# Investigation Update

November 2024

This document provides an update on the CSB investigation of the July 31, 2024, incident at the Cuisine Solutions, Inc. food processing facility in Sterling, Virginia.

## Incident Summary

- On July 31, 2024, at approximately 8:20 p.m., anhydrous ammonia was accidentally released at the Cuisine Solutions, Inc. ("Cuisine Solutions") food processing facility in Sterling, Virginia. At the time of the incident, 286 personnel, which included employees and contractors, were on site. An emergency pressure relief valve discharged the ammonia horizontally near the roof of the building. The released ammonia formed a toxic cloud. As personnel evacuated from the facility, some were exposed to the ammonia vapor, causing four workers to be admitted to local hospitals. Cuisine Solutions reported that approximately 170 pounds of anhydrous ammonia was released.

## Background Information

- Cuisine Solutions, a privately held U.S. Corporation headquartered in Sterling, Virginia, began operations at the Sterling, Virginia, plant facility in 2013 [1].

- Cuisine Solutions produces cooked, packaged food products for hotels, airlines, restaurants, and other industries, as well as for consumers, using the sous vide cooking method [2, 3]. According to Cuisine Solutions, "Sous vide is French for 'under-vacuum.' In the sous vide cooking method, food is vacuum-sealed in a specially designed pouch and slow-cooked in a water bath… [2]." As part of the food preparation process, the food products were immersed in chilled water after completing the cooking process.

- Cuisine Solutions had a refrigeration system to control chilled water temperature in its processes and to operate freezers and food storage areas. The refrigeration system used anhydrous ammonia as the refrigerant,[a] which is commonly used in the food industry [4, pp. 549-552].

- The chilled water used in the sous vide process was cooled by ammonia refrigerant in heat exchangers. Emergency pressure relief valves, set at 300 pounds per square inch, protected the heat exchangers and associated equipment from excess pressure conditions. When activated, these emergency pressure relief valves discharged ammonia to the atmosphere through shared piping (the "atmospheric emergency relief header"), exiting to the atmosphere through a horizontal tee. **Figure 1** shows a typical simplified heat exchanger arrangement, with emergency pressure relief valves and part of the atmospheric emergency

[a] Anhydrous (meaning "without water") ammonia is essentially pure $NH_3$ with no water present. However, when released, anhydrous ammonia is hygroscopic (has an affinity to water) and will absorb atmospheric moisture. Ammonium hydroxide, or aqueous ammonia, is formed when ammonia gas combines with water [9, p. 1.2].

relief header. For each pair of emergency pressure relief valves, a three-way selector valve ensured that one emergency pressure relief valve was in service while the standby was isolated.[a]

