magnetic Particle Test	
Most recent year conducted:	
- Dry Magnetic Particle Test	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
Complete the following if Excavation Damage by Third Party is selected as the sub-cause.	
6. Did the operator get prior notification of the excavation activity?	
6a. If Yes, Notification received from: *(select all that apply)* -	
- One-Call System	
- Excavator	
- Contractor	
- Landowner	
Complete the following mandatory CGA-DIRT Program questions if any Excavation Damage sub-cause is selected.	
7. Do you want PHMSA to upload the following information to CGA-DIRT (www.cga-dirt.com)?	
8. Right-of-Way where event occurred: *(select all that apply)* -	
- Public	
- If "Public", Specify:	
- Private	
- If "Private", Specify:	
- Pipeline Property/Easement	
- Power/Transmission Line	
- Railroad	
- Dedicated Public Utility Easement	
- Federal Land	
- Data not collected	
- Unknown/Other	
9. Type of excavator:	
10. Type of excavation equipment:	
11. Type of work performed:	
12. Was the One-Call Center notified?	
12a. If Yes, specify ticket number:	
12b. If this is a State where more than a single One-Call Center exists, list the name of the One-Call Center notified:	
13. Type of Locator:	
14. Were facility locate marks visible in the area of excavation?	
15. Were facilities marked correctly?	
16. Did the damage cause an interruption in service?	
16a. If Yes, specify duration of the interruption (hours)	
17. Description of the CGA-DIRT Root Cause *(select only the one predominant first level CGA-DIRT Root Cause and then, where available as a choice, the one predominant second level CGA-DIRT Root Cause as well):*	
Root Cause:	
- If One-Call Notification Practices Not Sufficient, specify:	
- If Locating Practices Not Sufficient, specify:	
- If Excavation Practices Not Sufficient, specify:	
- If Other/None of the Above, explain:	
G4 - Other Outside Force Damage - *only one **sub-cause** can be selected from the shaded left-hand column*	
Other Outside Force Damage – Sub-Cause:	
- If Damage by Car, Truck, or Other Motorized Vehicle/Equipment NOT Engaged in Excavation:	
1. Vehicle/Equipment operated by:	
- If Damage by Boats, Barges, Drilling Rigs, or Other Maritime Equipment or Vessels Set Adrift or Which Have Otherwise Lost Their Mooring:	
2. Select one or more of the following IF an extreme weather event was a factor:	
- Hurricane	
- Tropical Storm	
- Tornado	
- Heavy Rains/Flood	
- Other	
- If Other, Describe:	
- If Previous Mechanical Damage NOT Related to Excavation: Complete Questions 3-7 ONLY IF the "Item Involved in Accident" (from PART C, Question 3) is Pipe or Weld.	

3. Has one or more internal inspection tool collected data at the point of the Accident?	
3a. If Yes, for each tool used, select type of internal inspection tool and indicate most recent year run:	
- Magnetic Flux Leakage	
Most recent year conducted:	
- Ultrasonic	
Most recent year conducted:	
- Geometry	
Most recent year conducted:	
- Caliper	
Most recent year conducted:	
- Crack	
Most recent year conducted:	
- Hard Spot	
Most recent year conducted:	
- Combination Tool	
Most recent year conducted:	
- Transverse Field/Triaxial	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
4. Do you have reason to believe that the internal inspection was completed BEFORE the damage was sustained?	
5. Has one or more hydrotest or other pressure test been conducted since original construction at the point of the Accident?	
- If Yes:	
Most recent year tested:	
Test pressure (psig):	
6. Has one or more Direct Assessment been conducted on the pipeline segment?	
- If Yes, and an investigative dig was conducted at the point of the Accident:	
Most recent year conducted:	
- If Yes, but the point of the Accident was not identified as a dig site:	
Most recent year conducted:	
7. Has one or more non-destructive examination been conducted at the point of the Accident since January 1, 2002?	
7a. If Yes, for each examination conducted since January 1, 2002, select type of non-destructive examination and indicate most recent year the examination was conducted:	
- Radiography	
Most recent year conducted:	
- Guided Wave Ultrasonic	
Most recent year conducted:	
- Handheld Ultrasonic Tool	
Most recent year conducted:	
- Wet Magnetic Particle Test	
Most recent year conducted:	
- Dry Magnetic Particle Test	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
- If Intentional Damage:	
8. Specify:	
- If Other, Describe:	
- If Other Outside Force Damage:	
9. Describe:	
G5 - Material Failure of Pipe or Weld - only one **sub-cause** can be selected from the shaded left-hand column	
Use this section to report material failures ONLY IF the "Item Involved in Accident" (from PART C, Question 3) is "Pipe" or "Weld."	
Material Failure of Pipe or Weld – Sub-Cause:	
1. The sub-cause shown above is based on the following: *(select all that apply)*	
- Field Examination	
- Determined by Metallurgical Analysis	
- Other Analysis	
- If "Other Analysis", Describe:	
- Sub-cause is Tentative or Suspected; Still Under Investigation	

