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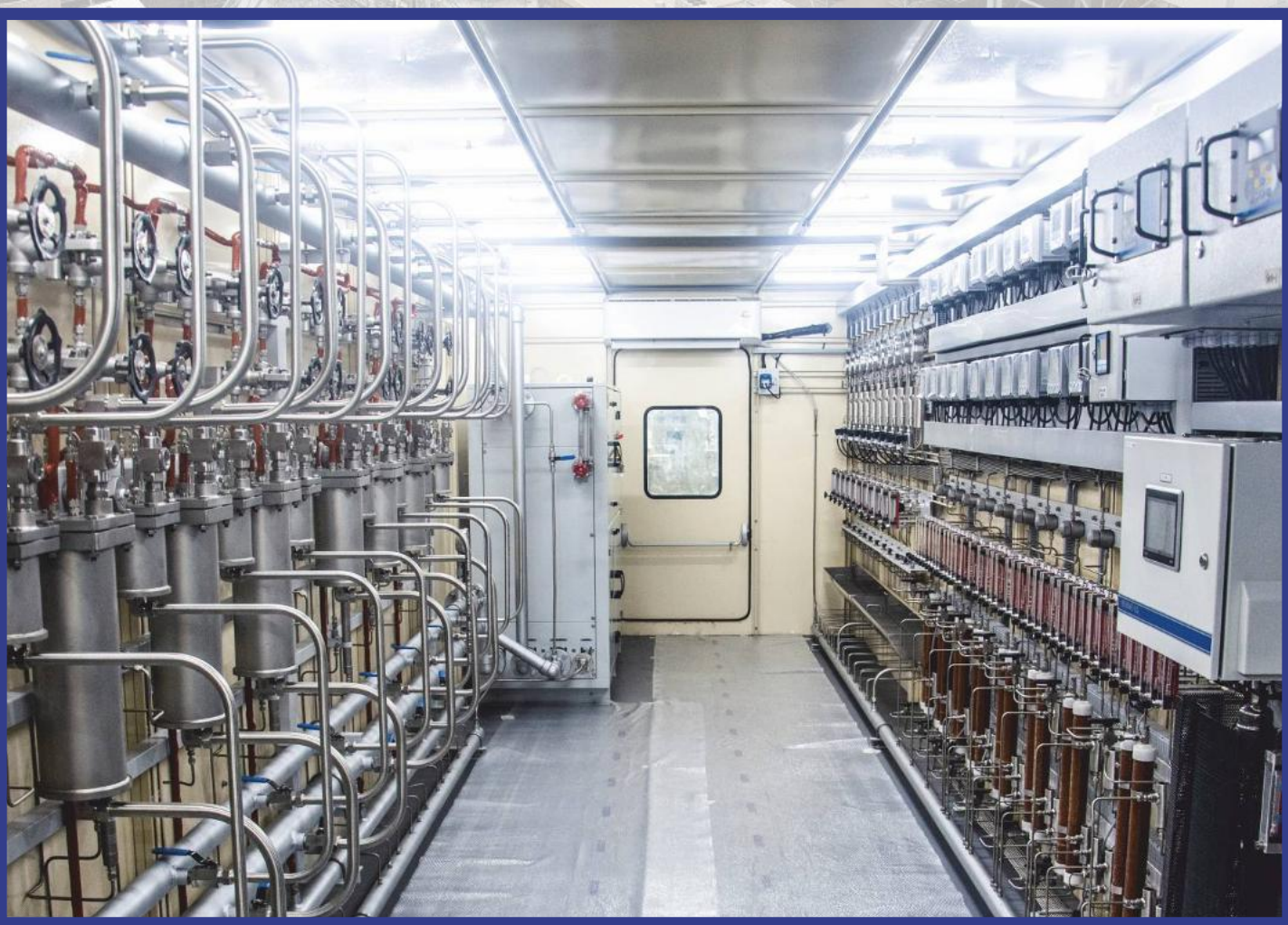


Precision Monitoring, Accurate Analysis

Reliable steam and water analysis systems for advanced sample conditioning

Boilers and turbines are critical capital equipment. Unplanned shutdowns due to failures can lead to stoppage of production / processes and significant financial losses. A survey of over 633 plants found that 3-4% of forced outages in boilers and turbines were due to poor water quality, causing corrosion and erosion in components like water tubes, superheater tubes, reheater tubes, and economiser tubes, leading to leaks in the steam and water circuits.

