Incident Summary #II-1021754-2020 (#18134) (FINAL)

SUPPORTING INFORMATION	Incident Date		June 5, 2020
	Location		Abbotsford
	Regulated industry sector		Boilers, PV & refrigeration - Refrigeration system
	Impact – Injury	Qty injuries	0
		Injury description	No injury reported
		Injury rating	None
	Impact – Damage	Damage description	A piping connection failed and released ammonia that was intended to be contained within the refrigeration system.
		Damage rating	Moderate
	Incident rating		Moderate
	Incident overview		The ammonia piping connection within a refrigeration system of an industrial food processing facility failed and released ammonia in a cold storage room.
INVESTIGATION CONCLUSIONS	Site, system and components		Ammonia refrigeration systems are typically designed for maximum allowable working pressure of 250 psig on the high pressure side and 150 psig on the low pressure side. The refrigeration cycle contains four major components; compressor, condenser, evaporator and expansion devices. The refrigerant remains piped between these four components and is contained in the refrigerant loop. In cold storage facilities, food products are kept well below freezing for maintaining their texture and keeping them safe. The evaporators are installed in the cold storage rooms to cool the air going to the space by evaporating the refrigerant flowing through it. As the evaporator operates with a temperature below freezing, ice may form on its coil. This ice comes from the moisture present on the air inside the cold room that freezes when in contact with the evaporator coil. For de-icing and to avoid the excessive frost from obstructing the air flow through the evaporator coil, the system stops periodically to apply defrost procedures. The defrost line is connected to the evaporator through a special distributor. With this system, the hot gas flows directly through the evaporator coil, bypassing the expansion valve. To do this, the system controller activates the solenoid valves to divert the fluid flow through the defrost line. The solenoid valve on the refrigerant inlet side is closed, blocking the liquid refrigerant line. The solenoid valve on the defrost line (hot gas line – Fig.1) is opened, the heated vapors (high pressure and high temperature) are released from the compressors discharge and directed to the evaporator coil where heat is released to melt ice that has gathered on it, and then the low pressure and low temperature vapors returns to the compressors through the defrost condensate line. A defrost regulator valve on the suction line reduces the vapor pressure to the suction level before it reaches the compressor. Strainers are also important components of piping systems to protect equipment from potential damage due to dirt and other particles that may be carried by the process fluid. Products like valves and gaskets do wear and can deteriorate over time. Environmental conditions can significantly accelerate this process. Therefore, the valves and gaskets need to be serviced or replaced on routine intervals. The ammonia-based refrigeration systems present a risk of accidental exposure to people from high concentrations of ammonia if the system, any components or any connections fail, and the ammonia is allowed to escape from the enclosed system.

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Failure scenario(s)	• In the cold storage room, ammonia from the flanged valve (strainer – Fig.3) of the hot gas defrost line was released which triggered the audio ammonia alarm. • The ammonia monitor located outside the cold storage room showed 400 ppm and then dropped to 0 ppm when the hot gas system was shut off. • Doors were opened and Industrial fans were used to move ammonia fumes out of the cold storage room and out of the building.
Facts and evidence	Plant activities • The evaporator and the associated ammonia system in the cold storage room was in operation. • The alarm went off at 2:45am. • At 3:00am, the unit that was leaking the ammonia was shut down. • Then, the system was operated in suction to prevent any further release. • Maximum ammonia reading noted was 400 ppm. • The maintenance contractor was contacted. • The plant building was evacuated. • Maintenance contractor identified the leak and isolated the system • The industrial fans were turned on and exterior doors were opened to help exhaust the ammonia. Maintenance contractor's activities • Maintenance contractor isolated the refrigerant liquid line and hot gas line. • The maintenance contactor investigated the leak and performed pressure test by using nitrogen. • The leak was found on the Strainer cover plate and flange connection of defrost hot gas line (inlet side of evaporator). • Repair was performed by replacing the strainer, flange, gasket and bolts • Then, the lines were pressure tested before use. Phone Interview with Chief Engineer and Maintenance supervisor & Manager • Reported the above mentioned plant and maintenance contractor's activities • Informed that the piping was installed in 1980s, the lines were pressure tested two weeks ago but no other inspection was performed on piping (hot gas line) • Also informed that only Gasket was found deteriorated upon detailed inspection (Fig. 4 & 5) Information gathered from the manufacture's recommendations: • Recommendation for maintenance**:** The owner/user must establish appropriate service and/or replacement internals for refrigeration system parts (fittings, valves, gaskets etc.), these products do wear and can deteriorate over time. Environmental conditions can significantly accelerate this process. The valves and gaskets need to be serviced or replaced on routine intervals. *(Copied from manufacturer's recommendations)* • Recommendation for Design**:** Valves/ fittings part of refrigeration piping can and do fail without warning for many reasons. Thus, design all systems and equipment in a fail-safe mode, so that failure of these products and related accessories will not endanger persons or property. *(Copied from manufacturer's recommendations)*
Causes and contributing factors	It is very likely that the gasket associated with the strainer valve failed as it deteriorated over time. The gasket was never replaced since it was installed in the 1980s despite the manufacturer's recommendation for service and/or replacement at appropriate intervals.

