

Incident Summary #II-1508412-2023 (#31811) (FINAL)

SUPPORTING INFORMATION	Incident Date	February 10, 2023	
	Location	Langley	
	Regulated industry sector	Boilers, PV & refrigeration - Refrigeration system	
	Impact	Qty injuries	0
		Injury description	None
		Injury rating	None
	Damage	Damage description	Over 1000 pounds of ammonia leaked from the refrigeration system and an extensive amount of refrigerated food product was lost.
		Damage rating	Major
	Incident rating	Major	
	Incident overview	A forklift struck a liquid ammonia refrigeration line at an industrial food processing facility causing an uncontrolled leak. The leak released over 1000 pounds of toxic ammonia into the building and resulted in the evacuation of the facility.	
INVESTIGATION CONCLUSIONS	Site, system and components	<p>The building is a 110,000 square foot industrial food processing facility built in the year 2000. The facility employs approximately 430 workers and consists of warehouses, food processing areas and office spaces. The facility has multiple areas for refrigerating or freezing food products and has a large refrigeration system that contains a charge of approximately 8000 pounds of ammonia.</p> <p>The refrigeration and freezer areas are insulated areas constructed within the building consisting of insulated walls and ceilings. The refrigeration lines for the condensers in the areas are mostly run on the outside of the insulated panels and only enter when they drop down to connect to the condensers. The lines are suspended from the metal ceiling structures and run in a mezzanine above the insulated ceiling panels.</p> <p>The adopted refrigeration code for BC (<i>CSA B52 Mechanical refrigeration code</i>), states that the location of refrigerant piping shall be installed with consideration of its location to minimize the danger of the piping being struck from any direction (such as by material handling equipment) and should a danger exist, that appropriate protection shall be provided.</p> <p>Electric forklifts are used in the refrigerated receiving and freezer areas to move pallets of food product. The forklifts are operated by employees who receive training and a forklift certification. The forklifts in the receiving areas operate in areas of differing ceiling height. The forklifts require the ability to reach the product in the highest ceiling areas while still being able to operate in the areas of less ceiling height.</p>	

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<p>Failure scenario(s)</p>	<p>When the refrigeration system was installed in the mezzanine above the insulated panels of the refrigerated receiving area, the refrigeration lines were suspended from the metal ceiling structure and maintained a clearance to the insulated panels (Photo 4). A 1/2-inch liquid ammonia line was routed underneath the other lines with only approximately 1-inch clearance between the insulated pipe and the ceiling panels (Photo 5). There was no identification of the location of the ammonia piping from the area below.</p> <p>An employee was moving a pallet of food product from an upper storage rack, with an electric forklift in the refrigerated receiving area. The employee lifted the forklift forks too high and contacted the roofing panel at the location of the ammonia line with reduced clearance. The roofing panel was pushed up bending the ammonia line. The force physically strained a two-bolt flange connection and caused liquid ammonia to escape past the sealing gaskets of the flange. The refrigeration system was shut down and the building was evacuated.</p> <p>Ammonia concentrations were measured inside the building up to 4000 parts per million (ppm) from personal sensors in the area of the piping damage from emergency response personnel. The system leaked approximately 1100 pounds of ammonia indoors and into the atmosphere before the ammonia line was able to be isolated and the leak stopped.</p>
<p>Facts and evidence</p>	<p><u>Statements</u> Mangers and safety personnel</p> <ul style="list-style-type: none"> • The employee who was operating the forklift that struck the ceiling had been employed for about two years and had been working in the receiving department operating a forklift for over a year. • The employee had received forklift training and a qualification to operate the equipment and was familiar with the equipment. • The employee had worked in the specific area and performed the same tasks before. • There had not been any recent changes to area the employee was operating the forklift in. • The forklift operates in different areas with different ceiling heights and needs to be able to reach higher than the ceiling height in the receiving area while working in the freezer. <p><u>Documents</u> Refrigeration contractor report</p> <ul style="list-style-type: none"> • The area of the ammonia leak was from a two-bolt flange where the sealing gasket was damaged by the upward force on the pipe. <p>Forklift specification</p> <ul style="list-style-type: none"> • The maximum lift height of the forklift is 31 feet. <p><u>Site assessment</u></p> <ul style="list-style-type: none"> • The ceiling height in the receiving area was measured at 21 feet from the floor. • The ceiling height in the freezer area was approximately 30 feet from the floor.

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Causes and contributing factors

The cause of the incident was physical contact between the mobile forklift equipment and the ammonia line.