(Supplemental Report required)	
- If Construction, Installation, or Fabrication-related:	
2. List contributing factors: *(select all that apply)*	
- Fatigue or Vibration-related	
Specify:	
- If Other, Describe:	
- Mechanical Stress:	
- Other	
- If Other, Describe:	
- If Environmental Cracking-related:	
3. Specify:	
- If Other - Describe:	
Complete the following if any Material Failure of Pipe or Weld sub-cause is selected.	
4. Additional factors: (*select all that apply*):	
- Dent	
- Gouge	
- Pipe Bend	
- Arc Burn	
- Crack	
- Lack of Fusion	
- Lamination	
- Buckle	
- Wrinkle	
- Misalignment	
- Burnt Steel	
- Other:	
- If Other, Describe:	
5. Has one or more internal inspection tool collected data at the point of the Accident?	
5a. If Yes, for each tool used, select type of internal inspection tool and indicate most recent year run:	
- Magnetic Flux Leakage	
Most recent year run:	
- Ultrasonic	
Most recent year run:	
- Geometry	
Most recent year run:	
- Caliper	
Most recent year run:	
- Crack	
Most recent year run:	
- Hard Spot	
Most recent year run:	
- Combination Tool	
Most recent year run:	
- Transverse Field/Triaxial	
Most recent year run:	
- Other	
Most recent year run:	
Describe:	
6. Has one or more hydrotest or other pressure test been conducted since original construction at the point of the Accident?	
- If Yes:	
Most recent year tested:	
Test pressure (psig):	
7. Has one or more Direct Assessment been conducted on the pipeline segment?	
- If Yes, and an investigative dig was conducted at the point of the Accident -	
Most recent year conducted:	
- If Yes, but the point of the Accident was not identified as a dig site -	
Most recent year conducted:	
8. Has one or more non-destructive examination(s) been conducted at the point of the Accident since January 1, 2002?	
8a. If Yes, for each examination conducted since January 1, 2002, select type of non-destructive examination and indicate most recent year the examination was conducted: -	
- Radiography	
Most recent year conducted:	
- Guided Wave Ultrasonic	
Most recent year conducted:	
- Handheld Ultrasonic Tool	

Most recent year conducted:	
- Wet Magnetic Particle Test	
Most recent year conducted:	
- Dry Magnetic Particle Test	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
G6 – Equipment Failure - only one **sub-cause** can be selected from the shaded left-hand column	
Equipment Failure – Sub-Cause:	
- If Malfunction of Control/Relief Equipment:	
1. Specify: *(select all that apply)* -	
- Control Valve	
- Instrumentation	
- SCADA	
- Communications	
- Block Valve	
- Check Valve	
- Relief Valve	
- Power Failure	
- Stopple/Control Fitting	
- ESD System Failure	
- Other	
- If Other – Describe:	
- If Pump or Pump-related Equipment:	
2. Specify:	
- If Other – Describe:	
- If Threaded Connection/Coupling Failure:	
3. Specify:	
- If Other – Describe:	
- If Non-threaded Connection Failure:	
4. Specify:	
- If Other – Describe:	
- If Other Equipment Failure:	
5. Describe:	
Complete the following if any Equipment Failure sub-cause is selected.	
6. Additional factors that contributed to the equipment failure: *(select all that apply)*	
- Excessive vibration	
- Overpressurization	
- No support or loss of support	
- Manufacturing defect	
- Loss of electricity	
- Improper installation	
- Mismatched items (different manufacturer for tubing and tubing fittings)	
- Dissimilar metals	
- Breakdown of soft goods due to compatibility issues with transported commodity	
- Valve vault or valve can contributed to the release	
- Alarm/status failure	
- Misalignment	
- Thermal stress	
- Other	
- If Other, Describe:	
G7 - Incorrect Operation - only one **sub-cause** can be selected from the shaded left-hand column	
Incorrect Operation – Sub-Cause:	
- If Tank, Vessel, or Sump/Separator Allowed or Caused to Overfill or Overflow	
1. Specify:	
- If Other, Describe:	

