Investigation Update

March 2025

This document provides a second update[a] on the CSB's investigation of the October 10, 2024, incident at the Deer Park Refining, Limited Partnership's ("PEMEX Deer Park") refinery in Deer Park, Texas.

Incident Summary

On October 10, 2024, at 4:23 p.m., approximately 27,000 pounds of hydrogen sulfide gas were released during a maintenance activity at the PEMEX Deer Park Refinery in Deer Park, Texas (**Figure 1**) [1]. The release fatally injured two contract workers. Officials in the neighboring cities of Deer Park and Pasadena issued shelter-in-place orders that lasted several hours.

Figure 1. PEMEX Deer Park Refinery Logo [12]. (Credit: PEMEX Deer Park)

Background Information

PEMEX Deer Park Refinery

The PEMEX Deer Park Refinery is a petroleum refinery located in Deer Park, Texas [2]. Deer Park Refining, Limited Partnership is an indirect subsidiary of Pemex, a petroleum company headquartered in Mexico City, Mexico, that is wholly owned by the Federal Government of Mexico [3]. Pemex owns seven refineries, six in Mexico and the PEMEX Deer Park Refinery in the United States [2, 4]. The PEMEX Deer Park Refinery employs approximately 1,000 personnel and 1,200 contract workers [2]. The United Steelworkers union represents PEMEX Deer Park hourly maintenance and operations employees [2].

Hydrogen Sulfide

Hydrogen sulfide is created as a byproduct of the refining process from sulfur that naturally exists in crude oil [5, p. 833]. Hydrogen sulfide is a colorless, highly toxic gas that can cause damage to the eyes and the respiratory system [6, 7]. Exposure to concentrations as low as 100 parts per million (ppm) is considered immediately dangerous to life or health [6]. Concentrations over 1,000 ppm can cause a near-immediate fatality [7]. Hydrogen sulfide is heavier than air and tends to travel near the ground during a release [6]. Hydrogen sulfide forms a flammable mixture with air between concentrations of 4.3 percent and 45 percent [6].

[a] The CSB published a previous investigation update in November 2024.

Amine Regeneration Units and Sulfur Recovery Unit

The incident occurred in the PEMEX Deer Park Refinery's Amine Regeneration Units (ARUs), which separate hydrogen sulfide from aqueous amine. The resulting vapor, called acid gas, is a mixture of approximately 90 percent hydrogen sulfide and 10 percent carbon dioxide. The acid gas is transferred through process piping to the downstream Sulfur Recovery Unit (SRU) to convert the hydrogen sulfide into sulfur. The relative locations of the ARUs and the SRU at the refinery are shown in **Figure 2**.

