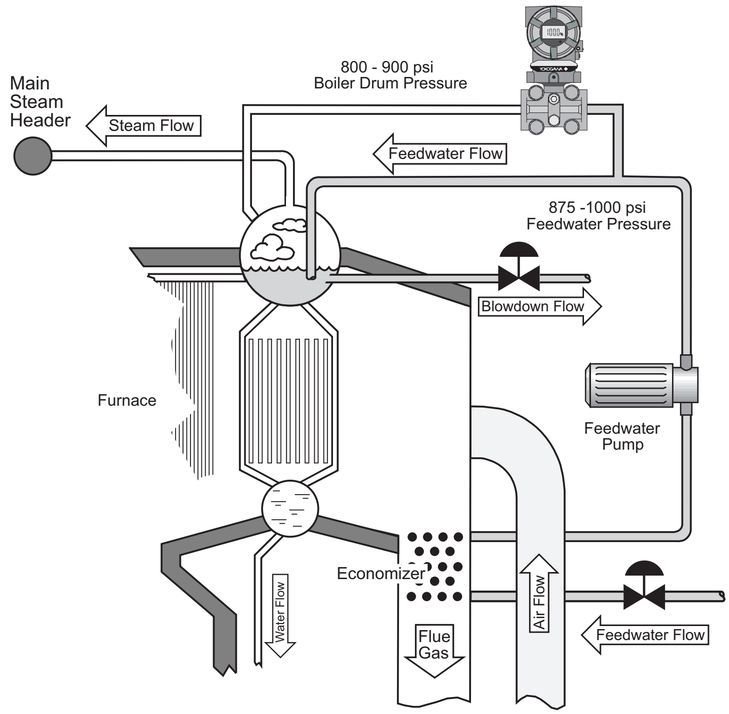
APPLICATION NOTE

Boiler / Feedwater Pump Efficiency Optimization

INTRODUCTION

The primary function of a utility boiler is to convert water into steam to be used by a steam turbine / generator in producing electricity. The boiler consists of a furnace, where air and fuel are combined and burned to produce combustion gases, and a feedwater tube system, the contents of which are heated by these gases. The tubes are connected to the steam drum, where the generated water vapor is drawn. In larger utility boilers, if superheated steam (low vapor saturation) is to be generated, the steam through the drum is passed through superheater tubes, which are also exposed to combustion gases. Boiler drum pressures can reach 2800 psi with temperatures over 680 degrees F. Small to intermediate size boilers can reach drum pressures between 800 and 900 psi at temperatures of only 520 degrees F if superheated steam is desired. Small to intermediate size boilers are only being considered for this application note.

With oil-burning and gas-burning boiler efficiencies over 90%, power plants are examining all associated processes and controls for efficiency improvements. Between 1 and 3% of the gross work produced by a boiler is used to pump feedwater. One method of improving overall efficiency is by controlling feedwater pump speed to save on pump power.



APPLICATION

Feedwater Flow Control

In electrical power plants, demineralized feedwater is pumped to the boiler tube header. The feedwater flow is regulated by either controlling the pump speed or by using a process control valve. The normal effect of pure water corrosion-erosion (or cavitation) that causes premature seat failure within the valve is amplified because velocities of 10fps + can be reached. The added cost of frequent valve replacement makes utilizing a feedwater pump the preferred method of flow control. Controlling pressure by varying the pump speed saves on overall pump power usage.

Pump Speed Control

Controlling pump speed is accomplished by variable-speed electric drives or by close-coupling a steam turbine to the pump. By definition, cogeneration power plants produce both electricity and excess steam where turbine exhaust is used as a heat source. A steam turbine driven feedwater pump is most often applied because of the abundance of available steam.

Boiler Optimization

With a boiler's firing rate held constant, feedwater pressure and flow affect boiler pressure. As electricity demands change, so do associated boiler loads. When more electricity needs to be generated, the boiler produces more steam, therefore feedwater flow must be increased to the boiler. Significant savings are realized if boiler drum pressure and feedwater discharge pressure are held to a constant differential. This can be accomplished by accurately measuring this pressure differential and controlling the pump speed and feedwater

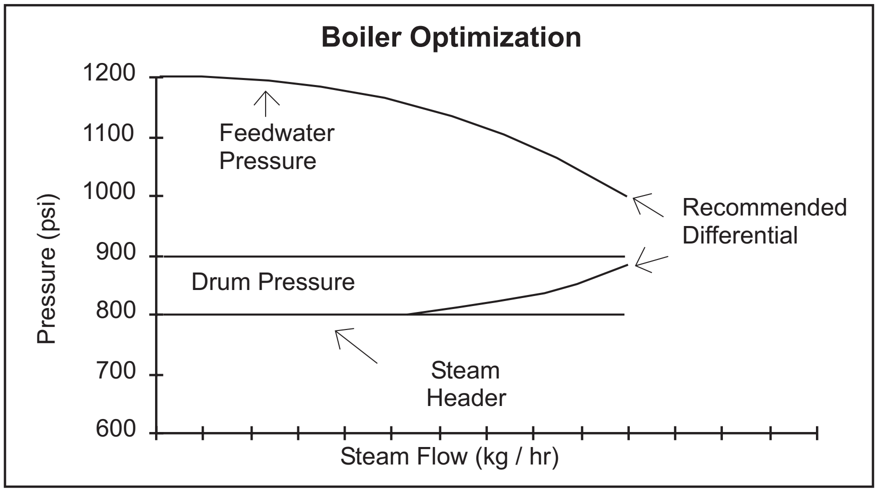


Chart 1

flowrate accordingly.

In this example, boiler drum pressures can vary between 800 and 900 psi depending upon the load, (see Chart 1). The feedwater pump discharge pressures can vary between 875 and 1000 psi depending upon boiler demand. Differential pressure between the two points can be up to 200 psi, (or even higher in system upset conditions). This differential pressure must be accurately measured, without regard to the 800 psi and above changing boiler drum static pressure.

SOLUTION

Use DPharp! DPharp's EJA110A "V" range capsule can measure differential pressures up to 2000 psid with the same ± 0.075% of span reference accuracy of lower ranges! In this common application example, ranging the EJA110A "V" range transmitter 0 to 300 psid allows for the measurement of both boiler pressure and feedwater pump discharge pressure. During pump start-up severe pressure spikes of 500 psi + can occur which can cause shifts in zero.

Many competitors claim re-zeroing their transmitter at static line pressure minimizes these zero shifts but this task may not be practical under fluctuating pressure conditions. The DPharp transmitter can be bench calibrated and installed into a high static pressure line without re-zeroing. DPharp is unaffected by these pressure surges due to its superior overpressure protection. We guarantee its performance for two years!

The power plant's control system can use the high pressure differential measurement to automatically set the feedwater rate depending on the boiler load demand. At lower demand periods, less steam is used to power the steam turbine driven pump and less feedwater is consumed. *Significant savings are realized through steam conservation and by lowered maintenance costs with the use of the DPharp transmitter.*

* (Also see Application Note SIC - 2911, Boiler Drum Measurement)

DPharp EJA110A

- ± 0.075% Accuracy
- 2000 psi maximum span
- 0.01% Adjustment Resolution
- 2000 psi Overpressure Protection
- 2-year As-left, as found calibration guarantee
- 0.2% Total Probable Error (TPE)

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