Boiler room routines (part 2)
by Harry de Jong

Previous articles covered: Boiler room care; Basic record system; Daily, Weekly, Monthly, Semi-annual and Annual maintenance; Boiler Room log; Low water cut-off and Feedwater Pump(s).

SAFETY AND RELIEF VALVES

Another extremely important safety check that should be performed is the testing of all safety and relief valves. How frequently the test should be done is an extremely controversial subject. Everyone seems to agree that safety and relief valves should be checked or tested periodically, but very few agree as to how frequently they should be tested.

The ASME book on "Recommended Rules for Care and Operation of Heating Boilers," Section VI, states that the safety or relief valves on steam or hot water heating boilers should be tested every thirty days. A try lever test should be performed every thirty days that the boiler is in operation or after any period of inactivity. With the boiler under a minimum of 5 psi pressure lift the try lever on the safety valve to the wide open position and allow steam to be discharged for 5 to 10 seconds (on hot water boilers hold open for at least 5 seconds or until clear water is discharged). Release the try lever and allow the spring to snap the disk to the closed position.

An optional method that may be preferred by the owner or operator is to slowly build up the pressure in the boiler until the popping point of the valve or valves is reached. As soon as the valve(s) pop, cut back on the firing rate or shut the burner off and allow the pressure to drop back to its normal operating range. This procedure should be followed once or twice a year.

The ASME book on "Recommended Rules for Care of Power Boilers," Section VII, does not list any specific period of elapsed time between testing of safety valves. The book does state that all safety valves should always be kept in good working order . The best time for testing the safety valves or relief valves on power boilers and high temperature hot water boilers (HTW) is just prior to the shutdown for mandatory inspection. The safety valves can be tested while operating at low output and throttling the nonreturn or boiler stop valve until the lowest set safety valve relieves. Normal pressure should then be restored by slowly opening the non-return valve. The valve which relieved may then be gagged and the procedure repeated until all valves have been checked.

If the boiler is the type where a stop or non-return valve is omitted, close the prime mover throttle valve and test the valves by raising the pressure by varying the firing rate. Use the vent or drain valves on the superheaters, reheaters, or steam piping to provide the minimum flow necessary to prevent any overheating. Install temperature measuring devices at the critical points to assure that safe metal temperature limits are not exceeded. The location of the critical points should be obtained from the boiler manufacturer.

To hand lift or test the valve operation with the boiler operating at design pressure, raise me lift lever to the full open position, then release to allow the valve to snap closed as it would have, had it opened automatically. Safety valves shall not be opened with the hand lifting gear when the steam pressure is less than 75 percent of the normal opening pressure of the lowest set valve on the boiler.
When a safety valve fails to operate at the set opening pressure, do not attempt to free it by striking the

body or other parts of the valve. The valve may be opened with the lifting lever and allowed to close, after which the pressure of the boiler should be raised to the selected pressure for which the valve is set to pop. If the valve does not then pop, the boiler should be taken out of service and the safety valve cleaned or repaired, by an authorized repair station for the valve manufacturer.

Do not try to stop valve leakage by compressing of the spring or by blocking it. When a safety valve leaks at a pressure less than that at which it is set to close, try to free the valve by operating the lifting lever; if this does not stop the leaking, repair or replace the safety valve as soon as practicable.

Safety or safety relief valve discharge piping is important to ensure proper operation of the valves.

Burner and Controls

During normal operation, maintenance of the burner and controls is extremely important. If the operation is of such a nature that the boilers are firing continuously day and night around the clock, most of the maintenance and repairs that can be made under these conditions are of a minor nature.

Spare oil guns or oil tip and swirlers should be kept cleaned and ready to be changed as necessary. Keeping a spare oil gun on hand is recommended. Check all the valves in the fuel lines, feedwater and steam lines for leaks and packing gland conditions. Repair, repack and tighten where possible.

Check out burner linkage, jackshafts, drive units, cams, etc. Make sure all linkage, linkage arms and connections are tight. Lubricate or grease where required. Note any wear or sloppiness in any of this equipment. If it cannot be repaired while the boiler is in operation, then it should be noted in the logbook so proper repairs can be made when the boiler is taken out of service.