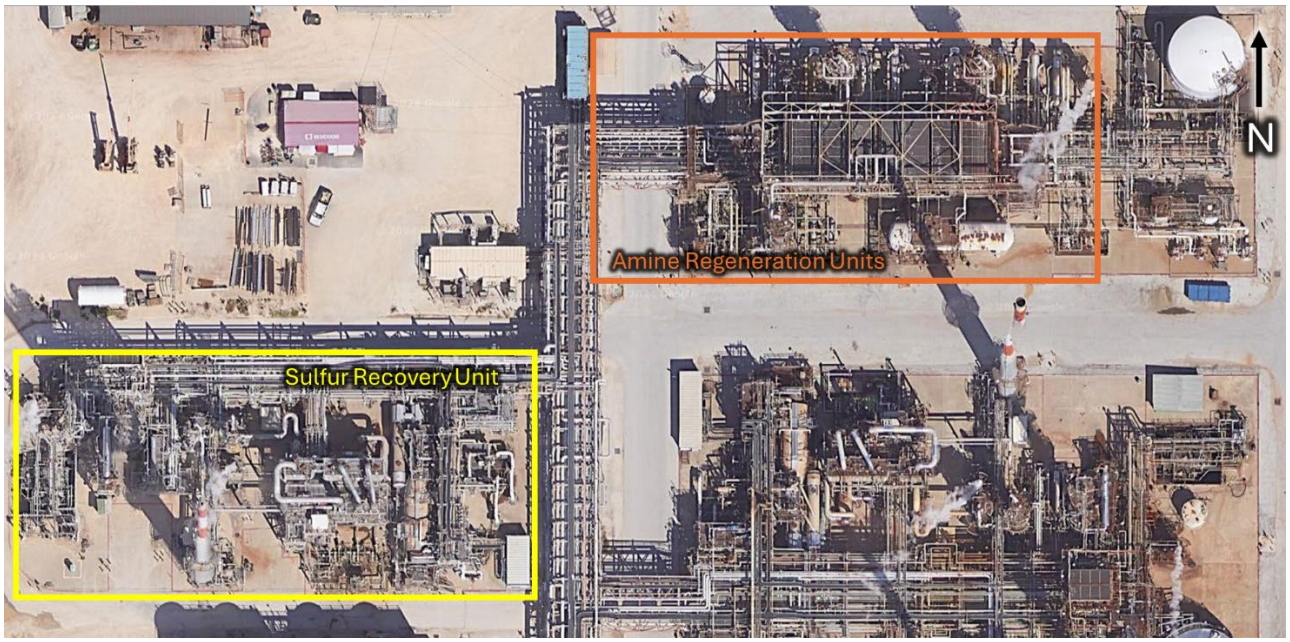

Figure 2. Relative locations of ARUs and SRU. (Credit: Google Earth, with annotations by CSB)

The PEMEX Deer Park Refinery has two ARUs, ARU6 and ARU7, which are identical in function and capacity. The ARU6 and ARU7 equipment and piping are in the same general area, with piping segments for both units sharing the same platforms to access the equipment. ARU6 was shut down for maintenance activities at the time of the incident, and the unit's process piping had been depressurized, purged, and isolated. ARU7 was operating normally after having gone through the same maintenance activity. The nearby SRU (**Figure 2**) was in a scheduled unit shutdown for planned maintenance activities, called a turnaround.

The areas containing the ARUs and the SRU are equipped with permanently mounted hydrogen sulfide gas detectors with alarms. When the gas detectors identify a hydrogen sulfide concentration exceeding 10 ppm, an alternating high/low tone sounds in its respective unit accompanied by a red light signal. The detector also activates a flashing light and audible alert on the control room console for the ARUs and the SRU. The SRU's fixed gas detectors were not operable on the day of the incident due to maintenance related to the SRU turnaround.

Contractors

Repcon

Repcon, Inc. (Repcon) is an industrial services contractor headquartered in Baton Rouge, Louisiana, that provides mechanical, maintenance, and construction services [8]. The PEMEX Deer Park Refinery contracted with Repcon to conduct pre-planned maintenance activities during the SRU turnaround. Additionally, PEMEX Deer Park tasked Repcon with installing and removing piping isolation devices, called blinds, from ARU6 equipment unrelated to the SRU turnaround activities.[a]

Code Red

Code Red Safety (Code Red) is an industrial services contractor headquartered in Chicago, Illinois [9]. PEMEX Deer Park contracted with Code Red to provide safety-related equipment, such as radios, gas detectors, and respirators, during the SRU turnaround. Code Red also managed radio communications for turnaround workers and monitored for hydrogen sulfide emissions in the SRU. Because the hydrogen sulfide gas detectors in the SRU were shut down, PEMEX Deer Park tasked Code Red with providing continuous air monitoring using portable hydrogen sulfide gas detectors stationed throughout the unit.[bc]

ISC

ISC Constructors, LLC (ISC) provides electrical, instrumentation, and control system engineering and construction services [10]. PEMEX Deer Park used ISC as its electrical and instrumentation contractor for the SRU turnaround.

Personal Protective Equipment

PEMEX Deer Park requires personnel to wear personal hydrogen sulfide gas detectors when entering the ARUs and SRU, which are worn on the user's clothing near the breathing zone. Upon detecting hydrogen sulfide above 10 ppm, the detector alerts the user with a tone, lighting, and vibration.

