Technical paper: Digital positioner technologies reduce risks at nuclear plants

Loop instability is a common issue in commercial power plants. For nuclear sites that are using digital technology, changes can be made within the setup of the positioner itself without requiring any hardware changes. This provides an optimum solution for both plant operations and engineering as the plant is generally able to operate more efficiently, producing more power, and with less risk.

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The basic advantages of digital positioner technology are generally well known and understood. The best models available provide users with:

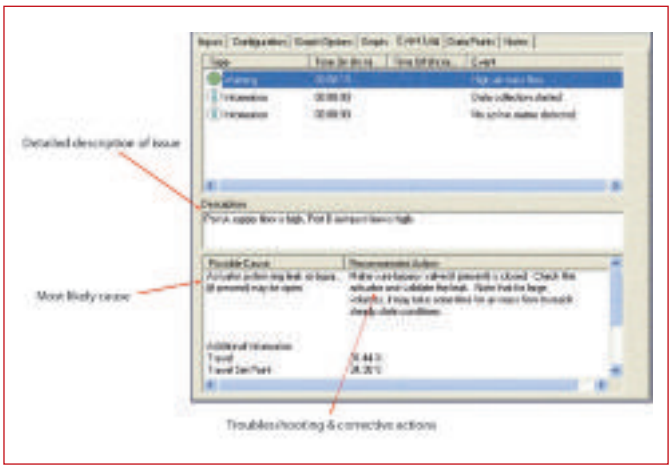
- Quick and repeatable setup to save time in commissioning and startup.
- High capacity and accuracy to ensure fast response with minimal overshoot.
- Customizable characterization to optimize loop tuning without hardware changes.
- Performance data that can be used to diagnose valve and system issues that would have previously gone unnoticed or caused costly shutdowns.

Process plants in all industries have been able to use this technology to help stabilize unstable loops and systems and to diagnose and fix problems before they impact their overall process. The nuclear industry, while later to adopt the digital positioner platform, is at the forefront of maximizing the diagnostic and custom characterization capabilities of the positioners. This article will discuss the use of this technology in the nuclear industry and also new features that further reduce risk and enable plants to operate more reliably and efficiently.

Custom characterization

Loop instability is a common issue in commercial power plants and nuclear plants are no exception. For plants, this instability costs money and power output. It requires systems to operate further from optimum set point because of the risk of overshoot of a critical level or pressure and the resulting trip. It also introduces risk by causing equipment oscillations, which result in increased wear rates, component failure rates, and reduced maintenance intervals. Because of this, several nuclear plant sites in North America have commissioned loop stability studies to improve and optimize their performance. In many cases these studies recommend tuning and characterization changes to stabilize processes. With traditional analog valve technology, the recommended changes would require hardware modifications such as a custom cam in an analog positioner or physical changes in the valve internals. These hardware changes are both costly and time consuming for the plant site.

For nuclear sites that are using digital technology, the tuning and characterization process can be much simpler. In many cases, the changes can be made within the setup of the positioner itself without requiring any hardware changes at all. This is truly a win for both plant operations and engineering as the plant is generally able to operate more efficiently, producing more power, and with less risk. The change process itself is also simplified by not requiring hardware modifications and the associated change review process.



Online Performance Diagnostics

Diagnostics

In addition to the stability studies, several North American plants have extensively utilized the diagnostic capabilities of digital positioners. Plants are now able to use valve diagnostics during outages to evaluate the health of valves remotely with a simple command that can evaluate several valves at once. This is a huge time saver for maintenance crews that would otherwise have to hook up to and diagnose each valve individually. This also reduces risk for plants with shorter outage durations that otherwise might not have time to evaluate a number of the non safety significant valves.

Online diagnostics in digital positioners enable users to monitor the health of the valve and the positioner itself while the valve is in operation. This allows users to be notified of issues in the system, the valve assembly, or the positioner itself as they occur and before they result in a failure. For example, configurable alerts in the Fisher® FIELDVUE™ DVC6000 Series digital valve controller and ValveLink™ software notifiy you of:

- Packing friction levels rise above or drop below a specified value
- Air supply changes
- Required air consumption to maintain control increases

These issues and alerts signify problems before they become critical and allow users to fix the issue before it impacts performance.

