

Facility Dynamics

ENGINEERING

Controlling Analog Processes

“It All Depends on the Lags” David W. St. Clair (Supplemental)

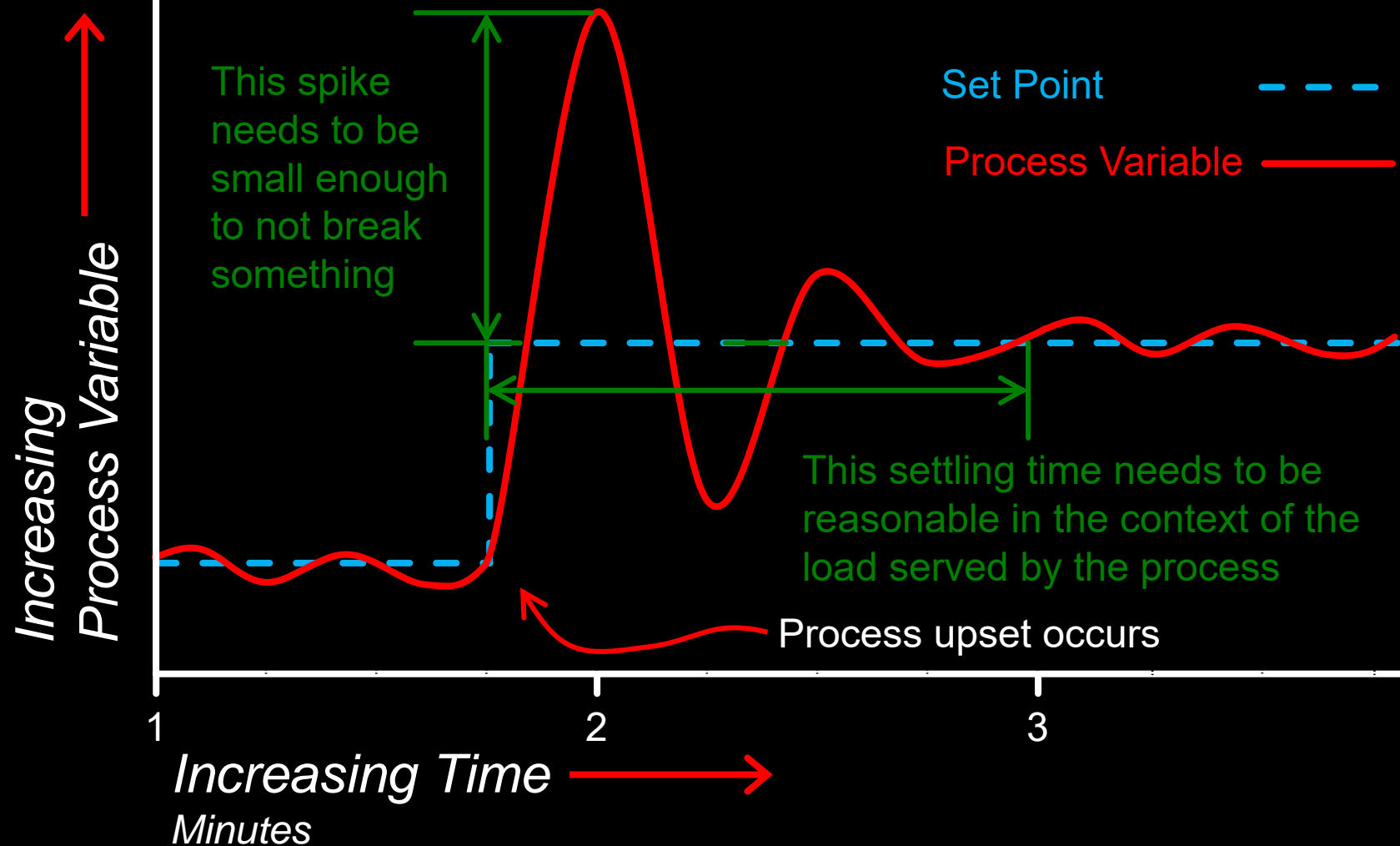
Presented By:

