



2018 STEAM POWER PRODUCT CATALOG

SERVICES

ge.com/power

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With well over a hundred years of experience across more than 90 OEM brands, we customize solutions around:

- Planning and installation
- Long-term operation and maintenance
- Performance upgrades and improvement
- Asset/plant repowering and repurposing

Steam Power brings GE's digital industrial culture to life by blending advanced hardware and software technologies to help you achieve productive outcomes for your operational and business goals.

Thought leadership for today's energy challenges:



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This is Steam Power

Your Steam Lifecycle Partner

Worldwide network of steam experts delivering locally



The World's Largest Installed Base

- ✓ 5000+ Steam Turbines
- ✓ 4900+ Generators
- ✓ 1000+ Boilers
- ✓ 4000+ AQCS



Enabling Us to Deliver Each Year to Our Customers

- ✓ 1000+ outages
- ✓ 200+ long-term service agreements*
- ✓ 100+ steam turbine upgrades
- ✓ 200+ robotic inspections
- ✓ 50+ generator rewinds
- ✓ 50+ boiler upgrades
- ✓ 30+ AQCS upgrades



Our Dedicated Community of Experts

- ✓ 24/7 product support
- ✓ 10,500 field service representatives
- ✓ Complete **OEM services partner**
- ✓ Services for **90+ other OEM brands**



Total Plant Solutions

Power producers around the world face growing pressure to drive their plants' performance to new levels—enhancing reliability, efficiency, output and flexibility while lowering life cycle costs. In this increasingly competitive marketplace, you deserve a trusted partner with the expertise, technology and resources to help you achieve your desired outcomes. Through GE's Fleet360 portfolio, we can deliver solutions for total power plant assets across 90+ OEM brands, including:

Components/ Systems

- Steam turbine
- Generator
- Boiler
- Air Quality Control Systems (AQCS)
- Balance-of-plant systems

Solutions & Service Agreements

- Asset/plant-level software, controls and data analytics
- Repairs
- Parts programs
- Operations and maintenance (O&M) management
- Service agreements

Outcomes



Output



Efficiency



Reliability & Availability



Flexibility



Emissions



*Trademark of General Electric Company.

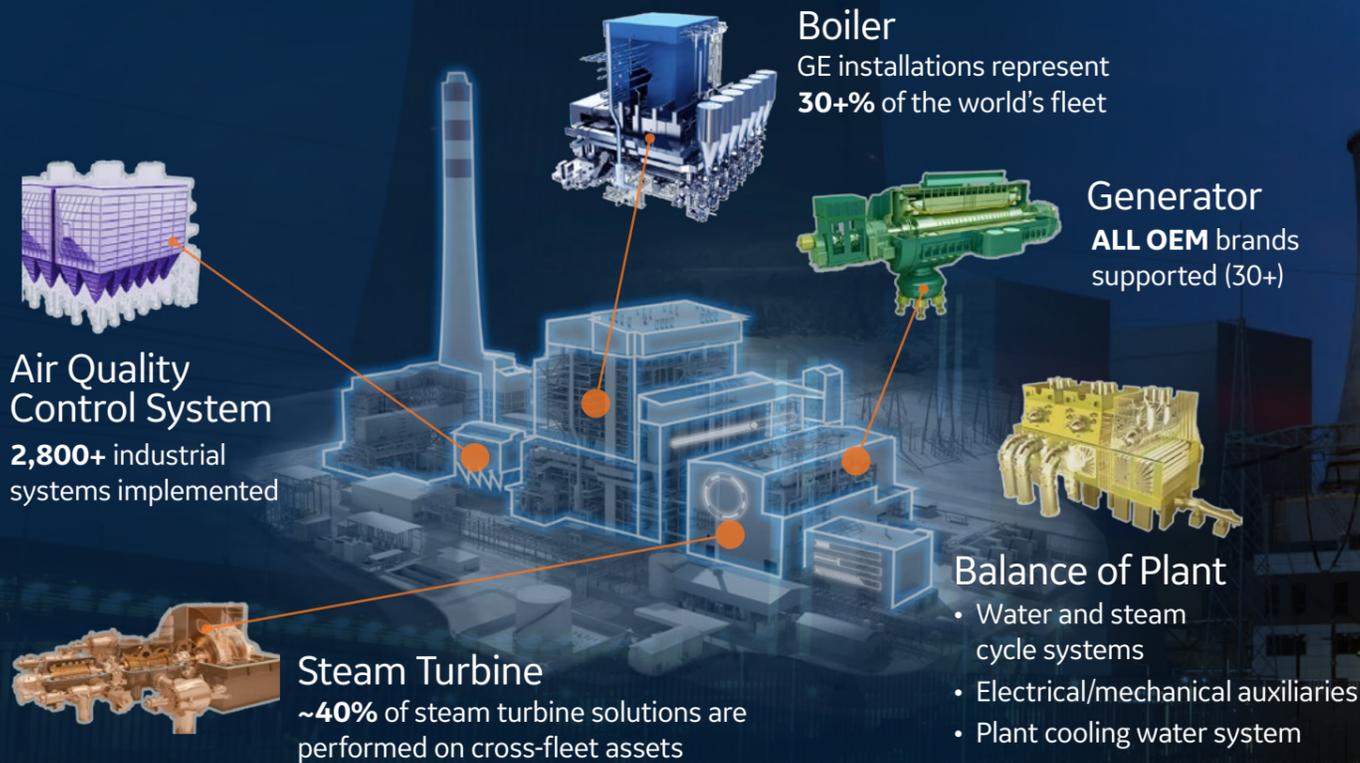
Steam Power Plant Solutions

- **120+** years of “plant-as-a-system” expertise
- **90+** OEM brands serviced
- **120+** million hours of operating data analyzed
- **1** partner to deliver all of your plant solutions

 **Click** each icon below to see specific outcomes.

Whether you’re operating a large fossil steam plant, nuclear plant or mechanical drive plant, you need flexible and creative solutions. Steam Power can work with you to develop a ‘no-regrets’ strategy that enhances your current performance, while protecting you against future uncertainty.

- Large fossil steam plant ... operating cost reduction
- Industrial and cogeneration ... reliability and operating flexibility



