# What is Process Control? and Why You Should Care – Unintended Consequences

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## BACKGROUND

Steam temperature is one of the most difficult control loops in a modern power plant.

The efficiency of the generating station depends strongly on maximizing this temperature within very narrow constraints.

The ability of the steel-alloy heat-transfer tubing to retain its strength limits the allowable temperature. Excessive temperatures, and especially temperature cyclic behaviour, cause stress and distortion and can significantly shorten the life of a superheater.

To maintain operating efficiency and to extend equipment lifetime, among other requirements, steam temperature deviations must be kept within 1-2% of the rated values (Figure 1).

## UNINTENDED CONSEQUENCES

Changing processes to accommodate the challenges faced by the chemical processing industries has become a staple in todays' industry landscape.
Unintended or unforeseen consequences often accompany these changes.
In this article I present an instance of an unforeseen byproduct arising from a change in the process.

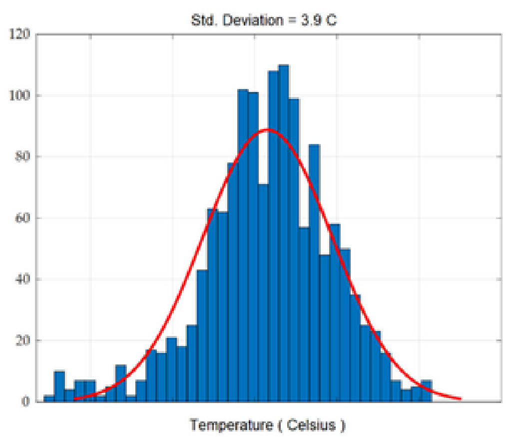


Figure 1 - Steam Temperature Histogram and Standard Deviation

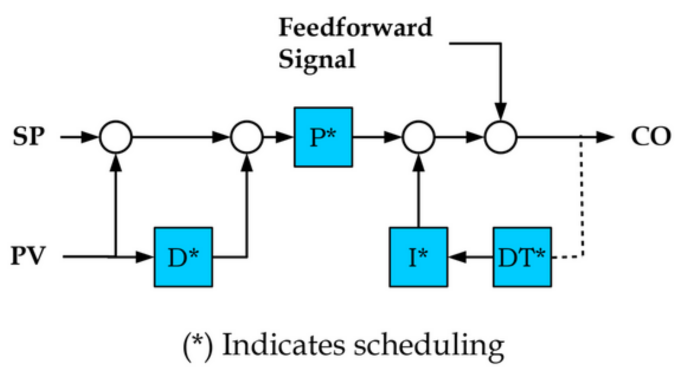


Figure 2 - Predictive PID with modes scheduling -Star means that the parameter changes with unit load. DT stands for deadtime

### CASE STUDY

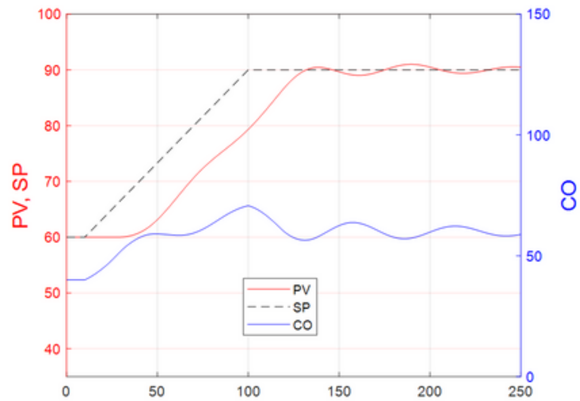

Figure 3 - Power Station Ramping

A few years ago, I consulted a thermal power plant. I resolved the inability of the steam temperature control to maintain the controlled variable at the setpoint during ramping operation (Figure 3). The control strategy became more difficult after the plant converted from fuel oil to a natural gas-fired station.

For clarity, I illustrate in Figure 3 how a process variable lags behind a ramping setpoint.

### PROCESS CONTROL SOLUTION

After attempting to improve the loop performance by retuning all the modes of the PID controller, I realized that a model-based solution using a Predictive PID controller (aka PID-deadtime compensated) would be the best path forward.

I step-tested the process and analyzed the system's behavior under varying loads. This approach allowed me to implement adaptive control principles by scheduling the different controller modes, including deadtime compensation. Furthermore, incorporating feedforward into the strategy resulted in a significant performance improvement. In Figure 2, I show a sketch of the structure of the controller.

The implemented solution successfully allowed the plant to meet control center targets while ramping up the unit.

The customer and I monitored the controller performance for a few weeks. When the work was complete the customer asked me: "what can we do if the controller stops working?"
My answer was: The controller has been in service 24/7 for the past few weeks; if it stops working, it is not the strategy or the tuning; it has to do with something that changed in the field, perhaps the thermosensor or the spray valve, etc.

### ECONOMIC BENEFITS

Similar to Process Control Briefing No. 3, in this case, there is a quantifiable benefit, although not straightforward to calculate.

The electric grid's ability to handle intermittent renewable energy depends on the power generating stations' capacity to ramp up at certain megawatts-per-minute. Proper coordination of control loops and strategies is essential at the plant level.