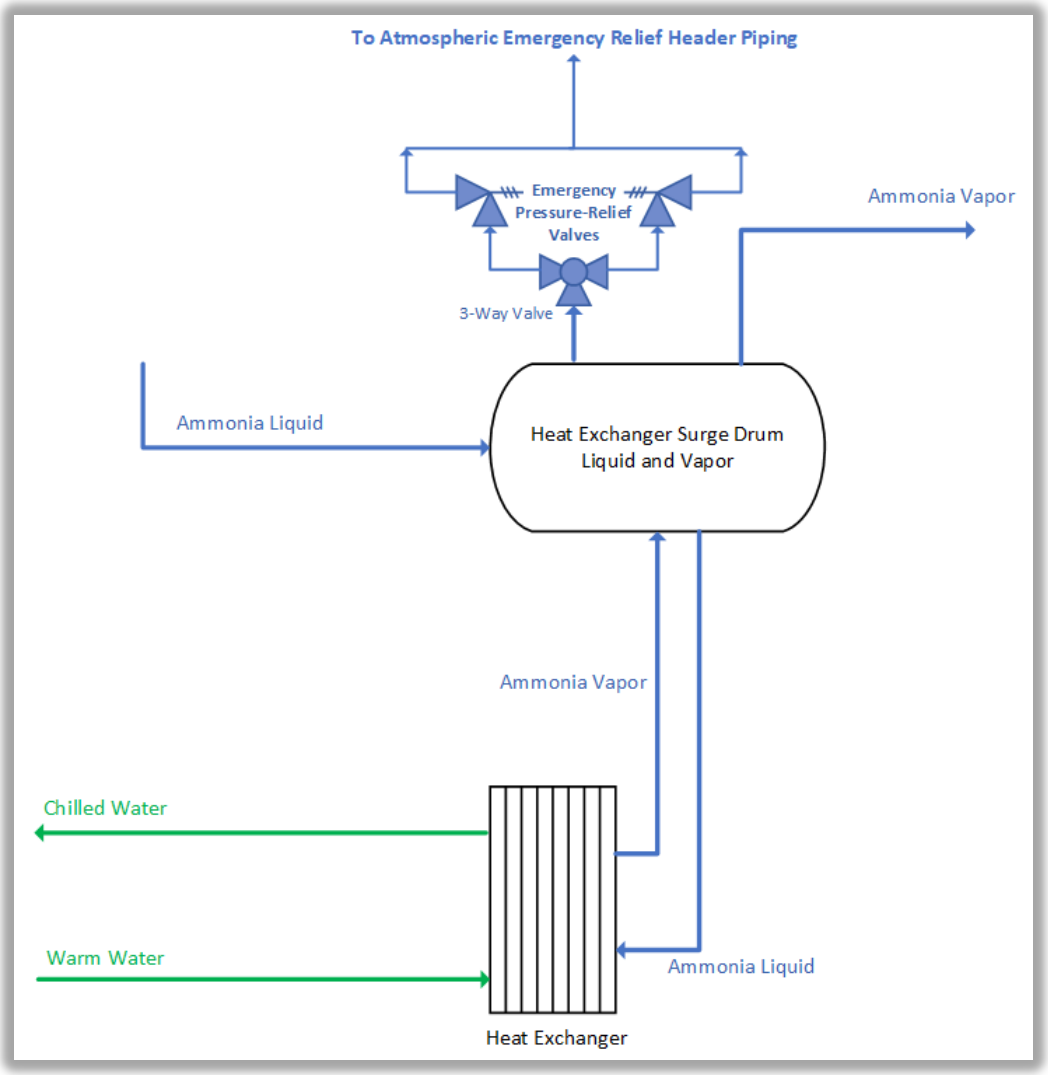


**Figure 1:** Simplified process diagram showing a typical chilled water heat exchanger system and part of the emergency pressure relief system. (Credit: CSB)

- The facility's ammonia refrigerant inventory can total up to approximately 21,000 pounds. This quantity of ammonia means that the facility is subject to the Occupational Safety and Health Administration's (OSHA) Process Safety Management (PSM) standard[b] and the Environmental Protection Agency's

[a] Ten other pieces of equipment in this area of the ammonia system had similar emergency pressure relief valve arrangements, where one emergency pressure relief valve was in service while the other was isolated and offline, depending on the position of the three-way valve. All these emergency pressure relief valves discharged into the atmospheric emergency relief header, and ultimately into the atmosphere (not shown).

[b] 29 CFR § 1910.119, Appendix A

(EPA) Risk Management Program (RMP) rule.[a] The reportable release quantity of ammonia under EPA's Superfund, Emergency Planning, and Community Right-to-Know rule is 100 pounds [5, 6].[b]

- Ammonia is toxic when inhaled. A concentration of 300 parts per million (ppm) or greater is considered immediately dangerous to life and health (IDLH) [7, 8, pp. 4, 5]. An anhydrous ammonia release can absorb moisture from the atmosphere and form a dense, visible white cloud [9, p. 1.2]. A toxic ammonia cloud may not be visible if the cloud does not condense sufficient atmospheric moisture. Exposure to ammonia below 300 ppm can cause headaches, nausea, vomiting, coughing, wheezing, and irritation to the nose, mouth, and throat [9, p. 1.2].

- When mixed with air, ammonia has a lower flammability limit of 16 percent and an upper flammability limit of 25 percent [10]. The ammonia Safety Data Sheet notes that "outdoors, ammonia is not generally a fire hazard [8, pp. 3, 5]."

## Incident Description

- On the evening of July 31, 2024, at approximately 8:15 p.m., a Cuisine Solutions employee reported experiencing a chemical exposure outside the building near the main employee entrance after smelling a chemical odor and suffering tearing eyes, throat irritation, and difficulty breathing.[c]

- A few minutes later, maintenance employees investigated the report and observed a white cloud coming out of the atmospheric emergency relief header piping in the ammonia system, as shown in **Figure 2**.