Multi-Year Agreements

Performance-based strategies that evolve through your plant life cycle

Operations & Maintenance (O&M) Services

GE manages **30+** O&M sites globally that produce 15 GW of total power

Digital Solutions

Outcome-based solutions that transform knowledge into power

OUTCOMES



Output



Efficiency



Reliability & Availability



Flexibility



Emissions

TOTAL PLANT SOLUTIONS



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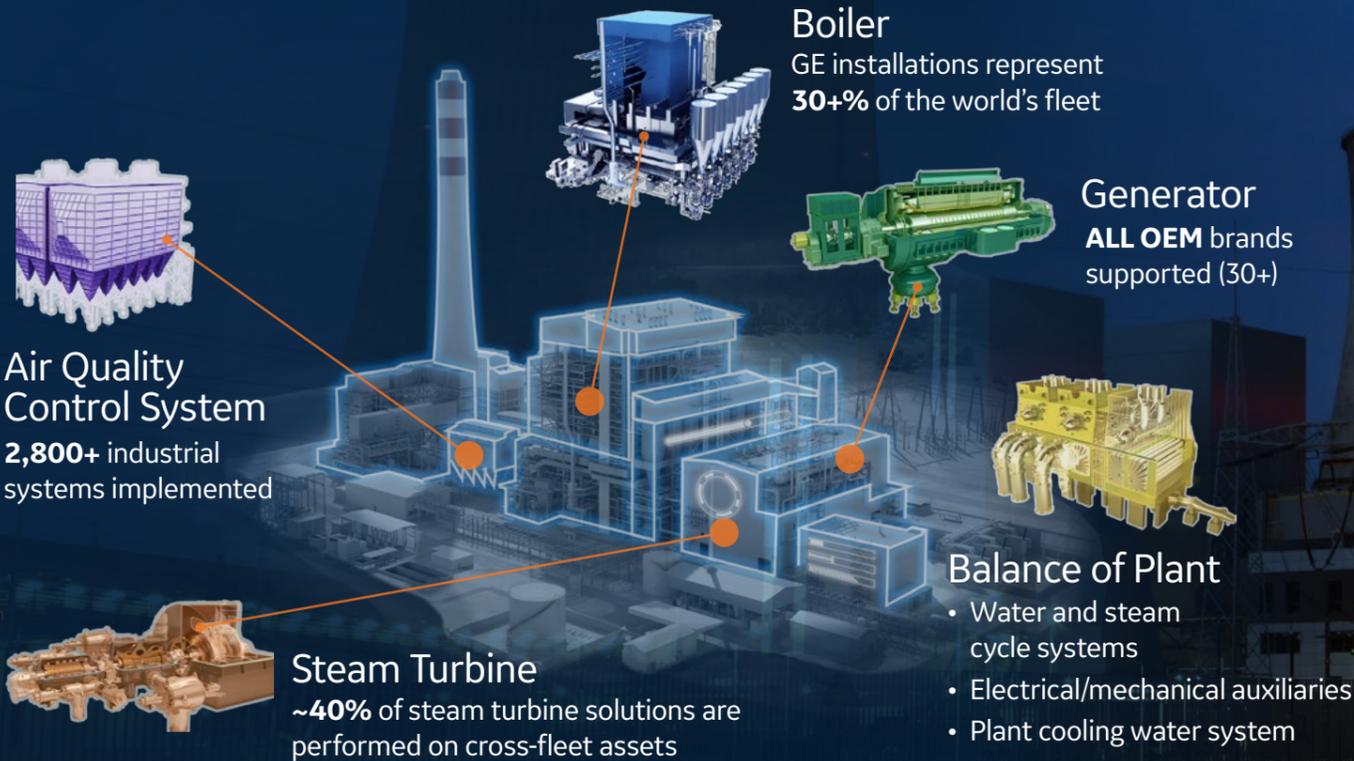
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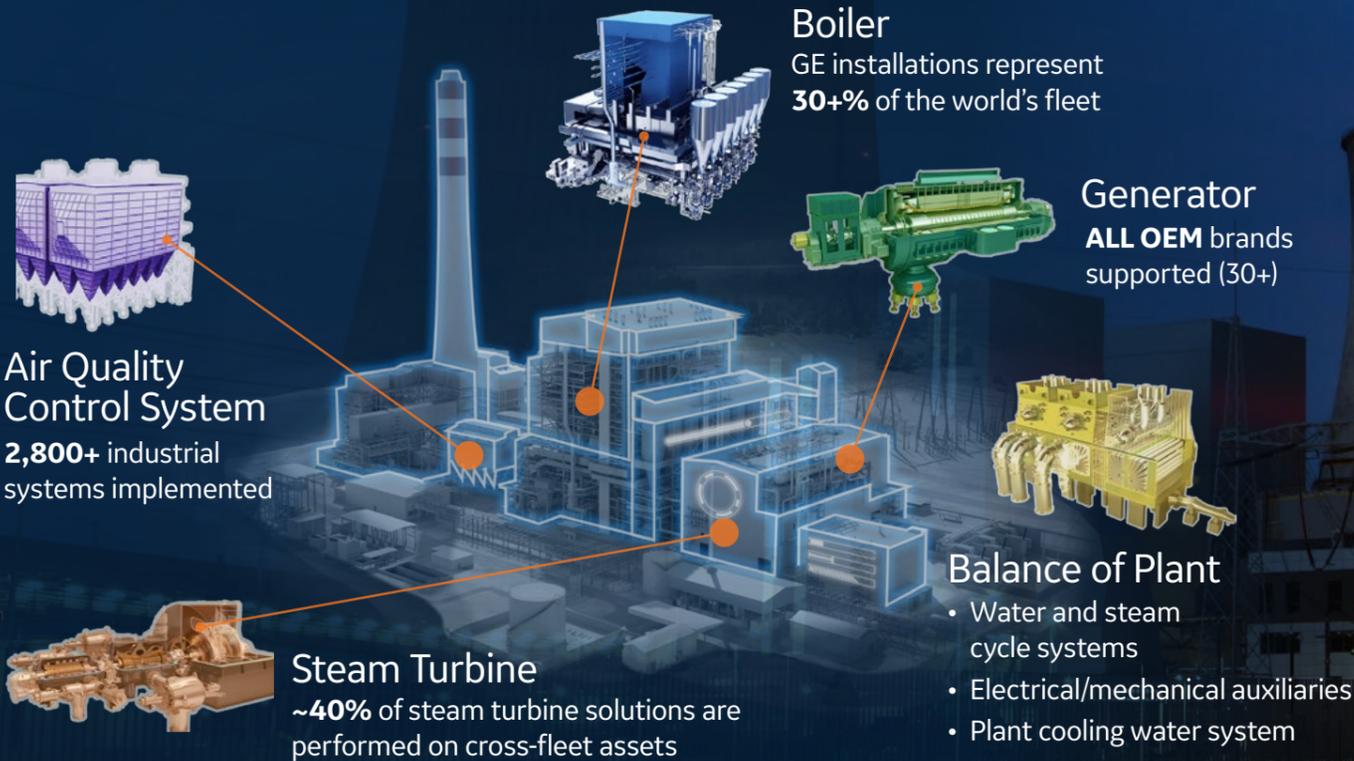
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OUTCOMES



Output



Efficiency



Reliability & Availability



Flexibility



Emissions

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PARTS

GE uses advanced engineering techniques and high-quality materials to manufacture spare parts that help you get more out of your assets. Every part is thoroughly tested and backed by our OEM warranty, leading to improved output, increased efficiency and extended maintenance intervals.

REPAIRS

Our advanced repair solutions are cost-effective, properly scoped to your operational needs and enhanced to reduce your downtime. Our vision is to support one of the world's best-running fleets, and we do this by delivering new capabilities and programs, all of which are driven by a culture of accountability and a commitment to your organization's desired outcomes.

MAINTENANCE

Make the right decisions about repairs, replacement and appropriate upgrades for performance improvements with help from GE's outage services team. Proper planning and expert support are essential to minimizing the length of your outages and decreasing downtime.

 [Click the tabs below for more information](#)

[Steam](#)

[Generator](#)

[Boiler](#)

[AQCS](#)

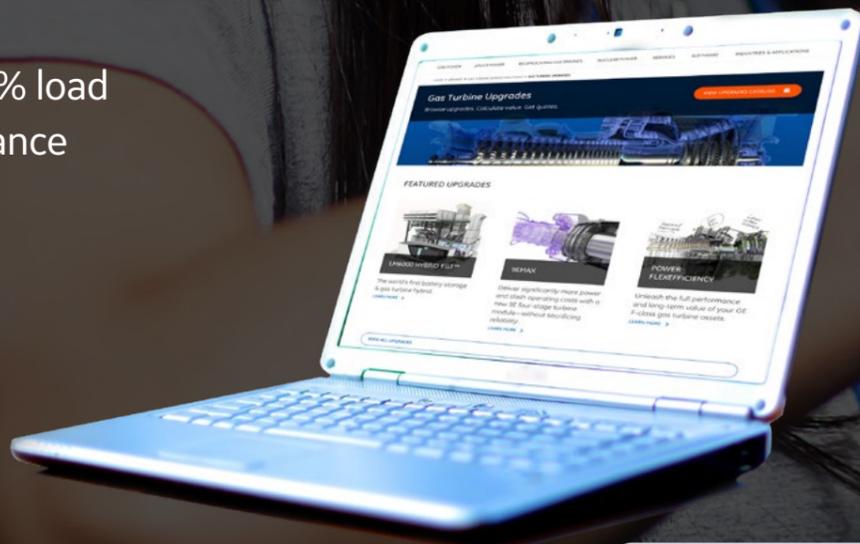
Adapting to a Changing Industry

The global power industry is changing rapidly. Today's power plants are required to operate in new ways that differ from their original concept. GE's comprehensive suite of plant upgrades provides the capability and flexibility to position your plant for a successful future.

Whether you need more output, improved emissions, extended asset life or enhanced operational flexibility to run at lower loads or on a non-traditional fuel, we can customize a solution to meet your commitments.

Steam Power's solutions portfolio can:

- Improve plant heat rate as much as 15%
- Increase output by up to 10%
- Reduce emissions to as low as 5 ppm NO_x
- Help achieve part-load operation as low as 10% load with emissions compliance
- Extend asset life up to 20 Years
- Harness digital insights to drive plant improvement and scenario evaluation



[Click the tabs below for more information](#)

Steam

Generator

Boiler

AQCS



Industry in Transition

The convergence of industrial with digital is transforming the way we power our lives. Decarbonization, decentralization, digitization, democratization — these trends are creating an environment of disruption and driving the need for digital industrial software and services. In response, energy needs to become more efficient, reliable, secure, and sustainable.

The energy landscape will change more over the next 10 years than it did in the previous 100. In addition to the expansion of digital power solutions, power generation will grow more complex and encompass a diverse range of sources. Renewable energy will expand exponentially, and with more people installing solar and scrutinizing the sources of their electricity, a new type of customer — the prosumer — is emerging.

Challenges? Yes, but also unprecedented opportunity — at least for forward-thinking organizations. Success in this new digital power era will require adaptation, innovation, and leadership. Energy companies of the future will be predictive, prescriptive, and fully autonomous. And we stand ready to help reach these goals with energy software that harnesses the potential of an entire connected system. By creating a common data fabric, making applications modular, layering in machine learning, and taking a distributed approach with architecture and execution, we can help you achieve Network-Level Optimization.

[Click the tabs below for more information](#)

[Asset Performance Management](#)

[Operations Performance Management](#)

[Business Optimization](#)

[Field Service Management](#)

[PREDIX](#)

[Cyber Security](#)

Multi-Year Service Agreements

In today's dynamic industry, power producers are challenged to deliver more flexibility and improved profitability. Through our multi-year service agreements, we continue to demonstrate our commitment to adding value to your operations as a long-term partner. Now, GE is revolutionizing and enhancing our offerings by providing a new type of multi-year agreement (MYA).

Our MYAs are tailored to yield specific outcomes that are important to your business by utilizing new technology and digital solutions while mitigating operational risks. These MYAs extend beyond providing parts, services and repairs to focus on delivering your key outcomes—from enhancing availability and operational flexibility to improving variable output and efficiency.

They provide the financial certainty, simplification, flexible scope, customized solutions, risk management, and substantial performance guarantees your business needs in today's challenging environment.

Through GE's portfolio of Steam Plant solutions, our MYAs look beyond the power island to increase value and make your plant more competitive in your operating space.

Delivering Productive Outcomes



Plant Profitability



Plant Competitiveness



Plant Attractiveness

How We Help Enable Them



Technical Training



Asset Management Planning



Maintenance, Repairs and Field Services



Advanced Technology Upgrades



Software and Data Analytics Solutions



Total Plant Capabilities



Flexible Commercial Models

Customer Stories:

Operations & Maintenance



A long-term partnership

Let us take your plant to the next level with our customizable O&M services options.

Whether you're seeking advisory services to enhance your own operation or looking for a full service operator to perform all of the daily activities associated with operating your site, we can customize an operational partnership with solutions to meet your business goals.

By combining an O&M partnership with our expanded MYA and plant capabilities, we provide you with the expertise you need to increase your productivity and lower your cost.