Without accurate measurement and monitoring, harmful elements like silica, sodium, dissolved oxygen, calcium, chloride and phosphates deposit on turbine blades leading to imbalance. In boilers, these deposits hamper heat transfer, reducing efficiency.

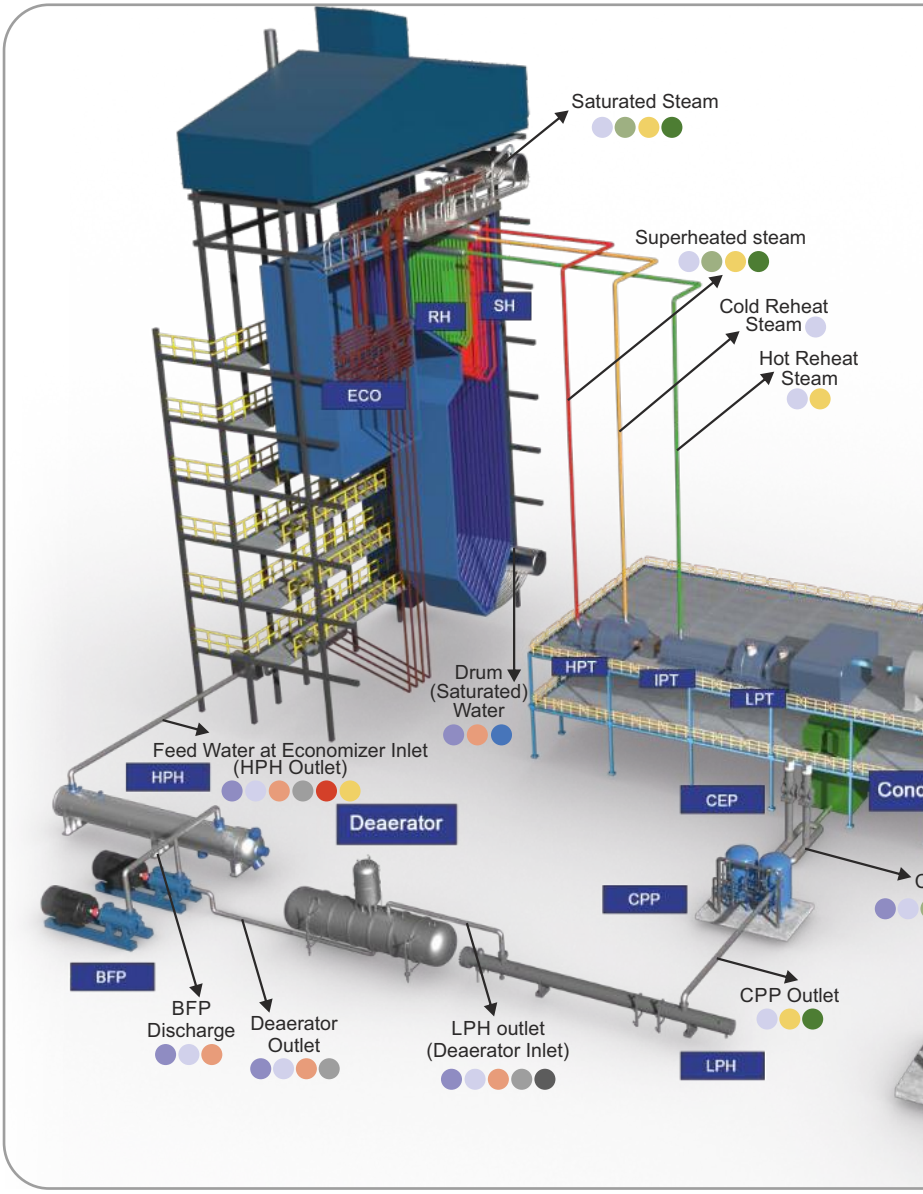
Forbes Marshall's steam and water analysis solutions (SWAS) analyse samples across critical points like DM water, condensate pump outlet, deaerator outlet, economizer inlet, boiler blowdown, and main steam outlet. The system, designed to handle samples up to 600°C and 350 bar g, operates in two stages: sample conditioning and analysis. This ensures timely corrective actions for safe, efficient, and reliable boiler and turbine operations.

Forbes Marshall solutions for steam and water analysis monitor the chemistry of feed water, drum water, steam, and condensate. The data provided helps operators to detect leaks, maintain optimal parameters, and control chemical dosing, blowdown, and condensate polishing. This reduces chemical costs, lowers energy consumption and minimises environmental impact.

