

# PERFORMANCE BEHIND THE POWER



Gas and steam turbine solutions

# SOLUTIONS FOR A HIGHER LEVEL OF TURBINE RELIABILITY

Manufacturers of gas and steam turbines have relied on Moog motion control solutions for nearly twenty years. But today, the challenges are tougher than ever.

Maintaining reliable 24/7 operation, lowering system and operating costs, and ensuring long service life are just a few of the issues you now face on a daily basis.

Add to these meeting strict safety and environmental restrictions, and adapting to the rapid growth of electric technologies, and it's clear that the power generation industry is undergoing significant change.

Around the world, Moog experts help customers adapt to this shifting landscape with a robust product line of hydraulic and electric solutions, proven engineering leadership in all types of turbine applications, and a commitment to delivering innovation and reliability. Our goal is to deliver the expertise and products that maximize your technology investment today—while building a solid foundation for future productivity.

# ELECTRIC SOLUTIONS DRIVE RELIABILITY AND PERFORMANCE

While many customers look to Moog for world-class hydraulic systems, increasingly turbine engineers are turning to electric solutions that provide a range of key benefits. Our technology-neutral approach means Moog engineers stand ready to equip turbines with existing hydraulic controls to meet new performance demands. Or to provide the expertise and product lines required for the move to electric technologies.

Here are some of the ways Moog solutions provide a higher level of performance for gas and steam turbines everywhere:

## Improved precision and reliability

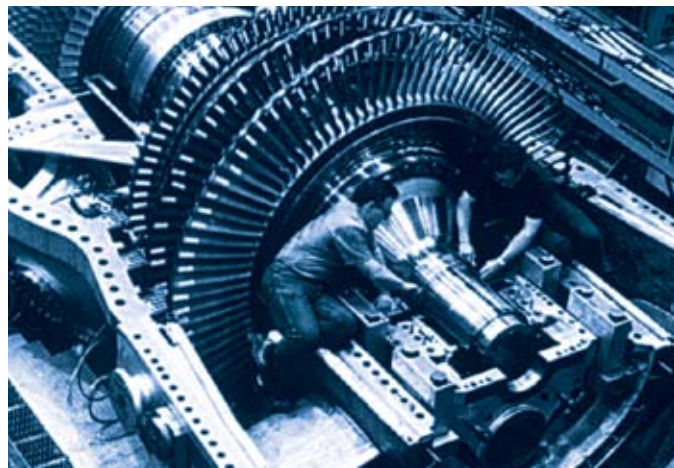
Moog's full product range and specialized engineering expertise mean customers gain advanced metering or positioning control matched with total reliability in 24/7 operating environments.

## Lower operating costs

Moog electric solutions provide overall cost savings in comparison with the infrastructure investment and operating costs of hydraulic systems.

## Safer operation

By eliminating potential fire hazards from high-pressure oil leaks and incorporating innovative fail-safe actuation technology for emergency shutdowns, Moog electric solutions meet the world's highest safety requirements. In fact, our models for use in hazardous areas are approved to FM, CSA and ATEX standards.



## Simplified installation and maintenance

Reduced plumbing infrastructure, easy setup and smaller system footprints help Moog electric solutions reduce your overall installation investment. What's more, the systems' extensive diagnostic capabilities and reliable operation afford lower maintenance costs over the life of the turbine.

## Cleaner operation

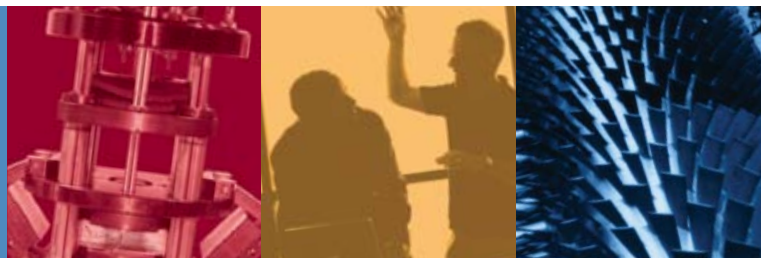
Today's environmental regulations are stricter than ever. Moog electric solutions combine precision performance with significantly cleaner operation.

## A NEW DEFENSE AGAINST DOWNTIME

A leading German manufacturer of gas and steam turbines turned to Moog for an electric solution that would help their customers maximize productivity while minimizing costly downtime. Moog engineers introduced an integrated package that was tailored to the customer's specific technical requirements.