Our Capabilities:

Experience – 50+ years of global O&M services experience applied by a dedicated team of up to 1,400 plant O&M specialists

Expertise – Proven capability across steam, and balance-of-plant for GE and oOEM equipment

Scale – O&M contracts totaling about 35 GW of generation at more than 50 customer sites spanning 22 countries



Your Results:

Increased productivity – Increased reliability, availability, fuel efficiency, output and flexibility via our cutting-edge Digital Power Plant solutions

Asset improvement – Total lifecycle approach from the initial plant design review through the full operating life of your asset. Our experiences from nearly 28,000 equipment assets in operation allow us to identify what you need to ensure greater financial predictability, reduce your risks and increase your profit.

Lower operating costs – Access to the latest training, technology, tools and cost-effective practices to help ensure safe, compliant and economic performance. Robust maintenance strategies, anomaly detection and equipment health analytics all drive lower maintenance costs.



Field Services

A Global Field Services Powerhouse

GE's expert team of field services personnel has deep technical knowledge and cutting-edge tools to deliver the outcomes you need. Our technical field advisors, craft personnel and on-site services teams are highly regarded across the industry for their ability to create customized solutions to virtually any power generation challenge, when and where you need it.

Field Services will deliver:

- More productive, reliable, outcomes
- Greater communication and collaboration with you and within our team
- One team of technical field advisors, craft personnel and other field services experts
- Standardized processes and consistency in field service methods and practices
- Operational excellence in all we do
- A structure offering you the right mix of GE's total plant capabilities



SOLUTIONS POWERED BY GE'S TOTAL PLANT CAPABILITIES



SHARED VALUES OF SAFETY, QUALITY AND INTEGRITY



EXPERT PROBLEM SOLVERS WITH ADVANCED TOOLS & TECH

150
MILLION
HOURS
OF
OPERATING DATA

250+
YEARS
COMBINED
FIELD SERVICES
EXPERIENCE

90+
OEM
BRANDS
SERVED

ENHANCED COLLABORATION



BETTER COMMUNICATION



FLAWLESS EXECUTION

*Trademark of General Electric Company

¹A proposal to transfer Power Services field services fulfillment activities and related support functions in Europe to field services and the proposed organization design is being discussed with employee representatives across Europe as appropriate and where required by law before any final decisions are taken. This process is likely to take some months and the proposed transfer to field services to be implemented on a phased country by country basis.

Customer Training

Meeting your continuous learning needs

A continuous path of learning helps plant personnel gain the knowledge and skills needed to run an efficient, successful plant. GE's Steam Power Customer Training can suggest the right mix of training options to align with your plant configuration, equipment technology, employee audience, and time constraints.

- Site-Specific Courses.** Our high value training service offers a variety of 200 courses that are tailored to your specific site by your assigned GE instructor and dedicated training project manager. Courses are delivered either at your site or at one of our Steam Power global learning centers in the language of your choice, and on a schedule that works for you. Courses may contain a mix of classroom learning, site walkdowns, and hands-on training.
- Open Enrollment Courses.** With technology-specific content, our Open Enrollment training offers a comprehensive selection of more than 75 English-language courses for small staff or new team member training, or to expand the skills of select employees. Your employees train at one of our Steam Power learning centers with students from around the world. Courses offer a mix of classroom learning techniques, and may contain walkdowns and/or hands-on training.
- Online Courses.** A cost-effective solution for a broad range of employees, our 25-plus Online English-language courses let you train your personnel anytime, anywhere, and at their own pace. Each course ranges in duration from one to four consecutive hours, and can be started and stopped at the student's discretion.
- Multi-Year Training Agreements.** Simplify your training, budgeting, and planning efforts with our long-term flexible training offering. This agreement entitles you to a fixed number of annual training days for GE's Site-Specific and/or Open Enrollment courses, unlimited use of all our available Online courses, plus exclusive access to our Remote Turbine Operations Simulator. We partner with you throughout your plant's lifecycle to help you select the training solutions that best meet your evolving needs.

GE Steam Power Customer Training

Comprehensive Flexible Training Solutions to Meet your Total Plant Needs

Controls | Steam Turbines | Generators | Boilers | HSRG | Generators



Plan & Install



Operate & Maintain



Upgrade



Improve

TECHNOLOGY-SPECIFIC ONLINE E-LEARNING SELF-PACED

TECHNOLOGY-SPECIFIC OPEN ENROLLMENT AT PS LEARNING CENTER

SITE-SPECIFIC AT CUSTOMER SITE OR PS LEARNING CENTER



Leadership



Supervisors



Operators



Mechanical Maintenance Engineers



Electrical Maintenance Engineers



Instrumentation & Controls Specialists

www.geenergytechnicaltraining.com

TOTAL PLANT SOLUTIONS 

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RePower and Relocation Services

RePower

Achieve significant performance improvements in output and fuel efficiency to restart the clock on your plant's life with GE's RePower service. This flange-to-flange upgrade can improve your existing turbine's performance and add years of profitability and life to your power plant. With more than 100 successfully completed flange-to-flange replacement projects across all frame sizes and on five continents, GE has the proven capability and experience to craft the right solution to keep your plant running at its peak potential. GE can RePower existing GE assets or non-GE assets to gain significant performance improvements for your plant. With GE's RePower and relocation services, you can:

- Address multiple asset improvements in one simple upgrade
- Reduce emissions to comply with new regulations
- Increase profitability by improving your steam turbine, plant efficiency, reliability, availability and output
- Lower lifecycle maintenance costs

Plant Rehabilitation and Relocation

Plant rehabilitation and relocation provides operators with a fast track to reliable power supply, combining our plant integration expertise with the proven performance of GE equipment.

Rehabilitating plants that are currently in standstill mode, partially dismantled or damaged offers operators a quick path to power recovery and an opportunity to inject technology for more competitive operation.

Plant relocation is an option to not only revitalize an underutilized asset, but also move it to a more advantageous location. Through this program, we help you return standstill units to operation.



Solutions Developed To Meet Your Needs

[i](#) Click the links below for more information



Output: Is your plant ready to increase return on current capacity

Rapid changes in the power industry are making capacity management an increasingly critical operational challenge for power producers in today's volatile conditions, particularly plants providing reserve capacity during periods of high demand. GE can deliver an integrated view at the plant level and across all of your assets.

- ASP upgrades for large fossil LP
- SEC/DEC 600MW ASP solutions
- ASP upgrades for Industrial ST OEM

- Stator Rewind
- Rotor Rewind
- Replacement Generator

- Boiler Tuning
- PV-PRO* System for Mills
- Pressure Part modifications

- SulfiTrac* for reduced WFGD parasitic load
- EPOQ and OpOpt for reduced ESP parasitic load



Efficiency: Is your plant delivering on your desired business outcomes through enhanced efficiency?

The growing mix of renewables, volatile fuel prices and emergence of competitive applications globally requires today's power generation fleet to run more efficiently than ever before. Plants facing variable fuel prices, fuel quality and load levels are adopting new approaches to improve efficiency and reduce operating costs. GE's Steam Plant solutions can help your plant achieve better efficiency results with more frequent dispatch, more attractive margins and lower fuel costs.

- Operations Performance Management

- SIR high-voltage power supply for ESP
- Upgraded Controllers for ESP-EPIC & ERIC; and for FF- EFFIC
- Optimization algorithms for ESP and FF operation
- SulfiTrac* Sulfitte Analyzer for wet FGD power reduction and mercury control
- Optipow valve for FF bag pulsing
- Isoswirl for SCR flow mixing optimization

- Dense Pack Advanced Steam Path upgrade
- Full Shaft line package for Chinese OEM
- Fossil Plant Solution for Regulatory Compliance
- Hitachi/Toshiba® Steam Turbine ASP

- Boiler Tuning
- PV-PRO* System for Mills
- Pressure Part modifications





Flexibility: Is your plant configured and controlled for enhanced cyclic operation?

Improved plant and fleet flexibility is essential when responding to the challenges of increased renewables, grid fluctuations and fuel price volatility. Plants are increasingly focused on increasing revenue during high demand while decreasing costs when demand is low. With cutting-edge tools and data-driven insights, GE can unlock new opportunities to increase your plant's flexibility.

- Operations Performance Management

- WFGD SulfiTrac* for greater range of coal quality flexibility
- ESP EPOQ and OpOpt for greater range of coal quality flexibility

- OpFlex* package
- Shell Warming System
- Low Load District Heating
- Steam Turbines Subject to Flexible Operation
- Digital ASP

- FlexSuite for Boiler including Low Load and Ramp Rate packages
- Fuel Conversions and Co-Firing
- Hot Gas Temperature Control Solutions



Reliability & Availability: Is your plant providing the information and insights you need to proactively manage key performance metrics?

As the power industry faces a complex set of new dynamics and emerging disruptive forces to the operating environment, the expectation to maintain high reliability and availability benchmarks remains. Incentive and penalty levels associated with achieving these benchmarks are increasing in many regions. GE's proven technologies can help your plant meet rising performance expectations.

- Asset Performance Management (APM)

- Stator Rewind
- Rotor Rewind
- Replacement Generator

- Valve Upgrades for extended maintenance interval
- Control System Upgrades
- ASP Upgrades for AEG KANIS and Wesel
- Lifetime Assessment and life extension

- AmStar* Thermal Spray coatings
- Component Rebuilds
- T-PRO* Fuel Firing System
- PV-PRO System for Mills

- Preventive maintenance via Predix / ProMo for ESP and dry FGD



Emissions: Is your plant prepared to increase returns within emissions regulations?

Power plants that rely on fossil fuels to generate electricity will play a significant role in producing the world's electricity long into the future. For example, coal-based power is expected to contribute 30% of the world's electricity through 2025. Changing regulations and developing emissions standards have created the need for active management of emissions levels. GE understands how to navigate evolving conditions and deliver tailored solutions to help your plant comply with stringent emissions regulations.

