SAMSON AND EVERYTHING FLOWS

POWER GENERATION

SAMSON Ringo
Type 3595 and others

SPECIAL PRINT

POWER GENERATION

SAMSON RINGO TYPE 3595 AND OTHERS

Application

Reliable and precise control valves are essential in power plants to ensure safe and stable operation in key systems such as boiler feedwater regulation, steam conditioning, and turbine bypass control. In these applications, process conditions involve extreme pressures and temperatures that place high mechanical and thermal demands on the valve components.

Power generation technologies vary, ranging from nuclear and conventional fossil-fired plants to solar thermal or biomass systems, but all rely on the transformation of energy through a steam and water circuit (based on the Rankine Cycle).

- Nuclear plants use fission heat to produce steam that drives turbines.
- Conventional thermal plants burn fossil fuels (coal, gas, oil) to heat water into high-pressure steam.
- Solar thermal plants concentrate sunlight to generate steam via molten salts or direct heating.
- Biomass and geothermal plants follow similar principles with different energy sources.
- Even concentrated solar power (CSP) and waste-to-energy facilities operate through variations of the water-steam cycle.

Despite the energy source, all these plants share the common challenge of managing high-pressure water and high-temperature steam circuits. At SAMSON RINGO, we provide tailored valve solutions for the most demanding limits in these systems, ensuring safety, control accuracy, and durability.

For example, in water service, particularly in high-pressure feedwater circuits, cavitation is one of the main concerns. It occurs when the local pressure in the valve drops below the vapor pressure of the water, forming vapor bubbles that collapse violently in the recovery area. This phenomenon can lead to severe erosion of the valve internals, noise, vibration, and ultimately a reduction in service life if not properly managed with the correct solution.

In contrast, valves operating in steam lines must withstand very high temperatures, often above 500 °C. These conditions require materials and designs capable of resisting thermal fatigue, deformation, and scale formation. Thermal expansion, frequent cycling, and steam impurities also contribute to long-term wear, making robustness and tight shut-off performance critical.

At SAMSON RINGO, we specialize in the design and manufacturing of high-performance globe control valves, such as the type 3595, and other valve types engineered specifically for these demanding conditions. Our control valves are equipped with anti-cavitation trims for water service and thermally optimized components for steam operation with velocity and noise control features, ensuring reliable performance, extended durability, and precise control in critical power plant systems.

Power Generation Fundamentals: The Role of the Rankine Cycle

Power generation is fundamentally rooted in the Rankine cycle, a thermodynamic process in which water is pressurized, heated, vaporized into steam, and then expanded through a turbine to generate mechanical work. This mechanical energy is subsequently converted into electricity via a generator. The cycle concludes with the steam being condensed back into water and returned to the system, completing a closed-loop process. In its simplest form, the cycle starts in the feedwater system,

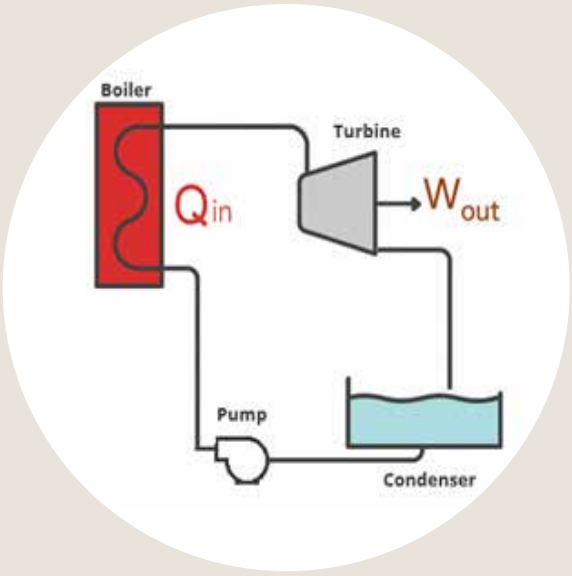

Fig. 1. The Rankine cycle begins with high-pressure water in the boiler, where heat turns it into saturated and then superheated steam, used to get work from the system

where high-pressure water is pumped into a boiler or heat recovery steam generator (HRSG). Here, thermal energy (regardless of its origin) is used to raise the temperature of the water until it becomes saturated steam, and then superheated steam, depending on plant configuration.
This high-pressure, high-temperature steam is then routed through steam turbines, where it expands and imparts kinetic energy to turbine blades. The resulting mechanical rotation is harnessed by generators to produce electrical power. After expansion, the steam enters a condenser, where it is cooled, usually by an external cooling system, back into liquid form and recirculated to the boiler.
Though conceptually simple, the Rankine cycle involves complex operational dynamics and extreme process conditions. These include rapid thermal transients, high differential pressures, and potential phase change effects, all of which place critical demands on valve performance, materials, and control strategy. Reliable flow control devices like those engineered by SAMSON RINGO play a vital role in maintaining the stability, safety, and efficiency of every phase of this cycle.

