Incident Summary #II-900379-2019 (#15064) (FINAL)

SUPPORTING INFORMATION	Incident Date		July 26, 2019
	Location		Abbotsford
	Regulated industry sector		Boilers, PV & refrigeration - Refrigeration system
	Impact – Injury	Qty injuries	2
		Injury description	Two persons felt drowsy and light headed from exposure to ammonia.
		Injury rating	Minor
	Impact – Damage	Damage description	The evaporator within a refrigeration system failed and released ammonia that was intended to be contained within the evaporator and refrigeration system.
		Damage rating	Moderate
	Incident rating		Moderate
	Incident overview		The evaporator within a refrigeration system of an industrial food processing facility failed and released ammonia in a cold storage room. Two workers suffered minor symptoms as a result of exposure to the released ammonia.
INVESTIGATION CONCLUSIONS	Site, system and components		Ammonia refrigeration systems are typically designed for maximum allowable working pressure of 250 psig on high pressure side and 150 psig on low pressure side. The refrigeration cycle contains four major components: compressor, condenser, evaporator and expansion devices. Refrigerant remains piped between these four components and is contained in the refrigerant loop. In cold storage facilities the evaporator is installed in the cold room to cool the air going to the space by evaporating the refrigerant flowing through it. This happens when warm air is blown across the evaporator as cold refrigerant moves through the evaporator coil. Heat transfers from the air to the refrigerant, which cools the air directly before it is vented to the space. Like the condenser coil, the evaporator coil also winds through the evaporator to maximize heat transfer from the refrigerant to the air. The low-pressure liquid refrigerant is easily evaporated by the warm air blown across the coil and the evaporated gas returns to the compressor as a low pressure and low temperature gas/vapor. The ammonia-based refrigeration systems present a risk of accidental exposure to high concentrations of ammonia if the system or any components fail and the ammonia is allowed to escape from the enclosed system. The evaporator is essentially a coil made of aluminum tubing that is surrounded by thin metal fins and enclosed in a metal enclosure. The tubing is joined together at various locations within the evaporator. Leaks within the evaporator can occur if the tubing is damaged from external mechanical force, vibration, or from expansion and contraction happens due to change in temperature such as changes between operating and defrost modes.

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Failure scenario(s)	• In the cold room, ammonia from the evaporator was released which triggered the audio ammonia alarm. • Two workers within the cold room noticed a strong smell of ammonia and immediately left the room. • The ammonia monitor located inside the cold room initially showed 167ppm and then dropped to 22ppm as the ammonia dissipated into atmosphere. • A refrigeration maintenance contractor was contacted. The refrigeration contractor's personal monitor was reading 5ppm and then dropped to 0ppm during the duration of working in the area.
Facts and evidence	Plant activities • One evaporator in the cold storage room was not in operation for a long time as the process for which it was being used was no longer in operation. • The evaporator was then put back into operation for extra cooling in the cold storage room. Frost built up on the surface of evaporator as its surface temperature was below 0°C. The evaporator was turned into defrost mode to remove the frost from the surface of evaporator. Defrosting was performed by using hot gas which was diverted from the high-pressure side of the refrigeration plant. • Two workers within the cold room noticed a strong smell of ammonia and immediately left the room. • After that the ammonia sensor triggered the alarm (35 ppm set point). • A team of two refrigeration operators commenced the investigation of the release but the source of the leak was not found. • The industrial fans were turned on and exterior doors were opened to help exhaust the ammonia. • The ammonia system in the cold storage room was isolated. • The maintenance contactor investigated the leak, performed pressure test using nitrogen. • The leak was found inside the evaporator but the exact location was not explored as it involved the removal of the evaporator from the site in order to open it up. • The owner decided to isolate the evaporator from the system permanently and will remove the evaporator as it was not being used for a long time. Leak Detection • The ammonia piping and evaporator was pressure tested by using nitrogen to locate the leak. • The source of the leak was found to be the evaporator. • The exact location of the leak was not found as the evaporator was not removed from its location, however it is isolated permanently from the ammonia system and will be discarded by the owner. Owner's Investigation • The owner's report indicated that the evaporator was meant to quickly chill small amounts of product rather than a large area.

