Position Indication for the Power Industry

Coal-Fired Power Plants

TopWorx and the Coal-Fired Power Industry

TopWorx has been involved with the Power Industry for over 50 years and our GO Switch has been used on many different applications throughout plants

TOPWORX

EMERSON
Process Management

Introduction

Reliable measurement and position indication are integral to the efficient operation of today's power plant. Because maintenance personnel must perform more tasks with fewer resources, unreliable position feedback is often the cause for unplanned shutdowns and cannot be tolerated. To avoid these unplanned shutdowns, position indication devices in a coal-fired power plant must be able to endure one or more of the following environmental extremes:

- Physical abuse
- Coal dust
- Caustic lime slurry
- High/Low temperatures
- Moisture
- Caustic wash down
- Caustic fly ash
- High vibration

Figure 1: GO Switches mounted on a Fisher 657 diaphragm actuator

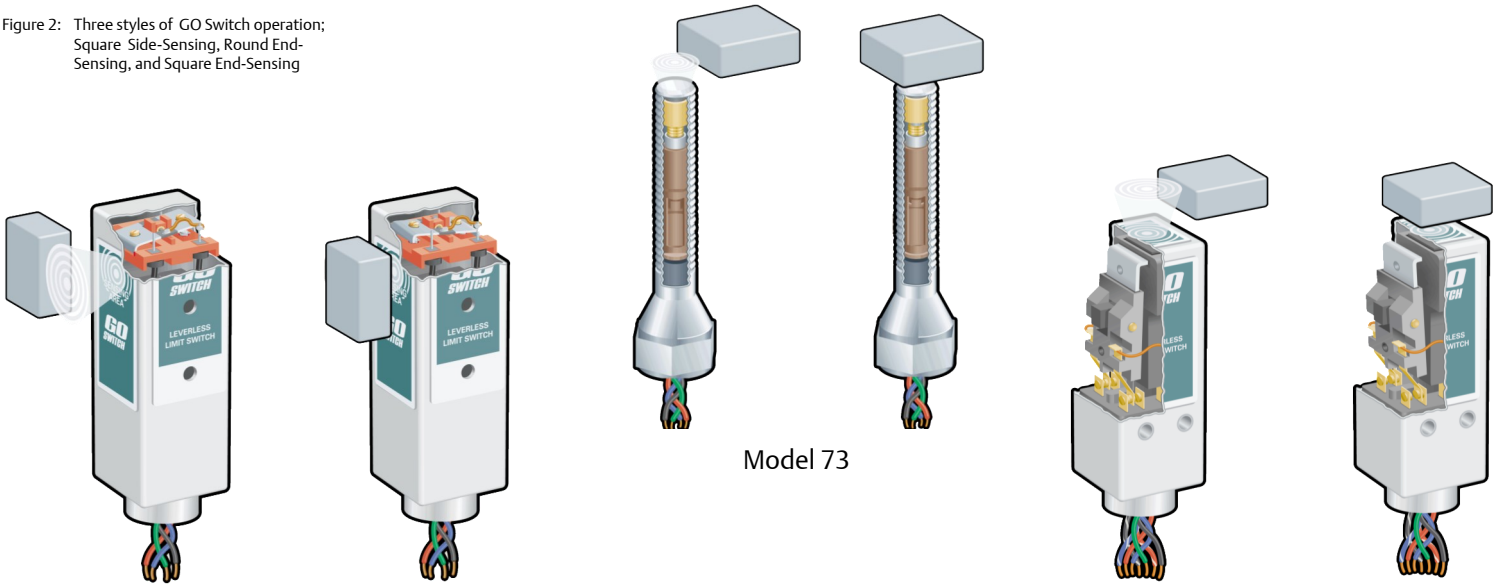
When reliability is critical in an application, coal-fired power plants use GO Switch™ magnetic position sensors. Mechanical limit switches rely on a lever arm that must make physical contact with a target for position feedback. This lever arm often warps and breaks, causing the operator to replace the lever arm and in some instances the entire switch. The internal mechanism of mechanical switches cannot be sealed against the environment due to the very same lever arm. GO Switch is different.