Key Features for Power Plant Applications
Multistage and Anti-Cavitation Trim Design:

In feedwater circuits and other high-pressure water applications within power plants, cavitation poses a major threat to valve longevity and operational integrity. To mitigate this, SAMSON RINGO employs multistage pressure-reducing trim designs combined with advanced anti-cavitation cages.
These technologies work by distributing the pressure drop across multiple stages, ensuring that the fluid pressure remains above vapor pressure always, thus avoiding cavitation. Additionally, the directional flow path engineered into the CAVLESS cage redirects and absorbs the energy of any vapor bubbles that may form, preventing them from collapsing violently on critical surfaces.
This results in reduced erosion, extended service life, and minimized maintenance requirements, especially in severe service environments such as boiler feedwater control and HP heater drain systems.

Anti-Noise and velocity control solutions:

In steam lines, where velocities are high and pressure drops are significant, excessive noise and mechanical stress can be a critical issue, particularly at control points like turbine bypass and steam conditioning stations.
SAMSON RINGO addresses these challenges through a combination of multistage velocity control and integrated silencing technology. Our globe control valves are available with specially designed silencer plates and cage-guided multistage trims, which work together to reduce the velocity of the steam and attenuate noise before it propagates through the pipeline.
These internal elements are engineered to handle high-temperature environments and are optimized to prevent flow-induced vibration, sound resonance, and damage to downstream equipment. By attenuating both noise and dynamic forces, our valves ensure a quieter, safer, and more stable operation in high-energy steam circuits.

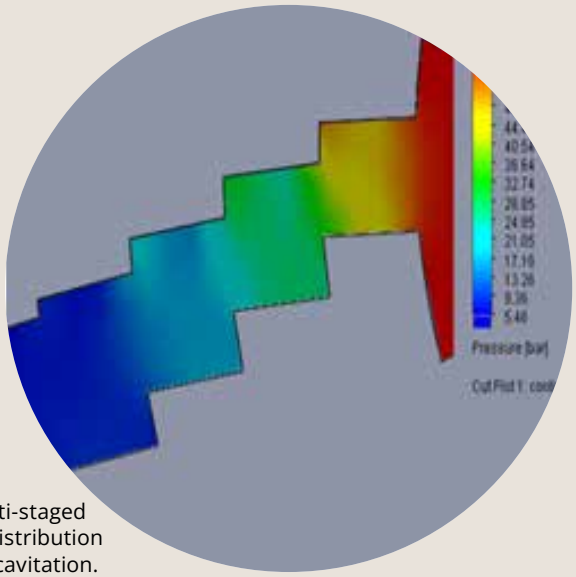

Fig. 2. Multi-staged pressure distribution to control cavitation.

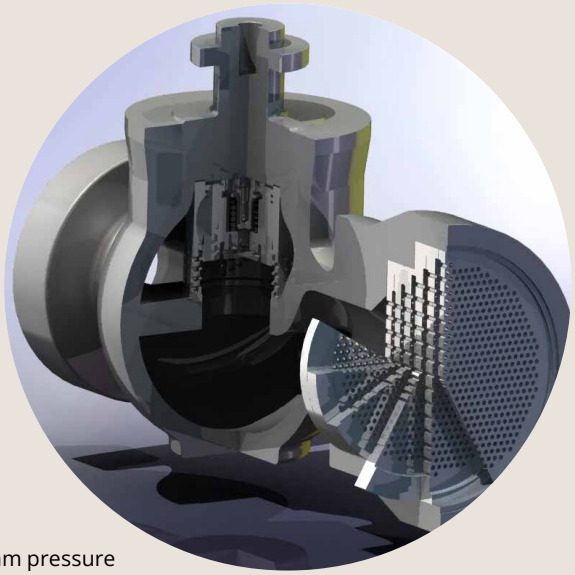

Fig. 3. Steam pressure reducing valve with silencer plates at valve outlet.