Figure 3. Supplied air respirator system. (Credit: 3M [11])

When completing a portion of the ARU6 blind removal work, Repcon workers used a supplied-air respirator system equipped with a compressed air cylinder (**Figure 3**). The system consisted of a mask, a compressed air cylinder,[d] a regulator, and hoses connecting the mask to the cylinder and a supplied air quick-disconnect fitting. To properly use the cylinder during an

[a] PEMEX Deer Park also had tasked Repcon with installing and removing blinds on ARU7 equipment the week prior to the incident.

[b] Upon activation, the monitor would emit an alternating high/low tone with accompanying flashing light.

[c] PEMEX Deer Park did not develop a Management of Change for the shutdown of SRU gas detectors and the use of temporary gas detectors during the SRU turnaround.

[d] When full, the pressure in the cylinder measures 2,200 pounds per square inch gauge, allowing for five minutes of breathing air.

emergency release, the user must first open the air supply valve on the air cylinder and then pull on the quick-disconnect fitting to disengage from a supplied air hose. The user can then evacuate the area wearing the mask and using the emergency air supply. PEMEX Deer Park policy did not require personal gas detectors to be worn while using supplied-air respirators.

Incident Description

Permit-to-Work Activities

On October 10, 2024, at 8:18 a.m., a PEMEX Deer Park operator issued a work permit to Repcon to remove blinds from the ARU6 piping after unit maintenance activities were completed. The permit authorized the removal of 15 blinds from ARU6 piping flanges. For the first 13 blinds, the permit required workers to wear air-purifying respirators, leather gloves, and hearing protection.[a] For the final two blind locations, which included the acid gas piping, the permit required workers to wear supplied-air respirators due to the risk of acid gas backflow or leak-by from the associated process piping.

PEMEX Deer Park procedures required operators to develop a list of blinds and a drawing to identify blind locations. A PEMEX Deer Park operator provided a Repcon foreman with a list of 15 blinds to remove and a drawing of the ARU6 blind locations. The operator escorted the foreman through the unit to visually identify the blinds. During the walkthrough, the PEMEX Deer Park operator verified that all piping connected to the first 13 blinds had been depressurized. However, they did not visit the final two blind locations because the operator expected to be present later when those flanges were opened.

One of the blinds that the operator and Repcon foreman did not visit – the 14th blind, labeled Blind 407 – was located on the acid gas piping approximately 25 feet above the ground (**Figure 4**). The operator and foreman viewed Blind 407 from the ground underneath the piping.

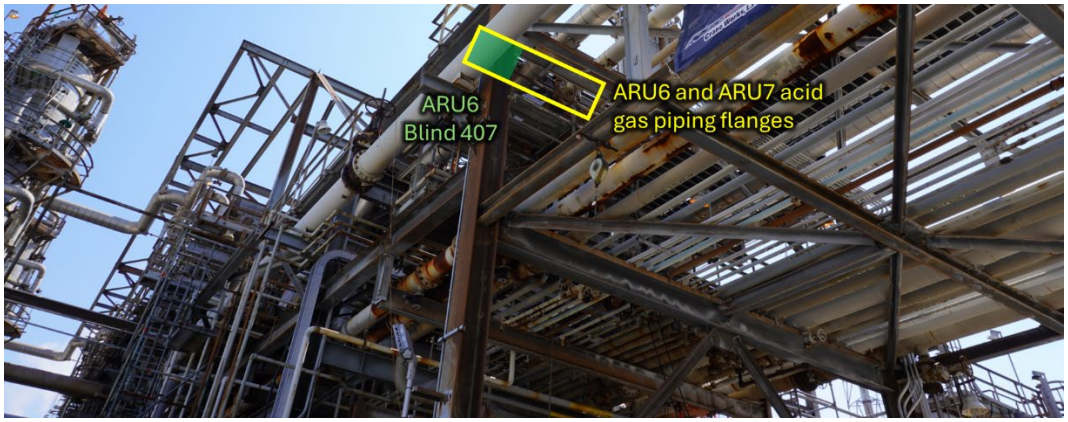

Figure 4. View of Blind 407 from the ground. (Credit: CSB)

[a] All workers in the ARU6 were also required to wear fire resistant clothing, safety shoes, a hard hat, hearing protection, a personal hydrogen sulfide monitor, and safety glasses.