GO Switch employs completely sealed, non-contacting, magnetic technology to deliver extremely reliable position feedback. Non-contacting technology also eliminates external torque to the actuator, allowing maintenance personnel to perform diagnostic tests on valves without having to remove or disable the GO switch. Where the bulk and size of mechanical limit switches make it difficult to maintain surrounding valves and equipment and make the switch itself susceptible to failure in high vibration environments, GO Switch is smaller and lighter, making it less susceptible to these issues and a natural fit in the valve's framework.

How it Works

GO Switch uses a specially designed arrangement of magnets to control a set of mechanical contacts. The switch operates with a snap-action response, providing precision position sensing and feedback. This unique technology allows for non-contact detection of ferrous metal and magnetic targets. The GO Switch is a dry contact device, meaning it does not require any power to operate. The single pole double throw contact arrangement gives the user the ability to wire the GO Switch either normally open (NO) or normally closed (NC), as well as apply either AC or DC current without having to make any special arrangements or modifications.

Figure 2: Three styles of GO Switch operation; Square Side-Sensing, Round End-Sensing, and Square End-Sensing



Model 11

Model 73

Model 81

Typical GO Switch Applications in Coal-Fired Power Plants:

- Coal yards
- Coal processing
- Boilers
- Turbines
- Water cooling/circulation
- Flu gas desulphurization

COAL YARDS

The entire process begins with coal being brought to the power plant. Coal is brought in by barge, railcar, or truck. Once it is unloaded, the coal is stored in the coal yard until needed. This area of a coal-fired power plant can be quite severe. Most of the process is outdoors and equipment is exposed to coal dust, high vibration, hot/cold temperatures, moisture, and physical abuse. These types of environments are best suited for a sealed, non-contact position sensor like the GO Switch.

Typical coal yard applications:

- Barge Unloaders - Coal is unloaded from a jetty using a grab bucket and placed in a hopper to be transported to the coal yard. GO Switch provides position indication on various moving parts of the barge unloader, including the grab bucket.
- Coal Car Dumpers - A coal car dumper, or railcar dumper is used to rotate the railcar in order to dump the coal into a collection hopper. GO Switch senses the position of the dumper during rotation to prevent spills.
- Conveyors - GO Switch detects speed variances and reverse direction of conveyor line, which indicate a broken belt drive.
- Gate - Gates are used to direct coal to different conveyor belt systems. GO Switch is mounted on valves using brackets to report open/closed position of the gate.
- Hopper Valves - Hoppers are used to collect coal and the valves under the hoppers open when coal is needed. GO Switch provides open/close indication for the hopper valve.

Figure 3: A coal barge

COAL PROCESSING

When processed, the coal is moved from the coal yard on a conveyor system which incorporates valves to move the coal. The coal is moved through a crusher house, a sampler, a bunker and then through a feeder into a pulverizer, which turns the coal into a fine powder prior to entrance into the boiler.

Typical coal processing applications:

- Gate - Gates are used to direct coal to different conveyor belt systems. GO Switch is mounted on valves using brackets to report the open/closed position of the gate.
- Hopper Valves - Hoppers are used to collect coal and valves under the hoppers open when coal is needed. GO Switch provides open/close indication of the hopper valve.
- Coal Samplers - Coal Samplers are used as quality control to ensure the coal being fed into the process meets an acceptable grade prior to being fed into the boiler. GO Switch is used in multi-stage sampling systems to give gate position indication.
- Coal Feeders - Coal feeders use a conveyor belt system to feed coal into the pulverizer. GO Switch detects speed variances and reversed direction of the conveyor line, indicating a broken belt drive.
- Pulverizers - Pulverizers grind coal into a fine powder. GO Switch provides open/close indication of the paddle on the swing valves at the ends of the pulverizer feeder tubes.
- Diverter Gates - Diverters direct coal to different containers/hoppers. GO Switch is mounted on the diverter to indicate the position of the diverter gate.