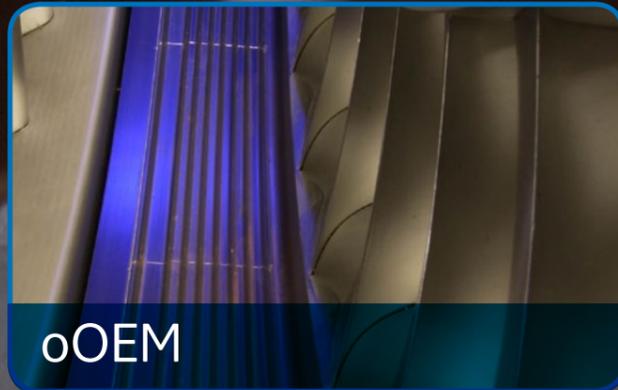
- Operations Performance Management

- Mer-Cure for advanced Mercury reduction technology
- ESP and FF upgrades for particulate control
- Wet and Dry FGD upgrades for SO_x control
- SCR Upgrades for NO_x control

- Ultra Low NO_x Burners
- Umbrella SNCR (U-SNCR)
- Fuel Conversions and Co-Firing
- Bottom Ash and Fly Ash Systems

Product Offerings

 Click the tabs below for more information



Other Original Equipment Manufacturing (oOEM) Solutions



115 years of **power generation** services experience



Plant solutions for **90+ OEM brands**



4,000+ engineers globally



50+ repair shops in **25 countries**



3,200+ monitored plant assets across numerous **OEMs**



24/7 monitoring and diagnostics

With the largest services portfolio in the industry, Steam Power can support more than **90 OEM** brands across all major plant assets.



80+ steam turbine OEM brands, including: Siemens, KWU, Westinghouse, Toshiba, MHI, and LMZ

~40% of steam turbine upgrade solutions are performed on cross-fleet brand equipment



Maintenance and repair solutions for steam turbine brands, including: Siemens, LMZ, SEC, Ansaldo, Brush, and Electrosila



Capabilities to service **Any** type of generator (over 30 OEM brands), including: Siemens, Ansaldo, BHEL, Brush, Dongfeng, MHI, and Hitachi

GE's **boiler solutions** support **all OEM brands**, including Babcock Borsig (now Bilfinger), MHPS, B&W, Babcock Power and FosterWheeler.

AQCS service and upgrade capabilities for all brands and mechanical & electrical spare parts for OEM and selected oOEM designs including MHPS, Lurgi, Rothemühle, Joy and Buell

Additionally, our robust portfolio of digital solutions features breakthrough power generation capabilities that bridge assets across your plant and fleet infrastructures, delivering turnkey solutions regardless of configuration or OEM asset mix.

Other Original Equipment Manufacturing (oOEM) Solutions

Our oOEM portfolio spans supply, repairs, multi-year agreements (MYAs), inspections, upgrades and digital solutions, while applying patented technologies to help extend maintenance intervals and improve asset performance for over 90 OEM brands across major plant assets.

Steam Turbine Solutions

Our portfolio includes:

- Technical support through lifetime assessments and MYAs
- Field service for minor and major overhauls
- Parts solutions, including reverse engineering, design improvement, and supply
- Simple and complex repairs and mobile machining
- Balance of plant services, including component improvements and auxiliary systems upgrades
- Steam path and condenser upgrades

Additionally, our Powering Efficiency Center of Excellence (COE) brings together cross-business experts applying a total plant hardware and software approach to significantly boost efficiency and reduce emissions at the world's new and existing steam plants.

Air Quality Controls System (AQCS) Solutions

Our portfolio includes:

- Comprehensive parts replacement, including reverse engineering, design improvement and supply
- Advanced technology upgrades to digital solutions
- Field Service for minor and major overhauls
- Life extension

Generator Solutions

Our portfolio includes:

- Sensor monitoring of equipment operation to support condition-based maintenance
- Robotic inspections not requiring field removal to reduce outage time and lower maintenance costs
- Rewinds for all conventionally cooled turbine generators within a C-inspection
- Zero cycle time maintenance with off-the-shelf parts
- Large stator upgrades for steam nuclear and coal plants to extend output and operating life

Boiler Solutions

Our portfolio includes:

- Comprehensive parts replacement, including reverse engineering, design improvement and supply
- Advanced technology upgrades to digital solutions
- Field Service for minor and major overhauls
- Fuel conversions and emissions solutions
- Life extension

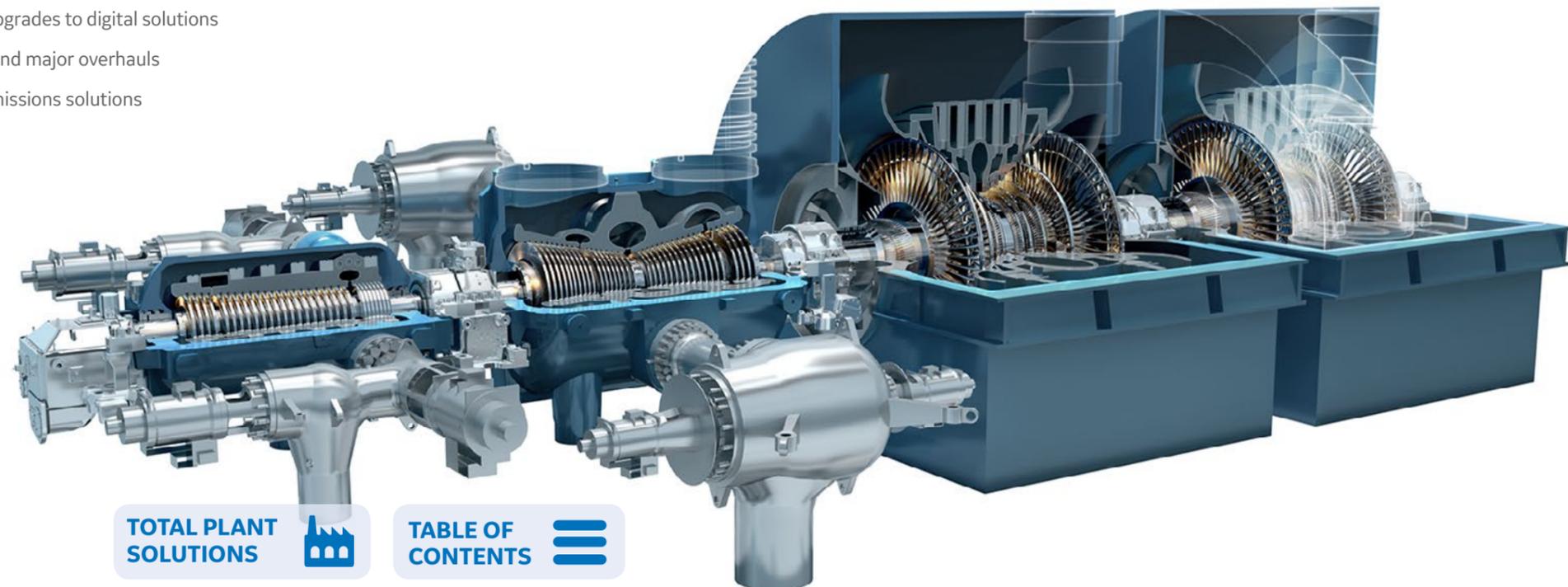
By harnessing GE's MYAs, you not only have access to our numerous commercial and operational offerings, but also benefit from outcome-based solutions warranted by our unprecedented digital capabilities.



1000+ oOEM assets now being monitored



MYA contracts on steam plants with other OEM equipment that **guarantee improvements** in asset performance and customer service over the life of the contract



TOTAL PLANT SOLUTIONS



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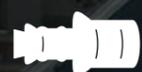


Digital Solutions

Built on Predix* to Empower the Electricity Value Network (EVN)



More than \$1 billion annual investment by GE



10% of world power generation capacity connected to Predix



30,000+ developers using GE's Predix solution



5,000+ electricity sector patents

Key Solutions:

Operations Performance Management

- Up to \$1,500,000 in fuel savings; 0.5-2% heat rate improvement

note: For a 600MW net, 70% capacity factor, 10,000 kJ/kWh net, coal: 4,200 kcal/kg @ 40\$/t

Operations Performance Management

- Up to 20% reduction in NOx and 4% reduction in other greenhouse gas (GHG) emissions

Asset Performance Management

- Up to 5% reduction in unplanned downtime and as much as \$2,000/MW annual reduction
- Up to 2% improvement in total plant readiness

Operations Performance Management

- Faster start times, better ramp rate, better turndown

PROFITABILITY

Business Optimization: Up to 1% reduction in fuel costs and higher revenues with optimal dispatch and streamlined communications

SECURITY

Cyber: From avoidance of \$1 million per NERC infraction to reduction of lost production due to a catastrophic cyber event

FIELD SERVICE MANAGEMENT

Digital Worker: Up to 8% reduction in service costs

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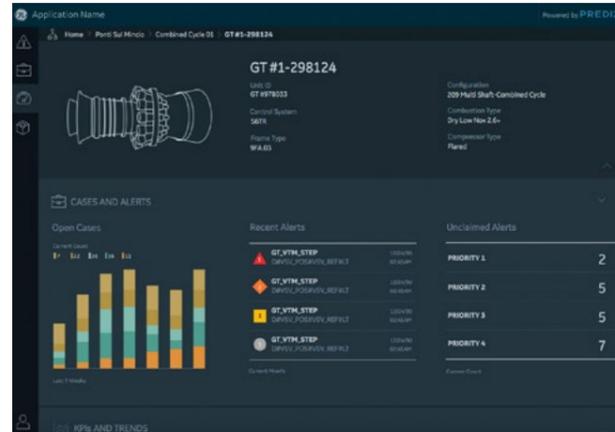
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Asset Performance Management (APM)

IMPROVE RELIABILITY

APM software enables the improvement of asset reliability and availability while reducing risk and maintenance costs. It connects historical data, real-time machine data, and other disparate data sources and **applies advanced analytics**, including physics-guided machine and deep learning, to deliver actionable insights. By predicting potential equipment failures and quickly diagnosing related issues, APM reduces unplanned downtime and improves availability. Additionally, the software helps develop customized maintenance strategies that enhance plant reliability while reducing overall maintenance needs.