Process Efficiency

Modern thermal power plants operate on a modified Rankine cycle, designed to enhance the thermal efficiency of steam generation and utilisation in steam turbines. Scaling and deposition in the boiler significantly reduce this thermal efficiency and also affect its mechanical efficiency by narrowing steam nozzles and pathways.

Therefore, it is important to maintain the purity of water and steam for efficient operation of the Rankine cycle. A well-designed Steam and Water Analysis System (SWAS) aids in monitoring and controlling critical chemical parameters present in water and steam, such as pH, conductivity, silica, sodium, dissolved oxygen, phosphate, and chlorides, thereby enabling the plant to operate at optimal efficiency.



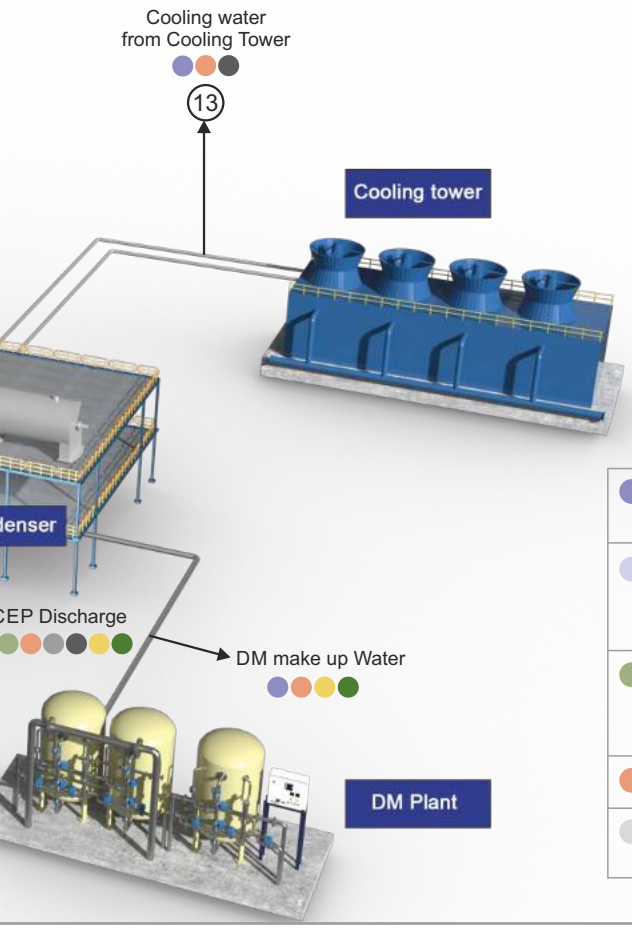
Energy Efficiency

Corrosion and erosion of critical high pressure parts is a major concern for any thermal power plant operating on steam. Impurities in water result in Forced Outages (FO) of the Boiler and steam turbine with a direct impact on the energy output from the plant. Steam reaching the turbines needs to be ultra-pure and hence needs to be monitored for its purity. This can be done with a well designed Steam and Water Analysis system (SWAS) which will prevent forced outages, enhance the overall equipment effectiveness and improve energy efficiency.

Environment

A well designed steam and water analysis system (SWAS), must ensure that samples taken are representative, from the point of sample tapping to analysis. These samples are often at extremely high pressures and temperatures. In next generation ultra-super critical power boilers, feed water pressures can reach upto 350 Bar and superheated steam temperature can be close to 600 Deg C.

Given these extreme conditions, it is critical to prioritise both instrument safety and occupational health and safety for those operating high pressure boilers. Forbes Marshall SWAS Packages are engineered to withstand these high pressure and high temperature samples in thermal power plants, ensuring a high level of safety for both, operator and instruments.



Benefits

Improved Efficiency

By providing continuous and accurate monitoring, SWAS helps in optimizing the efficiency of boilers, turbines, and other equipment.

Enhanced Safety

Regular monitoring of water and steam quality helps prevent conditions that could lead to equipment failure or unsafe operating conditions.

Cost Savings

Early detection of issues and predictive maintenance capabilities help reduce downtime and maintenance costs.

Environmental Protection

By ensuring optimal water and steam quality, SWAS helps in minimizing the environmental impact of industrial operations.