Figure 4: A tripper car hopper

BOILERS

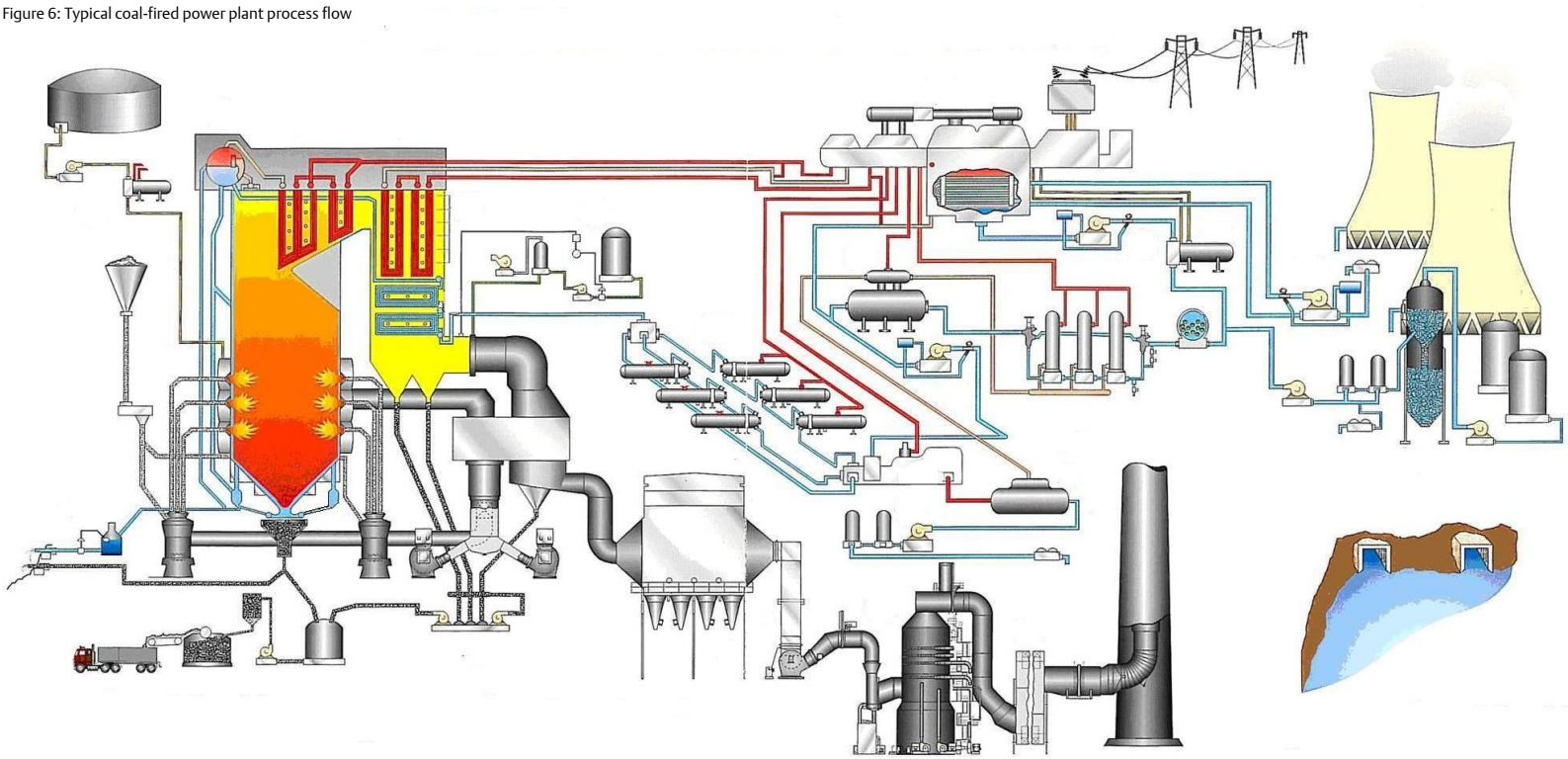
Once the coal is pulverized, it enters the boiler where it is ignited and mixed with air. Dampers modulate the air flow into the boiler and the heat generated by the coal burning process turns the water in the pipes surrounding the boiler walls into steam. This steam enters the turbine and generates electricity. During the coal burning process, soot collects on the boiler walls and pipes, creating an equipment hazard and reducing the heat transfer efficiency of the flame into the boiler. Reliable position sensing of soot removal equipment is critical for efficient boiler operation. GO Switch is a completely sealed, moisture resistant device with a standard operating temperature of 204°F (400°F hi-temp option) and an ideal solution for boiler applications.