Built on **Predix**, APM offers a cloud-based solution that provides a unified and accurate view of assets and full asset histories. This adaptable and extraordinary scalable solution gives you the flexibility to develop or adopt new analytics, capabilities, and applications as needed.

Learn More about APM

APM Case Studies:

Discover how [Bord Gáis Energy](#) is using GE's APM software at its Whitegate power plant in Ireland.

See how [SSE's](#) Equipment Performance Monitoring Centre is using APM to improve reliability, reduce downtime, maintain uptime, and realize operational savings.

This solution offers four key functional components:

Health: The foundation of APM, this component provides a unified, complete, and accurate view of assets along with their operating state, status, and health. It functions as a visual reference of the status of an asset, plant, and fleet. The software lets you drill down into the data to perform your own analyses—including root cause—as well as to configure dashboards for various roles and to benchmark performance. It improves asset performance, availability, reliability, and time-to-value while reducing maintenance costs.

Reliability: APM enables prediction and accurate diagnoses of issues, responding before they negatively impact assets for improved operational reliability and availability. The software's reliability management functionality layers advanced, predictive analytics to anticipate potential failures earlier and with unprecedented accuracy. It uses a single point of management for anomalies, advisories, alerts, and cases, capturing the complete detail of each case or incident for root cause, reliability, or future analysis.

Strategy: This feature balances reliability, availability, performance, and costs against risk to enhance the value of the asset and reduce maintenance costs. It lets you optimize your approach to performing maintenance, inspection, or redesign activities and enables intelligent asset strategies to help manage it all.

ASSET AVAILABILITY



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ASSET RISK CONSEQUENCE

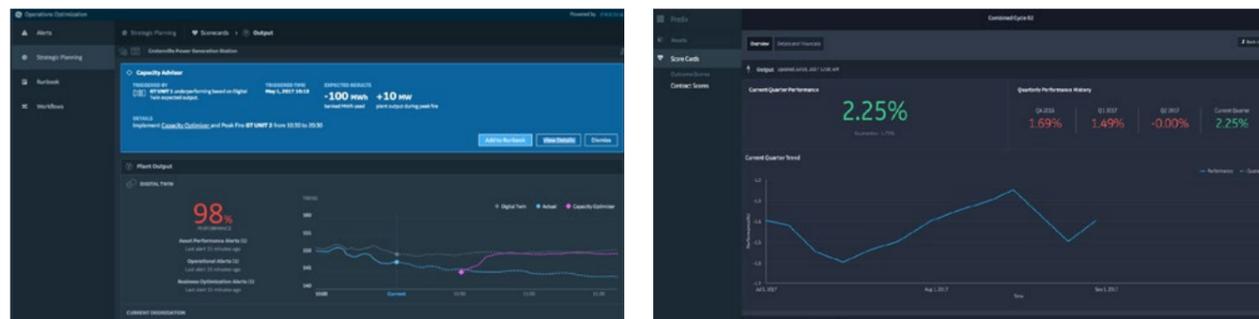


Operations Performance Management

IMPROVE PRODUCTIVITY

Operations Performance Management is a digital solution that provides critical decision support and improves productivity by pushing the operating envelope to capitalize on more economic operations for every plant in the fleet. Enabled by edge-to-cloud technology and built on Predix, the solution analyzes historical, plant, and other data sources to deliver executable advice or close the loop and drive desired outcomes for better efficiency, flexibility, availability, capacity, and emissions.

The solution allows power generators to directly align operational priorities to business strategy—at scale—across their fleet, regardless of original equipment manufacturer (OEM).



[Learn More about Operations Performance Management](#)

Steam Power Plant Case Study:

Watch how [OMU](#) in Kentucky reduces emissions and improves heat rate with GE's Operations Performance Management.

This solution has two functional components:

Strategic Planning: This component helps your central operations, fleet managers, and power plant managers create production plans across many planning horizons for the power generation assets in your fleet. The solution leverages key performance indicators (KPIs), advisors, and scorecards along with scenario analysis to determine the best plant configurations to meet desired production schedules and achieve target results. The production schedule generates a runbook that has more granular operational detail in the short term and automatically updates operational plans based on actual plant activity, events, and results.

Plant Optimization: Operations Performance Management software provides the visibility, insights, advanced analytics, and decision-making support to help optimize your portfolio and improve KPIs. With automation and sophisticated optimizers, our plant optimization functionality can close the loop to help achieve your desired results. This solution gives your plant managers the help they need to achieve production targets, keep the plant running longer, and improve your overall return on assets.

Plant optimization benefits include:

- **Greater efficiency:** Helps your central operations and plant managers improve heat rate and better manage operating margins across your fleet.
- **Enhanced flexibility:** Provides insights and recommendations to help your plant managers identify enhanced configuration, process, or operational settings to achieve faster startup, lower fuel consumption, quicker ramp up, and lower turndown.
- **Reduced emission rates:** Establishes operating thresholds during startup, turndown, full load, and part load to help comply with regulatory guidelines and emissions goals for NOx, SOx, and CO2.

TOTAL PLANT SOLUTIONS



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Business Optimization

Business Optimization combines physical asset capability, contractual commitment, and essential market data to enable energy marketing and trading teams to succeed in the complex modern power industry. This software revolutionizes energy trading and risk assessment with visibility and insight into financials and transparency into operations.

Our Business Optimization software alerts power generation businesses about profitable trading opportunities—often highly profitable short-term opportunities—and provides utilities with valuable market bidding information. It helps utilities engage in new profit pools such as the market for ancillary services to help manage grid stability, and new market opportunities such as cross-border trading.

Built on **Predix**, Business Optimization is a cloud-based software solution that enhances portfolio profitability, unit commitment, and economic dispatch in real time. It also supports portfolio planning in the short term and for up to 30 years into the future. **Business Optimization comprises the following functional components:**

Market Intelligence and Forecasting: This component forecasts plant capability and market behavior to increase revenue. It accurately predicts megawatt capacity—accounting for a rigorous set of operational and market factors—as well as market pricing. It also provides effective load forecasting and more dynamic pricing in response to change.

Portfolio Management: The software includes portfolio scheduling and planning to increase profits. Its enhanced production scheduling capability helps meet demand set by load or market pricing to reduce total production costs and boost revenue. On an hourly basis, the software uses operational data to recommend optimal bids/offers for energy and ancillary services. Its analytics improve portfolio structuring to enable faster and more efficient transactions, better fuel management, and enhanced maintenance timing.

Business Communication: This component efficiently communicates and transfers data with independent system operators (ISOs) and both internal and external parties, including gas nominations and fuel tracking. It delivers efficient, streamlined, and automated communications with ISOs, generation dispatchers, and other key stakeholders. It also provides greater transparency through detailed tracking of transported fuel and electronic tagging of transaction flows.

Financials: The software's functionality includes complete financial forecasts, settlements, and post analysis. It forecasts financials from different market instruments, supports settlement with ISOs and third parties for traded energy, and provides KPIs. This component also manages meter reads for consolidation and provides an interface to General Ledger. It delivers more detailed and effective financial management processes while enhancing clarity, granularity, and insight into financial performance.

See how Digital drives bottom-line success: gathering real-time generation data, grid demand, fuel pricing, and other factors into an optimization equation drives more refined trading and portfolio decisions. **Read eBook**

TOTAL PLANT
SOLUTIONS



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Field Service Management

Workers in the power industry are expected to maximize reliability, productivity, safety, and compliance while controlling operating expenses—all while managing the challenges of complex assets, remote locations, aging infrastructure, generational workforce turnover, and the growth of new generation technologies. Never has the need and opportunity been greater to empower workers with the digital technologies to help deliver exceptional service.



GE's Predix-based [Digital Worker solutions](#) augment the abilities of workers at every skill level. Mobile service delivery solutions—paired with predictive analytics—give your remote or onsite workers the information they need, when they need it, and enable greater collaboration with other workers to accelerate knowledge sharing.

GE's Digital Worker solutions include our [ServiceMax Field Service Management \(FSM\)](#)—an industry-leading, cloud-based, mobile solution for field service delivery. The comprehensive ServiceMax solution helps your service workers track assets, leverage analytics from connected devices, collaborate with other workers, schedule the right engineer for the right job, stay in regulatory compliance, and track performance. And when integrated with APM analytics, ServiceMax enables more predictive maintenance to reduce unplanned downtime and drive reliability.

ServiceMax includes the following functionality:

- **APM/IIoT Integration:** Connects to APM to drive connected field service by executing analytics-driven work requests before a failure occurs. Enables more proactive, predictive maintenance to reduce unplanned downtime, improve reliability, and extend asset lifetime.
- **Work Planning and Scheduling:** Enables you to manage field service teams, their territories, and the corresponding field activities for all service models: break-fix, preventative, condition-based, and predictive maintenance. Improves reliability, availability, and productivity with enhanced scheduling and dispatch so that the right worker is sent to the right task at the right time.
- **Mobile Technician Enablement:** Increases productivity with a mobile app that empowers field workers to successfully complete complex work orders, present service reports for customer signature, and provide dynamic pricing of labor, parts, and products in the field. Allows for offline synchronization, using a standard mobile framework for the field-ready functionality needed to improve productivity with any device.