[a] 40 CFR § 68.130

[b] 40 CFR § 302.4(a) and 40 CFR § 355, Appendix A.

[c] The odor threshold for ammonia is 5 to 50 parts per million in air [10].

**Figure 2**. Images of the visible ammonia cloud during the release and of the release point (circled, right) through a horizontal tee. (Credit: Cuisine Solutions employees, annotation by CSB)

- Meanwhile, personnel located in a cafeteria and break area inside the building and adjacent to the release point identified and reported an ammonia odor.[a] Since the emergency exit door for this area led directly into the white cloud, on the west side of the building, the site manager directed all personnel to evacuate the building via the opposite (east) side of the building. **Figure 3** shows the building layout relative to the ammonia release.

[a] The ventilation intake for this area was located approximately 21 feet from the ammonia release point, based on a three-dimensional model of the roof.

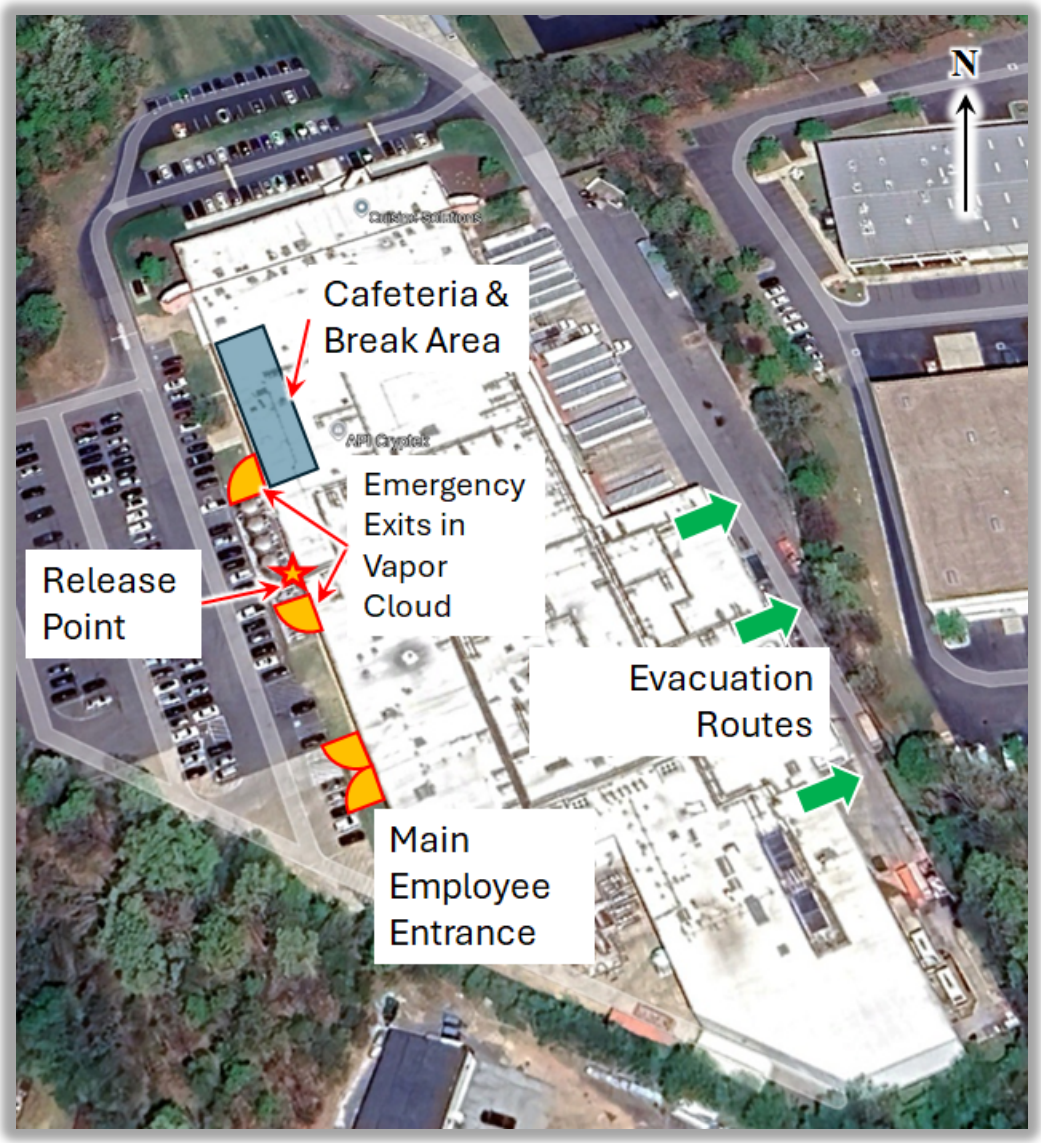


**Figure 3:** Overhead view of the facility, indicating the main employee entrance near where the odor was first detected, the break area (blue rectangle), the emergency exits compromised by the release, some commonly used evacuation routes (green arrows), and the release point (star). (Credit: Google Earth, annotated by CSB)

- Some personnel unwittingly exited the building near or into the ammonia cloud and were exposed to ammonia vapor. Although part of the ammonia vapor cloud was not visible, the ammonia concentration was high enough to harm some evacuees, including outside of the visible cloud.

- On the east side of the building, or along the evacuation route directed by the site manager (**Figure 3** above), some evacuees reported smelling a strong ammonia odor. However, no visible ammonia cloud on the east side of the building was reported to the CSB.

