



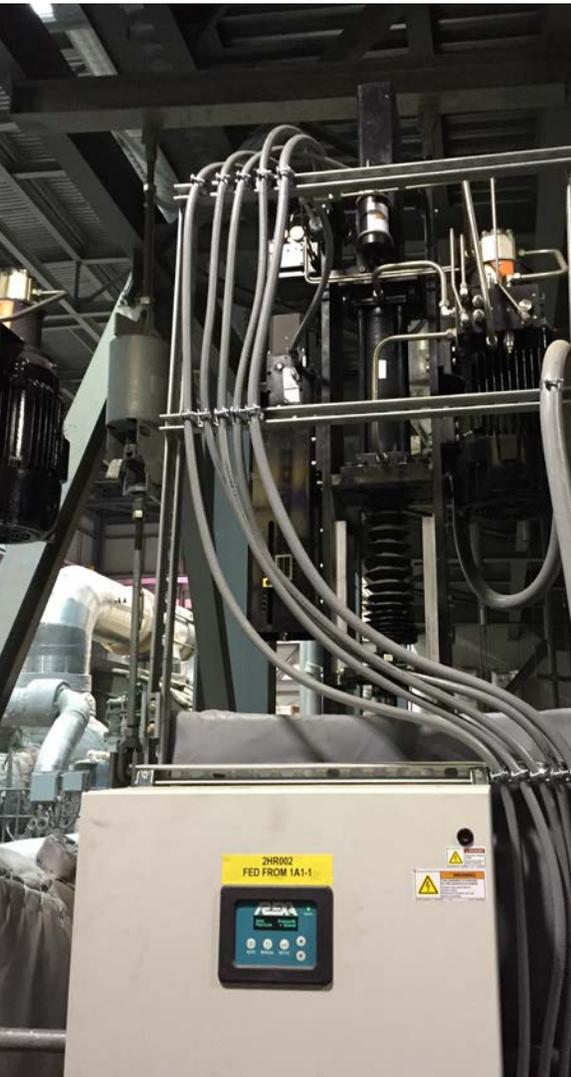
## TURBINE BYPASS SYSTEM OPTIMIZATION

**BACKGROUND:** Combined Cycle Power Plant operators are under constant pressure to increase on-line availability. One of the most critical systems to facilitate this undertaking is the Steam Turbine Bypass System. Commonly used for startup, shutdown, and steam turbine trips, as plants are more frequently cycled, these systems are often being called-on to perform in low load and simple cycle operations. For plants with multiple Combustion Turbine Generators (CTG)/Heat Recovery Steam Generators (HRSG) and a single steam turbine, the Bypass System also allows staggered startup of the CTG's and warming of other critical components.

A commonly found arrangement is a cascading bypass system which helps in managing thermal imbalances between the CTG and the HRSG in cycling scenarios. A triple pressure system includes HP, Hot Reheat (HRH) and LP Bypass valves. In this control scheme, the HP Bypass valve maintains HP drum pressure to minimize thermal stresses on the drum. The HRH bypass is downstream of the reheater, maintains LP drum pressure, and reduces steam pressure/temp to the condenser.

Finally, the LP Bypass valve maintains LP drum pressure and protects the condenser by reducing LP steam pressure/temp to an acceptable exhaust condition.

**KEY TO SUCCESS:** Of Bypass Steam Pressure and Temperature control are valves that can precisely track control signals and prevent adverse effects on the turbine and HRSG. Even small changes in temperature or pressure to the steam turbine cause thermal/mechanical fatigue, and can lead to Gas Turbine or safety valve trips. "Windage" overheating of the HP turbine back-end due to steam recirculation is a result of poor control HP and HRH steam



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pressure. The goal is to improve overall heat rate, decrease startup and shutdown times, and decrease the potential for turbine trips due to instabilities.

**PROBLEM:** A leaking HP Bypass valve decreases turbine efficiency, and if it's unable to stroke due to thermal expansion of the valve internals, turbine damage or unwanted trip events can occur. The HRH Bypass Valve is the heart of the system. Poor control of Reheat pressure due to oscillations caused by pneumatic actuator "stiction", overshoot or dead time can cause significant fluctuations in IP drum level. This in turn causes the desuperheating spray valves to become over-active, and cascades to the feed water valve to continually compensate the IP drum level for improper HRH pressure and temperature control.

Even small changes in temperature or pressure to the steam turbine cause thermal/mechanical fatigue, and can lead to Gas Turbine or safety valve trips. "Windage" overheating of the HP turbine back-end is also possible due to poor control of HP and HRH steam pressure.

**SOLUTION:** REXA Electraulic™ Actuation offers a rugged, responsive, and repeatable solution for Turbine Bypass Valves. Designed for continuous modulating service, the patented self-contained hydraulic circuit provides stiff, stable control in the harshest conditions (-40°F to +250°F).

A dedicated microprocessor based control enclosure operates the drive unit, and is usually located in a convenient area. Set-up and calibration is made simple through a membrane key pad on the enclosure cover. Performance is unmatched in the industry with adjustable dead-band to 0.05% of stroke, resolution of <0.1% and full stroke speeds to 1 second.



## RESULT

A Combined Cycle Power Plant operator can realize significant savings due to decreased ramp-up and ramp down times (up to 25%), leading to reduced off line fuel usage, and substantial yearly savings. With increased on-line availability, additional generation can easily be double that saved in fuel.

A reduction or elimination of cycling trips can improve the number of metal fatigue cycles for the superheater, reheater and steam drums that were caused by poor pressure/temperature control.

This equates to reduction in the number of equivalent starts/operating hours, and a lower frequency of maintenance inspections that effect long term service agreements. Turbine Bypass Valves that shut-off tight, improve heat rate and can add years to the service life of the equipment, reducing the frequency of expensive rebuilds.



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