- **Work Order Debrief:** Allows your engineers to complete work order debriefs, account for time and material costs, collect data and surveys, and capture digital signatures while onsite, significantly reducing the need for additional back office processing.
- **Entitlements and Logistics:** Drives revenue and customer loyalty by helping to ensure maintenance of warranty plans and service contracts. Provides parts visibility across locations, in vans and at depots.
- **Installed Base Management:** Keeps track of every asset and provides visibility into assets, their location, configuration, and service history. Provides workers—including managers, dispatchers, service technicians, and engineers—with instant access to accurate asset information and connected devices data through an intuitive mobile app.
- **Service Performance Metrics:** Tracks critical service KPIs, including utilization, first time fix-rate, and mean time to repair so companies can achieve performance, reliability, and productivity objectives.

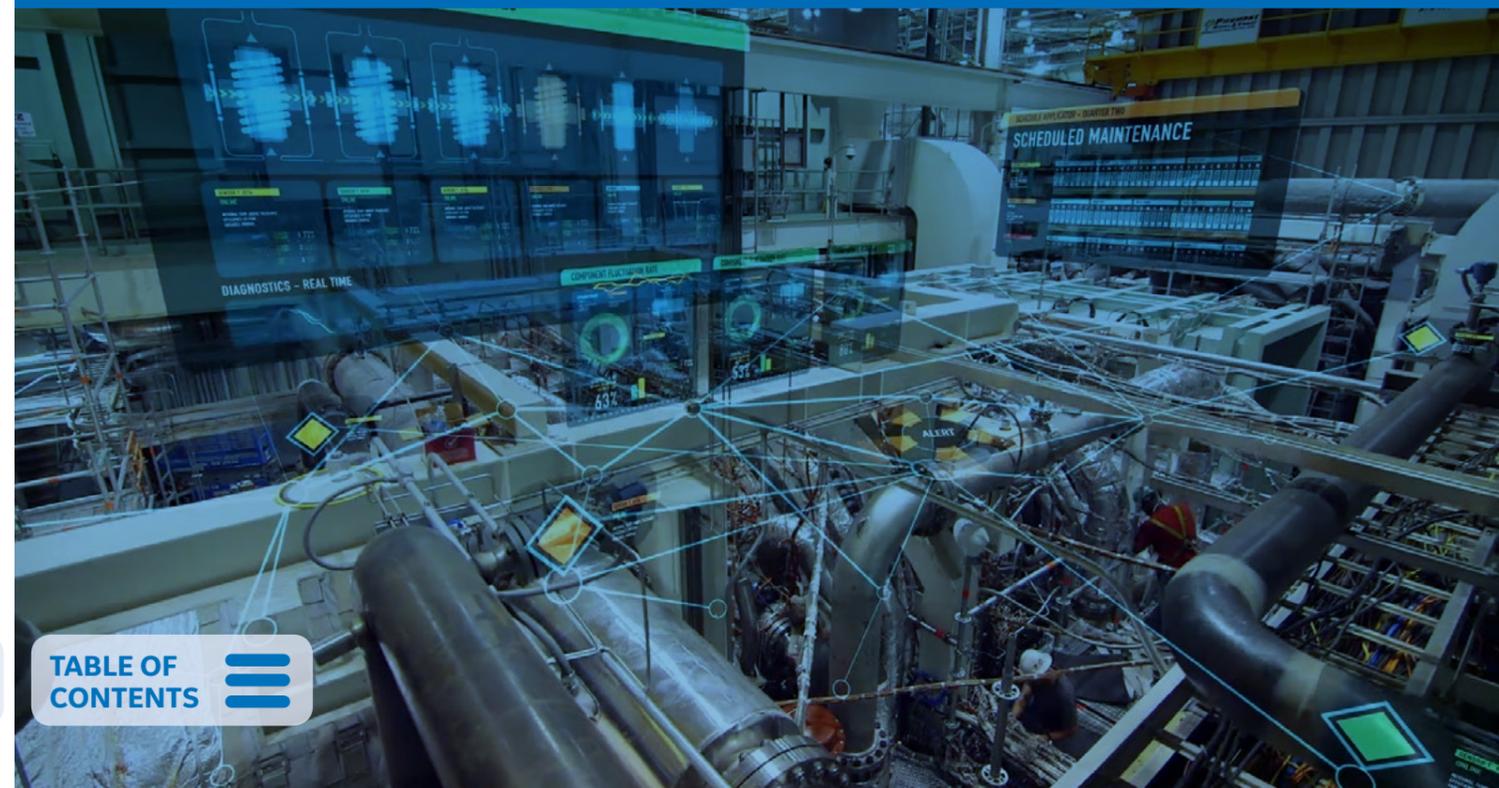
The Service Delivery Effect

ServiceMax customers report:

↑	18% increase in technician productivity	↓	12% decrease in repair time
↓	8% reduction in service costs	↓	15% fewer safety incidents
↑	13% boost in machine uptime	↑	13% increase in service revenue

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Cyber Security

Traditional risk management is focused on factors like fluctuation in renewables dispatch priority and dynamic fuel costs. Today, [cyberattack and security breaches](#) are equally prominent issues that can quickly cascade into serious financial damage or impact human safety.

GE's expertise in operational technology cyber security can help power companies and utilities plan, design and build operational resilience into people, processes, and technology. Our [cohesive risk management approach](#) addresses cyber security challenges throughout the evolution of a company's security maturity. We develop your [security strategy](#) using our three-stage cyber-security maturity model:



- **Stage 1** – Assess: Identify immediate security issues that can impact operations even if the environment is thought to be air-gapped.
- **Stage 2** – Protect: Implement security monitoring and defensive layers to comply with standards and strengthen the security posture of your company.
- **Stage 3** – Prevent: For sophisticated organizations, pursue proactive and predictive security measures such as running attack scenarios on cloud-collected data.

Across all stages, it is critical to maintain a constant vigilance to ensure basic security hygiene is implemented and cyber security policies are enforced. GE offers solutions that work at any stage of security maturity to bring greater control, less risk, and increased reliability to your power business. GE Power's Cyber Security solutions include:

Security Assessment Services: Consisting of a site security assessment, this in-depth, comprehensive evaluation of an operational site facility is based on industry standards and best practices, resulting in an individualized report with prioritized mitigation recommendations and strategies. The assessment consists of:

- **Site Security Health Check:** Provides a rapid overview of your operational site facility, including a baseline of cyber strategy with recommendations on further analysis as well as economic justifications for remediation.
- **NERC CIP Cyber Vulnerability Assessment:** Delivers an in-depth evaluation for electric utilities following the requirements prescribed by NERC CIP. The report includes mitigation plans aligned to NERC CIP as well as other industry best practices.
- **IEC Security Practices Certification:** Provides certification for system supplier compliance with industry standard security best practices (IEC62443-2-4), covering areas such as hardening, anti-malware, patch management, network, and data security.
- **IEC 62443 GAP Assessment:** Helps industrial automation manufacturers and system integrators understand potential security gaps in their software development, and aligns their practices to IEC 62443-2-4. Specialists are highly qualified to perform both onsite and remote assessments.

Baseline Security Center: This risk management platform provides a set of tools, configurations, and services focused on reducing cyber risk that follows the Center for Internet Security's 20 Critical Security Controls (CIS Controls). CIS Controls are a concise, prioritized set of 20 cyber practices created to stop today's most pervasive and dangerous cyberattacks. Organizations that implement just the first five CIS Controls can [reduce their risk of cyberattack by around 85%](#).



Cyber Security Services

GE's three levels of Cyber Security Services focus on patch management and system protection. These services ensure that your hardware is protected, that your system's firewall, antivirus, and patches are up-to-date, and that through a highly secured remote access connection our trained professionals are able to access and maintain your control and intrusion detection systems.

SYSTEM PROTECTION

The system protection service hardens computers and network devices and secures the system by disabling unnecessary ports, services, and accounts.

ADVANCED SOLUTION

Advanced cyber security solutions include system hardening, firewall installation and configuration, whitelisting, and SIEM (Security Information and Event Management) interface. A dedicated organization has been put in place to fulfill cyber security features.

CYBER SECURITY ASSESSMENT

Leveraging our Wurdtech experts and other partnerships with cyber security experts we provide audits at three different levels to define site security, hardware protection, and access control and intrusion detection systems.

LEVEL 1 - SITE SECURITY HEALTH CHECK

We provide a rapid assessment of potential risks for parts of your installation and improve the overall security while identifying the main risks. Our audit provides feedback to justify additional security efforts based on requirements for an in-depth analysis.

LEVEL 2 - SITE SECURITY ASSESSMENT

Our Site Security Assessment details and prioritizes immediate risks to be mitigated and defines long term actions to improve the overall system security and to build a global security strategy. We also provide documents required for regulatory or audit purposes.

LEVEL 3 - ASSESSMENT FOLLOWING A SPECIFIC REGULATION

Our professionals will assess the Electronic Security Perimeter (ESP) to check the proper activation of software services running on your system and also evaluate critical and non-critical assets such as accesses, passwords, network management, and controls processes.



Predix

Turn asset data into value

Predix Platform is grounded on a simple premise: collecting and analyzing industrial machine and environmental data significantly increases the value of those machines and environments.

Applications that run on Predix Platform and harness this data can generate new insights to produce new value, such as improved equipment efficiency, reduced operating costs, improved maintenance operations, and new data-driven services for customers.

Digital twin technologies

Digital representations of physical assets and systems leverage Predix Platform's industrial-grade analytics to model and optimize those assets.

Edge-to-cloud distributed computing

Predix Platform comprises a cloud stack and edge stack that work together to support distributed computing.

Industrial data fabric

Flexible options for ingestion, workload execution, and storage for streaming and batch data.

Analytics and machine learning

Rich and robust industrial-grade analytics capabilities provide insight across the entire life cycle of industrial assets.

Security

Stringent security measures are designed into Predix Platform, forming a continuously monitored, protected platform for operators and developers.