Operation of the burner should be observed. Is the burner firing properly? Check the flame shape and combustion. If the burner is not operating properly, arrangements should be made to have a factory trained representative work on the burner to correct deficiencies.

Operating controls will normally function properly for long periods of time. For this reason, some operators become lax in their daily, weekly, or monthly testing, if normal operation will continue indefinitely. Malfunctions of controls leads to uneconomical operation and damage and in most cases, conditions can be traced directly to deficiencies in testing and maintenance. Here is where use of the boiler room log becomes extremely useful. When a boiler room log is kept with complete and accurate entries of operating conditions, the entries can be very helpful in detecting malfunctions or pinpointing trouble.

Normal and proper operation of a boiler usually follows a distinct pattern. When readings and tests are made and entered in the boiler room log, these entries define the pattern. Any deviation from the pattern should be checked into and, if possible, determined what is causing the change in operating conditions. Changes in the readings can be gradual over a prolonged period or it can be a sudden change. The gradual change can be something like a slow increase in the flue gas temperature. An increase in flue gas temperature can be caused by a loss in heat transfer caused by sooting up of the boiler on the fireside surfaces, baffle leakage or scale buildup on the waterside surfaces. A sudden or rapid change in some of the readings can indicate the fuel-air ratio has changed due to linkage slipping, damper movement, fuel or air cam adjustment screws changed, or a multitude of other points that can go out of adjustment.

Feedwater Treatment

Improper water treatment is probably the largest direct cause of boiler failure. When the boiler feedwater and the boiler water do not receive proper preparation and treatment, scale and sludge deposits, corrosion and pitting of the boiler surfaces result. The boiler owner and operator must know that proper boiler

feedwater treatment is an absolute necessity. Unless the boiler receives water of proper quality, the boiler's life will be needlessly shortened. The services of a "QUALIFIED BOILER FEEDWATER CONSULTANT" should be utilized. They would have to carefully study the plant conditions, materials employed, pumps, lines, heat users, prevailing water chemistry, etc., to establish a good boiler feedwater treatment program to accomplish the following:

- Prevent scale and deposits
- Remove dissolved gases
- Protect against corrosion
- Eliminate of carryover
- Correct against embrittlement
- Save on fuel and maintenance
- Achieve highest boiler efficiency
- Minimize of boiler outages

A properly executed boiler feedwater treatment program, along with proper blowdown procedures, will normally maintain the waterside surfaces in good condition. If fireside corrosion and erosion conditions are kept to a minimum, the boiler pressure parts should enjoy a long and useful life.

Boiler Blowdown

When a boiler is generating steam, the feedwater continuously carries dissolved mineral matter into the unit. The material remains in the boiler shell or drum, causing an increase in the total solids until some limit is reached beyond which operation is unsatisfactory. Many difficulties in boiler operation occur because of excessive concentrations of sludge, silica, alkalinity, chlorides, or total dissolved solids.

To prevent an excessive accumulation of dissolved and undissolved solids which will interfere with proper boiler operation, a blowdown program should be established. The amount of blowdown or number of times the boiler is blown each day depends upon the concentration of solids in the boiler water. It is not possible to include any specific recommendation for blowing down a boiler because of the difference in the composition of the water that is used for makeup. Recommendations of the feedwater consultant should be followed regarding blowdown procedure.
Further, at installations where the condensate returns represent a high percentage of the total feedwater, it can generally be assumed that the amount of water that must be blown to waste to properly control the concentrations within the boiler may be relatively small in comparison to an installation at some other location. If no condensate return is available, then it is necessary to employ some means of establishing the frequency of blowdowns that are required to eliminate any trouble that would be caused by steam contamination, or any of the other aforementioned difficulties.

Bottom blow off valves are primarily meant to be used as drain valves; however, it is frequently necessary to use the blow off valves to get rid of mud and sludge that have settled to the bottom of the boiler shell or drum. Generally, when boilers are being operated at or near rated capacity, the circulation is great enough that the mud and sludge do not have much chance to settle out.