Fig. 1: Evaporator (Image provided by repairing contractor)

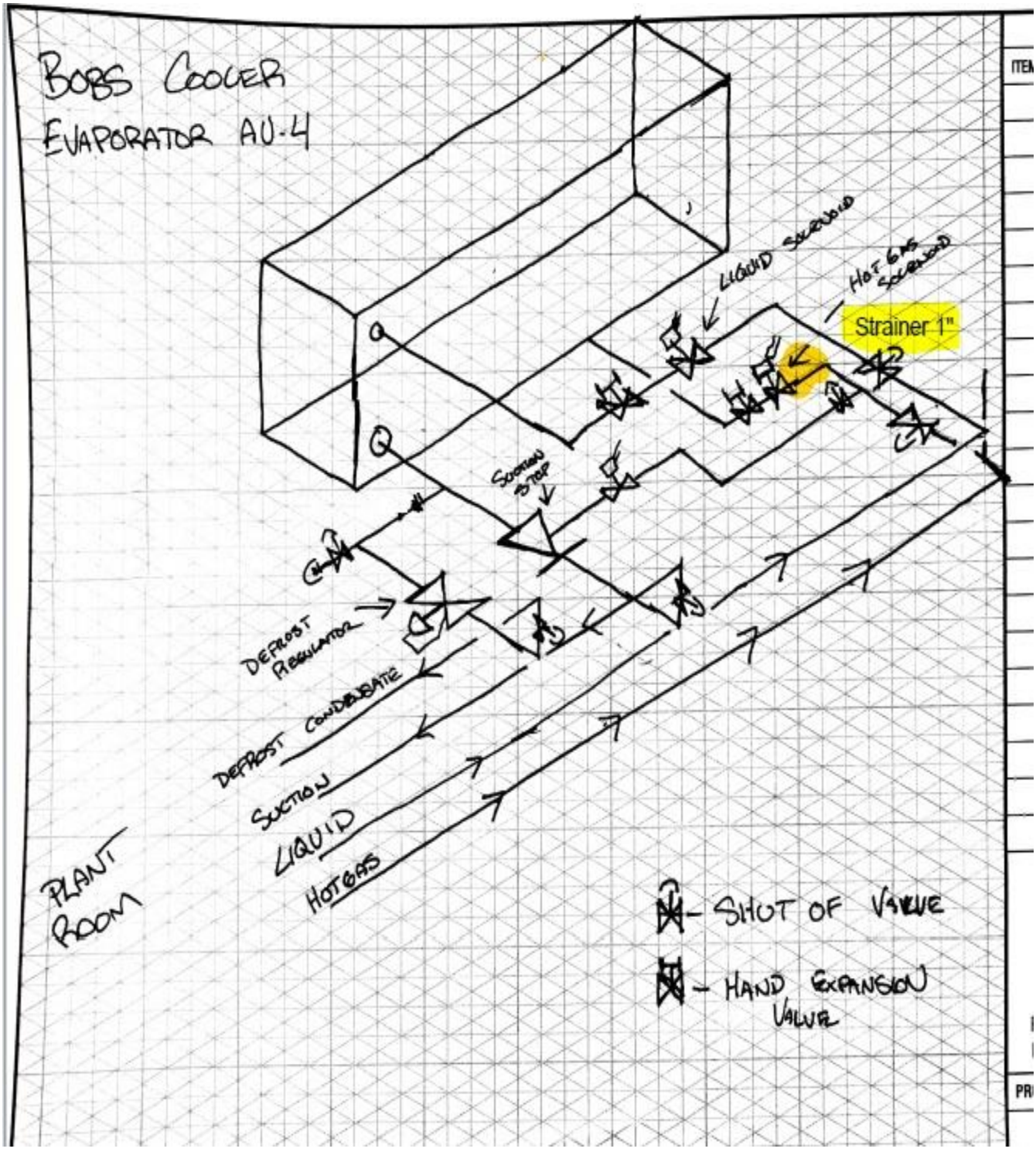

Fig. 2: Location of Leak (Image provided by repairing contractor)

Fig. 3: Strainer cover plate and flange (picture taken during leak investigation)

Fig. 4: Gasket

Fig. 5: Strainer parts