

Incident Summary #II-1017254-2020 (#17872) (FINAL)

SUPPORTING INFORMATION	Incident Date	May 25, 2020	
	Location	Vancouver	
	Regulated industry sector	Boilers, PV and Refrigeration	
	Impact	Qty injuries	0
		Injury description	None
		Injury rating	None
	Damage	Damage description	During the annual safety valve pop testing, the flange connecting the south end steam drum safety valve outlet to the drip pan failed and the drip pan arrangement was blown off by the force of the discharging steam.
		Damage rating	Minor
Incident rating	Minor		
Incident overview	During a pop test of a steam boiler safety valve a cracked cast iron flange resulted in a failure of the downstream piping and drip pan allowing steam to escape into the boiler room.		
INVESTIGATION CONCLUSIONS	Site, system and components	Steam boilers are protected from over pressure by safety valves that are set to open at a pressure no greater than the maximum allowable steam pressure as calculated by the boiler design. When the safety valve opens, the steam is directed to the outside of the boiler room by a drip pan assembly and a vent pipe, (this is a typical industry practice). The drip pan assembly has to be designed to restrain the forces imposed by the volume of steam exiting the safety valve when it makes a directional change from a horizontal to a vertical direction.	
	Failure scenario(s)	Operations crews were conducting the annual safety valve pop testing before the boiler was shutdown for the annual maintenance period. This boiler has 3 safety valves and valves 1 and 2 tested as expected. During the testing of the last valve, the boiler pressure was raised above the normal opening pressure to 285 psig. At this pressure the safety valve opened. The testing procedure required that the valve be popped three or four times. During the second to last test there was a noticeable change in the sound level within the plant as the steam was discharging into the boiler room. Upon investigation, insulation was noticed floating in the air as well as larger particles on the boiler room floor. The drip pan was no longer attached to the safety valve and had fallen between the steam drum and the boiler flue gas uptake ducting. Further testing was aborted and the boiler shutdown.	
	Facts and evidence	This was an in-service failure, discovered by the operating crew after testing of the safety valve was stopped. The drip pan was found to be no longer connected to the safety valve and was laying between the steam drum and the flue-gas uptake ducting. The safety valve flange showed significant damage (see photos). The drip pan arrangement no longer connected to this safety valve (see photos). The flange that connects the drip pan assembly to the safety valve was found to have multiple radial cracks that extended from the threads to the outer flange rim (see photos)	

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Causes and contributing factors

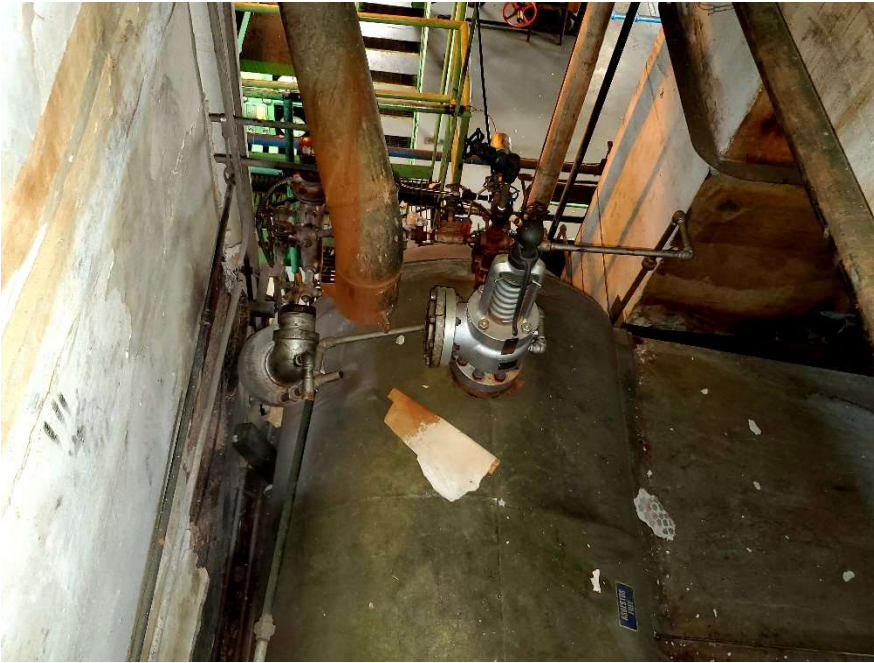
It is very likely, these flange cracks allowed the short pipe nipple to be forced out of the safety valve by the discharging steam forces.

The flange material was determined to be of cast iron material. Although acceptable for the pressure and temperature expected in the discharge piping, consideration for the cycling shock stresses generated may not have been considered at the time of installation.