VALVE TYPES

Type 3595 Control Valve: Modular Cage Guide Construction

The Type 3595 control valve from SAMSON RINGO is a robust, cage-guided valve engineered to meet the demanding needs of power generation processes. Designed for use in high-pressure, high-temperature steam lines and water systems, the valve combines mechanical durability with thermal resistance, ensuring safe and efficient performance under severe operating conditions.

Exceptional Thermal Performance for Steam Service

In steam lines, such as turbine bypass systems, steam discharge, desuperheaters, or reheater pressure control, the 3595 valve excels due to its capability to withstand temperatures up to 700 °C (1292 °F). Its forged or cast body can be supplied in high-temperature steels like A217 WC6 or WC9, and even Inconel or super duplex grades for extreme conditions

To manage high velocities and significant pressure drops in superheated steam applications, the type 3595 has PILOT/STD™ and PILOT/LDB™ trims, allowing tight shut-off even under high temperature and differential pressure. These trims reduce wear on the valve plug and seat while maintaining Class V leakage across the full temperature range, a crucial factor in energy plant safety and efficiency.

Cavitation Control in High-Pressure Water Systems

For feedwater or condensate service, the risk of cavitation is substantial. The Type 3595 offers several advanced internal trims to combat this:

- CAVLESS™ trim: Designed with offset boreholes in the cage to redirect and dissipate cavitation energy away from critical surfaces. Ideal for applications where cavitation is unavoidable, such as in economizer or HP heater drains.
- MULTICYL™ trim: A true multistage pressure letdown solution, available in up to five stages, for applications with extreme pressure differentials. It provides gradual energy dissipation, avoiding flashing, cavitation, and noise, all in a compact, modular configuration.
- MULTISTEP™ trim: A labyrinth-style seat available for smaller valve sizes (up to NPS 2), optimized for low-to-medium flow rates and severe pressure drops.

Together, these options allow plant engineers to tailor the valve performance precisely to their water-side process requirements, minimizing maintenance and extending service life.

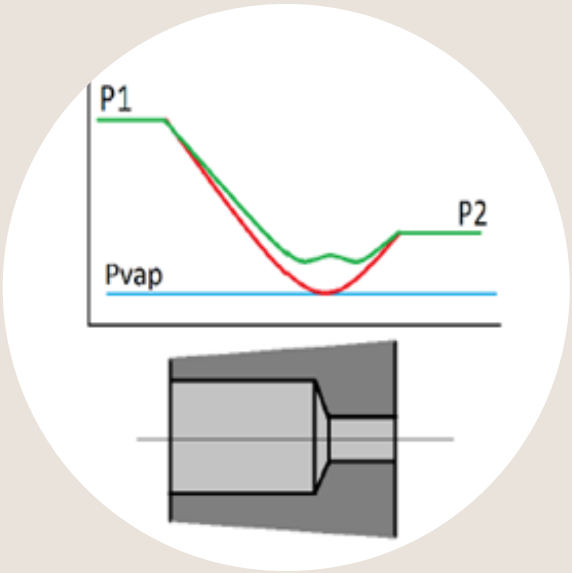

Fig. 4. CAVLESS cage hole detail, The pressure drop by this cage is painted in green against the pressure drop for a usual cage painted in red. This ensures no-cavitation with single staged construction.

Noise and Velocity Reduction in Steam Flow

In steam applications, controlling velocity and acoustic noise is as important as pressure management. High flow rates through undersized or poorly designed valves can lead to damaging noise levels and downstream erosion.

The 3595 valve offers integrated low-noise LDB™ cage designs and silencer plates, which are especially useful in turbine bypass and steam conditioning systems. These attenuate high-frequency turbulence and reduce downstream noise propagation, improving both environmental conditions and regulatory compliance.

Multistage flow paths and engineered flow characteristics (linear, equal percentage, modified) help ensure non-sonic flow conditions across the valve, minimizing wear and maintaining stable control.

Modular Construction and Maintenance Efficiency

The Type 3595 features a fully modular internal design, allowing rapid replacement or reconfiguration of plug, seat, and cage components. This not only simplifies spare part management but also enables field upgrades when process conditions change over the life of the power plant.