A perfect example of the use of online diagnostics in the nuclear industry happened in 2007 when packing friction in the main feedwater control valves at an operating nuclear plant dropped unexpectedly signifying a problem with the packing. In this instance, the engineers at the site were able to monitor the drive signal, valve position and packing friction levels through the use of online valve diagnostics in their Fisher digital valve controller while temporarily repairing the failure. This enabled the plant to stay online where otherwise they might have been required to shut down the plant to repair the problem.

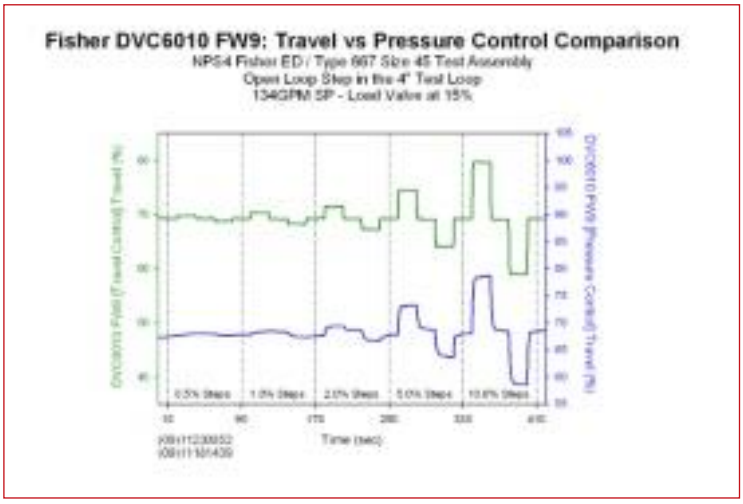
New features to further reduce risk

Digital positioner capabilities have continued to evolve as the technology has matured. For example, a recently added capability in the Fisher DVC6000 Series digital valve controller is pressure fallback mode. With this feature enabled, the positioner can detect travel sensor failure or other position feedback issues and continue to operate in pressure control mode as a calibrated I/P transducer. In many cases this will allow the system and valve to stay online and operating until maintenance can be scheduled and the positioner can be restored to full travel control mode.

The nuclear industry is again at the forefront of maximizing the use of this new technology. The industry's more extensive understanding of advanced functionalities they are gaining through use of the product

Pressure control mode test setup

has provided a clearer picture of their own processes. With this, they are requiring suppliers to undergo significant testing of all product features to better understand their impact on the end process. In the case of pressure fallback mode, North American



Open loop step response test graph

nuclear utilities requested performed detailed comparison testing of DVC6000 Series digital valve controllers in travel control and pressure modes. As requested, the testing was conducted in December 2009. Tests consisted of:

- Open loop tests to evaluate how well the valve travel responded to changes in positioner input signal.
- Closed loop tests to determine how well the positioner and valve assembly remove disturbances from a process.
- Friction effect testing to quantify the effect packing friction has on the relative performance of pressure fallback mode and travel control mode.

The testing performed did show that accuracy of the positioner in pressure fallback mode was reduced from that of travel control mode and that valve friction does impact this accuracy. Both of these outcomes were expected. More importantly however, it demonstrated that this feature has the potential to keep plants online if a travel feedback failure does occur.

Another new technology that will be released by Emerson Process Management for the DVC6000 Series digital valve controllers this year is an alternate linkage-less non-contact position feedback sensor technology that uses field proven Hall Effect sensors that magnetically measure valve travel. This technology eliminates the contact points and mechanical linkages that are found on digital and analog positioner feedback assemblies. Not relying on a mechanical means of travel feedback virtually eliminates the risks associated with vibration and wear that can have an impact on any mechanical component.

Right now is an exciting time for the nuclear industry and operating plants as they continue to utilize the features and technologies in digital positioners. New technologies will continue to help plants to operate more efficiently and safely.

About the author

Mr Jeff Troutner manages the sales and marketing programs for the Fisher Nuclear Business unit of Emerson Process Management. Having started his career as a civil design engineer after graduating from the University of Iowa with a BSc in Engineering, he joined Emerson Process Management in 2004 and has held roles in application engineering, sales, and marketing over the last 6 years. Jeff also received an MBA degree in Business Management in 2008 and lives in Bondurant, IA with his wife, Andrea, and two children, Grace and Nicholas.

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