Reduction of Maintenance Costs and Improved MTBR of Boiler Steam Drum and Superheat Safety Valves

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The goal of this project was to reduce the cost of maintenance and repair of the safety valves on all six boilers at ArcelorMittal Burns Harbor. Historically, the practice has been to disassemble and replace the parts for every valve annually. Studies show that the majority of valves that are disassembled do not require a total disassembly and repair. The U.S. Occupational Safety and Health Administration states that each company will establish a good engineering practice on the frequency and type of repair based on the historical data collected. By changing the frequency and type of testing, the time between repair has been increased from one year to two years.

The boilers at ArcelorMittal Burns Harbor's power station have high-pressure drum and superheat valves that are welded in-line. This eliminates any flange issues that could arise and leaves the valves suitable for field repairs. The valves are all 1700 series Maxi-flow safety valves. They range in setpoint from 1,025 to 1,050 psi on the drums and 950 psi on the superheats, and meet the American Society of Mechanical Engineers (ASME) code requirements for setpoint and capacity for the plant boilers. Lake Michigan water is processed by a reverse osmosis system to remove impurities prior to reaching the boilers.

Since the requirements on manpower, training and certifications do not make it cost-effective to repair the valves in-house, the plant has maintained a process of using a vendor to repair the safety valves. Historically, a complete disassembly, replacement of the disc, resurfacing the nozzle and resetting of the valves was included in the annual rebuild of each valve. The in-line setting of the valves was done with a hydraulic lift assist device as the boiler was being returned to service.

Discussion

Past Practice — Prior standard practice was to repair valves during annual outages. Vendors would disassemble, repair and reset the valves on each boiler. This work was usually completed in two to three days with an additional day for testing the valves after the boilers were being brought to operating pressure. This was considered the best practice based on the time allowed for boiler outages and the many critical jobs being performed concurrently. The need for certified repair facilities to conduct the repairs allowed for the vendors to develop the practice of automatically replacing the discs in the valves at each downturn.

Costs — The cost of a certified vendor, scaffolding services, replacement discs and time to test valves at start-up are incurred at each boiler outage.

Justification for Improvement — Per the ASME code, the maintenance of pressure-relieving devices falls on the owners of the valves. The owners are required to follow guidelines set by the National Board of Boilers and Pressure Vessel Inspectors and those in the National Board Inspection Code (NBIC) book.

Based on this information, it is not required to disassemble the valves and perform repairs on each valve every year. Per the U.S. Occupational Safety and Health Administration (OSHA) standard,

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Figure 1

Asst Number	Location	Manufacturer	Model Number	Size	Set Pressure	Capacity	Serial Number	Notes	Last Repair/Test	Testing Frequency	ASME Code	Next Repair	Vendor
M6015261202	#7 North Drum	Consolidated	1747WA-2-S	3	1025		BS02364	disc/VR	7/3/2018	2	v	7/2/2020	Emerson
M6015261204	#7 South Drum	Consolidated	1747WA-2-S	3	1050		BS02365	disc/VR	7/3/2018	2	v	7/2/2020	Emerson
M6015261206	#7 Superheat	Consolidated	1747WD-2-S	3	950		BS02366	disc/VR	7/3/2018	2	v	7/2/2020	Emerson
M6015281202	#8 North Drum	Consolidated	1747WA-1-S	3	1050	.	BM9328	Tested	5/31/2017	2	v	5/31/2019	MVS
M6015281204	#8 South Drum	Consolidated	1747WA-1-S	3	1025		BM9327	Tested	5/31/2017	2	v	5/31/2019	MVS
M6015281206	#8 Superheat	Consolidated	1747WD-1-S	3	950		BM9329	Tested	5/31/2017	2		5/31/2019	MVS
M6015301202	#9 North Drum	Consolidated	1747WA-1-S	3	1025		BM9330	disc/VR	5/4/2018	2	v	5/3/2020	Pentair
M6015301204	#9 South Drum	Consolidated	1747WA-1-S	3	1050		BM9331	disc/VR	5/4/2018	2	v	5/3/2020	Pentair
M6015301206	#9 Superheat	Consolidated	1747WD-1-S	3	950		BM9332	disc/VR	5/4/2018	2	v	5/3/2020	Pentair
M6015321202	#10 North Drum	Consolidated	1747WA-1-S	3	1050	191750	BL8610	test only	1/18/2018	2		1/18/2020	
M6015321204	#10 South Drum	Consolidated	1747WA-1-S	3	1025	192150	BL8609	test only	1/18/2018	2		1/18/2020	

Example of the drum and superheat valve list.

the frequency of complete repairs should be based on "good engineering practices." The historical data was reviewed, including purchase orders written for repairs on the drum and superheat valves with power station personnel. It was determined that the practice of completely repairing valves every two years instead of every year would be acceptable. The practice of examining the seats for any defects and measuring the "critical dimensions" (height of seats on the thermal discs) and reusing them if they were within the standards for the size of the valve was also initiated.

Testing the setpoint in the non-repair year is done to ensure the functionality of the valve is maintained. This is based on several conditions, including: (a) no visible signs of leakage, (b) proper reseating without leakage if it had lifted and (c) meeting the setpoint criteria when tested in-line under normal operating conditions in the previous 12 months.

Actions Taken — The process followed was to build a database of all superheat and drum safety valves. The valves were identified by their unique serial numbers and each valve has a file that also includes the setpoint, capacity, asset number, model number, last repair/reset date, frequency of testing, applicable ASME code and vendor who performed the work (Fig. 1). Each valve has its own tab where the valve repair documents can be attached and is readily available. This is posted on a company SharePoint site enabling the information to be accessible to all power station personnel and is updated after every boiler outage.

The process enables the power station staff to determine, as each boiler outage was planned, whether they needed to repair or simply test the valves. It has also been established that the valves could be tested in-line prior to bringing the boilers down in a non-repair year to determine if they meet the setpoint criteria. If they meet the criteria, no additional work is required until the following year. Pre-outage testing eliminates having to test the valves at the end of an outage.

A lunch-and-learn on pressure relief valves was developed to educate power station staff on safety/relief nomenclature and what was included in the new process. It was also stated that vendors would be required to have a "VR" stamp certifying that they adhered to the ASME code requirements for the correct repairs to pressure-relief devices. A procedure stating the policy on how these valves would be maintained was developed and is updated as necessary, including the information on vendors and frequency of testing. Safety valve repairs are incorporated in the process developed at the power station for planning outages. The process for safety valves began in Q4 2017 and was utilized in 2018, with a cost savings of 61%.

Another benefit of utilizing this new program has been retaining used, but acceptable, discs that previously would have been discarded. At the time of this writing, four of these discs had been used. Since vendors are not required to automatically replace the discs, there has been no need to purchase discs.

Conclusions

The Burns Harbor power station staff was able to make informed, economical decisions on the maintenance path to use on the drum and superheat safety relief valves: extending the mean time between repairs to two years for each boiler safety valve, leading to reduced labor and material costs.

References

1. PD665 – ASME BPV Code, Section I: Power Boilers.
2. National Board Instruction Codes (NBIC).
3. T. Shelton, Power Station Cost Savings. ✦

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