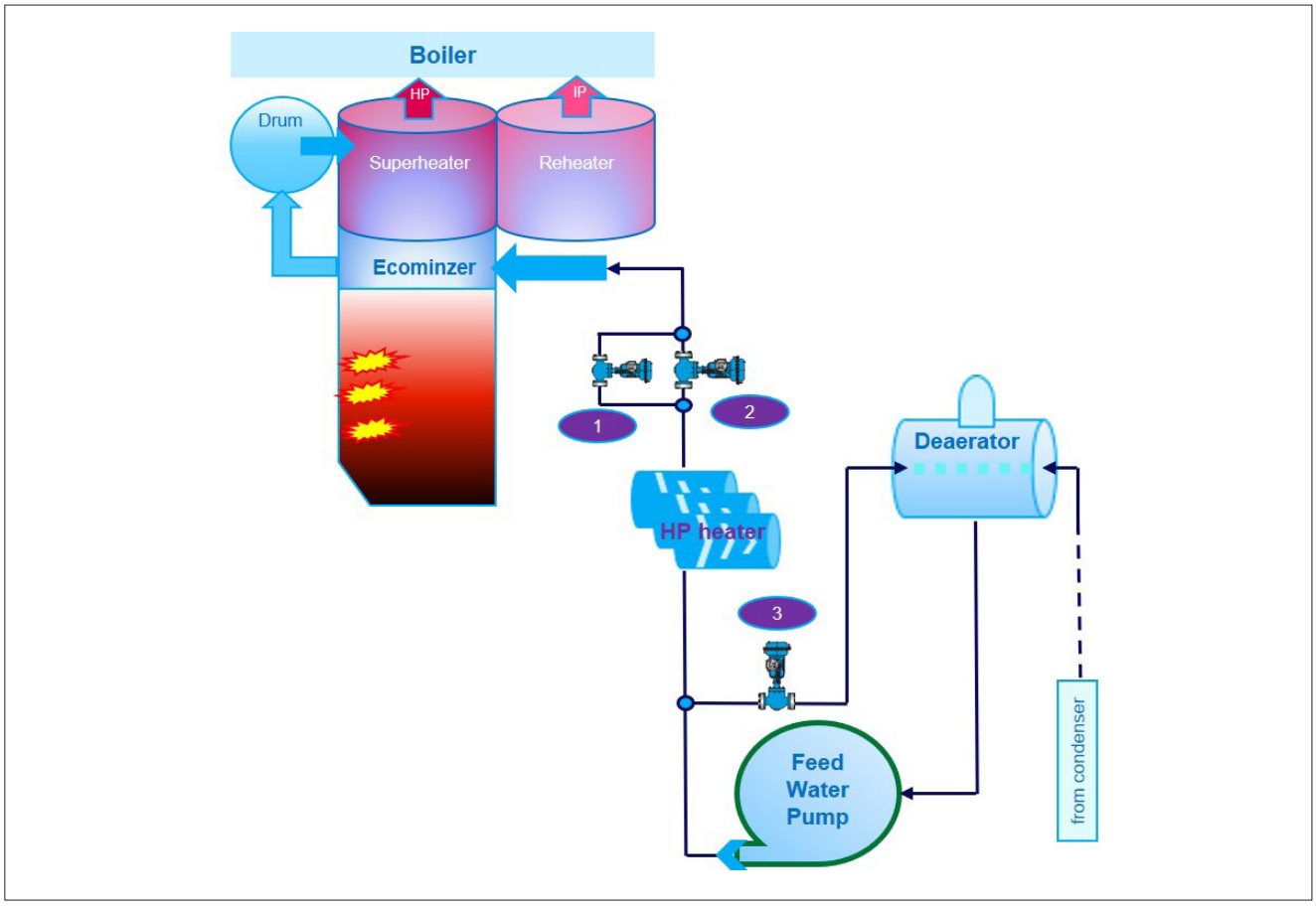
Boiler feedwater valves



Purpose:

Maintain the required boiler level for safe, reliable and efficient plant operation

Process overview:

When steam condenses, it is called condensate, which means it is, in fact, very hot water. The hot water is intended to be returned to the boiler plus balancing fresh water via a deaerator → to the boiler feedwater (BFW) pump → and the high-pressure (HP) heater to the economizer.

The feedwater pump system is part of the most challenging systems in a power plant.