Typical boiler applications:

- Feed Pump Recirculation Valves - These drag valves typically lower water pressure from 3500 psi to 500 psi. GO Switch is mounted on valves using brackets to report open/closed position of the valve.
- Bottom Ash Hopper Valves - The hoppers collect ash from the coal burning process and use either a pressure or vacuum system to move the ash to a collection area. Brackets are used to mount GO Switch on valves to report open/closed position of the bottom ash hopper valves.
- Soot Blowers - Soot blowers are used to clean soot that collects in the boiler from the coal burning process. GO Switch provides extension/retraction position indication on soot blowers.
- Boiler Igniters - Igniters are used to ignite coal, heating the water in the boiler walls and converting it into steam. GO Switch provides extension/retraction position indication of the igniters.
- Louver Dampers - Dampers are used to isolate or control flu gas flow in the coal burning process. GO Switch is used to give open/ close position indication of the damper.

Figure 5: A soot blower

Figure 6: Typical coal-fired power plant process flow



TURBINES

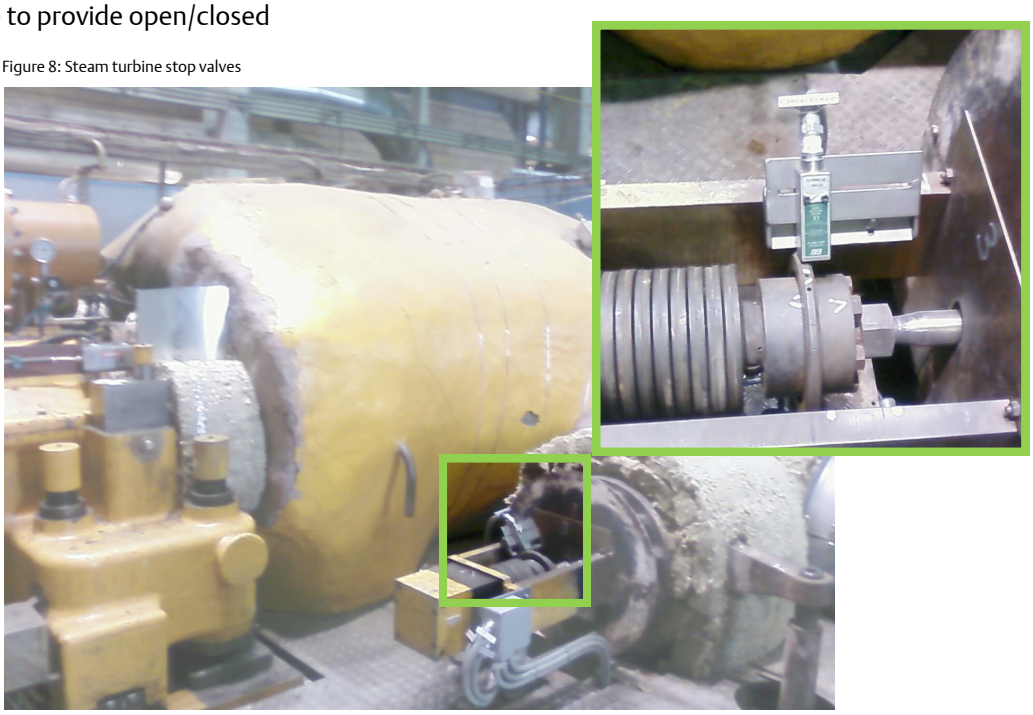
Turbines have a number of different valves that require monitoring for the proper start-up, shutdown, and operation. Electrical power 60 Hertz frequency is directly proportional to turbine generator RPM and if not governed, the RPM (typically 3600) will change as a function of the electrical load on the generator. Sudden, catastrophic loss of an electrical load will over-speed the turbine and destroy it. A steam turbine has large integral steam valves that govern and maintain its RPM and protect the turbine during catastrophic failures, such as a loss of a load. The throttle, reheat-stop, governor and intercept valves have switches that monitor and notify the control room of their open and closed positions. On some turbines the governor valves are ganged in groups of four and require only one switch system per group. The turbines that have independently operating governors will generally have switches on brackets rather than switch systems. The steam entering the turbine causes moisture to build up in the system, thus requiring drain valves to remove the excess moisture. GO Switch is a completely sealed, moisture resistant device with a standard operating temperature of 204°F (400°F hi-temp option) and an ideal solution for turbine applications.