The contributing factors to the incident include:

- The 1/2-inch ammonia line being installed without sufficient clearance or protection from the material handling equipment below.
- No identification of the location of the ammonia lines from the work area below.
- The reliance on the forklift operator's actions to not raise the forks high enough in the work area to contact the ceiling panels under the refrigeration lines.



Photo 1 – Exterior of building's receiving area with two open bay doors for ammonia ventilation following the leak.



Photo 2 – Refrigerated food receiving area with racks of stacked food pallets, refrigeration condensers, and forklift.



Photo 3 – [RED] Area food pallet was moved from.
[YELLOW] Area forklift contacted ceiling.



Photo 4 – Mezzanine area above refrigerated food receiving area showing refrigeration piping suspended above insulated panels.

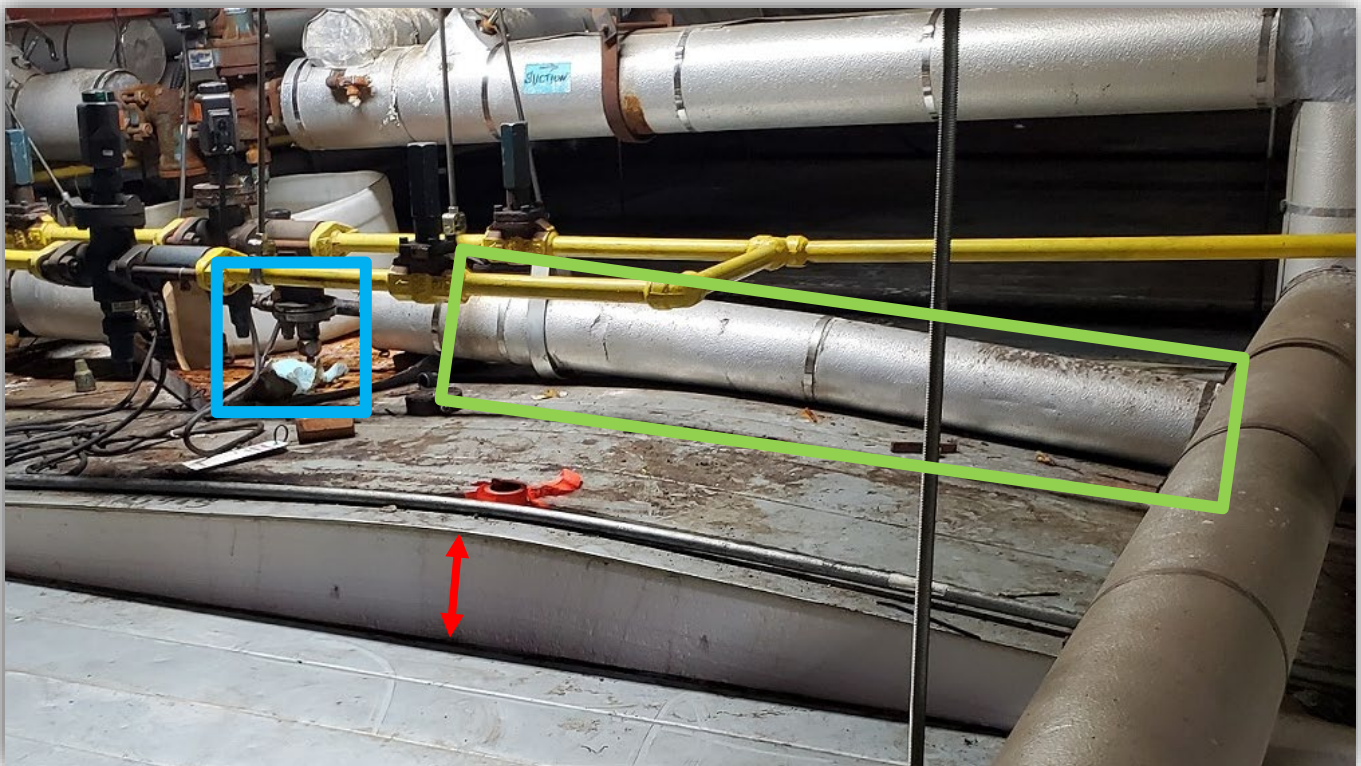


Photo 5 – Mezzanine area.

[GREEN] Insulated ammonia line contacted by insulation panel.

[ARROW] The distance the insulated panel was pushed up by the forklift.

[BLUE] Area of ammonia leak from a flange connection.



Photo 6 – Closeup of ammonia lines at the location on the leak. Ammonia line with two-bolt flanged connections with sealing gaskets.



Photo 7 - Two pieces of the damaged flange gasket from the location of the leak.