POWER

FEEDWATER REGULATOR **FOR DRUM BOILERS**

Background: Keeping accurate and stable drum level control is vital to optimal plant operation, but there are many challenges that are inherent with this process. Innate to level control on a drum style boiler is a dynamic called "shrink and swell", which is caused by the formation of vapor bubbles in the boiler evaporation tubes as steam demand changes. On increase of steam demand, the drum pressure decreases which, in turn, causes additional steam to be created through water evaporation, and causes expansion of the vapor bubbles below the surface of the water. This phenomenon actually causes the drum level to rise initially, instead of the drop that would be expected upon more steam leaving the drum (swell). Likewise, on a decrease of steam demand, the pressure in the drum increases and the drum level initially drops (shrink). In order to control drum level accurately, the effects of "shrink and swell" are typically compensated for in the control system with a cascade/feed-forward control strategy that utilizes steam flow and feedwater flow transmitters in conjunction with the drum level and drum pressure transmitter measurements.

Key to success is responsive and repeatable control of the Feedwater Regulator Valve. During start-up and through low fire conditions the feedwater valve sees high inlet pressures requiring low flow capacity with full pressure drop across the valve. As the boiler load increases, the valve is required to pass more flow, there is a reduction in inlet pressure to the valve, and outlet pressure (drum pressure) rises. This requires the valve to have a large capacity with minimal pressure drop across the valve. There are two different strategies to satisfy these conditions. One strategy employs the use of a parallel valve system that uses a start-up valve to handle the conditions through the first 20-40% of load, and a main valve to handle the conditions from mid load through to full load. A second strategy employs

ELECTRAULIC™ ACTUATION

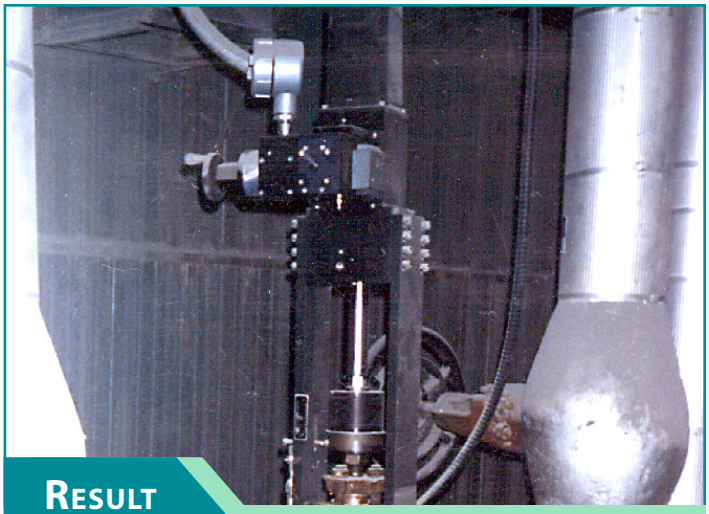
the use of a single valve with a characterized disc stack that can handle the wide range of process requirements for this application.

Problem: There are many problems associated with feedwater control that need to be addressed by the plant. From a maintenance standpoint, the Feedwater Regulator Valve can be problematic. It is typical that this valve needs to have trim rebuilds and/or retrofits frequently, due to cycling at low loads. Tight shut-off (Class IV or Class V) is desirable in this application and can help protect trim life. For drum level stability to be optimized, it is the goal of the plant to eliminate any dead time from the process. This is not to say this requires an overly fast operating actuator, but it is more important to have an actuator that does not add any dead time into the process loop, and that delivers repeatable, smooth positioning at high resolution.

Herein lies the problem; many plants are still utilizing pneumatic spring and diaphragm actuators to actuate their Feedwater Regulator Valves. Pneumatic actuators are responsible for creating additional lag time in the process loop. The use of pneumatic actuators inherently causes hysteresis due to "stiction", which is caused by the frictional forces created by the valve packing and any plug seals in the trim. In recent years, there has been improvement in pneumatic control due to the advent of "smart" positioners that reduce the "stiction" effect. The downside to these positioners is an additional increase in dead time, beyond the lag time previously mentioned, to help correct for "stiction", particularly in valves with larger actuators, and when the control signal step change is small (2% or less). The resulting total dead time associated with a typical pneumatic actuator for a utility power feedwater application is several seconds.

Solution: Based on the company's proprietary, Electraulic® technology, REXA Actuators offer a rugged, responsive, and repeatable solution for feedwater control applications. These actuators are designed for continuous modulating service with an adjustable dead-band as tight as 0.05% of stroke. The virtual incompressibility of hydraulics provides repeatable, stiff, and accurate valve control performance, while eliminating the dead time and overshoot dynamic caused by hysteresis that is inherent to pneumatic actuation.

REXA offers linear actuators that can be used to improve the controllability of any manufacturer's control valve. The actuator can easily be designed for fail position in either direction or to fail in place, in conjunction with the strategy of the plant.



Result

Upgrading from pneumatic actuators to REXA Electraulic™ Actuators on feedwater control can garner immediate benefits for any power plant. Maintenance savings can be immediately realized through improved trim life of the control valve, reducing labor and material costs.

Operationally, an upgrade to REXA Electraulic™ Actuators from pneumatic actuators may yield the following improvements:

- Greater boiler efficiency
- Increased ramp rate
- More unit availability
  (improved ability to survive process upsets)
- Improvement in unit turn-down
  (minimum load operation)

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