Typical turbine applications:

- Intercept Valves - These valves admit and regulate the flow of steam to the turbine. The DEFENDER, a steam turbine valve monitoring system incorporating GO Switch, is mounted on valves to report valve position.
- Reheat/Stop Valves - These valves admit and regulate the flow of steam to the turbine. The DEFENDER, a steam turbine valve monitoring system incorporating GO Switch, is mounted on valves to report valve position.
- Trip Valves - These valves shut the turbine down. GO Switches are mounted on valves to report open/closed position of the trip valves.
- Vent Valves - These valves allow steam to pass through to relieve pressure in the condenser. GO Switch is mounted on valves to report open/closed position of the valve.
- Blowdown Valve - Pressure relief valves alleviate steam buildup from the packing around the turbine. GO Switch is mounted directly on the valve to give closed or open indication.
- Drain Valves - Drain valves drain moisture from the turbine. GO Switch is mounted directly on the valve to provide open/closed

Figure 7: Steam turbine trip valves

Figure 8: Steam turbine stop valves



WATER COOLING/CIRCULATION AREAS

The water cooling/circulation area of the power plant has many valves used to direct water to different areas of the cooling tower. Typically, butterfly or knifegate valves are used in this part of the power plant. This area can be very tough on mechanical limit switches because of the substantial amount of moisture in the environment. Available with submersible cables GO Switch is the perfect position detection device to use in this area of the power plant.

Typical water cooling/circulation area applications:

- Butterfly Valves - These valves control the flow of water into the water cooling process. GO Switch is mounted on valves using brackets to report open/closed position of the butterfly valves.
- Knifegate Valves - These valves control the flow of water into the water cooling process. GO Switch is mounted on valves using brackets to report open/closed position of the knifegate valves.

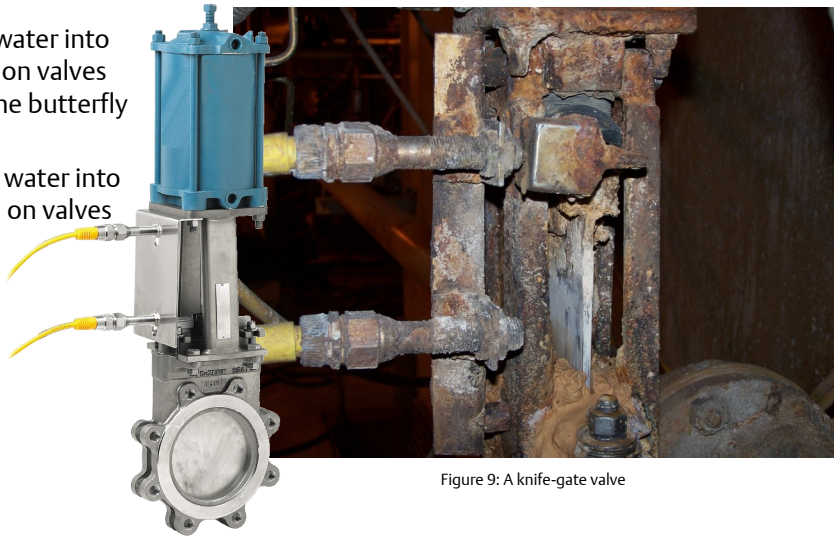


Figure 9: A knife-gate valve

FLUE GAS DESULPHURIZATION AREAS

Coal Fired Power Plants typically have three stages for flue gas desulphurization. The flue gas first passes through a Selective Catalytic Reduction (SCR) unit, which removes nitrous oxides (NOx). It then enters a particulate removal area where the fly ash is collected by hoppers and removed from the flue gas. The flue gas then enters the scrubber. Here a water spray mixed with crushed limestone reacts with the sulfur and removes it from the exhaust, thus creating a well-known compound, gypsum.

Typical flue gas desulphurization applications:

- Fly Ash Hoppers - The valves collect the fly ash from the coal burning process and use either a pressure or vacuum system to move the fly ash to a collection area. GO Switch is mounted on valves using brackets to report open/closed position of the fly ash hopper valves.
- Filter Dampers - These motor driven louver dampers use a heavy duty cloth filter to collect ash dust before it is released into the environment. GO Switch is used to give open/close position indication of the damper.
- Knifegate Valves – These valves control the flow of slurry from the gas desulphurization process. GO Switch is mounted on valves using brackets to report open/closed position of the knifegate valves.