The plug is continuously guided by the cage, ensuring smooth actuation and minimizing vibration, even under fluctuating loads. The minimal gap between plug and cage reduces instability and protects the trim from premature erosion.

Fig. 5. High pressure 12”x16” steam emergency discharge valves for a Nuclear power plant

Flexible Configuration and Proven Design Envelope

- **Sizes:** NPS ¾ to 32
- **Pressure classes:** ANSI Class 150 to 2500
- **Connections:** flanged, welding ends, or welding-neck ends
- **Actuators:** Type 3271 and 3276 pneumatic actuators available in single- or multi-spring configurations, with fail-open or fail-close action
- **Materials:** wide range including A216 WCB, WC6, WC9, CF8M, duplex/super duplex, Inconel®
- **Trim combinations:** USS, BSS, PILOT, MULTICYL, CAVLESS, MULTISTEP — with optional noise-attenuation versions (LDB™)

For detailed technical specifications and sizing information, please refer to data sheet T 8079.

Desuperheater Units.

In power plants, desuperheating is used to control steam temperatures in systems like turbine bypass lines, reheater outlets, or Heat Recovery Steam Generators (HRSGs). This is achieved by injecting water directly into the steam flow.
SAMSON RINGO desuperheater units represent a critical valve category for modern thermal power plants, designed for severe service environments, are built to withstand steam temperatures up to 650 °C (1200 °F) and pressures up to Class 2500 / PN 400. Their robust construction, modularity, and high turndown ratio make them essential in achieving thermal balance and efficiency across the plant’s steam circuits.
Principle of Operation
Effective cooling depends on delivering water at the correct pressure, flow rate, and droplet size. In high-pressure sections—such as those downstream of boilers or within superheated steam loops—pressure reduction must accompany temperature control. This is managed using severe service multistage control valves with silencer plates and balanced trims, like the SAMSON RINGO PILOT plug, which provide smooth modulation, low actuator forces, and Class V shut-off performance.

Three Configurations:

1. **Spray Nozzle Type** – Compact and suitable for moderate conditions; supports high turndown ratios (>10:1).
2. **Venturi Type** – Ideal when low water pressure is available; includes venturi body, diffuser plates, and multi-stage PILOT plug.
3. **Integrated Type** – Combines water injection into the valve trim; perfect for tight spaces and low flow control, maintaining performance in critical areas.

Fig. 6. Steam desuperheater with SAMSON RINGO steam control valve and water control valve, including integral desuperheater unit.

Other Valve Types for Power Plant Applications

In addition to its range of control valves, SAMSON RINGO also manufactures a full portfolio of on-off and check valves specifically designed for power plant applications. These include ball valves, gate valves, butterfly valves, axial on-off valves, and check valves, all engineered to provide reliable isolation and backflow protection in high-pressure, high-temperature steam and water systems.

Each type plays a critical role in plant safety and efficiency: ball valves offer tight shut-off and easy automation; gate valves are ideal for full-flow isolation in steam and feedwater pipelines; butterfly valves provide compact, cost-effective solutions for large diameters; and axial valves are favored for fast-acting isolation in limited-space layouts. Complementing these, check valves ensure unidirectional flow and prevent reverse flow damage in pump outlets, condensate lines, and auxiliary systems.

Manufactured to international standards and available in a wide range of pressure ratings and materials, SAMSON RINGO's on-off and check valve solutions form an essential part of any power plant's critical valve architecture, offering robust performance, low maintenance, and long service life.

Power plant applications

Power plants, particularly those relying on thermal cycles such as fossil fuel, biomass, and combined-cycle installations, require a wide array of specialized control valves to manage the behavior of high-pressure steam and water circuits. The Type 3595 globe valve and SAMSON RINGO's range of on-off valves are used extensively across the following key applications within power generation facilities:

