Keep the fires burning.
by Edward J. Estabrook Jr.

A closer look at boiler system technology reveals opportunities to maximize efficiency.

A multitude of boiler types are available on the market, each using a different type of technology. Among the types are the Scotch marine — or fire-tube — boiler, the fire-box boiler, the commercial water-tube and flexible water-tube boilers, membrane water-tube boilers, pulse combustion boiler, and cast-iron and electric boilers.

The most common boiler type and, therefore, the most frequently used commercial boiler of 100 hp or larger is the fire-tube boiler. To ensure efficient operation and longevity of this boiler requires that maintenance and engineering managers pay close attention to the various fire-tube boiler configurations, applications and required maintenance procedures.

Boiler configurations
All fire-tube boilers are cylindrical, with the flame located in the furnace and the combustion gases enclosed within tubes that run the length of the boiler. The tubes are located within a larger vessel containing the water or steam. Heat is transferred through the tubes to the water within the boiler.

Fire-tube boilers are available in two basic configurations:

- The dryback boiler design provides easy access to all internal areas of the boiler, including the tubes, burner, furnace and refractory from either end of the boiler. Easy access makes for easy maintenance and cleaning, although the refractory requires some additional maintenance. The openness of this design virtually eliminates the possibility of waterside sludge build-up. One manufacturer of dryback boilers offers a new low-emission option that provides NOx control. This technology combines the packaging of induced flue gas re-circulation with the integral front head. Flue gases are routed through the front head from the fourth pass then to the fan and burner assembly. This configuration provides for maximum NOx reduction at all firing rates without loss of burner efficiency. This feature is available in sizes ranging from 125-800 boiler horsepower (bhp).
- The wetback configuration uses a water-cooled turndown chamber to direct flue gases from the furnace to the tubes. This design requires less refractory maintenance, but internal cleaning is much more difficult and costlier. Since the turndown chamber restricts the flow of water at its edges, this boiler is more susceptible to waterside sludge build-up.

Modern fire-tube boilers use either a three-or four-pass design. The number of passes refers to the path of the combustion gas through the boiler from burner to flue outlet. A four-pass boiler typically is more efficient than a three-pass boiler. When using heavy oil with high sulfur content, operators must take care not to reduce the gas temperatures too much or resulting condensation can cause the stack to rot.

Fire-tube boilers can be used for either low or high-pressure steam and hot-water applications. All fire-tube boilers are rated in terms ofbhp, which should not be confused with other types of horsepower measurement.

Boiler maintenance

As boiler technology becomes increasingly sophisticated, the need for more complex monitoring devices also increases. Monitoring devices alone will not do the, job, however. They also require experienced application operators and regular maintenance.

Monitoring devices, as well as the boiler systems, must be maintained and overhauled at specific intervals to ensure proper function, reliability and safety of the system. With the increasing complexity of modern boiler systems, the need to use trained operators is more critical as a way of ensuring the boiler's longevity, reliability and safety.

Maintenance and engineering managers should set up specific guidelines for the maintenance of their specific boiler plant. The operation and maintenance manuals that are supplied with the boiler should be read carefully so operators are familiar with all the boiler functions and controls.

Managers also should make sure written instructions are posted in clear view so that they can be quickly accessed in case of an emergency. Also, boiler operators should be periodically retrained in boiler operation procedures. Most manufacturers offer such training programs.

Cleaning issues

Since today's boilers have a high heat absorption rate, internal surfaces must be kept clean of scale and sludge.

Water treatment is very important to the life of a boiler. Because it is a specialized field, water treatment should only be undertaken by trained personnel. Proper boiler water treatment:

- keeps internal surfaces clean
- minimizes the amount of blow down
- prevents corrosion.

Moreover, properly treated boilers operate more efficiently, which in turn lowers operating costs and extends the life of the boiler. It should be noted that it is very dangerous to climb inside a boiler chamber, even if it is drained, because water treatment chemicals are present.

Preventive maintenance programs are critical to the proper functioning of modern boiler plants. All plant managers should have a regular maintenance program set up in their plant.

The better maintenance and engineering managers understand the operation, capabilities and maintenance requirements of boilers, the more confident they can be that these essential pieces of equipment will continue to perform at peak efficiency for many years to come.

Boiler Maintenance Program:

Daily:

Blowdown the boiler according to the manufacturer's instructions, which will remove accumulations on the water surface.

Test and internally check the low water cut-off and feed-water regulators. They also should be cleaned regularly.

Monitor the gauge glass carefully to avoid dry firing the boiler in case of low-water control malfunctions.

Check all safety valves to ensure that they operate properly.

Inspect valves visually to ensure there is no rust buildup, impeding its operation.

Steam discharging from a safety valve is very dangerous, so technicians should be careful that no

personnel are near a valve discharging during testing.
Monitor burner ignition and flame color carefully during boiler fire-up.
Inspect water column gauges. For steam boilers, blown down the gauge to keep it clean and easily readable.

Monthly:
Inspect the inside of the boiler for evidence of corrosion, pitting or scale buildup. Technicians should clean the inside of the chamber thoroughly.
Install new gaskets on boiler doors.
Inspect all feed water valves and safety valves for evidence of leakage and blow down the valves. If there are any leaks, have the valve repacked or replaced.
Inspect supply and return headers and valves for evidence of leaks. Water and steam are most lost through defective or old gate valves, which should be completely repacked or replaced if found defective.
Check each valve to ensure that it is operating properly.
Refill the boiler to proper levels and add water treatment chemical as required. These steps should be done by an experienced water treatment specialist.

Twice a year
Have a licensed inspector or local authority conduct a complete inspection of the boiler plant.
Inspect and test all of the electrical connections and safeties, replacing those found to be defective.
Have an experienced technician disassemble and clean the low water cut-off and feed water regulator.
Inspect, clean and repair all auxiliary equipment as required.
Inspect, test and, if necessary, overhaul burners and refractories.

Most boiler manufacturers offer these maintenance procedures as part of a service agreement. Regular maintenance not provided by the manufacturer should be performed only by a qualified and experienced technician.

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