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Senior Engineer

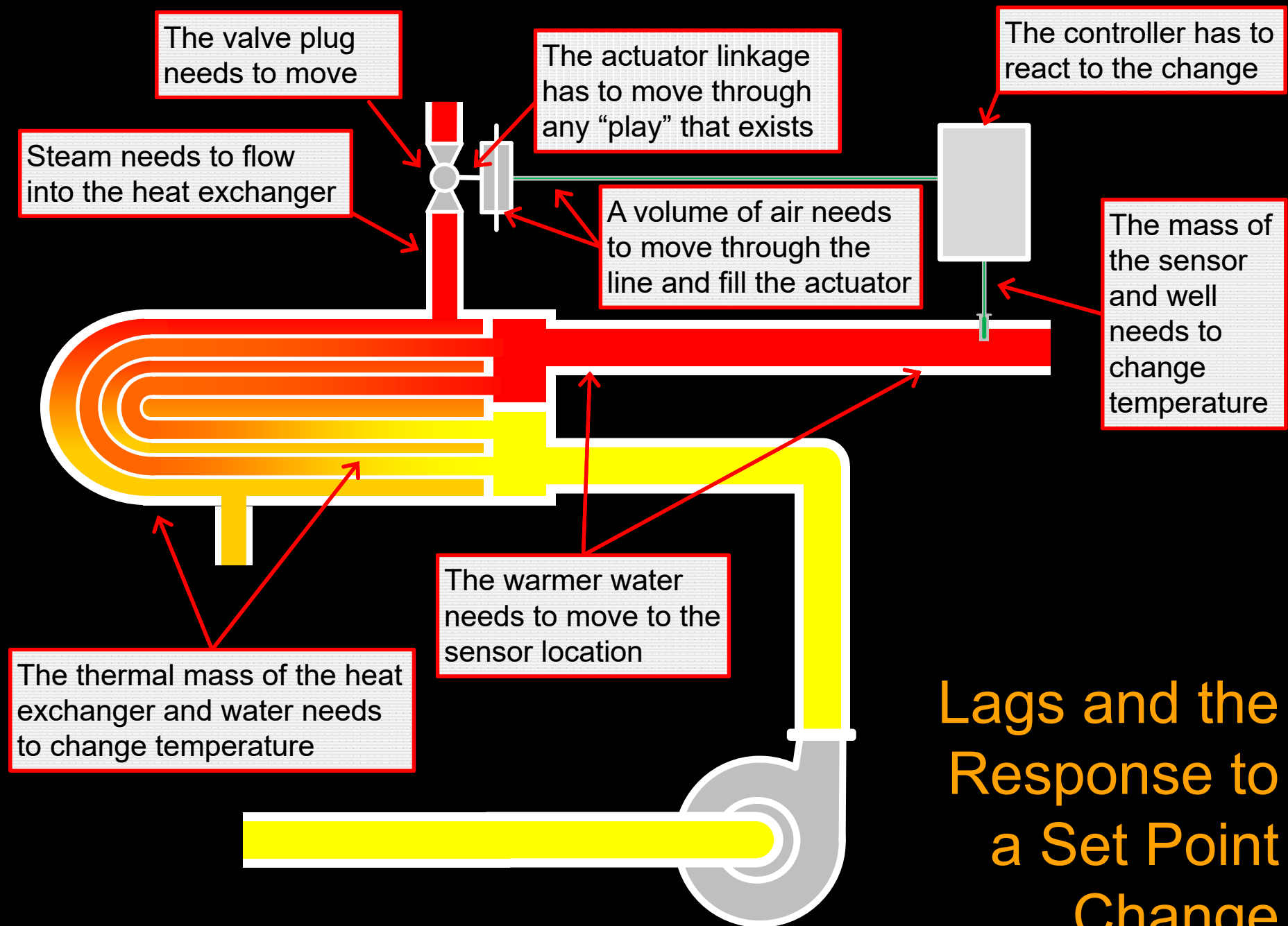
NAVFAC, San Diego

The Quarter Decay Ratio; Signature of a Well Tuned PID Loop