- If Other Incorrect Operation	
2. Describe:	
Complete the following if any Incorrect Operation sub-cause is selected.	
3. Was this Accident related to *(select all that apply)*: -	
- Inadequate procedure	
- No procedure established	
- Failure to follow procedure	
- Other:	
- If Other, Describe:	
4. What category type was the activity that caused the Accident?	
5. Was the task(s) that led to the Accident identified as a covered task in your Operator Qualification Program?	
5a. If Yes, were the individuals performing the task(s) qualified for the task(s)?	

G8 - Other Accident Cause - only one **sub-cause** can be selected from the shaded left-hand column

Other Accident Cause – Sub-Cause:	
- If Miscellaneous:	
1. Describe:	
- If Unknown:	
2. Specify:	

PART H - NARRATIVE DESCRIPTION OF THE ACCIDENT

On 2/22/2020 at 19:07, the Denbury Control Center (DCC) observed a low-pressure alarm at the Satartia motor operated valve (MOV) location on the Delhi segment. The Control Center Supervisor was notified and at 19:15 the upstream MOV, downstream MOV, and the Satartia MOV were closed by the DCC. Denbury operations personnel were immediately notified by the DCC of low-pressure alarms and valve closures and were mobilized to the area in addition to emergency response contractors. While mobilization of personnel occurred, the DCC closed all CO2 sources to Delhi segment between 19:26 and 19: 28. At 19:54, a Denbury representative contacted the Tri-Community Fire Chief, who was on-site and identified himself as the Incident Commander on location acknowledging the incident was being managed in the Unified Command. Denbury personnel arrived on-site at 20:20 to confirm the Delhi segment had experienced a pipeline failure upstream of the Hwy 433 road crossing. At 20:21, a Denbury representative contacted the Yazoo County EMA, who was directing the Yazoo County Sheriffs Department, MS Highway Patrol, and MDOT. The Yazoo County EMA confirmed that they began facilitating the evacuation of residence near Satartia, MS at approximately 19:20. MSDEQ was notified at 19:58. Both MSDEQ and MEMA were on-scene and performing supporting agency roles during the emergency phase of the response (4 hours). At 20:51, the NRC was notified, and the CO2 leak was reported (NRC #1271847). At 21:36 emergency response contractors arrived on-site and began conducting preliminary air-monitoring for response personnel. At 21:55 additional emergency response contractors arrived on-site and began conducting community air monitoring and atmospheric testing in and around the failure site and the City of Satartia and the surrounding area. Air monitoring and atmospheric testing continued throughout the night. At 23: 06, Denbury personnel observed no product coming from the failure location. At 0:00 on 2/23/2020, an Operation Period Briefing was conducted by the Unified Command. During the briefing, the incident command team instructed responders to continue air monitoring, conduct reconnaissance within the evacuated areas to ensure no people were left behind, clear the debris and soil off of HWY 433, and begin developing a plan to lift the evacuation. At 06: 00 a planning meeting was conducted by the Unified Command. The recon team confirmed all personnel had been evacuated and reported seeing live cows, dogs, and cats throughout the evacuated area. The air monitoring team also reported that CO2 levels were down to ambient levels and the evacuation could be lifted. At 08:00 the Unified Command gave the All Clear, and the roads were opened and residents in the surrounding area were allowed to return to their homes. Personnel and a toxicologist from CTEH were made available to inspect homes prior to the residence re-entry. At 18:39 on 2/24/2020, the NRC was contacted and given a 48-hour update report (NRC #1272001). A total of 200 residents were evacuated and 45 residents were taken to the hospital. To Denburys knowledge, one individual was admitted to the hospital for reasons unrelated to the pipeline failure.

On 3/9/2020 pipeline samples of the failure location were removed, prepared for shipment, and sent to a testing laboratory on 3/11/2020. The results from the laboratory testing were received and shared with PHMSA on 6/26/2020.