	Ks	Specific conductivity measurement
	Kc	Conductivity after Cation Exchange (CACE) Measurement
	Kg	Degassed Conductivity after Cation Exchange (DCACE) measurement
	pH	pH measurement
	ORP	Oxidation and Reduction Potential Measurement

	DO_2	Dissolved Oxygen Measurement
	Tur	Turbidity Measurement
	Hz	Hydrazine/ Oxygen Scavenger Measurement (Only for Mixed Metallurgy AVT-R Treatment)
	Si	Silica ion (SiO_2--) Measurement
	Na	Sodium Ions (Na+) Measurement
	PO_4	Phosphate (PO_4---) Measurement

Sample Conditioning

The first section of any SWAS is the sample conditioning section or the wet panel.

Here the sample is first cooled in sample coolers, de-pressurised in pressure regulators and then fed to various analysers while keeping the flow characteristic constant by means of a back pressure regulating device. The panels are also equipped with several features to ensure operational safety.

Open Frame-Free Standing Wet Rack

QSWAS™ is a compact pre-assembled modular, flexible and easy to use system that enables maximum utilisation of installation space along with an ease of operation. It gives the user complete flexibility in design layout, customisation and expansion of the SWAS panel to suit his ever changing requirements.

Walk-way Type Wet Panel

The Forbes Marshall Walk-way Type Wet Panels are designed for installation outside air-conditioned areas within the steam turbine building. They feature a walkway for easy maintenance, an optional stainless steel sink and countertop for durability, and a special locking mechanism to prevent accidental opening of high-pressure isolation valves. Equipped with ASME-certified components and tested to ASME standards, they ensure reliable sampling, controlled access, and enhanced safety for downstream analysers and operators.

Shelter Mounted SWAS Package

Forbes Marshall's shelter mounted SWAS packages are tailor-made analytical systems enclosed within protective shelters. They are designed with well insulated walls reducing energy consumption for heating, ventilation and air conditioning, and also curb energy losses. They ensure that the sensitive analysers are safeguarded from adverse environmental conditions and operate efficiently to provide reliable analysis.

Important Components of Sampling Systems (Wet Rack)

Sample Probe

Forbes Marshall isokinetic probes are designed as per ASTM D1066 standards, to isokinetically extract samples of saturated and superheated steam at high temperatures and pressures. This ensures a representative sample is taken from process steam lines thereby enabling prompt action on water chemistry.

Sample Cooler

Forbes Marshall Sample Coolers are coil-in-shell type contra-flow heat exchangers. Validated by a premier institute like IIT Bombay, we are one of the few sample cooler manufacturers in the world offering a guaranteed performance. With in-house tests set-up for performance testing, world-class manufacturing and welding facilities, we offer one of the most trusted sample coolers in the power sector. Various options of coil materials such as stainless steel AISI 316 and inconel 625 etc are available.

Sample Pressure Reducing Valve

Forbes Marshall's Relisafe-PR is a rod-in-tube type pressure reducing device with a combined functionality of pressure reduction and flow modulation. As the high pressure sample is forced to pass through the narrow annular region between the rod and tube, the frictional resistance causes a pressure drop while at the same time modulating the flow.

Back Pressure Regulator

Forbes Marshall back pressure regulators (BPR) prevent low flow (or fluctuating flow) conditions in analysers during grab sample valve operations. In the absence of the BPR, the sample flow would divert to the grab sample line when the grab sample valve is pened, causing low flow alarms in analyzers. A combination of pressure and back pressure regulators ensures stable pressure and flow for reliable and accurate analysis.

Important Components of Sampling Systems (Wet Rack)

Sample Filters

We also manufacture filters required to ensure particle-free samples. Particles of size up to 40 microns size can be filtered out. Forged stainless steel body and hexagonal cap help easy cleaning of the filter element.

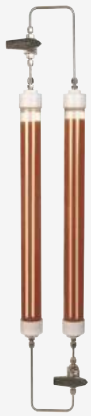
Relisafe-TP Temperature Safety Shutoff Valve with Manual Reset

The Relisafe-TP is a mechanical device which ensures over temperature protection in case of sample from cooler not getting cooled and crossing the limit of allowable temperature of analysers.

We recommend the use of temperature safety off valve to block the high temperature samples which otherwise can damage the analyser sensors that are delicate and costly.

High Temperature Isolation Valves

These valves are easy to operate and can be used for most high pressure and temperature applications. The unique plug/seat geometry and stuffing box design allow these valves to operate for extended periods of time without gland leakage and passing. Valves are designed for PN 500 (class 2500) and are offered for all ratings upto PN 500 and class 2500. Body seat integral stellite is hard faced by a special automatic welding process. Unique non-rotating single piece spindle plug design guarantees long seat life as grinding between plug and seat is eliminated.



