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Explanation of recovery boiler leak indications

Scope

The purpose of this technical information paper is to itemize and illuminate boiler operating parameters that may provide information about a pressure part leak in the recovery boiler. Each item is accompanied by an explanation of how and why the parameter is indicative of a leak. This TIP is not intended to be used as a decision making tool for any specific boiler, but is intended to serve as part of a training guide. The items listed in this TIP, which may be relevant to a particular boiler, should be assessed and assembled by the operators of that boiler and may be used to enhance their own decision making process.

Safety precautions

There are no safety precautions as this TIP offers information only for use by trained operators in the course of monitoring recovery boiler operations.

Significance

There is a moderate likelihood that sometime in the life of any boiler it will experience chemical or mechanical damage that will result in the release of steam and/or water into the furnace area. Instrumentation and the operators' own senses should be used to make judgments about the furnace condition and the appropriate action. Information on changes or unusual boiler conditions must be communicated to the control room and discussed with the operating crew promptly to minimize the time required to respond.

Severe leaks will likely have unmistakable signs and may even initiate boiler shutdown without operator intervention. Less severe leaks may have fewer, less dramatic indicators, or perhaps remain undetected until a hydrostatic test. By familiarizing operators with leak indicators, the operator can better understand the boiler condition and have confidence in the decision to continue operations or to shut down. An operator's perception of the location of any leak will determine whether to perform a normal shutdown or to initiate an emergency shutdown procedure.

Indicators

Some of the indicators listed may be relevant to other kinds of boilers, but the information provided here was assembled to support the operators of chemical recovery boilers in use in paper and pulp mills.

A leak in the furnace of a recovery boiler may be found by operator walkdown inspections, control room indications, or a combination of both. Indications include one or more of the following:

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1. A change in the steam/feedwater flow differential
2. High furnace pressure - steady or erratic
3. Increased speed/load of the induced draft (ID) fan
4. Noise from the furnace or convection passes
5. Falling drum pressure
6. Drum pressure may be different from header pressure
7. Steam drum water levels indicate differently at different transmitters
8. Difficulty maintaining steam drum water level
9. Falling flue gas temperature
10. Steam/water seen through boiler openings
11. Localized smelt bed blackout
12. Popping/spitting at smelt spouts
13. Color change in smelt at spouts
14. Trouble keeping spouts clear
15. Wetness on clean-out rods
16. Falling O₂% of flue gas
17. Increased sparking in electrostatic precipitator
18. Falling percentage of the solids in the black liquor
19. Loss of boiler feedwater chemical concentrations
20. Closing of automatic blowdown valve
21. Leak detection system alarm

Steam/feedwater flow differential

If the total volume of steam and controlled water leaving the boiler, including sootblowing steam if this comes from the recovery boiler, is less than the equivalent water volume entering the boiler, then it can be inferred that water or steam is escaping from the boiler in an uncontrolled way. Short term fluctuations in steam flow and feedwater flow due to header pressure swings and drum level swings may hide the steam/feedwater flow differential. A trend of the average steam flow and water flow over time will highlight smaller steam/feedwater flow differences. The technology to identify flow differentials and illuminate relatively small leaks is available commercially, but can be assembled with in-house resources.

High furnace pressure - steady or erratic

The additional mass coming from the steam or water entering the furnace through a pressure part leak can cause an increase in furnace pressure. A steam and water mix may generate surges of furnace pressure based on the different expansion characteristics of the two fluids.

Increased speed/load of ID fan

The ID fan is typically controlled by a governor that incorporates a signal from the furnace pressure. The governor attempts to maintain a balanced draft within the furnace. If additional mass is introduced into the furnace, such as water and water vapor, then the fan speed will increase to compensate. A trend of ID fan speed over time can detect small leaks in the recovery boiler if all other operating conditions are stable.

Noise from the furnace or convection passes

Uncontrolled flow from leaking pressure parts can cause a variety of noises resulting from rapid expansion of steam or water, or impact of the fluid against adjacent surfaces. These noises may make only a slight difference in the ambient sound field or they may be dramatically different from the norm. Differences need to be investigated and understood. Leak-related noise may be identified during a walkdown of the boiler when sootblowers are not operating. Caution must be used when opening casing doors during boiler operation.