PHOTOS



Drip Pan between steam drum and flue-gas uptake ducting



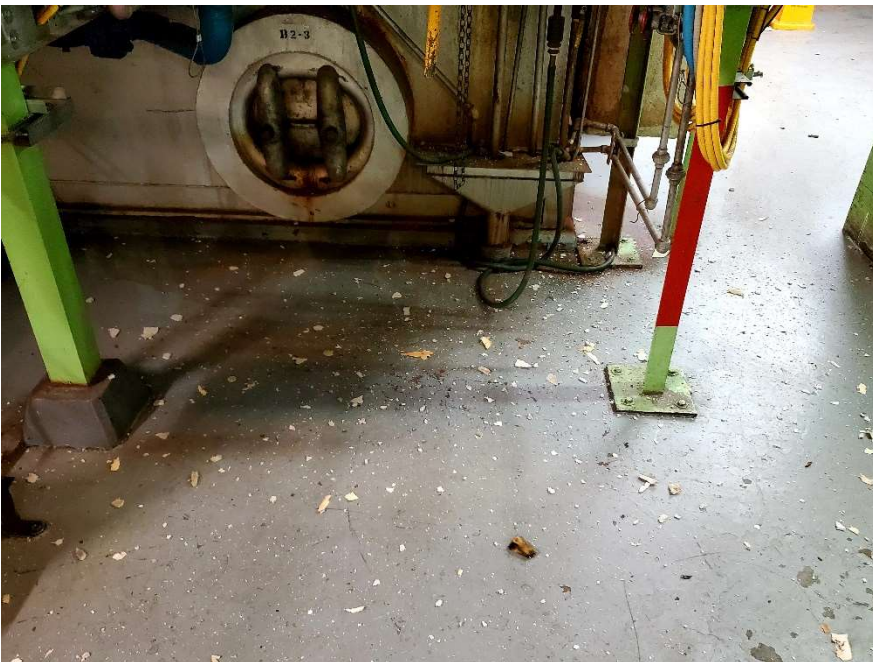
Safety Valve drip pan location from above.



Safety Valve outlet flange showing radial cracking



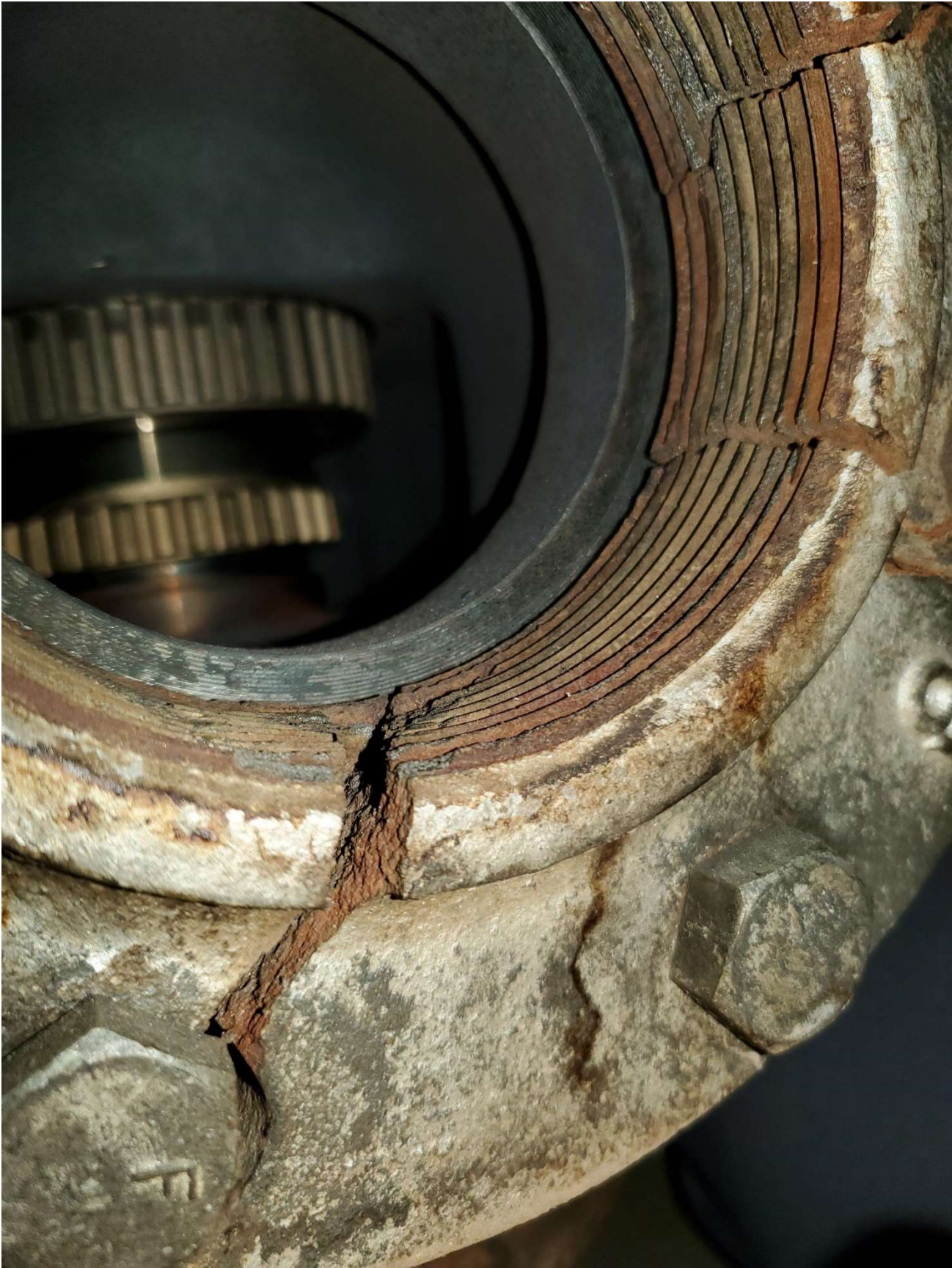
Safety Valve outlet flange showing internal through cracking



Disturbed asbestos from the steam hitting the ductwork insulation.















Outlet safety valve flange, still in place, note radial cracking.



Safety Valve outlet internal cracks



Safety Valve outlet flange cracking