

Incident Summary #II-967938-2020 (#16365) (FINAL)

SUPPORTING INFORMATION	Incident Date	January 12, 2020	
	Location	Mackenzie	
	Regulated industry sector	Boilers, PV & refrigeration - Refrigeration system	
	Impact	Qty injuries	0
		Injury description	None
		Injury rating	None
	Damage	Damage description	Ammonia compressor seal failure
		Damage rating	Minor
Incident rating	Insignificant		
Incident overview	An intermittent compressor shaft seal leak resulted in multiple ammonia releases . which activated low level (<50 ppm) ammonia detector alarms. The premises were not evacuated as the release was contained in a well ventilated mechanical room and the detector did not initiate a high level evacuation alarm.		
INVESTIGATION CONCLUSIONS	Site, system and components	<p>Ice arenas use an ammonia compression refrigeration system for ice making. The refrigeration plant is in a public assembly site-ice rink with a plant capacity less than 50 kW's. It is not subject to continuous supervision but is monitored by qualified personnel and an alarm monitoring system.</p> <p>The plant is an indirect closed loop vapour compression refrigeration system. The ammonia compression system uses two single stage reciprocating compressors to compress ammonia vapour and condensed it into high pressure liquid. High pressure liquid is then fed to the plate and frame evaporator which cools a brine solution. The chilled brine solution is circulated through coils under the rink floor which then freezes the ice surface in arena.</p> <p>An electric motor drives the compressor via a connected shaft and seal. The shaft seal of the compressor consists of stationary and rotating parts which prevents ammonia from leaking out around the shaft where it extends out of compressor. The seal utilizes a seal face, O-rings and oil between the O-rings to create a seal and contain the ammonia vapour. Oil also provides lubrication and cooling of the seal which minimizes frictional wear of shaft seal.</p>	
	Failure scenario(s)	The compressor had been subject to idle use for extended periods during its service at a previous location. The seal was nearing the end of its recommended service life. Seal wear resulted in ineffective sealing allowing ammonia from the compressor crankcase to leak into the room.	
	Facts and evidence	On 6 occasions, over 4 days, low level ammonia alarms less than 50 ppm were responded to by facility staff. The intermittent ammonia releases were contained within the compressor room area but on one occasion an ammonia odour was reported in the public assembly area. On each occasion the alarm was silenced after the ammonia concentration was dissipated by the mechanical room exhaust system. Facility refrigeration operator(s) looked for the source of the leak each time and eventually identified a small leak on a valve after the 5 th alarm occurrence which happened 3 days after the first alarm. A Refrigeration contractor was contacted and arrived the following day. The refrigeration contractor located the primary ammonia	

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	<p>leak at the compressor shaft seal, the compressor was isolated and ammonia removed from the compressor pending repair. The seal leak was very minor as it only occurred for a short time when the compressor started up and that there was no evidence of oil bypassing the seal was evident. Typical seal leaks result in an accumulation of oil around the seal location. A visual inspection of the seal components during the subsequent repair failed to identify any obvious defect. Shaft seals are subject to wear through normal operation and are inspected and maintained every 8,000-12,000 hours of operation, according to manufacturer's recommendations. This compressor was serviced and inspected within the manufacturers recommended time period but was nearing the manufacturers recommended service interval.</p> <p>The compressor was previously used at another site and installed recently at this site. A review of the history of previous compressor use found that it was in-service for only 2-3 months a year and subject to extended idle time. Extended idle time can be detrimental to seal operation and its life expectancy. The compressor was serviced and inspected within the manufacturers recommended time period.</p>
<p>Causes and contributing factors</p>	<p>It is likely that that seal wear from normal operational and previous extended idle time contributed to the seal's failure prior to the maximum service interval period recommended by the manufacturer.</p>