Application development

Predix Platform provides a high-control and high-productivity environment for application development.

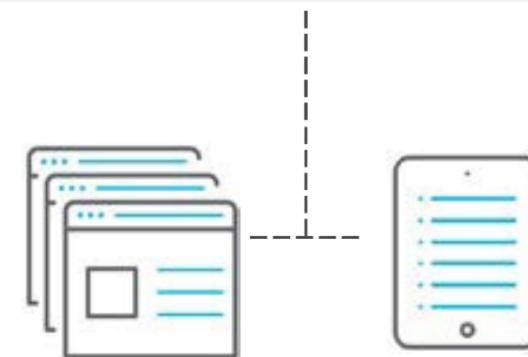
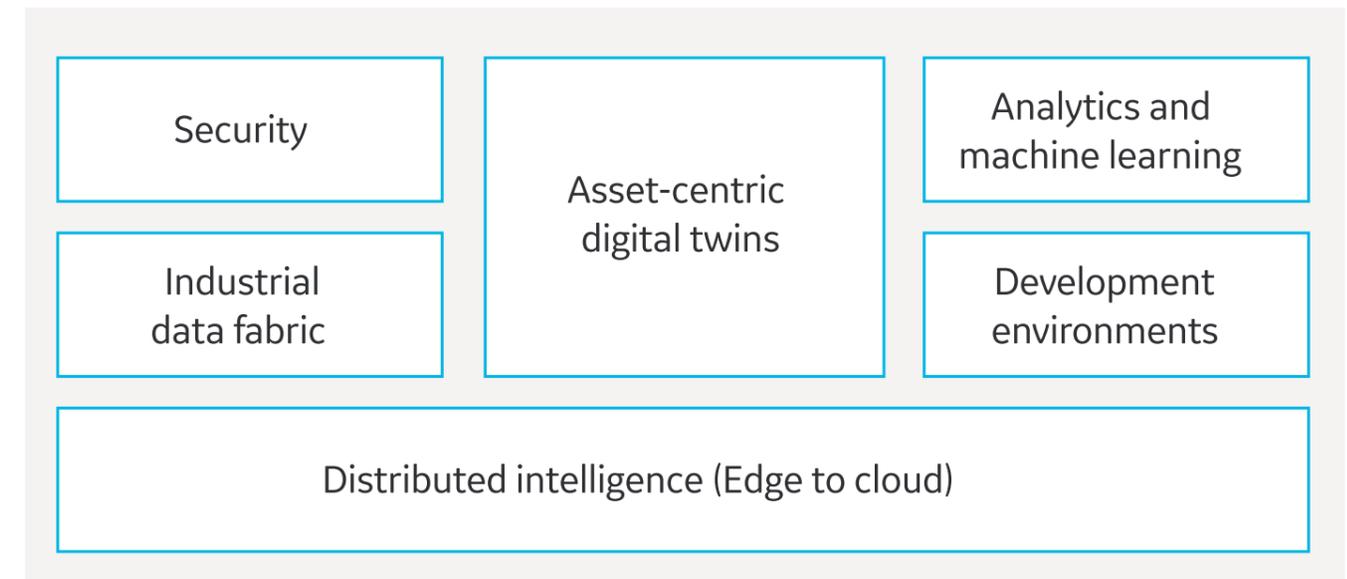
Asset connectivity and management

Predix Platform can collect, process, and securely transfer data from assets to analytics and applications in the cloud.



IT and OT Data

Industrial IoT Platform



Industrial Applications



Steam Turbines



5,000+ installed units (not include GW)



Up to **1,700 MW** configurations



More than **110 years** of steam turbine experience
 – 1,000+ steam turbine upgrades from all major OEM fleets



Strategic outage planning for **rapid response** to emergent needs

- Experienced steam turbine specialists in every region
- Fulfillment process aligned to support long-lead critical parts
- Commercial process to support your inquiries



Wide **variety** of offerings to **meet your key needs**

Key Programs:

- ASP upgrades for large fossil LP
- SEC/DEC 600MW ASP solutions
- ASP upgrades for Industrial ST OEM

- Shell Warming System
- Low Load District Heating
- Steam Turbines Subject to Flexible Operation
- Digital ASP

- Dense Pack Advanced Steam Path upgrade
- Full Shaft line package for Chinese OEM
- Fossil Plant Solution for Regulatory Compliance
- Hitachi™/Toshiba™ Steam Turbine ASP

- Valve Upgrades for extended maintenance interval
- Control System Upgrades
- ASP Upgrades for AEG KANIS and Wesel
- Lifetime Assessment and life extension



Global Repair Service Centers

STEAM TURBINE REPAIR NETWORK

Through our continual investment in local resource development, GE is well-positioned to deliver repair services where and when you need them. Critical to managing our global presence, GE has mastered the logistics necessary to maintain reliable supply chains, coordinate resources, and comply with regional regulations.



Repair capabilities by region:

Steam Turbine GRSC

	Americas		Europe		Asia		Middle East/Africa	
	Repair	New Parts	Repair	New Parts	Repair	New Parts	Repair	New Parts
Rotor Inspection	✓		✓		✓		✓	
Rotor Welding	✓							
Turbine Bucket		✓	✓		✓		✓	
Shell/Casing Machining	✓		✓		✓			
Valve Repair/New	✓	✓	✓	✓			✓	✓
Diaphragm Repair/New	✓	✓	✓	✓	✓	✓	✓	✓
Pump & Gearbox Overhauls			✓		✓			
Turbine Manufacturing		✓		✓				
Turbine Spare Parts		✓		✓		✓		
Auxiliaries			✓	✓				
Rotor				✓				

Electro-Mechanical Testing

SPECIALIZED TESTS FOR IMPROVED PERFORMANCE

Our specialized tests help you detect unusual situations before they become serious problems. The following tests and activities are typically recommended by GE's Product Services team to improve unit performance:

- **Torsional testing:** Determines resonant frequencies for torsional vibration. This test supports engineering to help ensure adequate separation between the rotor train and grid frequency.
- **Acoustic testing:** Measures sound pressure levels and analyzes spectral content to identify root causes of excessive machinery noise.
- **Operational deflection shape (ODS) modeling:** Deduces the cause of excessive vibration and develops recommendations for resolution. A vibration survey is conducted to build a three-dimensional "forced running shape" model of the unit.
- **Improved tenon stress relief:** Greatly reduces environmental health and safety (EHS) and quality concerns with the salt bath process for relieving welded tenons through this self-contained induction stress relief system.
- **Portable vertical boring mills:** Offers increased onsite machining capabilities that allow for diametrical machining and horizontal milling for circumferential cuts, joint facing and much more.
- **Enhanced bore plug removal:** Provides the ability to mount and drill bore plugs on any size unit and for any coupling hole pattern, with guaranteed straight and true drilling.
- **Gang milling dovetail pins:** Transforms the time-consuming process of cross-pin removal. With this gang milling procedure, all pins are removed at the same time.



Onsite Services

REPAIR OFFERINGS

Transporting turbine components off site for repair can increase your outage time by days or weeks, while the additional handling requirements can expose the equipment to risk of further damage.

GE's On-site Services (OSS) offers highly technical onsite inspections and premium repairs for global power generation customers through our EHS, quality, technical, and operational excellence. We work hard to meet and exceed your expectations, on budget, every time. We bring the inspection and repairs directly to your location to help you reduce outage time and achieve substantial cost savings. Our On-site Inspection and Repair teams offer:

- **Comprehensive services:** We provide a full range of services—from typical inspections, repair and machining to highly specialized services offered by GE Power.
- **Extensive tooling:** GE's OSS is one of the largest onsite service organizations, with more than 500 pieces of portable equipment and an extensive tooling inventory.
- **Experience:** Our team of qualified GE specialists includes machining supervisors, engineers and technicians with an average experience level of more than 20 years.
- **Global responsiveness:** All equipment is completely mobile and can be transported to any required destination around the world within hours of notification.

Steam Turbine Inspections

GE's inspection services help prevent catastrophic high-speed rotor issues. Each configuration requires the following rotor-specific tests and analysis:

- Boresonic inspection of older bored rotors looks for indications of deterioration from the inside to the outside.
- Periphery ultrasonic testing for solid rotors examines the outside of the rotor for indications of potential issues.

- Phased array wheel dovetail testing looks for indications of stress corrosion cracking (SCC) in time to repair the wheel and prevent bucket liberation.
- Wheelsonic inspections employ a series of tests to evaluate the integrity of wheels on a built-up, low-pressure rotor.
- Finger bucket dovetail inspections provide a comprehensive look that includes:

- **Non-destructive Testing (NDT)**

- Boresonic inspection system
- UT bucket attachments (STG wheel dovetails)
- MT bucket attachments (STG wheel dovetails)
- Wheelbore
- Solid rotor volumetric

- **Electromagnetic Testing (EMT)**

- Rotor/bucket instrumentation

- **Borescope**

- Hot borescope

Steam Turbine Repairs

- **Machining**

- Collector ring grinding
- Stud drilling and tapping
- Bore plug removal/installation
- Valve bore and chest repair