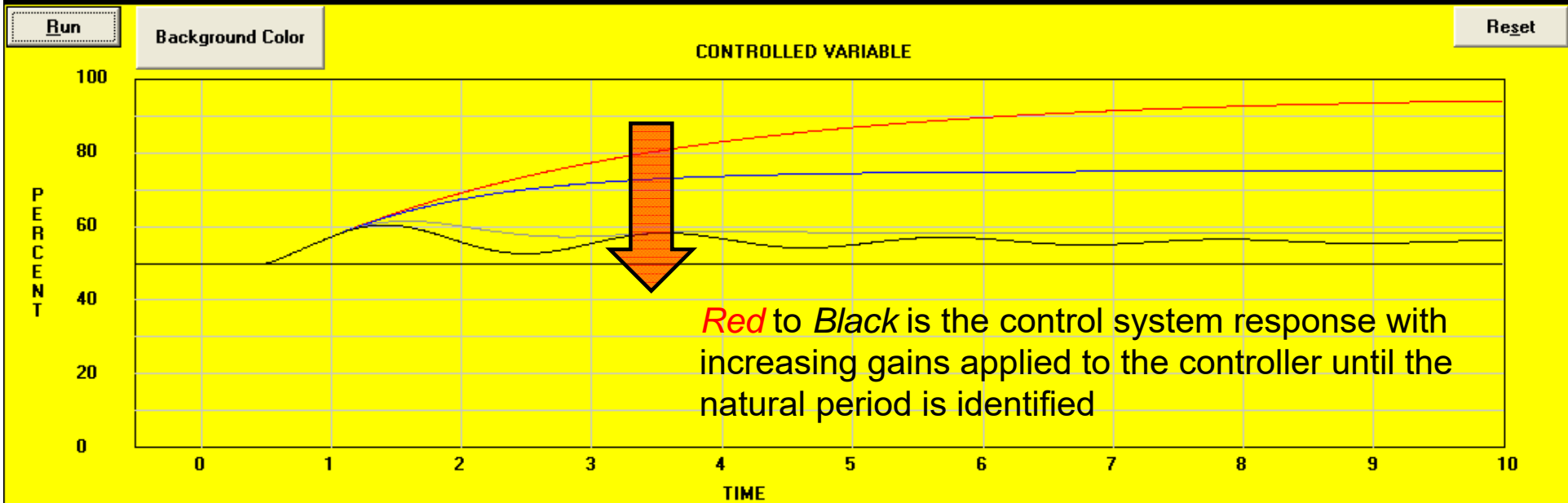
It All Depends on the Lags

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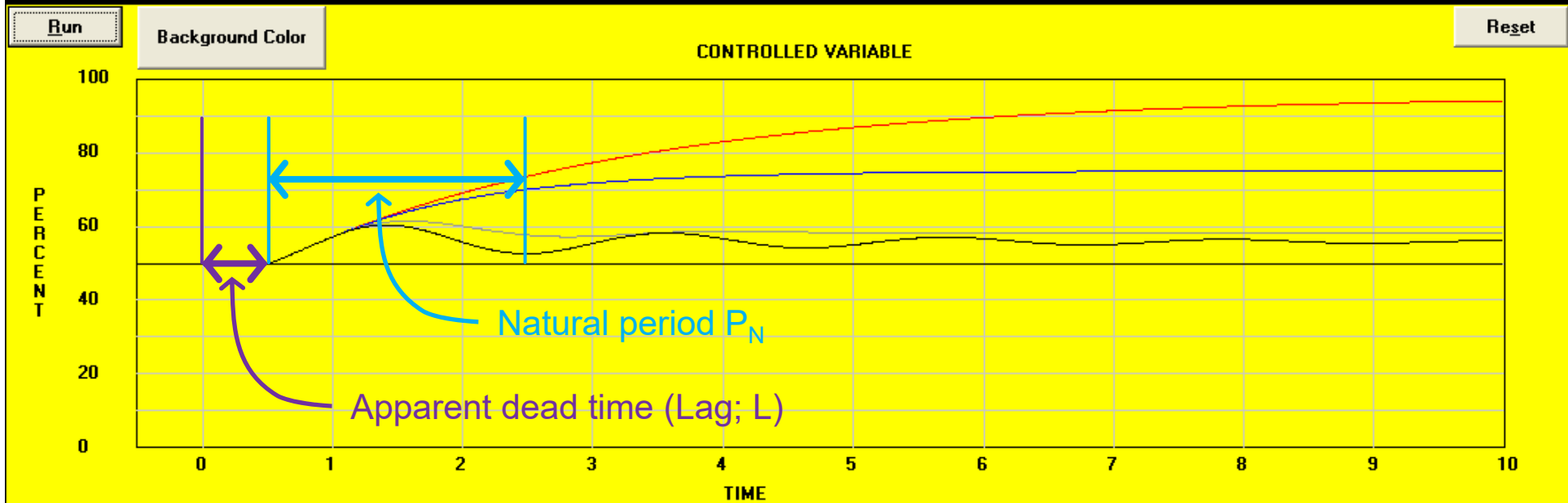