### The request

Develop full electric actuation for all gas turbine functions to improve reliability, meet stricter emission regulations with better performance and provide easier maintenance and better system diagnostics.



### The solution

To meet the customer's needs, Moog designed and delivered a complete electric solution consisting of linear fuel gas process valve assemblies, rotary air bleed process valve assemblies, linear inlet guide vane actuator, brushless motor for fuel oil split valve, servodrives and position control electronics. All components meet hazardous environment ATEX requirements.

### The result

Moog's solution helped the customer deliver turbines that offer proven reliability, cleaner operation and higher performance. Most importantly, the solution will help the end users avoid costly downtime due to unforeseen turbine maintenance.

# HIGH-PERFORMANCE SOLUTIONS FOR HYDRAULIC AND ELECTRIC TURBINE APPLICATIONS

When it comes to reliability, Moog solutions provide unsurpassed, critical control functions on all sizes of gas and steam turbines. From large frame size through to the smaller aeroderivative engines, or on gas, liquid or dual fuel configurations, Moog has extensive experience in providing reliable hydraulic and electric technologies. In addition, Moog's proven gear pumps provide compact, flexible and cost-effective options for liquid fuel, lube or hydraulic oil pressure.

In both hydraulic and electric systems, core "building block" products are integral to the performance of Moog motion control solutions. Our solutions-based approach means Moog engineers have the products, technologies and expertise to

tailor control systems to your unique technical, performance and safety requirements.

From maximizing the longevity of a hydraulic turbine to helping you transition to an all-electric system, we can engineer a reliable, high-performance solution that is precisely tailored to your specialized needs. In fact, Moog has provided thousands of products to more than 1,000 plants worldwide.

Here is a look at some of the key Moog products and systems employed by forward-thinking turbine engineers around the world.

## ELECTRIC TECHNOLOGIES

### ELECTRIC FAIL-SAFE ACTUATOR

Our patented, hazardous area fail-safe actuator controls the flow characteristics of the process valve defined by the position commands of the turbine controller. In safety-relevant systems, spring-controlled systems are used to close/open the valve at emergency condition to a safe position. The actuator employs flexible interfaces for command and feedback between the turbine controller and the Motion Controller, including CANopen, Profibus and 4-20 mA.

- A total integrated solution, including the electric actuator, motion controller and servodrive
- Features a patented, lockable spring-controlled assembly with the highest safety level due to decoupled control and fast-closing spring mechanism
- Offers a high-performance alternative to traditional technologies that is certified for hazardous environments
- Eliminates system piping to lower installation costs, minimize interface complexity and save on installation time



### 880 SERIES ELECTRIC ACTUATOR

Moog Electric Actuators provide the ideal solution for inlet guide vane, gaseous fuel and liquid fuel controls.

- Available in linear and rotary actuator types
- Compact integrated approach for high temperature environments
- Customizable with various size servomotors, servodrive configurations and custom mounting arrangements
- Certified for hazardous environments



### MODULAR MULTI-AXIS PROGRAMMABLE MOTION CONTROL SERVODRIVE (MSD)

The MSD is a new generation of servodrives that provides the highest levels of dynamic response, smooth performance and application versatility. It includes modular servodrives powered by a shared power supply and a motion controller to coordinate motion across multiple axes and single-axis modules with an integrated power supply. The MSD offers built-in closed-loop positioning capability, feedback sensors and an optional fieldbus interface. In addition, Moog certifies its use with cable lengths up to 500 m. (1,640 ft.), allowing placement of the servodrive and motion controller well outside the hazardous area of operation.

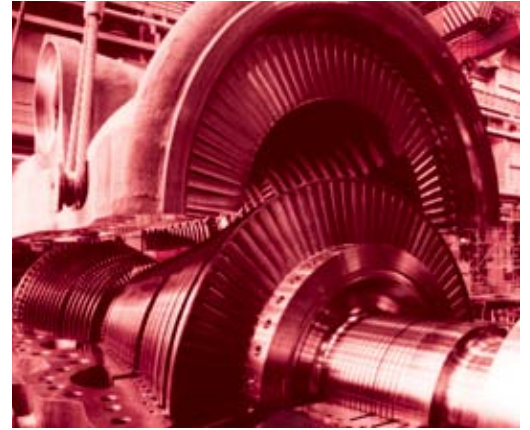


# HYDRAULIC TECHNOLOGIES

## 80 SERIES HYDRAULIC ACTUATOR

The choice for process control valves in hydraulic gas and steam turbine applications.