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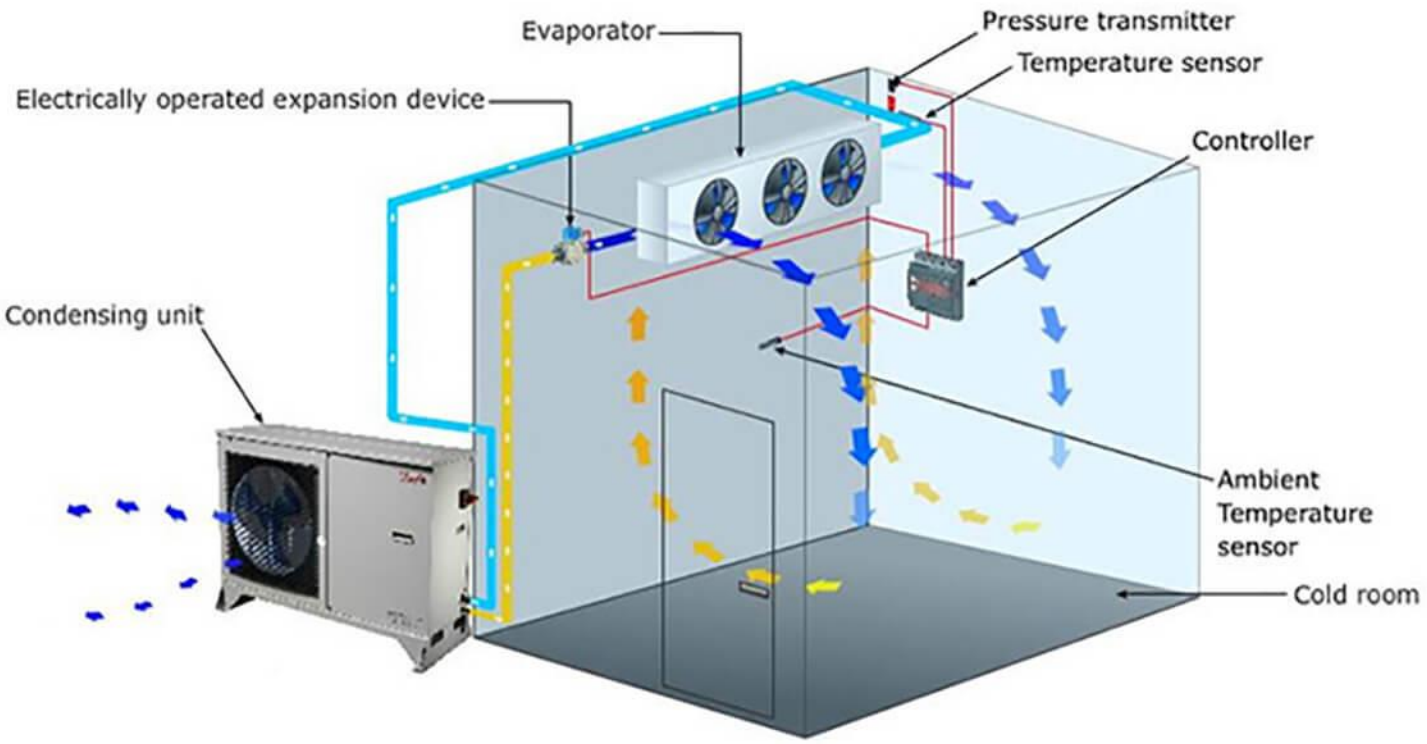
Causes and contributing factors	It is very likely that the evaporator failed because it was running for an extended period of time as the evaporator was meant to quickly chill small amounts of product rather than a large area, and resulted in a heavy frost built up on the surface of evaporator. Deforesting by using hot gas may have caused uneven heating and cooling of evaporator tubes, or thermal expansion and contraction of evaporator tubes and joints, which may have resulted in a damage inside the evaporator and resulted in an ammonia release.



Cold Storage room

Evaporator