Powering Up with Automatic Control

Electricity is an everyday necessity and while power generation is a $400 Billion industry in the US alone the availability of electricity is regularly taken for granted by consumers. Interestingly, power companies are often forced to err on the side of suboptimal control in order to assure availability of the electricity they generate. One common challenge for operations staff is the 100s of PID controllers that regulate a typical plant's steam generation processes. Operating PID control loops too close to their constraints can result in trips that bring down a plant. With a disruption of service and fines of $40K - $60K for each trip the incentives for configuring PIDs for "loose" control can be meaningful. Unfortunately for many the configuration and tuning of PID controllers is a mystery even when those same PIDs provide the backbone of their facility's control infrastructure.

For a combined-cycle plant in Colorado the goal of automating control of the facility's numerous steam generation units presented a particularly challenging problem. The team's manual tuning methods were known to be haphazard at best. In terms of their impact the hit-or-miss tunings resulted in Feedwater Flow loops that routinely became unstable when operated in automatic mode. Regulated by a simple cascaded architecture the controllers tended to oscillate excessively. What's more, issues stemming from poor tuning were exacerbated by the shrink/swell dynamic associated with drum level control. As a result, PIDs regulating the drums and other loops linked directly to steam generation were often operated manually. Fortunately, the operations team turned to the experts at Control Station for support with their automation initiative.

"[The] training and tuning session produced some of the best improvements this site has ever seen."

C. Kowalsky

I & C Technician

control station

Prior to engaging Control Station the plant's engineering staff had been unable to regulate drum level effectively. A combination of poorly tuned PIDs and other configuration settings had prevented the Level Controllers from responding properly. The single-element control strategy applied to the controllers prevented them from accounting for changes in steam demand. As a result, routine instability frequently forced plant staff to operate the units in manual whenever demand increased.

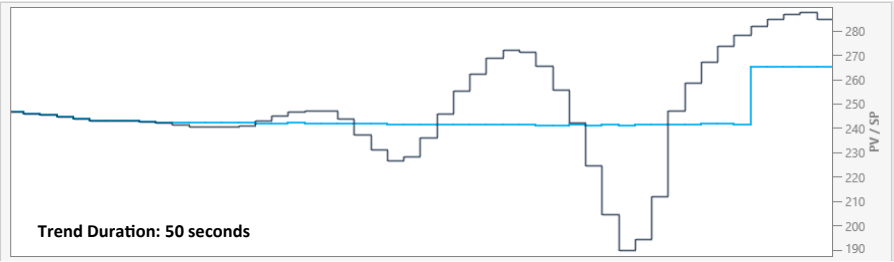

Image 1 *- As shown above a poorly tuned Feedwater Flow Controller trends toward instability once the associated PID is switched from manual to automatic mode. Oscillations are evident well in advance of the Set Point change.*

While a primary objective in steam generation is to maintain liquid level in a given drum there are other dynamics at play that hamper effective control. What should simply be a balance of feedwater entering vs. steam exiting a drum is made challenging by shrink/swell dynamics. On the one hand: If feedwater inflow exceeds steam outflow, then pressure within the drum increases causing the level to shrink and resulting in a counterintuitive increase in demand for feedwater. On the other hand: If feedwater flow falls short of the associated steam outflow, then the level swells in an equally counterintuitive fashion. This is due to a decrease in pressure within the drum which allows the liquid to expand.

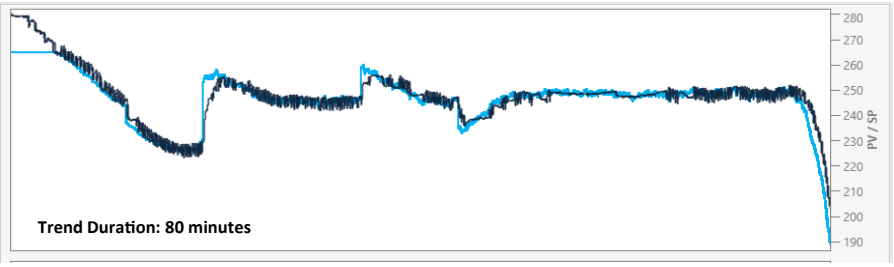

Image 2 *- Parameters recommended by csTuner quickly established steady, responsive control of the Feedwater Flow Controller. Improvements allowed operation in automatic cascade mode as part of a three-element strategy.*

Three-element control is a proven strategy that is well suited for the power industry and for the regulation of steam drums in particular. Unlike the application of single-element control which makes control adjustments based solely on a drum's liquid level, three-element combines the essential level control with a feed-forward element. The feed-forward element measures the outflow of steam from the drum and adjusts the flow of feedwater accordingly.

Experts from Control Station immediately identified the problem with the facility's existing single-element approach and devised a three-element strategy. By applying feed-forward and factoring steam demand into the strategy a safe volume of liquid would always be available within the drums. As a result any drops in pressure would be regulated more effectively. With the help of csTuner Powered by Control Station optimal PID tuning coefficients were quickly calculated and the oscillatory behavior was eliminated. Using the newly tuned controllers and reconfigured strategy, stable operation was maintained even when demand was pushed to full load.

Why the Model Matters...

Industrial processes are complex and inherently dynamic. They're noisy. The data oscillates and there's no escaping it. With an accurate model of those dynamics you can tune for optimal control. Without an accurate model, it's simply guesswork. Even so most commercial tuning products require a steady-state before they can function properly — eliminate the noise, remove the oscillations, make it simple. But that's not the real-world.

csTuner powered by Control Station's proprietary modeling capability works in open-loop and closed-loop, with integrating processes and non-integrating processes, even with long Dead-Time data. It is industrial grade software for use in real-world applications...just like yours.

csTuner is private-labelled by Yokogawa Corporation of America, and it has been licensed to world-class manufacturers across the process industries. Contact us today to learn how csTuner can help you to optimize production throughput and efficiency.

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Contact us today and learn how csTuner can solve your industrial grade tuning challenges

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