Cation Column

The duplex type cation conductivity column is a field proven design. Cation conductivity measurements are considered to be more reliable than ordinary conductivity measurements, as this method ensures elimination of masking effects of desired chemicals used in treating the water. This provides a more realistic picture of dissolved impurities in the sample. Our cation column is easy to operate, regenerate and maintain.

Important Components of Sampling Systems (Wet Rack)

Dissolved Oxygen

At high temperatures, dissolved oxygen can lead to corrosion, causing pipe failure and leaks at joints. To address this, mechanical deaeration and chemical additives are used. Monitoring dissolved oxygen is crucial, especially in power stations with neutral to slightly alkaline pH (7.0-8.5), and is typically performed at the deaerator inlet and outlet

Aqua4trans Series Transmitters For pH

pH : The steam which goes to the turbines has to be ultra pure. The pH value of feedwater gives direct indication of alkalinity or acidity of this water. Ultra pure water has pH value of 7. In a steam circuit, it is a normal practice to keep the pH value of feedwater at slightly alkaline levels. This helps in preventing the corrosion of pipe work and other equipment. Typically dedicated pH analysers are recommended at following locations in a steam circuit: high pressure heaters, DM make-up mater, condensate extraction pump discharge.

Aqua4trans Series Transmitters For Conductivity

Conductivity: Conductivity is an important parameter for detecting any contamination of steam in the boiler circuit. Conductivity of pure water is almost zero (1-2 µ Siemens). Ingress of any kind of dissolved impurity will raise conductivity instantly. Thus, conductivity is an important parameter for the detection of leakages. Typical points in the steam circuit where conductivity should be monitored are: superheated steam, drum water, high pressure heaters, low pressure heaters, condenser, plant effluent, DM plant, make-up water to DM plant.

Important Components of Sampling Systems (Wet Rack)

Lab Sampling Module

We offer a lab sampling module for steam analysis in boilers, designed to international standards. Its compact, lightweight design ensures easy operation and onsite installation, making it ideal for continuous sample collection. Essential wherever boilers are used

Chiller Package

Chilled water is needed when site cooling water can't cool the sample to the required temperature for analyzers. If cooling water exceeds 40°C, the sample exceeds 45°C, necessitating chilled water. We provide chiller packages to cool samples to 25°C, being the only SWAS manufacturers with this capability.

Advanced Analysers for Superior Steam and Water Control

The Forbes Marshall SWAS comes equipped with online water analysers from SWAN Analytical Instruments AG, Switzerland, a global leader for online analytical systems. SWAN has extensive expertise in steam and water cycle chemistry and manufactures a wide range of analysers suitable for analysis of power plant samples. With each component manufactured and tested within their factory, their products are of the highest quality and accuracy. Precision, reliability and a determination for excellence make SWAN analysers the ideal partner for Forbes Marshall SWAS.

Application and Parameter Matrix

Applications → / Parameters ↴	High Purity Water	Feedwater, Steam and Condensate	Pharma Water	Potable Water	Pool and Sanitary	Cooling Water	Waste Water and Effluents
Ammonium				●			
Chlorine / Ozone / ClO_2	●		●	●	●	●	●
Conductivity and Resistivity	●	●	●	●		●	●
Fluoride				●			
Hydrazine / Carbohydrazine		●					
Hydrogen		●					
Nitrate				●			
Oxygen (dissolved)	●	●		●		●	●
pH	●	●		●	●	●	●
Phosphate		●		●		●	●
Redox (ORP)	●	●		●	●	●	●
Silica	●	●					
Sodium	●	●					
Turbidity	●	●		●	●	●	●
Total Organic Carbon	●		●				
Various		●		●	●		

Transmitter AMI Powercon

Electronic transmitter and controller for the measurement of the conductivity in power cycles. For the measurement before (specific / total conductivity) or after a cation exchanger (acid / cationic conductivity).

Measuring and control transmitter in a rugged aluminum enclosure (IP66)

Transmitter AMU Powercon

Electronic transmitter and controller for the measurement of conductivity in power cycles, before (specific resp. total conductivity) or after a cation exchanger (acid resp. cationic conductivity).

