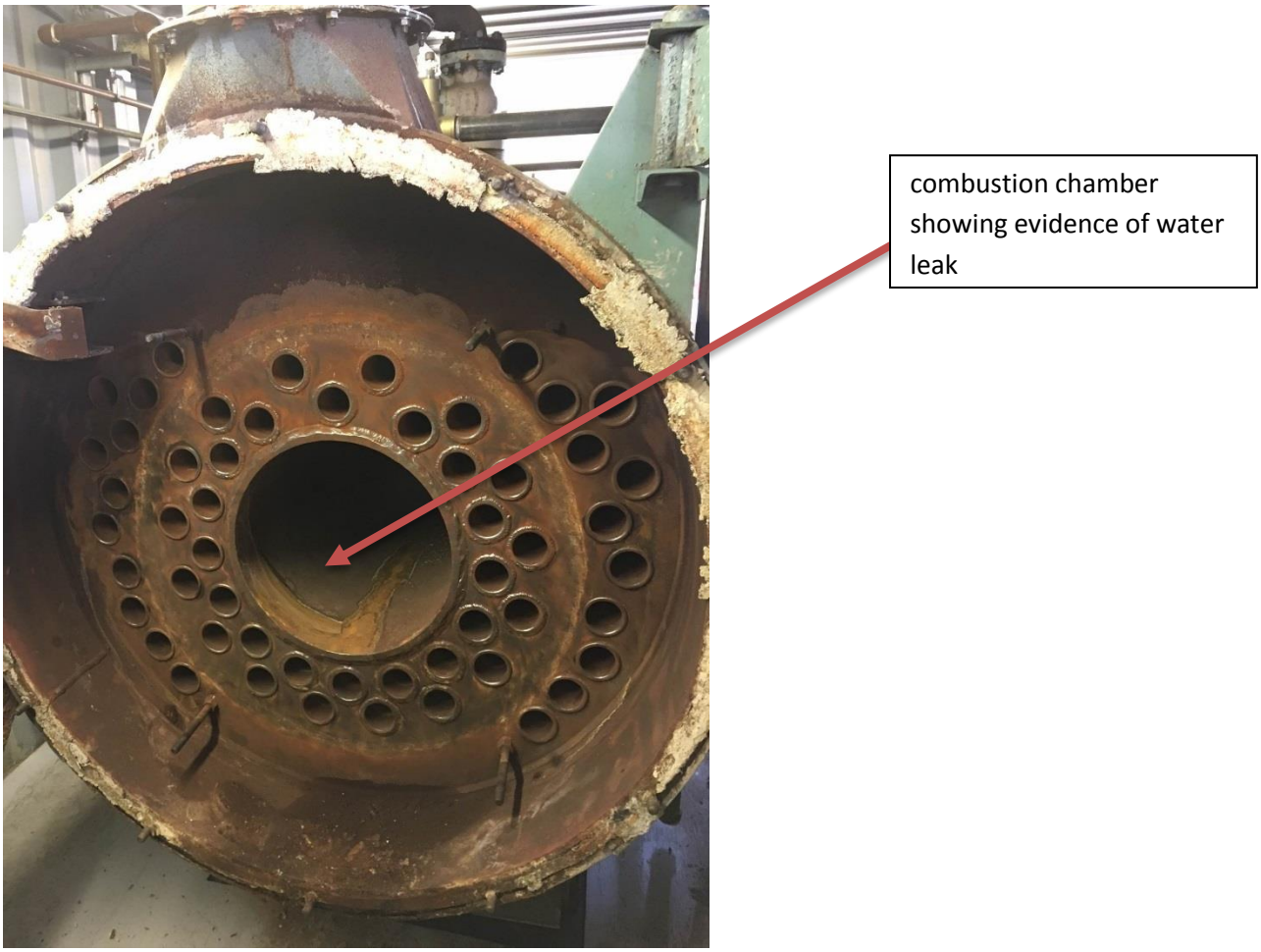
Incident Summary (Ref # 5618717)

