

ACTUATOR PERFORMANCE SIGNIFICANTLY IMPACTS BOILER CONTROL & PLANT PERFORMANCE

Harold Beck and Sons, Incorporated has been manufacturing electric actuators since 1936. The unique design of Beck actuators has made them a standard for modulating damper and valve applications in the North American power industry. This design is specially suited for precision modulation and control without duty-cycle limitations or high maintenance requirements. The better, more reliable actuator performance results in better, more efficient boiler control with far fewer unplanned outages. Simple actuator improvements can result in significant rewards as has been shown in studies like the one done by the Electric Power Research Institute (EPRI) in the US at the TVA, Kingston plant.

Today, Beck has expanded world-wide with growing representation around the Globe. The boiler control improvements driving Beck's success in the US power industry are equally applicable to the rapidly growing Asian power market. The advantages of better actuation are universal.

TRADITIONAL ACTUATOR PROBLEMS:

There is no shortage of instrumentation and control technology available today, and power plants make significant investments in this equipment. Often overlooked when making investments in plant control equipment, however, is the necessity of precise, reliable actuator response. Actuators are often considered with little thought to how they respond to the controller and how their performance and reliability can limit the control system performance and plant reliability.

Actuator selections are too often made based on purchase price considerations only. This is a short term approach that can have costly results. Typical actuator designs have a number of deficiencies that can cause boiler control problems that lead to inefficient combustion, poor emissions control, boiler trips and unplanned outages, thermal stress, and high maintenance expenditures.

Most electric actuators are not well suited for continuous modulating control, which is required

for good boiler control. Many electric actuators are constrained by duty-cycle limitations and can only modulate to the degree that the number of motor starts does not cause the motor to overheat and trip. This means that the more active a loop needs to be to control the process, the larger the actuator dead band must be to limit the number of motor starts and prevent a complete loss of control. Large dead bands decrease the ability of the damper or valve to make small corrections, which then causes cycling and increased process variability. (See figure 1 below left).

Pneumatic actuators have similar precision and cycling problems but for different reasons. Pneumatics are susceptible to stick and slip caused by frictional loads and the performance always suffers eventually. Maintenance is always required to keep pneumatic actuators performing in an acceptable range over time. (See figure 2 overleaf).

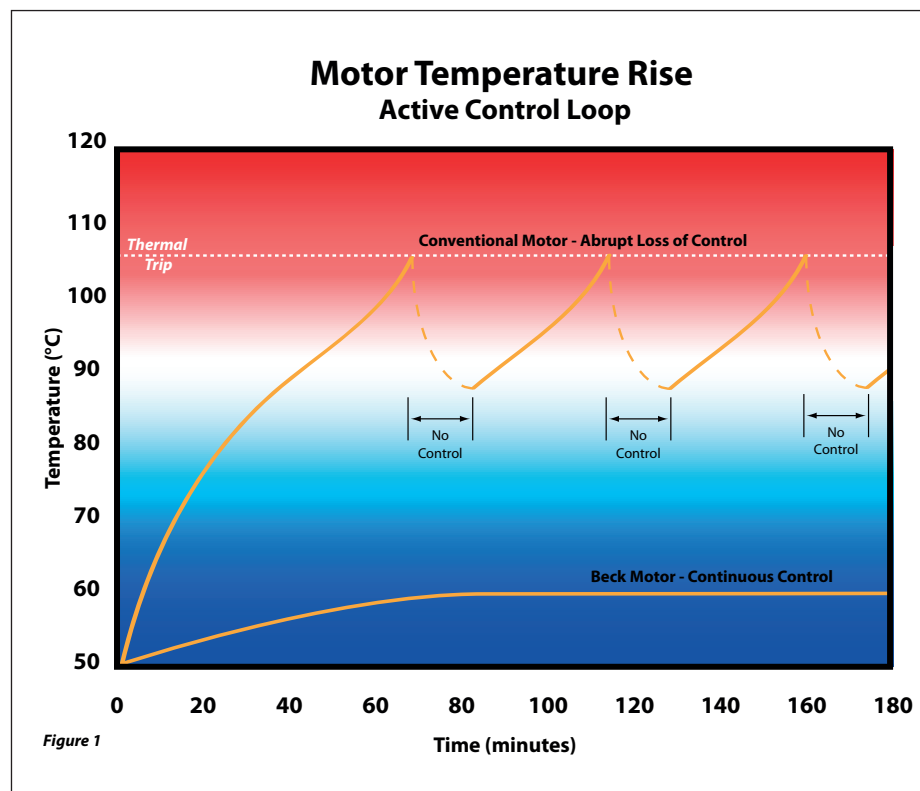
OPTIMAL CONTROL: WHAT KEY ACTUATOR CHARACTERISTICS ARE REQUIRED?