Blind Removal

The Repcon foreman gathered four Repcon boilermakers who had been working on the SRU turnaround and assigned them to remove blinds in ARU6.[a] The foreman gave the boilermakers the work permit, escorted them through the unit, and verbally and visually identified the locations of the 15 blinds to be removed.

The four Repcon boilermakers worked in pairs, opening flanges and removing blinds from the ARU6 piping. The boilermakers did not have the blind list or drawing; they used visual indicators to identify the location of the blinds to be removed. The boilermakers informed the CSB that they depended on an orange-and-blue blind identification tag or an unlocked red flange locking device to locate the 15 blinds (**Figure 5**).[b]

Figure 5. Blind identification tag (left) and flange locking device (right).[c] (Credit: CSB)

Acid Gas Piping Blind Removal

Around 3:30 p.m., the Repcon boilermakers had completed the blind removal at the first 13 locations and prepared to remove the final two blinds. The boilermakers obtained supplied-air respirators and emergency escape cylinders from Code Red (**Figure 3**) and donned the equipment. Two of the boilermakers went to the 15th blind location elsewhere in the unit. The remaining two boilermakers climbed to a fixed, elevated platform to begin work at the Blind 407 location. The Repcon foreman located a contractor from another company to serve as the "bottle watch," who is responsible for monitoring the supplied air tanks connected to the boilermakers' respirators, among other responsibilities. The boilermakers connected their respirators to supplied-air hoses. They removed their personal

[a] The removal of the blinds in ARU6 was part of a maintenance activity separate from the SRU turnaround.

[b] PEMEX Deer Park procedures required the use of the tags and locking devices on flanges with blinds during turnaround activities, such as the work occurring at the SRU, but these are not required during non-turnaround maintenance activities, like at the ARUs. Instead, PEMEX Deer Park policy required the development of an isolation list and a drawing depicting the blind locations, which the PEMEX Deer Park operator had provided to the Repcon foreman. Although blind identification tags were not required during non-turnaround maintenance activities, PEMEX Deer Park operators hung tags at ARU blind locations prior to the ARU6 blind removal activities.

[c] The photo of the red flange locking device was taken in another part of the facility and is displayed here as an example of an installed lock.

hydrogen sulfide gas detectors and placed them on the platform nearby because PEMEX Deer Park policy did not require personal gas detectors to be worn while using supplied-air respirators.

The two Repcon boilermakers at the Blind 407 location encountered two identical piping segments five feet apart. The ARU6 piping, which was the intended location of the work, had previously been depressurized, purged, and isolated via a closed and locked-out upstream valve. Five feet away, the ARU7 piping segment (**Figure 6**) contained approximately 90 percent hydrogen sulfide gas at a gauge pressure of about 15 pounds per square inch.