When necessary to blow down the boiler through the blow off valves (see figure on page 16), they should be opened slowly and carefully. The boiler should be blown down at lower firing rates. Blow off valves should be closed tightly after blowdown is completed. The boiler should be equipped with either two slow-opening valves or one quick-opening valve and one slow-opening valve piped in series. If the boiler has more than one bottom blowdown connection, a second quick-opening valve is needed. The following steps should be taken to blow down a boiler.

1. Open the quick-opening valves (ones closest to the boiler).
2. Open the slow-opening valve.
3. Blow down the boiler for time specified by your water treatment consultant by opening and closing the slow-opening valve. Pay close attention to the water level in the gauge glass. Some loads require several short blowdown cycles to maintain the proper water level in the boiler.
4. Close the slow-opening valve.
5. Close the quick-opening valve(s).
6.Open the slow-opening valve again to drain the line between the quick and slow-opening valves.
7. Close the slow-opening valve again and double check that the shutoff is tight after the valve has cooled off.
Note: Never pump the quick-opening valve to blow down the boiler. Such action could cause water hammer and damage piping and valves. It could also cause personal injury. Never leave an open blowdown valve unattended. Remember the valve(s) closest to the boiler must be opened first.

Blowdown valves on economizers are provided to serve primarily as drain valves, and this type of equipment should never be blown down in the ordinary sense while the boiler is in active steaming service, except under conditions specifically recommended by the manufacturer. Continuous blowdown or surface blowdown from a location designated by the boiler manufacturer is generally preferable to intermittent blowdown for control and solids concentrations. The boiler water may be flashed at one or more lower pressures and valuable heat recovered.
It is good operating practice just before cutting a boiler into service to give the boiler a good blowdown. This action helps to start circulation in the boiler before picking up load.

Deaerator

Deaeration (degasification) is one of the most important steps in boiler water treatment. Both the low-pressure condensate return, and the treated makeup water requires deaeration prior to passage to the boiler feed pumps. If degasification is carried out external to the boiler, a mechanical process is usually applied. Such a process depends on the decrease in solubility of dissolved gases as the water temperature is increased. The principle gases which are removed by deaeration, because of their contribution to corrosion, are oxygen and carbon dioxide.

The basic principle of deaeration is to heat the incoming water up to a temperature that causes the entrained gases to flash out of solution. The best results in releasing the gases can be obtained with steam at a pressure of not less than 5 psi (227 0 F). An atmospheric type of heater will only partially remove the gases. The column and spray types of deaerators are designed to operate under a positive pressure of 5 psi or greater. The amount of maintenance required to keep the average deaerator in operating condition is very minimal. With a column-type deaerator, there is a tendency to scale if there is the least amount of hardness in the water going to the deaerator. If this scale deposit should build up, it will impede the flow of water through the packing rings in the column, reducing the effectiveness of the deaeration process. The packed column type of deaerator may or may not be cleaned with acid solution depending on the type of packing in the column. If the column packing is stainless steel, then acid cleaning could be used. The column as well as the deaerator tank and all the piping should be thoroughly washed and backwashed.

The spray type deaerator will generally have a spray valve or spray pipe. With the spray valve, it may be necessary to check the valve seat for wear or pitting. The spring compression dimension should be checked and adjusted to manufacturer’s recommendations. If the deaerator has a spray pipe, then the pipe should be inspected to see if all of the spray holes are open. If any holes are plugged, they should be opened.

Strainers in all lines should be cleaned at regular intervals determined by conditions and usage; water gauge glasses should be kept clean and replaced if necessary. Tighten all packing glands and fittings to eliminate steam and water leaks. The overflow valve and makeup valve with their associated level control mechanisms should be checked out. Refer to appropriate manufacturer's literature for service recommendations on the components.

Pressure reducing valves feeding steam to a deaerator should be maintained in accordance with the manufacturer's recommendations.

Above article is part of the Cleaver Brooks Boiler Room Guide and was submitted by Harry de Jong of Canadian Boiler Industries Ltd. For further information Harry can be reached at 403-255-0186.

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