Incident Summary #II-1525688-2023 (#33731) (FINAL)

SUPPORTING INFORMATION	Incident Date		March 23, 2023
	Location		Richmond
	Regulated industry sector		Boilers, PV & refrigeration - Refrigeration system
	Impact – Injury	Qty injuries	0
		Injury description	None
		Injury rating	None
	Impact – Damage	Damage description	An internal failure of a heat exchanger had ammonia gas leak through and absorb into the circulating liquid brine for the underfloor loop. The ammonia within the liquid brine spilled out of the expansion tank where it pooled within an open sump in the mechanical room. The heat exchanger needed to be replaced as it was not repairable.
		Damage rating	Minor
	Incident rating		Minor
	Incident overview		The failure of the exchanger (Image 1) was internal between the ammonia hot gas side and the calcium chloride liquid brine side. This caused ammonia gas to escape and be absorbed by the brine side and escape out of an open to atmosphere expansion tank. (Image 2). The heat exchanger was isolated and stopped the flow of ammonia gas over to the brine side and as a result there was no underfloor brine heating available to the ice rinks affected as the pump was locked out and isolated.
INVESTIGATION CONCLUSIONS	Site, system and components		The heat exchanger is a regulated piece of equipment but too small for an annual operating permit or inspection. The ammonia gas to liquid brine heat exchanger allows the circulated brine to be pumped out under the ice rink to stop any frost heaves as it heats the ground enough to stop the ground from freezing but not enough to melt the ice. It is the responsibility of the owner to maintain system brine levels and brine chemical residual levels with testing and chemical additions as needed to keep system level and the correct chemical residual levels.
	Failure scenario(s)		The heat exchanger failure was caused by an internal tube failure from corrosion caused by a failure to maintain brine chemical and system levels that allowed oxygen to attack metal internal surfaces. Internal corrosion caused by the lack of brine system maintenance is the most likely cause of the failure.
	Facts and evidence		The heat exchanger was the only mechanical connection where ammonia gas could escape over to the liquid brine side and upon heat exchanger isolation the escape of ammonia gas immediately stopped. A failure report issued by the refrigeration contractor indicated that low levels had been found on several occasions that allowed oxygen to oxidize internal surfaces including low Ph levels that created an even more corrosive environment that accelerated corrosion.

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Causes and contributing factors	The heat exchanger failure due to internal corrosion that was most likely caused by a failure to maintain brine chemical residual levels and system levels allowing oxygen to enter the system and attack the internal metal surfaces. Brine system levels did not physically cover all internal surfaces and Ph levels were allowed to drop below 7 that caused an acidic brine to attack all internal metal surfaces.

Image 1 - Failed heat exchanger Isolated and awaiting replacement.

Image 2 - Open expansion tank for the brine where ammonia gas escaped into the mechanical room and liquid brine spilt down below to an open sump.

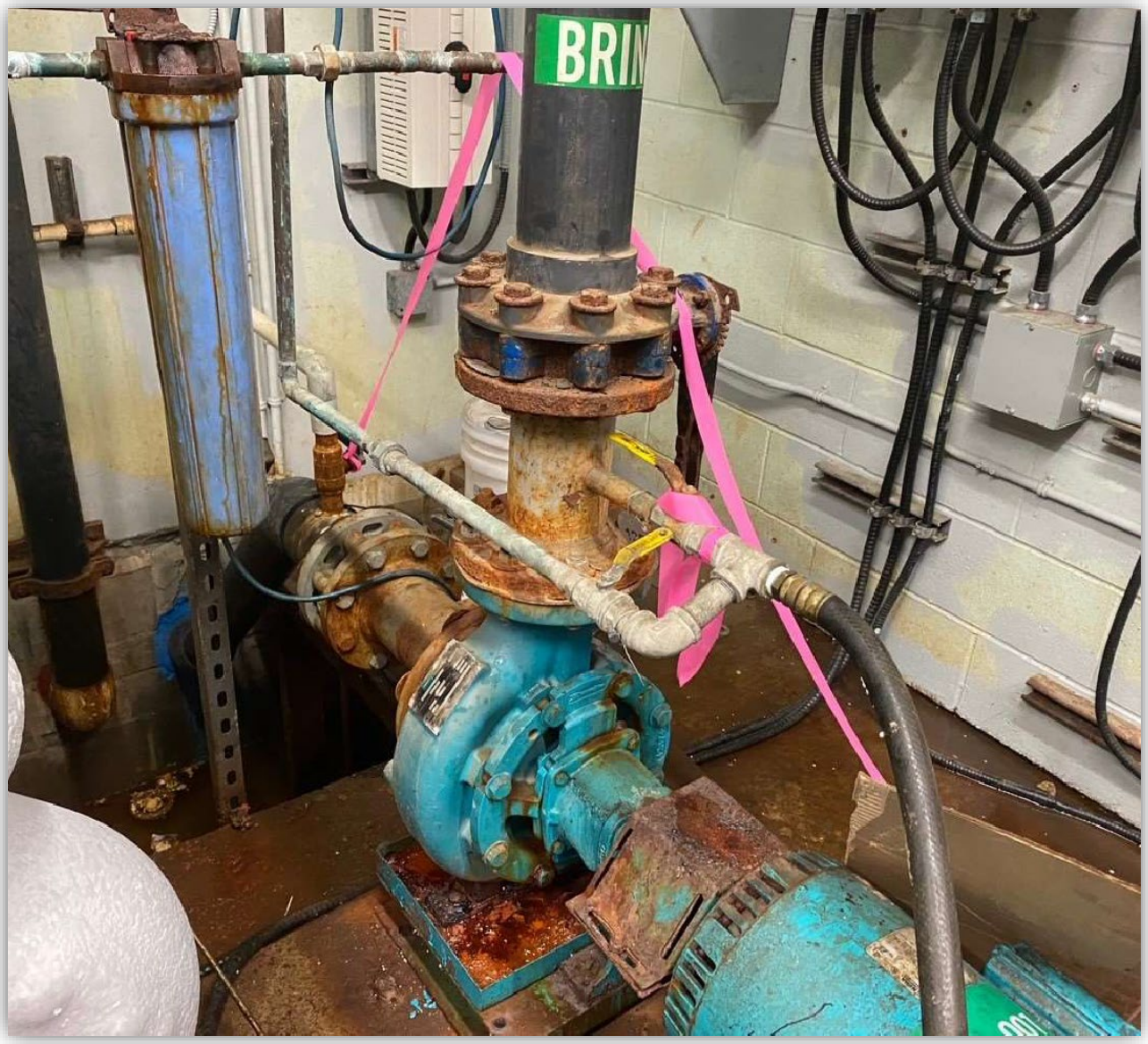

Image 3 - Isolated and locked out brine circulating pump.