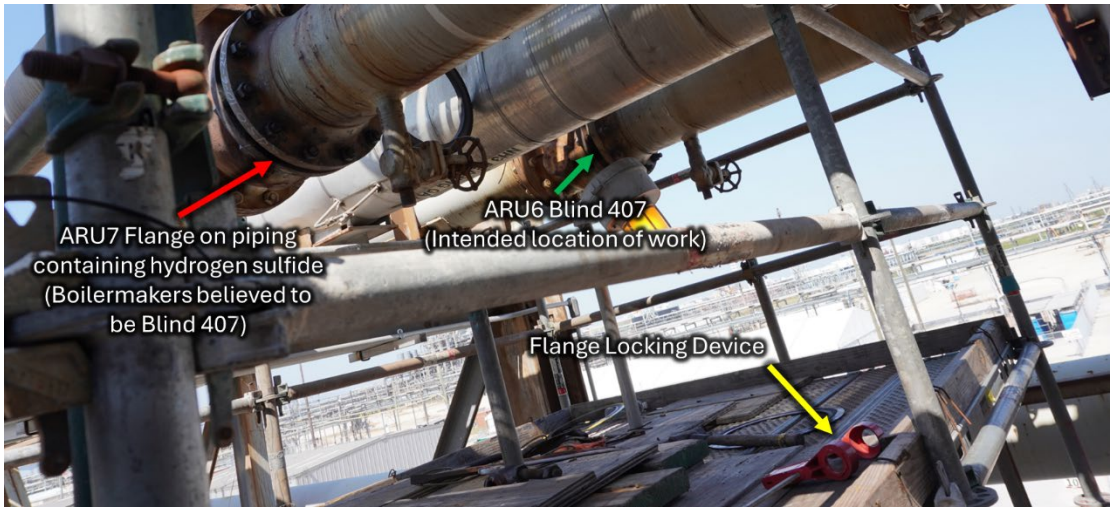

Figure 6. Adjacent ARU6 and ARU7 acid gas piping flanges. A flange locking device was found on the work scaffold underneath the ARU7 acid gas piping flange. (Credit: CSB)

The two Repcon boilermakers did not observe a blind identification tag on either of the ARU6 or ARU7 flanges. After the incident, the CSB located the Blind 407 identification tag attached to the railing on the grated platform above the piping where the boilermakers were working (**Figure 7**). The boilermakers observed a flange locking device on or near the ARU7 flange (**Figure 6**) and believed that the ARU7 flange was the intended location of the work, unaware that Blind 407 was located on the piping segment five feet away.

Figure 7. ARU6 blind identification tag location. (Credit: CSB)

Hydrogen Sulfide Release

Believing they were working on Blind 407, the Repcon boilermakers began removing bolts from the ARU7 flange, which was not covered by the work permit. Approximately 100 feet away, at 4:22 p.m., portable gas monitors in the SRU detected a hydrogen sulfide concentration above the low alarm threshold and alerted Code Red technicians, who attempted to notify PEMEX Deer Park operators of the release via hand-held radio. Wearing supplied-air respirators and without personal hydrogen sulfide gas detectors, the two Repcon boilermakers may have been unaware of a hydrogen sulfide leak. As a result, they continued to loosen and remove bolts from the ARU7 flange.

At 4:23 p.m., the connection was disassembled enough that the flange opened, forcefully releasing toxic hydrogen sulfide gas (**Figure 8**). The two boilermakers disconnected their supplied air connections to flee from the area. One boilermaker turned the valve to engage air flow from his escape cylinder and proceeded down a nearby ladder to the primary assembly point. The other boilermaker collapsed near the top of the ladder and was found by emergency responders with his respirator mask lying next to him, fatally injured from hydrogen sulfide poisoning.[a]

Figure 8. Hydrogen sulfide release from the ARU7 flange. (Credit: PEMEX Deer Park)

[a] The CSB is investigating how the boilermaker's mask was removed. The full analysis will be included in the CSB's final investigation report.

Alarms and Notification of the Release

The wind[a] carried the released hydrogen sulfide away from the gas detectors in the ARUs, and consequently the ARU alarms did not sound immediately. Although the wind brought the hydrogen sulfide gas through the nearby SRU (**Figure 9**), the SRU hydrogen sulfide detectors were disabled due to maintenance work associated with the turnaround and did not activate. The portable gas monitors, maintained by Code Red, were stationed throughout the SRU and detected hydrogen sulfide concentrations exceeding 500 ppm and reaching nearly 800 ppm in some areas.[b] At 4:24 p.m., the portable gas monitors began to alarm audibly at the location of each gas detector, and a functioning, permanently mounted alarm at a shelter within the SRU also started to alarm.