- **Boiler Feedwater Regulation:** In high-pressure drum or once-through boiler systems, boiler feedwater control is critical for thermal stability and steam quality. The 3595 valve equipped with CAVLESS™ or MULTICYL™ trims provides multi-stage pressure letdown, minimizing the risk of cavitation caused by flashing or low downstream pressures. The use of balanced plugs and high-alloy materials extends service life in aggressive water chemistry environments.
- **Turbine Bypass Systems:** During start-up, shut-down, or load rejection events, steam bypass systems protect the turbine by redirecting steam flow. These systems require valves capable of handling high enthalpy steam, rapid thermal cycling, and wide flow ranges. The 3595 valve, in its PILOT or MULTICYL configurations, ensures smooth throttling and Class V tight shut-off even at temperatures above 500 °C, while minimizing noise and vibration using LDB™ low-noise trim options.
- **HP and LP Heater Drains:** Heater drain valves experience variable flow rates and must operate under partial flashing conditions. To avoid cavitation and erosion, the 3595 with MULTISTEP™ or MULTICYL™ trims enables controlled pressure reduction in a compact footprint, ideal for applications with limited space and high reliability demands.
- **Main Steam and Cold Reheat Isolation:** For isolation duties in main steam lines or cold reheat lines, SAMSON RINGO offers robust gate and ball valves that ensure full-bore flow and absolute shut-off. These valves are designed with pressure seal bonnets and hardfaced seating surfaces, ensuring leak-free operation under extreme conditions and long maintenance intervals.
- **Desuperheater Control:** Steam temperature control via water injection requires precise modulation of both spray water and control steam. The 3595 provides finely tuned regulation, particularly when used with equal-percentage characteristics and positioners, helping to maintain outlet steam temperatures within tight tolerances during dynamic load changes.
- **Pump Protection and Recirculation:** Feedwater and condensate pumps are protected using axial or globe-type recirculation valves, which must react quickly to flow changes while resisting cavitation. The 3595 valve with CAVLESS™ trim ensures long-term performance with reduced maintenance needs. SAMSON RINGO also offers check valves to ensure backflow protection during pump shutdowns.
- **Steam Blowdown and Venting:** For safety-related venting and controlled steam blowdown, on-off valves such as butterfly or axial on-off valves are commonly used. These are designed for fast actuation, high flow capacity, and long cycle life.
- **Auxiliary System Isolation:** In condensate polishing, auxiliary steam, or startup loops, ball and butterfly valves offer compact, low-maintenance solutions for frequent actuation and long service cycles. Their availability in various materials and sealing types makes them adaptable to most fluid conditions within the plant.

Application Sample: Feedwater Pump Recirculation – Thermal Power Generation

In thermal power stations operating under varying load conditions, it is essential to guarantee continuous minimum flow through the feedwater pumps to prevent overheating and mechanical damage. During start-up, shut-down, or low-load conditions, the main feedwater flow may not be sufficient to maintain safe operating conditions for high-energy centrifugal pumps.

To address this, SAMSON RINGO supplied a series of globe-style control valves designed for high-pressure recirculation service, enabling automated protection of the feedwater pumps. These valves were built with forged bodies and included multistage, cavitation-resistant internals suited for sustained operation under high differential pressure conditions.

The second valve, the pump feedwater flow control, needs to cover the first stages with small flow rates and big pressure drops,

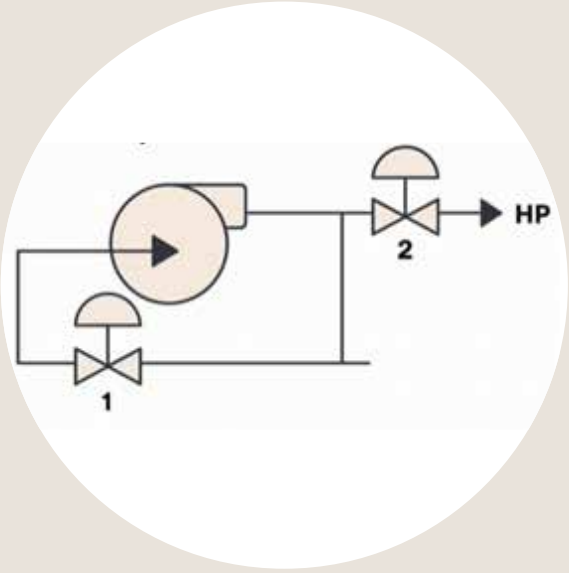

Fig. 7. Feedwater pump recirculation (1) and pump flow control (2) are the typical control valves used in the water pump system for any power plant

Key technical features of the solution include:

- Multi-cylinder trim architecture to absorb pressure energy gradually, eliminating cavitation risk even under throttled flows.
- 1:200 rangeability, allowing accurate control across wide operating windows—from low-flow startup to full-load operation.
- Metal-to-metal Class VI shutoff, ensuring no internal leakage or erosion during static recirculation hold modes.