- A Cuisine Solutions employee called 911 at 8:31 p.m. Loudoun County Fire and Rescue, including the Hazmat Team, arrived on the scene. With the Hazmat Team's assistance, a Cuisine Solutions employee switched the three-way valve to isolate the emergency pressure relief valve that had released the ammonia. The release was stopped by approximately 9:29 p.m.[a]
- The Cuisine Solutions employee who switched the three-way valve had determined which emergency pressure relief valve was releasing the ammonia based on frost buildup on the exterior of the piping. The ammonia releasing to the atmosphere was cold enough to freeze atmospheric moisture on the exterior of the emergency pressure relief valve and discharge piping [10].
- Loudoun County Fire and Rescue ventilated the building to remove residual ammonia and then returned control of the scene to Cuisine Solutions at approximately 11:45 p.m.
- Forty people working at the Cuisine Solutions facility were evaluated at various local medical facilities. Of those, four were admitted to local hospitals, with one admitted to the Intensive Care Unit.

## Evacuation and Muster Points

- During the evacuation, the initial muster point, shown in **Figure 4**, was abandoned due to the ammonia odor there. Evacuees then walked to the location marked "Final Evacuation Point" in **Figure 4**, approximately 1/3-mile away from the initial muster point, to escape the ammonia odor.
- The local wind direction and speed at the time of the incident[b] were from the south-southeast at 5-10 miles per hour [11]. The initial muster point and evacuation path Cuisine Solutions used was likely downwind of the ammonia release.

[a] Cuisine Solutions employees took action to depressurize the ammonia process prior to 9:29 p.m. To ensure the release stopped completely, the three-way valve was switched at approximately 9:29 p.m.

[b] The nearest weather station to the facility was at Dulles International Airport, approximately 2.7 miles south of the facility.