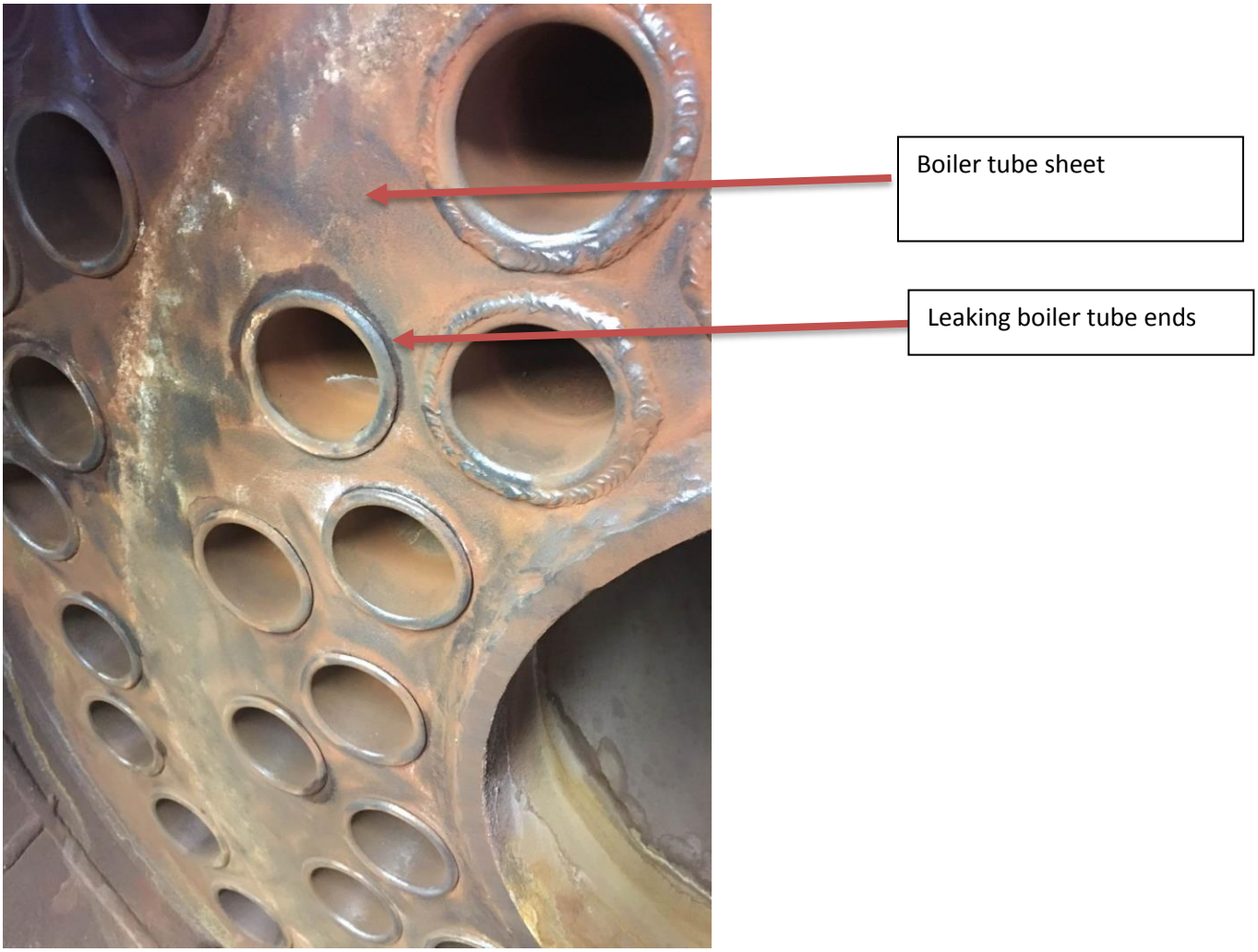
SUPPORTING INFORMATION	Incident Date			July 11, 2017
	Location			Abbotsford
	Regulated industry sector			Boiler, PV & refrigeration
	Impact	Injury	Qty injuries	0
			Injury description	Not Applicable
			Injury rating	None
		Damage	Damage description	Leaking boiler tubes and thermal shock to pressure retaining components.
			Damage rating	Minor
	Incident rating			Minor
	Incident overview			A few boiler tubes overheated causing water to leak into combustion chamber.
INVESTIGATION CONCLUSIONS	Site, system and components			In a steam boiler water is turned continuously into steam. This evaporation causes the water level within the boiler to drop. Some of the steam is condensed back to water (also known as condensate), to keep a minimum water level in the boiler, make-up water is fed back into the boiler by a pump. Make up water consists of condensate and fresh water supply. To operate steam boilers safely, an experienced/qualified operator makes sure that the boiler never runs in a low water condition.. A feed water tank and pump supplies water to the boiler, and keeps the required water level in the boiler. A bank of metallic tubes run inside the shell of the boiler, and these tubes are supported at both ends by round metallic sheets called “tube sheets”. The ends of the tubes are expanded and then rolled to ensure a tight fit and prevent water leakage. A low water cut off device is an important safety control which shuts down the fuel supply when the water level in the boiler drops below its lowest permissible operating level. In cases when the low water cut off device shuts the boiler down, the device must be manually reset to start the boiler again. If the boiler runs at a lower than required water level, the metallic tubes are exposed to intense heat and these will eventually start to extend in length, leaking water into the boiler. This can cause explosion as the water is converted to steam in the combustion chamber and expands 1700 times its volume. Water inside an operating steam boiler is at very high temperature and warm feed water must be continuously added to avoid thermal shock to pressure retaining boiler components. If Cold make up water is supplied to a boiler this will exacerbate the thermal shock on the metallic tubes.
	Failure scenario(s)			An insufficient supply of water to the steam boiler triggered the low water cut off device, and the boiler was shut down. Each time, the low water cut off device was manually reset by an unqualified & inexperienced operator causing the boiler to run in a low water condition. Short term overheating and thermal shock resulted in elongation of the metallic tubes. The mechanical tube seal was compromised and water leaked inside of the boiler. Cold water was fed directly into the boiler causing thermal shock to the metallic tubes and pressure vessel.

	Facts and evidence			• Witness statements confirmed that;
				  ○ The boiler was run in low water condition,
				  ○ Cold water was fed to the boiler
				  ○ An inexperienced and unqualified operator was operating the boiler
				  ○ The float valve in the feed water tank was not operating properly, causing the boiler to go into a low water condition at times
				• Visual inspection revealed evidence of water leakage at tube ends and inside combustion chamber.

	Causes and contributing factors			It is very likely that a combination of an insufficient feed water supply, thermal shock caused by cold water, and an unqualified/inexperienced operator caused this incident.



Boiler rear-end



Closer view of leaking boiler tubes

Boiler feed-water tank and pump

Low water cut off device