The system provides a fully automated safety loop for pump protection and seamlessly transitions between active recirculation and normal feedwater delivery modes. The design is particularly valued in high-capacity fossil fuel plants were pressure fluctuations and thermal cycling demand robust and adaptive valve solutions.

Application Sample: Desuperheating and Turbine Bypass – Combined cycle gas turbine (CCGT)

Combined cycle gas turbine (CCGT) plants rely on efficient and rapid-response steam bypass systems to ensure operational continuity and equipment protection during sudden load changes, startups, or trips. The turbine bypass circuit must condition steam precisely, reducing both pressure and temperature, before routing it to the condenser or HRSG (Heat Recovery Steam Generator) inlet.

For this application, SAMSON RINGO provided a fully integrated bypass and desuperheating solution, comprising:

- A pressure-reducing control valve, engineered with a high-pressure balanced SAMSON RINGO PILOT plug and hard-faced seat to withstand erosive flow and thermal shock.
- A water spray injection valve, equipped with multistage MULTISTEP trim to prevent cavitation under high ΔP injection.
- A venturi-type desuperheater, promoting uniform steam-water mixing and eliminating the risk of thermal stratification or impingement.

Fig. 8. Steam pressure reducing control valve type 3595 and venturi type desuperheater CCGT

Each component matches the specific temperature-pressure profile of the bypass header, considering fast actuation requirements and noise attenuation constraints. The valves were supplied with compact actuators and integrated into a modular skid to simplify on-site installation and minimize maintenance downtime.

The solution offered superior controllability during rapid pressure drops, ensured safe steam admission downstream of the turbine bypass, and supported efficient thermal integration in multi-pressure HRSG units.

Application Sample: Multi-Service Control – Thermosolar Plant

Concentrated Solar Power (CSP) systems present unique valve design challenges due to fluctuating flow regimes, frequent flashing, and elevated noise levels across the steam-water circuit.

Additionally, advanced CSP installations increasingly utilize molten salt loops, either as direct heat transfer media or in thermal storage systems, which introduce further complexities such as extremely high temperatures, crystallization risks, and corrosive service conditions.

The application spans feedwater, pressure control, temperature modulation, reheater drain, venting, and molten salt isolation and transfer tasks under severe service conditions.

SAMSON RINGO valves utilized a range of specialized internal designs:

- MULTICYL and CAVLESS trims for cavitation and noise attenuation
- MULTISTEP trims for controlled pressure reduction in flashing zones
- Angle-type cage-guided bodies for high reliability and simplified maintenance
- High-alloy or Ni-based materials (e.g. Inconel, Hastelloy) to ensure corrosion resistance under molten salt exposure
- Extended bonnet configurations to thermally isolate actuator and heat tracing systems from salt crystallization points
- Metal-to-metal seats with hard coatings, designed to resist wear and seal reliably at temperatures exceeding 565 °C

Fig. 9. Molten salt pump recirculation with detail of the concentric tower thermosolar power plant

Fig. 10. Feed water control valve for conventional power plant. Angle forged type of 8" class 2500# with an operation pressure drop of 300barg.

Application Sample: Feedwater Control Valves for Boiler Level and Flow – Thermal or Biomass Power Plant

Maintaining precise control of feedwater into the boiler drum is critical for safe and efficient steam generation. In both base-load and cycling power plants, the boiler feedwater control valve plays a key role in balancing drum level and flow stability during load ramps or start-up.

SAMSON RINGO supplied feedwater control valves featuring:

- Multi-stage, MULTICYL trims to avoid cavitation at high ΔP
- Linear flow characteristic for stable level regulation
- Forged construction for strength under thermal cycling

By ensuring precise modulation, fast response, and secure shutoff, these valves not only safeguard boiler internals and enable reliable control even with the most extreme cavitation conditions. In the case of SAMSON RINGO, we have supplied up to water pressure drops of 300 bar, a testament to engineering precision.

Conclusion

At SAMSON RINGO, we understand that power generation demands more than just performance, it requires precision, durability, and adaptability under the most challenging conditions. Our engineered valve solutions are designed to meet the high standards of today's power plants, whether in conventional, combined-cycle, or renewable-cofired configurations.

With proven experience in handling extreme pressure drops, critical steam and water control, and severe service conditions, SAMSON RINGO delivers reliability where it matters most. From boiler protection to turbine bypass and beyond, our valves are an integral part of building efficient, flexible, and future-ready energy systems.

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