- Innovative compact design requires lower actuation force
- Integrates fail-safe spring assembly and pressure balance control valve technology
- Features a modular manifold with high-performance Moog Servovalve for hydraulic servocontrol, position transducers, on-board filter and spring return for mechanical fail-safe protection



## SERVOVALVES CERTIFIED FOR HAZARDOUS ENVIRONMENTS

Moog has created an extensive product line of rugged and proven Servovalves and Servo-Proportional Valves that are ideally suited to power generation applications.

- Moog has supplied over 10,000 servovalves to over 1,000 power plants worldwide
- Intrinsically safe for use in hazardous environments, these models are specially designed for power generation applications
- Reliable design with built-in fail-safe



## DIGITAL AND AXIS CONTROL VALVES

Modern turbines use more diagnostics for preventative maintenance. Moog's Servo-Proportional Valve product line is ideally suited to the harsh conditions of the turbine environment.

- Optional onboard position control
- Remote diagnostic capabilities
- Less sensitivity to contamination due to direct drive linear force motor technology
- Models certified for hazardous environments are available



# ELECTRIC AND HYDRAULIC TECHNOLOGIES

## PRECISION PERFORMANCE IN KEY APPLICATIONS

The proven reliability and performance of Moog's products make them the right choice for:

- Gas fuel control
- Liquid fuel control
- Inlet guide vane control
- Combustor by-pass
- Bleed valve control
- Steam admission control
- Steam extraction control
- Steam by-pass control
- Active instability control (AIC)
- Wet NO<sub>x</sub> control (steam and water)
- Dry low NO<sub>x</sub> control
- Blow-off valves
- Steam turbine governing

## MOTION CONTROLLER

Moog's Motion Controller offers unbeatable performance in a closed-loop control and includes full PLC functionality and remote monitoring capability. It utilizes application software that controls motion sequence, homing, interpolated position, drive safety monitoring and application limits.



## INLET GUIDE VANE CONTROL ACTUATOR

Designed for customized performance, energy efficiency and low maintenance. This actuator is available in both hydraulic and electric versions.



# TOTAL SUPPORT FROM ROTABLE PROGRAMS TO RETROFITS

With a long heritage of supplying products to virtually all major turbine OEMs, Moog understands the support needs of this changing industry. Moog supplies replacement, repair and field service for all products for gas and steam turbines. Moog Servovalves are preferred by plants for their long-life performance and despite their high level of customization, all Moog locations worldwide can offer service and support. Moog Global Support™ includes world-class repair services with quick turnaround by trained experts. Your local Moog professional will work with you to plan and implement a service and support program that matches your unique needs and helps minimize downtime all year long.

From scheduling maintenance during regular shutdowns to implementing rotable programs to developing an all-inclusive repair arrangement, Moog engineers can help you increase productivity, design more efficient turbine systems and save costs too. When the time is right for an upgrade, Moog helps you access the latest technology and product upgrades. We also can help you navigate the transition from hydraulic to electric technology.

Contact your nearest Moog representative to see how our world-class solutions, technical expertise and proactive support can help you improve your turbine operations today.



## KEEPING THE PRODUCT MOVING

A leading steam turbine OEM in the Pacific needed to keep pace with customer demand by boosting its manufacturing capabilities. The company turned to Moog for support in designing and building high-performance hydraulic actuators for its steam turbines.

### The request

Provide high-performance hydraulic actuators for its steam-governing system that would ensure reliability and productivity in a 24/7 operation within a harsh environment.

### The solution

Moog was able to meet the customer's request by designing a unique hydraulic actuator tailored to the exact needs of

the application. This highly reliable actuator was based on a proven design and used an advanced manufacturing process, enabling Moog to deliver in a significantly reduced lead time. The support of the local team of Moog engineers not only enabled smooth and rapid implementation into full production, but also helped establish a series of standard actuator designs customized to support their future projects.

### The result

The manufacturer is now in full production schedules for the foreseeable future, while gaining the peace of mind that Moog is standing by with total product support. The reliability and quality of Moog's tailored solution guarantees the turbine will run safely and with the performance the customer demands.



# TAKE A CLOSER LOOK.

Moog solutions for gas and steam turbines are only a click away. Visit our worldwide Web site for more information and the Moog facility nearest you.

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