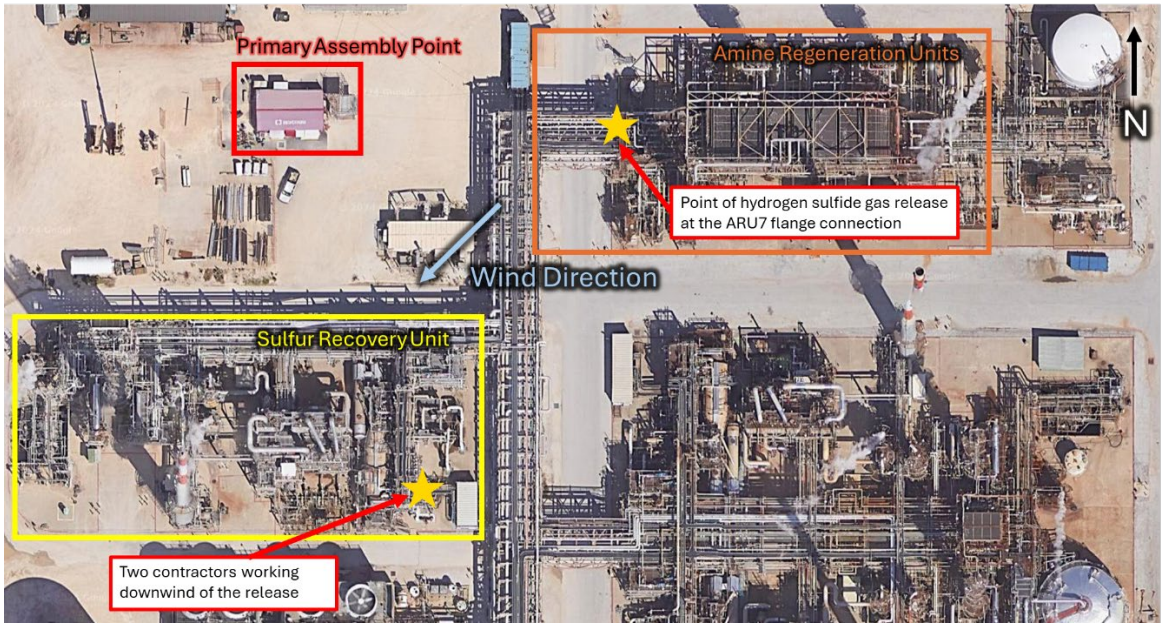

Figure 9. Overhead view of hydrogen sulfide release location and adjacent units with gold stars indicating the approximate location of the fatally injured. (Credit: Google Maps, annotated by CSB)

The bottle watch worker used his hand-held radio to alert PEMEX Deer Park of the unresponsive Repcon boilermaker. He ran to the control room to notify the PEMEX Deer Park operators of the release. The operators donned self-contained breathing apparatuses and ran to the ARUs to investigate the release. Between 4:27 and 4:28 p.m., at least four minutes after the release began, the ARU gas monitors detected hydrogen sulfide concentrations greater than 50 ppm, and alarms started to sound in the ARU.

Downwind Exposure to the Release

Two ISC contract workers were working on SRU equipment about 250 feet away and downwind from the release (**Figure 9**). PEMEX Deer Park did not require the ISC workers to wear respiratory protection for their permitted work,

[a] During the release, the wind blew from the Northeast at approximately 2 miles per hour, with gusts up to 8 miles per hour.

[b] Hydrogen sulfide concentration of 100 ppm is considered immediately dangerous to life or health [6]. Concentrations over 1,000 ppm can cause a near-immediate fatality [7].

and they did not have escape respirators. Just after the release, at least one of the ISC workers heard audible alarms in the area. Their personal hydrogen sulfide gas detectors alarmed, indicating that the hydrogen sulfide concentration in their breathing zone was at least 10 ppm. While attempting to evacuate, one of the workers lost consciousness and fell while descending a caged ladder. He was found on the ground on the east side of the SRU, fatally injured from hydrogen sulfide poisoning. The other worker stated to the CSB that he lost and regained consciousness and was able to escape the area.

Over the next several minutes, contractors working in the SRU became aware of the release either by hearing the portable gas detector alarms, unit alarms, or the alarms of their personal hydrogen sulfide gas detectors. The contractors began evacuating to the primary assembly point, which was located upwind towards the direction of the release, as shown in **Figure 9**. During the evacuation, 47 contractor workers from 10 companies were evaluated for hydrogen sulfide exposure. Many of their personal hydrogen sulfide gas detectors had exceeded the maximum reading of 100 ppm. An additional 13 contractors were taken to nearby medical facilities and evaluated for hydrogen sulfide exposure.