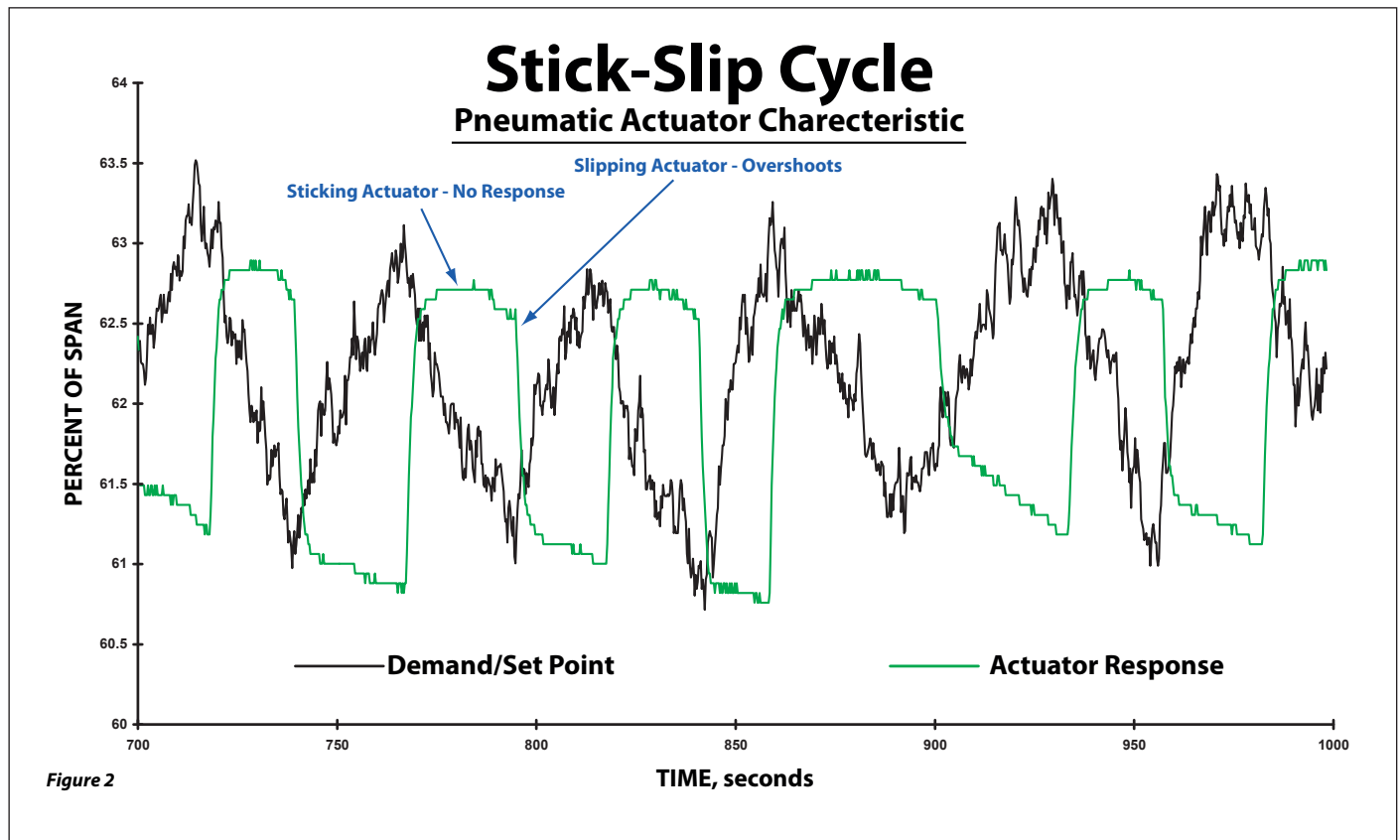
Actuators should be carefully selected to ensure that they can provide the necessary performance characteristics that will enable a control system to perform as designed. The key characteristics are as follows:

- Precise, repeatable positioning typically better than 0.15% of span.
- The ability to start and stop instantaneously without dead time or position overshoot.
- Continuous duty rating without limitations on the number of start per minute.
- Perform consistently and unaffected by load.
- Rugged industrial design capable of operating in difficult environments without an effect on performance.
- Minimal periodic maintenance required.