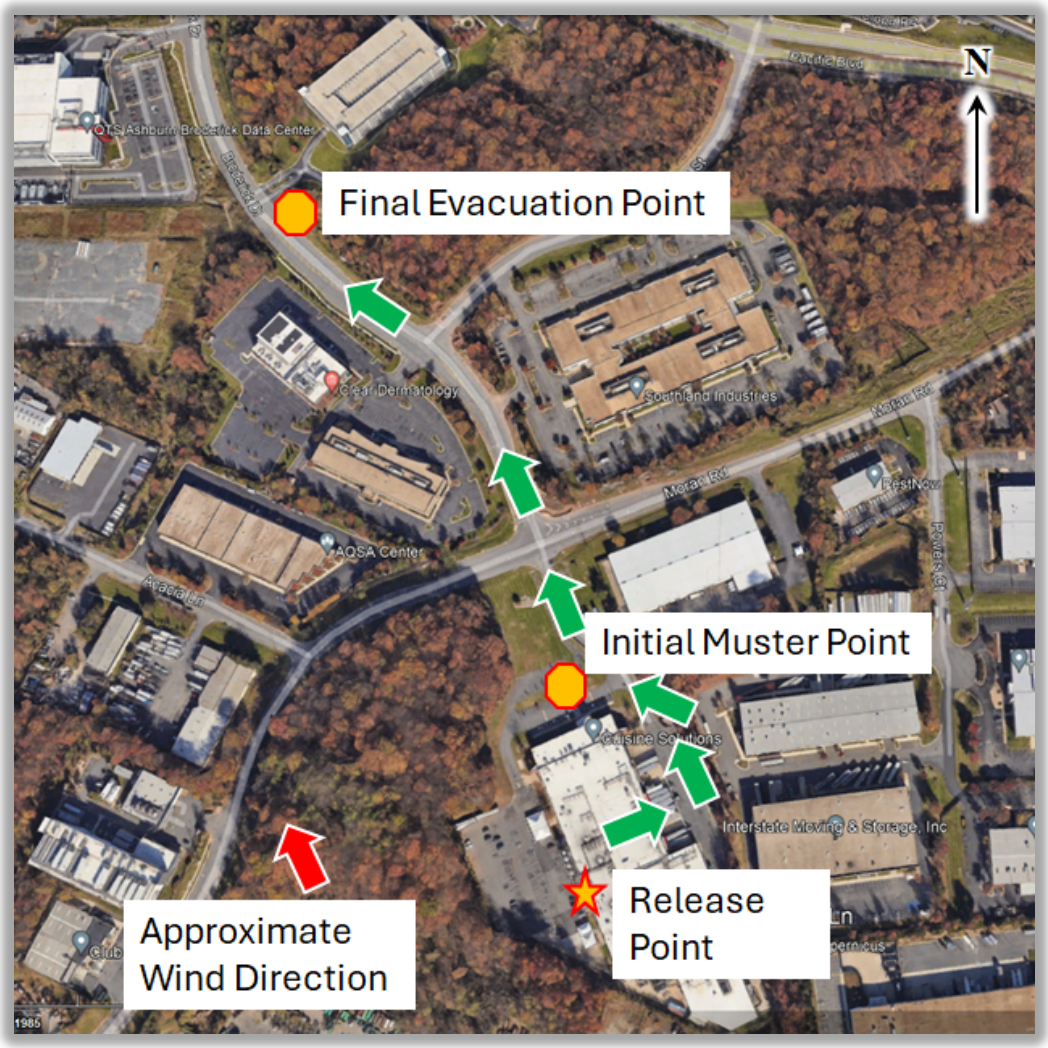


**Figure 4**. The Evacuation route (green arrows) that most workers followed via the east side of the building to avoid the release on the west side (yellow star). (Credit: Google Earth, annotated by CSB)

## Path Forward

- The CSB is continuing to gather facts and analyze several key areas, including:
    - Potential causes of the ammonia emergency pressure relief valve opening
    - The total quantity of ammonia released
    - Cuisine Solutions' emergency action plan for an ammonia release
    - Cuisine Solutions' process safety management and risk management programs and policies
    - Codes and standards for ammonia refrigeration systems

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

# References


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[3] Cuisine Solutions, Inc., "Industries We Serve," Cuisine Solutions, 2024. [Online]. Available: https://cuisinesolutions.com/industry/?. [Accessed 27 September 2024].

[4] Fellows, P.J., Food Processing Technology - Principles and Practice, 5th ed., Cambridge, Massachusetts: Woodhead Publishing | Elsevier, 2022.

[5] Code of Federal Regulations, "40 CFR Part 355 Emergency Planning and Notification," 3 January 2017. [Online]. Available: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-J/part-355. [Accessed 23 September 2024].

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[7] United States Department of Labor (USDOL), "Occupational Safety and Health Administration | Ammonia Refrigeration Overview," [Online]. Available: https://www.osha.gov/ammonia-refrigeration. [Accessed 28 September 2024].

[8] Tanner Industries, Inc., "Anhydrous Ammonia: (SDS) Safety Data Sheet," 19 January 2023. [Online]. Available: https://tannerind.com/anhydrous-sds.html. [Accessed 26 September 2024].

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