Based on the findings of metallurgical and stress evaluations and the evidence of a code compliant pipeline, it is concluded that soil movement upstream of the failure location induced axial stresses sufficient to cause an overload condition and resulted in the pipeline rupture. Soil movement was promoted by unusually high rainfall averages and not a singular rainfall event.

The pipeline segment was repaired and on 10/26/2020 at 12:30 the pipeline was restarted with no issues.

PART I - PREPARER AND AUTHORIZED SIGNATURE

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Preparer's Title	Regulatory Compliance Specialist
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Date	11/24/2020

Appendix D Mears Metallurgical and Root Cause Failure Analysis

4500 N. Mission Road
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Denbury

Study of Root Cause and Contributing Factors

Denbury – Yazoo County

Failure Investigation

Final Report

Revised 9/02/2021

Prepared for:

Denbury Resources Inc.

Prepared by:

Mears Group, Inc.

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September 2, 2021

Denbury Resources Inc.
5320 Legacy Drive
Plano, TX 75024
(214) 662-2536
chad.docekal@denbury.com

Attention: Chad Docekal

Subject: Denbury Delhi 24-inch Transmission Line failure Root Cause Analysis – Final Report, Revised 9/02/2021

Thank you for the opportunity to provide Denbury Resources with root cause investigation and analysis for the Denbury Delhi 24-inch transmission line near Satartia, Mississippi. This revision includes additional appendices providing supporting information and responses to questions provided to Mears 4/7/2021. If you have any questions or comments, please call me at (614) 832-3896.

Sincerely,

Kevin Garrity
Executive Vice President

Cc: Dan Wagner
Aida Lopez-Garrity
Kurt Lawson

mears
A QUANTA SERVICES COMPANY

SIGNATURE FORM

Study of Root Cause and Contributing Factors
Denbury – Yazoo County
Failure Investigation
Final Report

Prepared by:

Dan Wagner

Dan Wagner – Principal Technical Advisor — 9/02/2021 Date

Aida Lopez-Garrity – Executive Director – Special Projects — 9/2/2021 Date

Kevin C. Garrity, P.E., FNACE – Executive Vice President — 9/2/2021

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Executive Summary

Mears Group, Inc. (Mears) was retained by Denbury Resources (Denbury) to support investigation efforts and provide a Root Cause Analysis (RCA) in coordination with their response to a pipeline failure on the Delhi 24-inch Transmission Line near Satartia, Mississippi. The failure is reported to have occurred February 22, 2020, with a rupture approximately 6.59 miles (stationing 348+26) downstream of the Tinsley, MS station.

The investigation into the cause and contributing factors to the Delhi 24-inch failure has been undertaken through the following activities:

- In-Situ investigations at the incident location,
- Corrosion and coating related assessments,
- A review of available documents and information associated with the design, specification, construction, operation and maintenance of the pipeline infrastructure, and
- Laboratory Analysis of the Failure.

Metallurgical Testing and Failure Analysis was performed on three samples of pipe from the failure site. The metallurgical testing laboratory completed the following tests and examinations:

- Physical examination,
- Photographic documentation and videography,
- Magnetic Particle Inspection,
- Scanning electron microscopy,
- Metallographic analysis,
- Hardness testing,
- Mechanical testing, and
- Chemical analysis.

The results of the metallurgical testing have been analyzed for the purposes of this report and are relied upon in the formulation of the opinions and conclusions expressed in this report.

Based on the findings presented, the pipeline failure occurred at the girth weld due to an overload of axial stress on the weld. A possible contributing factor to the failure may have been axial stresses introduced by movement. These findings are supported by the following:

1. The brittle failure originated at a girth weld. The presence of soft regions with dimples (ductile mode) and cleavage facets (brittle mode) are characteristics typical of a failure from overload conditions.
2. The failure occurred due to axial stresses. There was no indication of a pre-existing defect and a specific failure initiation site was not apparent.
3. The weld metal for both the failed girth weld and the intact weld was found to have lower hardness values than the surrounding pipe materials indicating the weld metal was weaker than the pipe material and thus, more susceptible to overload under axial stress conditions. The findings do not suggest the failure resulted from a welding quality issue.
4. There was no evidence of internal or external corrosion that may have contributed to the failure mode.
5. The mechanical and chemical testing results were in accordance with the requirements for API 5L X-80M PSL 2 line pipe.
6. The microstructure of the pipe material U/S and D/S of the failed girth weld are consistent with modern X-80M PSL 2 line pipe steel.