Figure 10: Fly ash hoppers

Visit www.topworx.com or call (502) 969-8000 to speak with an Inside Sales Engineer regarding your application.

The TopWorx™ Family of Products

GO™ SWITCH
Using a unique technology, GO Switch outperforms conventional limit switches and proximity sensors in the toughest applications. If your plant conditions are hot, cold, wet, dirty, abusive, corrosive, or explosive, be sure to specify GO Switch for a long, trouble-free life.

VALVETOP™
Valvetop D-Series discrete valve controllers are certified for use in every world area. They carry IECEx, ATEX, UL, and CSA certifications in a single model, making it easier for global customers to standardize across plants in multiple world areas. Other certifications available include NEPSI, KOSHA, InMetro, and GOST. Valvetop D-Series discrete valve controllers can survive in virtually any plant condition. Their heavy-duty construction and corrosion resistance enable superior performance in the most demanding applications.

Valvetop T-Series switchboxes deliver outstanding value by providing full functionality in compact, direct-mount enclosures. Available with a variety of position sensors, integral solenoid valves, and bus networks, the T-Series is suitable for use in all hazardous areas and carry IECEx, ATEX, and CSA certifications.

TopWorx SIL-3 ESD Valve Controllers provide a complete Partial Stroke Test Solution with unique features and functionality that enable partial stroke testing of emergency shutdown valves without disrupting or shutting down the process.

WIRELESS
The TopWorx 4310 Wireless Position Monitor is a component of Emerson's Smart Wireless solutions for field instrumentation. Smart Wireless extends PlantWeb's predictive intelligence into areas that were previously out of physical or economic reach, opening the door for new possibilities in process management.

WIRELESS SAFETY SHOWER MONITORING SOLUTION
The TopWorx Wireless Safety Shower Monitoring Solution combines two 10 Series, latching GO Switches with a Rosemount 702 Wireless Transmitter that provide on/off indication, time stamping, and automated reporting functions for safety shower/eyewash stations.

VIP BRACKETS
With over 1,500 mounting kit designs, TopWorx products can be mounted on any rack-n-pinion, scotch-yoke, or vane actuator, quarter-turn manual valves, linear knifegate and control valves,

GLOBAL SUPPORT OFFICES

North America
3300 Fern Valley Road
Louisville, Kentucky 40213 USA
+1 502 969 8000
info.topworx@emerson.com

Middle East
P.O. Box 17033
Jebel Ali Free Zone
Dubai 17033
United Arab Emirates
+971 4 811 8283
info.topworx@emerson.com

Asia-Pacific
1 Pandan Crescent
Singapore 128461
+65 6891 7550
info.topworx@emerson.com

Africa
24 Angus Crescent
Longmeadow Business Estate East
Modderfontein
Gauteng
South Africa
+27 11 441 3700
info.topworx@emerson.com

Europe
Horsfield Way
Bredbury Industrial Estate
Stockport SK6 2SU
United Kingdom
+44 0 161 406 5155
info.topworx@emerson.com

Visit www.topworx.com for comprehensive information on our company, capabilities, and products – including model numbers, data sheets, specifications, dimensions, and certifications.

info.topworx@emerson.com

www.topworx.com

The Emerson logo is a trademark and a service mark of Emerson Electric Co. ©2013 Emerson Electric Co. ©2013 TopWorx™, All rights reserved.TopWorx, Valvetop, and GO Switch are trademarks of TopWorx™. All other marks used in this document are the property of their respective owners. Information contained herein - including product specifications is subject to change without notice.

valvetop™ GO SWITCH™

About Emerson Process Management

Emerson Process Management is a powerful, global, single source of process improvement technology and expertise. We help major companies in selected industries optimize their plants and processes to achieve higher quality, greater reliability and faster time to market, while steadily advancing productivity and profitability. We can build it - providing experienced project management, engineering and a single point of accountability for the entire instrumentation and automation system. We can connect it -- seamlessly integrating people and technology at every level of the process. We can improve it -- creating more efficient utilization of energy and raw materials. And we can sustain it -- producing greater reliability, month after month, year after year. From the field, to the plant, to the bottom line -- where performance is the question, Emerson is the answer.

TOPWORX™

EMERSON™
Process Management