It includes:

1. The feedwater startup valve
2. The feedwater control valve
3. The feedwater recirculation valve

(either with an isolating and control function or separated by two valves)

Boiler level control

The feedwater control valves regulate the boiler water, control drum pressure and spray water differential. They maintain a consistent water level, which is crucial for efficient, reliable boiler operation.

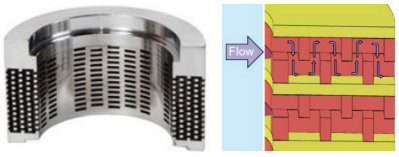
When the boiler is loading, the differential pressure over the valves is very high and the flow quite low. When the boiler has been loaded to approximately 30%, the steam-condense cycle switches to power mode. The differential pressure over the valves decreases, and the water flow reaches its required maximum.

Controlling the full range, from loading the boiler and steam lines to full power mode, cannot be done accurately with only one single control valve, since control requires a rangeability of above 200:1. There may be exceptions with special boiler designs, but in most cases, the loading and operation are done with two valves in a split range – one high-capacity valve (2) and a small startup valve (1) of approximately half the size.

The balanced Neles™ globe valve type GB is recommended for both functions, for full feedwater control and as a startup valve. The high differential pressure during boiler loading decreases the valve travel. At full opening, a high capacity is needed. As a startup valve, our Tendril-Trim should be applied.

Boiler feedwater recirculation

Boiler feed pump recirculation is needed to protect the BFW pump. The circulation is open during the startup phase when the boiler load is <30% or if the power plant is in idle mode. If the plant runs in the power phase when the boiler load is >30%, the boiler feed pump recirculation line is closed. In boiler feedwater recirculation, two valves are used, one for isolating and one for flow control, or then only one valve is applied that can perform both functions.



In both cases, the feedwater recirculation valve has the most severe service conditions of any control valve in a power plant due to the high differential pressure. We recommend the balanced globe valve type GM or AM with an angle body and Omega multi-stage trim.

If the valve also has an isolating function, a high leakage requirement is an additional challenge. Tightness according to ANSI FCI 70-2 Class V is highly recommended. If an on-off valve is used separately, the control valve tightness can be Class IV, but the tightness of the isolating valve must be according to Class V. The allowable leakage flow of ANSI FCI 70-2 Class IV at the high differential pressure between the BFW pump and deaerator causes cavitation, which leads to a worn-out valve seat. The valve quickly loses its tightness, and wear can even accelerate.

Worn-out seat trim due to Class IV leakage path cavitation on a feedwater pump recirculation valve. This can be avoided with Class V tightness and trim with wear-resistant martensitic steel.

Water treatment and condensate flow control

When the steam condenses, it is called condensate. Condensate is almost 100% pure hot water, which means it is corrosive to metal. That is because CO2 dissolves in H2O when it cools down. At the right pH, it starts to form carbonic acid. Keeping the pH value in the pipes within acceptable ranges is important for reliable boiler operation.

The two most common treatments to keep the pH value at an acceptable range are:

Volatile amines → Completely soluble → fed into the boiler for flash off and carriage through the system

Filming amines → Not completely soluble → injected into the steam header to coat the pipe inside with a microscopic layer of chemical that is almost oily in nature. The filming barrier protects the pipe from acid and oxygen pitting.

Volatile amines are typically fed by a metering pump. More challenging are the filming amines, which are directly injected into the steam header and dispersed throughout the piping system by specially designed injection quills and pumps. The amines do not have any adverse effects on copper or copper alloys in normal treatment conditions where pH is maintained between 7.5 and 9.0. However, if the injection is not performed well and it turns into elevated concentrations, these neutralizing amines may be corrosive to copper and its alloys.

A certain risk is caused due to the two phases of condensate – water and steam. Because of the high drop in pressure at high velocity, the condensate is erosive and may cause damage to the trim and outlet port. To take this risk into account, valves with angle bodies are recommended.

Neles globe valve material selection for valves in BFW or condensate services also addresses the risk of corrosion. For most power plants, ASTM A216 grade WCB valve body material and martensitic stainless-steel trim are entirely sufficient. If there is a risk of not keeping the chemical amine treatments at a proper level, a chromium-molybdenum steel body material may provide longer lasting operation. Please consult your valve manufacturer's experts on all special requirements for boiler feedwater and condensate.

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