Lags and the Response to a Set Point Change

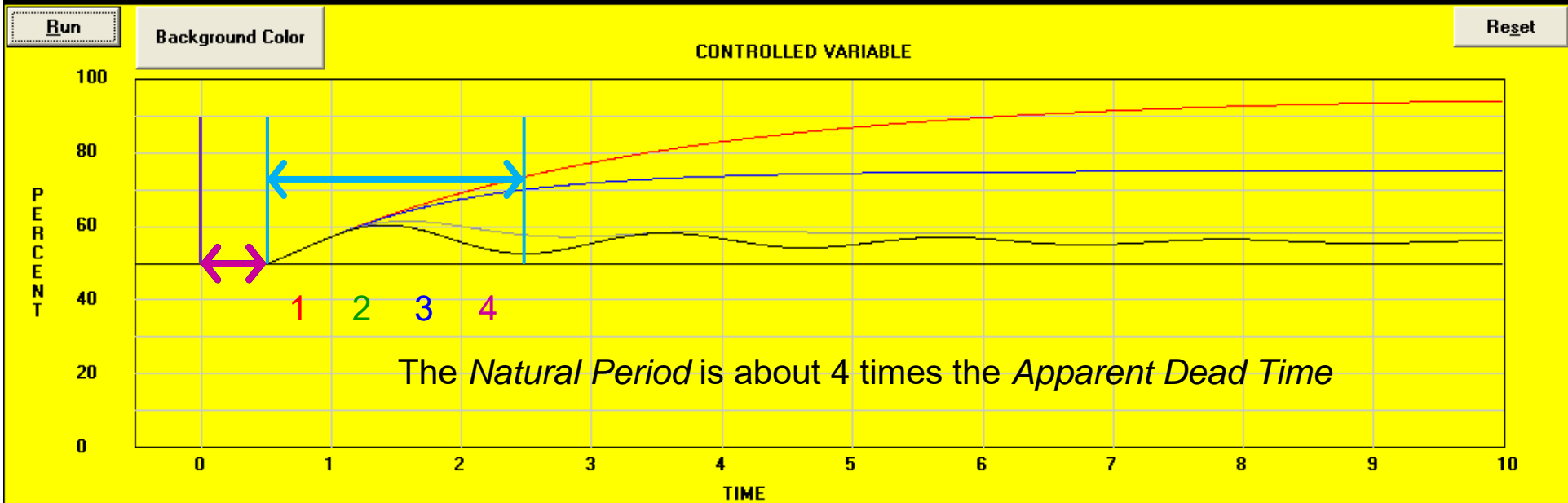
Some Observations



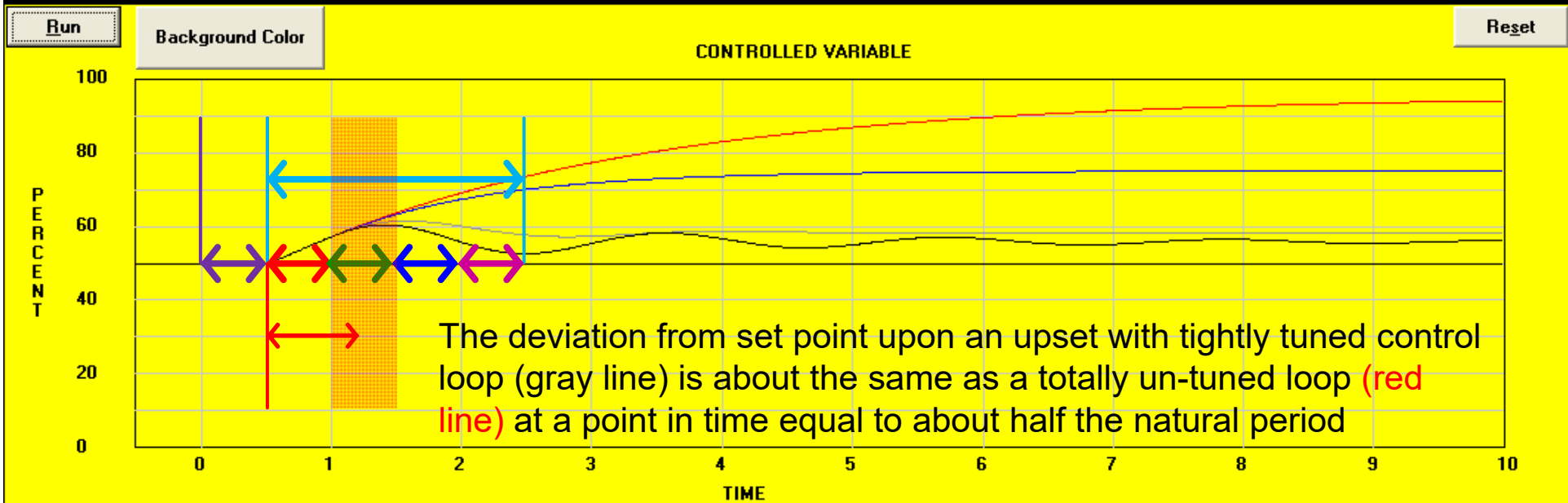
Some Observations



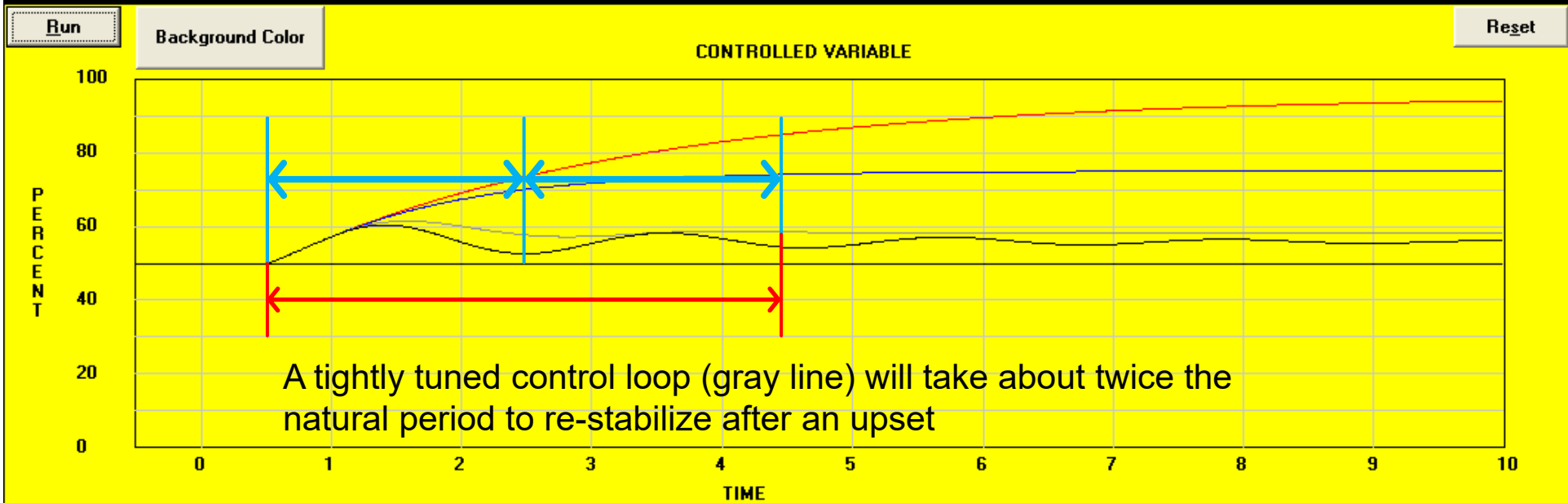
Some Observations



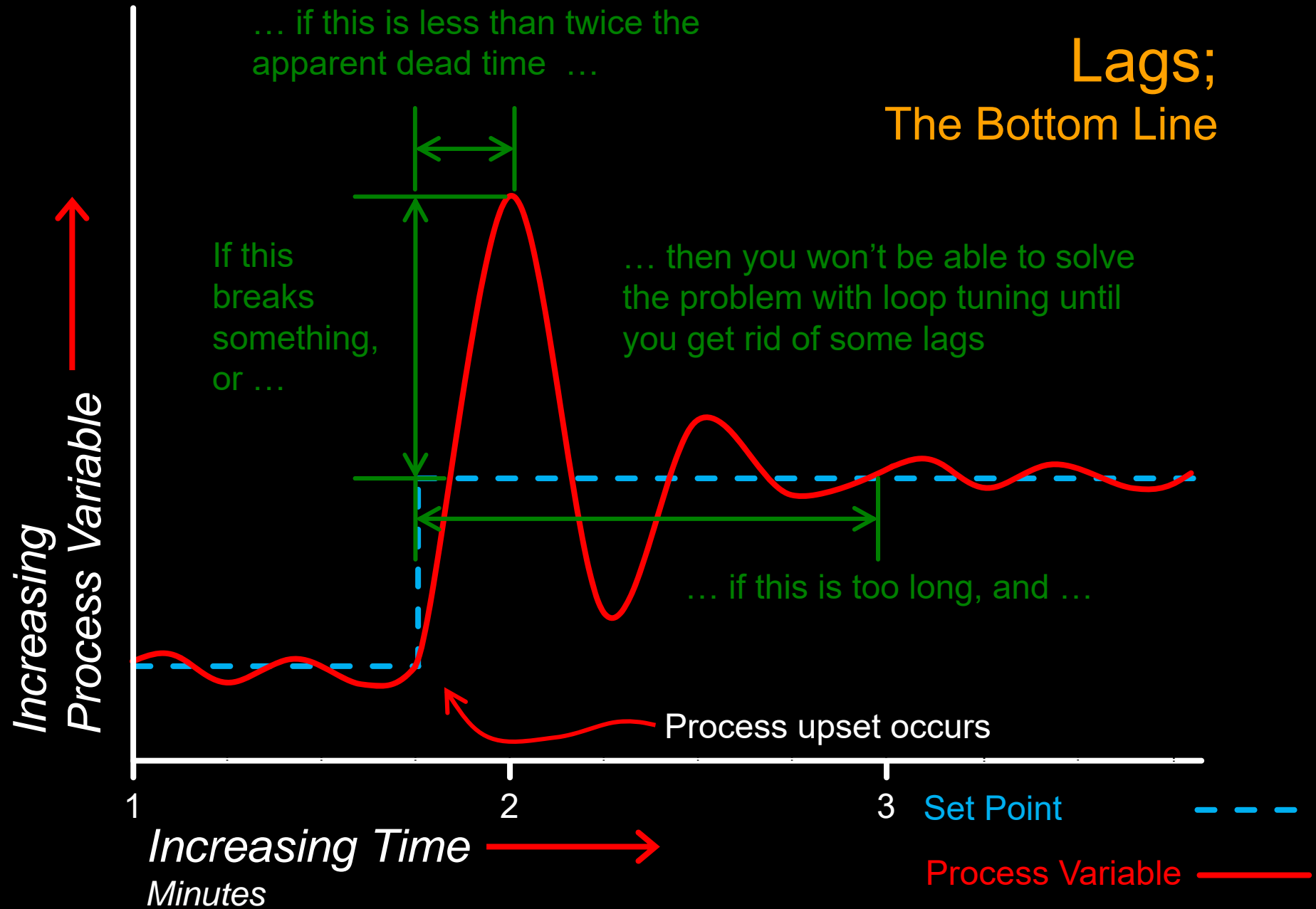
Some Observations



Some Observations



Lags; The Bottom Line



Getting Rid of Lags; Sometimes It's Easier than Others

Easier

1. Add positioning relays to valve and damper actuators
2. Install faster actuators (particularly applicable to electric actuators)
3. Reduce the thermal lag associated with wells by not using them
4. Use tighter linkages to minimize hysteresis
5. Use ramps instead of acceleration and deceleration times in VFDs

Harder

1. Reducing transportation times
2. Reducing the thermal lags associated with the size of the machinery (mass of coils, fans, duct, pipe, etc.)