Isolating the Leak

After locating the leaking flange on ARU7, a PEMEX Deer Park operator attempted to close manual valves upstream and downstream of the release. However, the operator could not fully close the manual valves necessary to isolate the leak before his contained breathing air supply became low, and he evacuated the area. There were no remotely operated isolation valves downstream of the release point capable of stopping the release. As a result, hydrogen sulfide continued to escape from the flange.

Between 4:26 and 4:34 p.m., emergency responders arrived at the ARU and assisted operators with isolating the leak. The sitewide alarm sounded at 4:35 p.m., twelve minutes after the release began. Around 5:22 p.m., nearly an hour after the release began, emergency responders reassembled the leaking flange, stopping the release.

Consequences of the Incident

The incident at the PEMEX Deer Park Refinery resulted in two fatalities and the release of more than 27,000 pounds of hydrogen sulfide into the atmosphere. The neighboring cities of Deer Park and Pasadena issued shelter-in-place orders that lasted several hours. While there was no physical damage to equipment, PEMEX Deer Park reported property damage from loss of use in the ARUs and downstream processes of $12.3 million associated with the incident.

Path Forward

The CSB is continuing to gather facts and analyze several key areas, including:

- Safe work practices
- Human factors
- Turnaround and maintenance policies and procedures
- Emergency preparedness and response systems
- Respiratory protection procedures and training
- Remote isolation capability

The CSB's investigation is ongoing. Complete findings, analyses, and recommendations, if appropriate, will be detailed in the CSB's final investigation report.

References

[1] Texas Commission on Environmental Quality, "Air Emission Report Database Incident 430966," 11 October 2024. [Online]. Available: https://www2.tceq.texas.gov/oce/eer/index.cfm?fuseaction=main.getDetails&target=430966. [Accessed 24 October 2024].

[2] PEMEX Deer Park, "About Us," 7 October 2024. [Online]. Available: https://www.pemex.com/deerpark/en/aboutus/Paginas/default.aspx. [Accessed 23 October 2024].

[3] PEMEX, "PEMEX," 13 December 2022. [Online]. Available: https://www.pemex.com/en/about-pemex/business-plan/Paginas/default.aspx. [Accessed 23 October 2024].

[4] Pemex, "Pemex Industrial Transformation," Petroleos Mexicanos, 2 May 2024. [Online]. Available: https://www.pemex.com/en/operations/Paginas/tir.aspx. [Accessed 7 November 2024].

[5] J. G. Speight, Chemistry and Technology of Petroleum, Taylor & Francis, 2014.

[6] CAMEO Chemicals, "Hydrogen Sulfide," [Online]. Available: https://cameochemicals.noaa.gov/chemical/3625. [Accessed 29 October 2024].

[7] Occupational Safety and Health Administration, "Hydrogen Sulfide," [Online]. Available: https://www.osha.gov/hydrogen-sulfide/hazards. [Accessed 29 October 2024].

[8] Repcon, "Contact," [Online]. Available: https://repcon.com/contact. [Accessed 28 October 2024].

[9] Code Red Safety, "Contact Us," [Online]. Available: https://coderedsafety.com/contact-us. [Accessed 28 01 2025].

[10] ISC Constructors, LLC, "What We Do," ISC Constructors, LLC, 2025. [Online]. Available: https://www.iscgrp.com/what-we-do/. [Accessed 24 January 2025].

[11] 3M, "Ska-Pak Supplied-Air Respirator," 3M, 2025. [Online]. Available: https://www.3m.com/3M/en_US/p/d/b5005047150/. [Accessed 27 January 2025].

[12] PEMEX Deer Park, "Visio," [Online]. Available: https://www.pemex.com/deerpark/en/aboutus/Paginas/vision.aspx. [Accessed 07 February 2025].