An actuator designed with these characteristics provides two extremely important advantages:

1. An ability to follow the demand signal from the controller precisely and instantly. This ensures that the actuator responds exactly as directed by the controller. Thus, the actuator is not the limiting factor in the control loop and the controller can function to its optimal levels.
2. A high degree of maintenance-free reliability. An actuator designed to function as outlined





above by default is more rugged than typical actuators. By design, then, it is capable of a much higher degree of reliability.

WHAT CAN BE GAINED?

When actuators that are appropriately designed for the task of process control are installed on a boiler, much can be gained from improved process control performance and better reliability. EPRI did a demonstration project at the TVA Kingston plant several years ago to determine how NO_x emissions can be reduced simply by employing good control technology without the addition of low NO_x burners or expensive selective catalytic reduction (SCR) equipment. In addition to modern distributed control and instrumentation upgrades, the study included the use of Beck electric actuators on all the Kingston boiler control dampers and tilts. Beck was selected for the study based on its long track record of success in the US power industry.

EPRI's NO_x reduction strategy was to improve boiler control and achieve the following:

1. Reduce the oxygen at the burner and introduce air at higher levels to complete combustion.
2. Reduce excess oxygen.
3. Reduce peak furnace temperatures
4. Reduce the particle size of the coal fines.

The EPRI team knew that several areas of control were critical to this strategy. Precise control of the windbox dampers was required to optimize the

combustion air ratio. From a physical standpoint the burner tilts needed to be controlled much more accurately and reliably to obtain better steam temperature control and reduce tube failures. The coal mill hot air dampers also needed to be controlled accurately. All these objectives were achieved using better instrumentation and better actuators.

The results were astounding. Not only was the boiler efficiency improved, but NO_x was reduced by 25%. Prior to the installation, the NO_x baseline was 0.6 to 0.7 lb/MMBtu. Within a month of the upgrade completion boiler NO_x had been reduced to 0.45 lb/MMBtu, all without the addition of low NO_x burners, SCR's or any other additions to the boiler. EPRI project leaders attributed two-thirds of all the project benefits directly to the new actuators alone, which meant the investment in the Beck actuators paid for itself in about one-and-a-half years.

EPRI project leaders point out that in addition to reducing NO_x and improving efficiency, the new actuators provided many more advantages. In particular, they noted that the actuators were the major contributing factor to improved steam temperature control, lower turndown, fewer boiler tube failures caused by thermal cycling, and reduced loss on ignition (LOI).

Now, some 15 years after the project completion, the unit is still enjoying the benefits of improved actuation and all the Beck actuators remain in service not only on the demonstration unit but on all the units at the TVA, Kingston facility. Equally important to the improvements themselves, is

the sustainability of the result. The senior plant instrument mechanic involved with the project has said that "the reliability and accuracy of the electric actuators installed at Kingston reduced our workload, allowing the instrument shop personnel to focus on preventive maintenance instead of spending all of their time on corrective maintenance."

SUMMARY & GROWING ENERGY NEEDS ACROSS

Optimum control requires actuators that are capable of continuous modulation and consistent performance over time, with changing conditions, and without required maintenance. These often overlooked capabilities are critical to process control performance. Investments in control systems and field instrumentation are only as useful as the performance of the final control element actuators allow. EPRI proved at the TVA Kingston demonstration project that actuator performance alone is the major contributing factor with respect to boiler control and performance improvements. The results were astounding, with immediate improvements in boiler efficiency and a 25% reduction in NO_x. Over the fifteen plus years since the initial project completion, the project success has continued and today all the boilers at the TVA, Kingston plant are equipped with Beck electric actuators. Installing actuators designed for the rigors of continuous modulating process control is the key to optimal control and sustainable improvements.

'OPTIMUM CONTROL REQUIRES ACTUATORS THAT ARE CAPABLE OF CONTINUOUS MODULATION AND CONSISTENT PERFORMANCE OVER TIME, WITH CHANGING CONDITIONS, AND WITHOUT REQUIRED MAINTENANCE. THESE OFTEN OVERLOOKED CAPABILITIES ARE CRITICAL TO PROCESS CONTROL PERFORMANCE.'