Measuring and control transmitter for panel installation in a Noryl resin enclosure

Monitor AMI CACE

Complete monitoring system for automatic, continuous measurement of conductivity before (specific / total conductivity) and after a cation exchanger with electro deionisation (acid / cation conductivity).

Transmitter AMI pH-Redox

Electronic transmitter / controller for the continuous measurement of the pH value or redox (ORP) in water

Measuring and control transmitter in a rugged aluminum enclosure (IP66)

Transmitter AMU pH-Redox

Electronic transmitter / controller for the continuous measurement of the pH value or redox (ORP) in water.

Measuring and control transmitter for panel installation in a Noryl ® resin enclosure

Transmitter AMI Oxytrace

Electronic transmitter and controller for the measurement of the dissolved oxygen in high purity water.

Transmitter AMU Oxytrace

Electronic transmitter / controller for the measurement of dissolved oxygen in high purity water

Monitor AMI Silica

Complete monitoring system for the automatic, continuous measurement of silica in water steam cycles

Analyser AMI Sodium P

For the continuous determination of dissolved sodium in the ppb-range for steam, condensate and high purity water for samples with pH ≥ 7

Monitor AMI Phosphate-II

Complete monitoring system for the automatic, continuous measurement of phosphate in potable water, effluents and cooling water

Monitor AMI Hydrazine

Microprocessor controlled system for the determination and control of hydrazine or carbohydrazide used as boiler feedwater oxygen scavengers

Monitor AMI Turbiwell Power

Nephelometric system based on ISO 7027 for the automatic and continuous measurement of turbidity in pure water in water steam cycles

Our Services

Digital services for a Steam and Water Analysis System (SWAS) can greatly enhance the efficiency, accuracy, and reliability of the system. Here are some key digital services that can be integrated with SWAS.

Remote Monitoring and Diagnostics

Real-Time Data Access

Enable real-time monitoring of water and steam quality through cloud-based platforms. Operators can access data from anywhere, allowing for immediate action if any parameter goes out of range

Data Analytics and Reporting

Trend Analysis

Implement data analytics tools to analyse trends over time. This can help in identifying patterns and making informed decisions to optimise water and steam quality.

Automated Reporting

Generate automated reports that can be customised for different stakeholders. This saves time and ensures consistency in reporting.

Alarm and Notification Systems

Real-Time Alerts

Set up real-time alerts and notifications for critical parameters. Operators can receive alerts, enabling quick response to any issues.

Integration with Plant Management Systems

SCADA Integration

Integrate SWAS with Supervisory Control and Data Acquisition (SCADA) systems for centralised monitoring and control. This provides a comprehensive view of the plant's operations.

Calibration and Configuration Management

Remote Calibration

Allow for remote calibration of sensors and analysers, reducing the need for on-site visits and ensuring continuous accuracy of measurements.

Training and Support

Remote technical support to troubleshoot issues quickly and efficiently.

Integrating these digital services with a Steam and Water Analysis System can significantly enhance its functionality, making it more reliable, efficient, and user-friendly. These advancements not only improve operational efficiency but also ensure better compliance with regulatory standards and help in maintaining optimal performance of power plants.

Industries We Serve

Power Plants

To maintain the quality of feedwater and steam, which is crucial for the efficient and safe operation of boilers and turbines.

Chemical Plants

To monitor the quality of water used in various chemical processes to ensure product quality and process efficiency.

Petrochemical Industries

To maintain the quality of steam used in refining and other processes.

Pharmaceuticals

To ensure the purity of water used in pharmaceutical manufacturing processes.

Customer Speak

We are thoroughly impressed by the reliability and low maintenance of the SWAS panel solution. We highly recommend it to other power plant operators.

- Combined Cycle Power Plant in Western Province, Sri Lanka

Using Forbes Marshall's SWAS has significantly boosted our plant's efficiency and prevented scaling issues. We're extremely pleased with the outcome

- Captive Power Plant In South India

We're extremely pleased with Forbes Marshall's SWAS. It has refined our plant's steam quality and operational dynamics beyond our expectations

- Gas fired Combined Cycle Power Plant in South America

Forbes Marshall's SWAS has made a substantial difference in our plant's steam performance and process accuracy. We're exceptionally pleased with the outcomes.