A Bit More About Ramps

Acceleration and Deceleration times

Apply all of the time, any time there is a change in the process

- 1. An acceleration setting of, for example, 1hz/second will always apply regardless of if the difference between set point and control point was because of a start-up or step change in set point vs. minor variations in the control point relative to set point*
- 2. This introduces a permanent lag into the control process with the associated implications for tuning the process*

Ramps

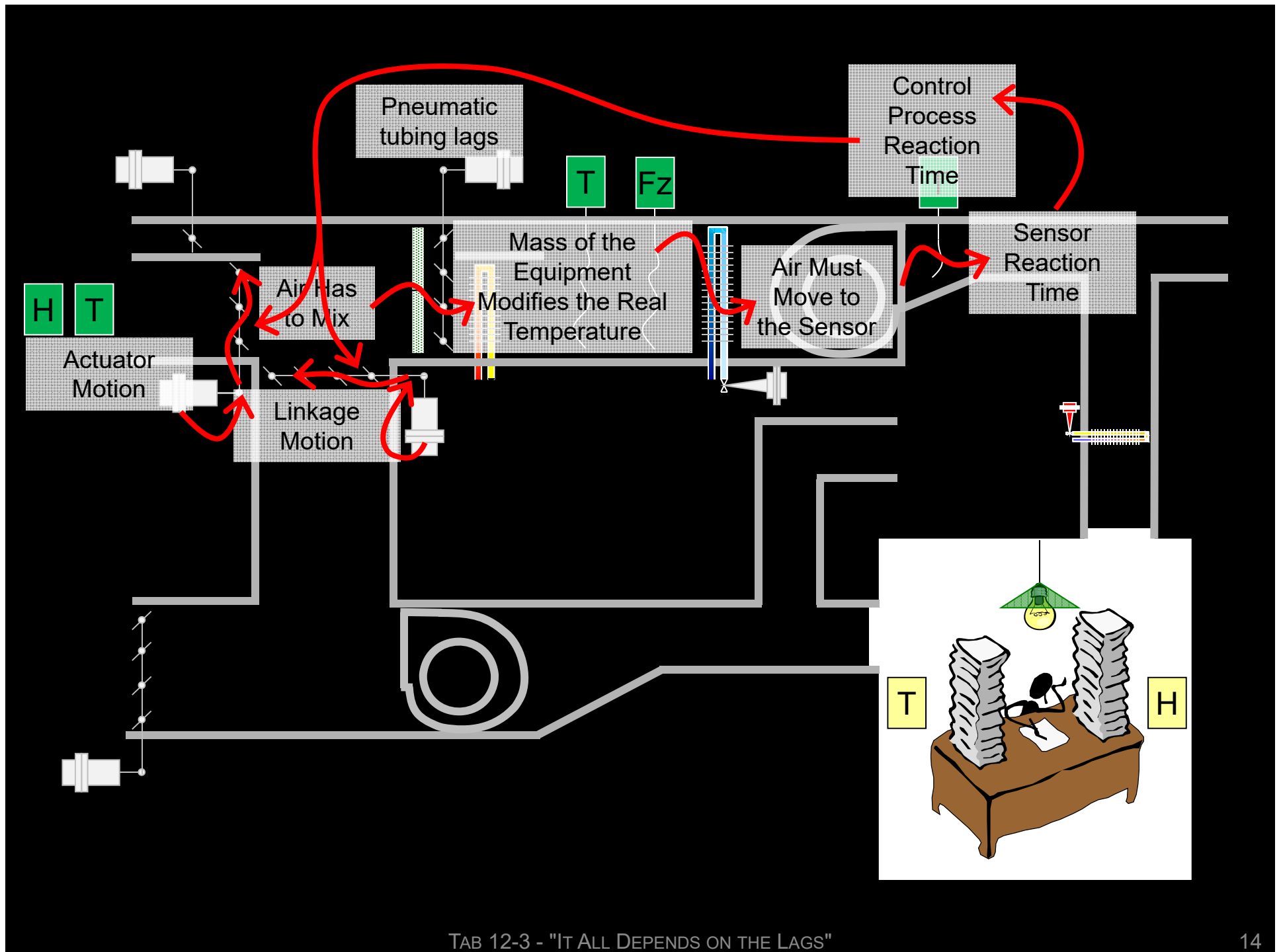
Only apply when the set point is outside some window relative to the control point

- 1. Ramps will only apply if the difference between the set point and control point is large (outside of some predefined window)*
- 2. If the set point and control point are inside the window, then the lag associated with the ramp drops out of the picture*
- 3. As a result, the response to a minor variation in set point is much faster than the response to a step change (start up or set point change)*

It All Depends on the Lags

David W. St. Clair

An Air Handling System Example



TAB 12-3 - "IT ALL DEPENDS ON THE LAGS"