- Thermal Power Plant in North India

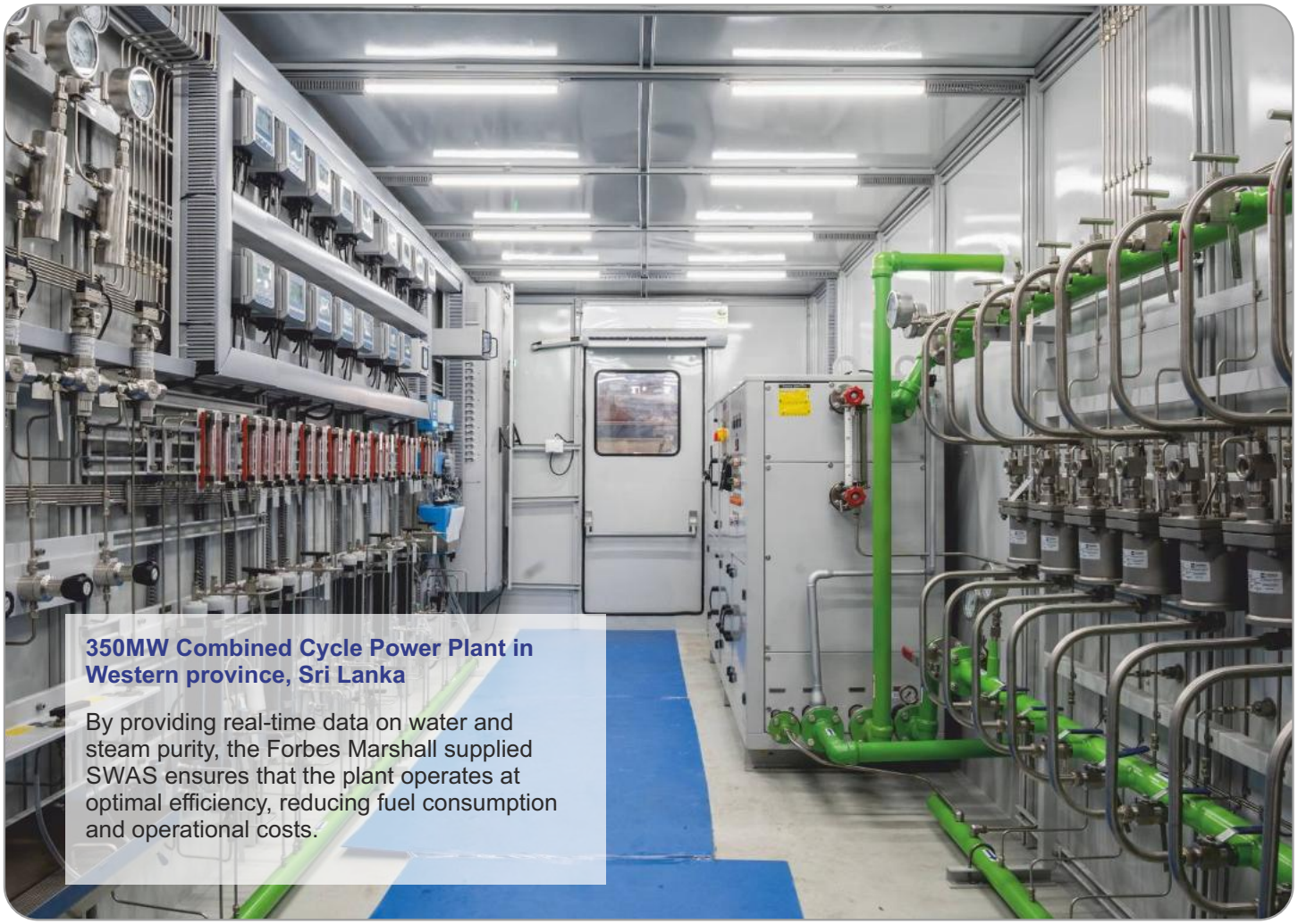
Installations Across the Globe

2X660MW Supercritical Thermal Power Plant in Northern India

Forbes Marshall supplied SWAS to India's largest EPC company, meeting the supercritical plant's requirement for precise water and steam quality control, preventing corrosion and scaling and enhancing overall efficiency and reliability.

Captive Power Plant in Eastern region of South Asia

Forbes Marshall's SWAS system installed at one of the biggest steel captive power plant ensures optimal efficiency, safety, and compliance, preventing corrosion and scaling, resulting in reliable and cost-effective operations.



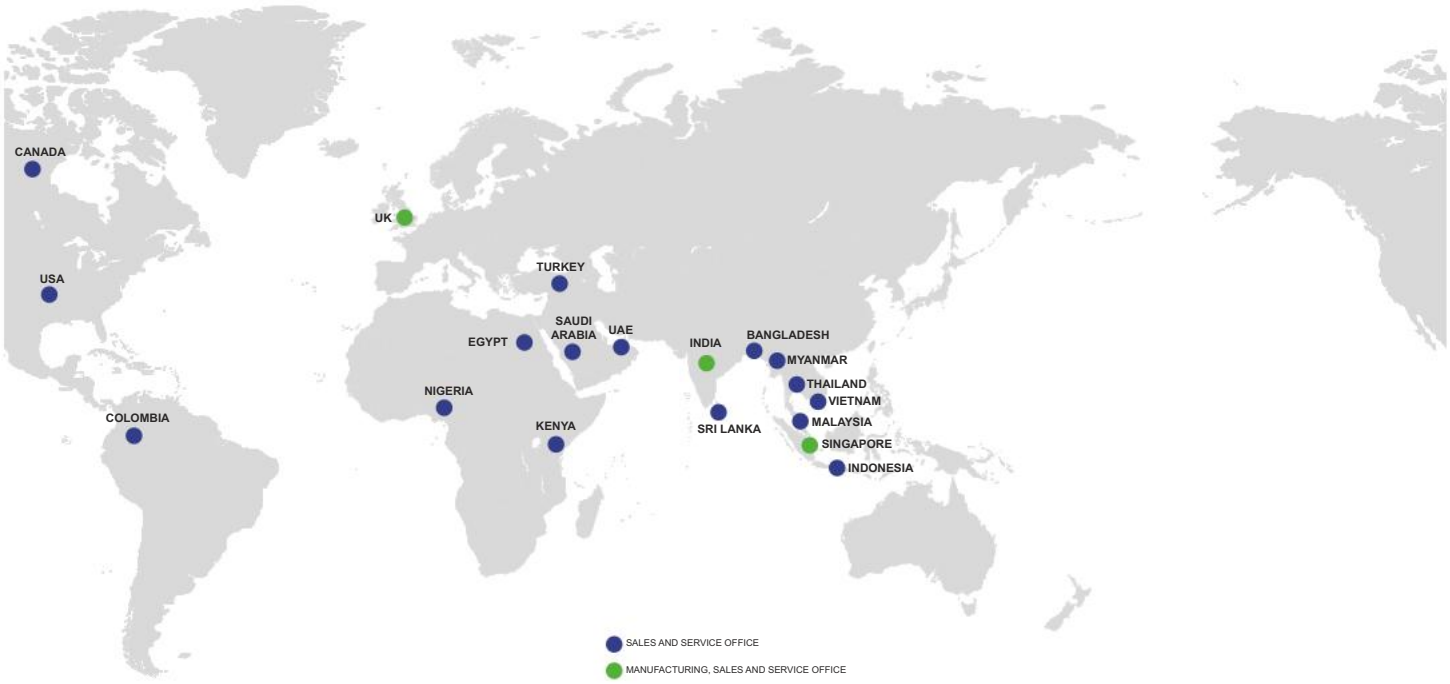
350MW Combined Cycle Power Plant in Western province, Sri Lanka

By providing real-time data on water and steam purity, the Forbes Marshall supplied SWAS ensures that the plant operates at optimal efficiency, reducing fuel consumption and operational costs.

517MW Gas-fired Combined Cycle Power Plant in South America

This project, on the coasts of South America, falls under a high seismic zone. The shelter is designed with Forbes Marshall's proprietary mechanical sampling components. The structural design is validated and certified by an authorised third party for high seismic zones.

Energising Businesses and Communities Worldwide



World Class Technology from World Class Facilities

Enabling Results

- **Process Efficiency**
- **Energy Efficiency**
- **Optimum Productivity**
- **Improved Asset Uptime**
- **Safety and Regulatory Compliance**
- **Environmental Responsibility**

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Forbes Marshall
Forbes Marshall Arca
Codel International
Krohne Marshall
Forbes Vyncke
Forbes Marshall Steam Systems

A: **Forbes Marshall Pvt. Ltd.**
Opp. 106th Milestone, CTS 2220, Mumbai-Pune Road,
Kasarwadi, Pune MH 411034 INDIA

P: 91(0)20 68138555 **F:** +91(0)20-68138402

E: intsolmarketing@forbesmarshall.com

W: www.forbesmarshall.com **CIN No:** U28996PN1985PTC037806

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