- **Welding**

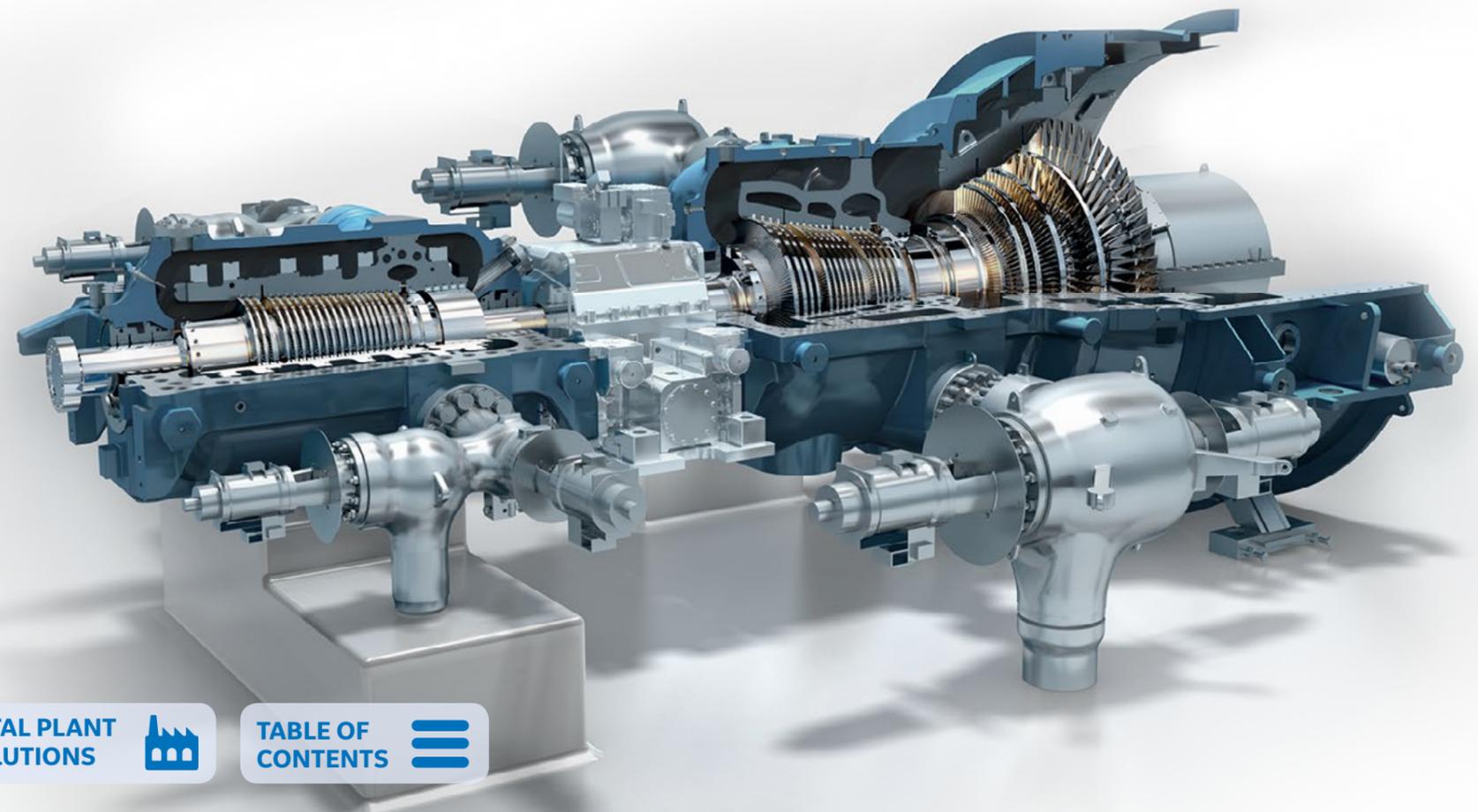
- Diaphragm repairs
- Faro arm inspections
- Shell and joint repairs
- Valve seat replacements

- **Bucket Repair**

- Bucket replacement/repair
- Cover installation and machining
- Finger-dovetail pin replacements
- Tie wire brazing and repair
- Tenon welding and cover foxholing

- **On-site Machining**

- Diaphragm fit machining
- Computer numerical control (CNC) dovetail/longshank machining
- Dense pack upgrades
- Coupling line and mirror boring
- Horizontal joint machining
- Large rotor machining
- Journal machining
- Low-speed balance



Steam Turbine Maintenance

EFFICIENCY IN PLANNING AND EXECUTION

GE performs a comprehensive range of overhaul and field services, and has a wealth of experience covering all GE and non-GE machine types, including impulse and reaction. These machines include 3,000 rpm and 3,600 rpm fossil units, nuclear units (including half-speed, wet machines) and high-speed industrial turbines.

With a global network and mobile workshops in a variety of strategic areas, GE is able to provide quick and effective engineering services at any location. These services include manufacturing and specialist repair of any part, from individual buckets to a new rotor.

We also provide a full range of outage planning, management and execution activities. Unplanned work is significantly reduced, thanks to our extensive fleet management experience. We achieve this by working with you to ensure that maintenance is properly targeted and spare parts are always ready.



Outage Applicability

Major	Minor
✓	✓

Steam Turbine Repairs

A RANGE OF SPECIALIST TECHNIQUES

To save the cost and lead times associated with replacement parts, GE offers a range of complex repair techniques. Many of these relate to weld repairs, as follows:

- **Rotor repairs:** With more than 80 years of welded rotor technology experience, GE provides joining of new forged sections, shaft buttering, disc repair, and disc head buildup with new material. We also offer a number of techniques for straightening rotors.
- **Blading repairs:** With experience across the range of impulse and reaction blading, GE provides dressing and weld repairs for all types of fixed and moving buckets, including linking and attachment features. For last stage buckets (LSBs), we also offer leading edge hardening and shielding options.
- **Casing repair:** GE can correct minor cracking and change the geometry of highly stressed areas. We can also re-round distorted casings and add new weld material.



Outage Applicability

Major	Minor
✓	✓



Bucket Stocking Program

QUICK RESPONSE TO YOUR DEMANDS

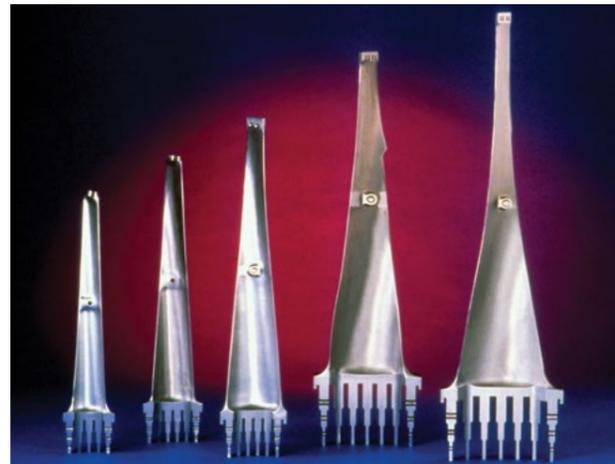


To meet the needs of a growing generation industry, GE is focused on quickly responding to your demands. Our bucket stocking program is one example. It employs a cross-departmental process to support emergent bucket requests for the following bucket types:

- Fossil last-stage and L-1 buckets of a broad range of sizes
- Industrial margin stage buckets
- Buckets for several other GE and legacy Alstom steam turbines

Outage Applicability

Major	Minor
✓	✓



Parts for Non-GE Turbines

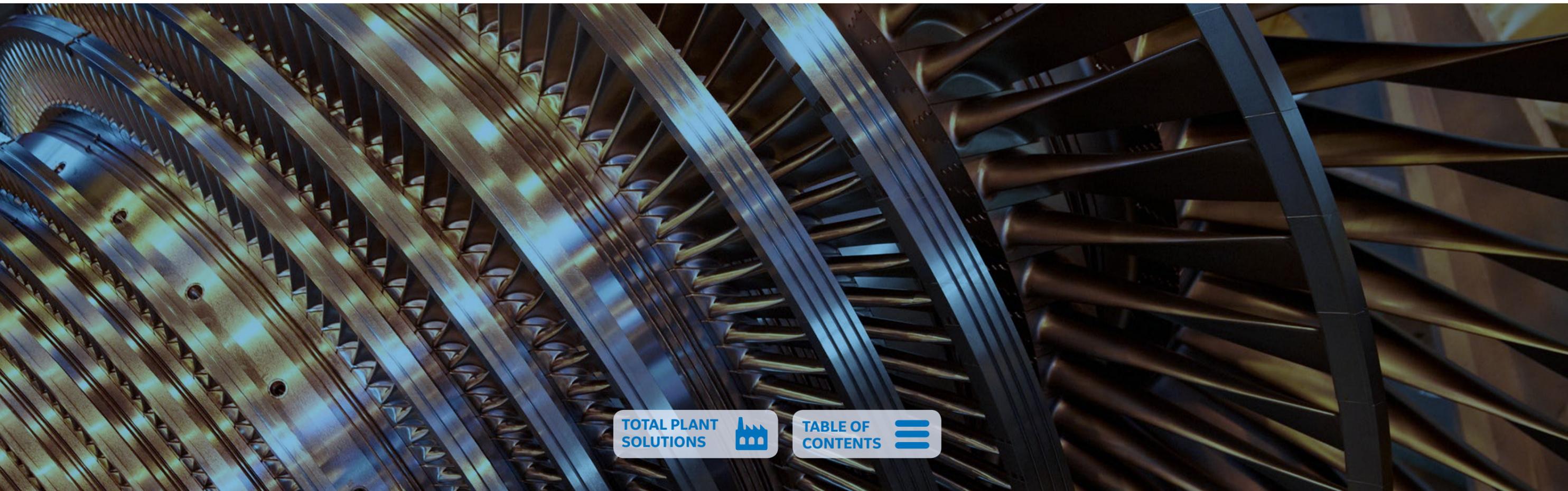
QUALITY REPLACEMENTS FOR ALMOST ANY TURBINE



With a broad technology legacy and extensive experience with other manufacturers' machines, GE can provide replacements for almost any turbine. When drawings and data are not available, we use our established laser scanning and re-engineering process. In addition to providing manufacturing data, the CAD model provides the basis for an engineering analysis. This allows us to offer technology improvements, including advanced materials and standard part replacements.

Outage Applicability

Major	Minor
✓	✓



Advanced Steam Path (ASP) Upgrade

IMPROVE EVERY ASPECT OF YOUR OPERATION

Steam turbines generally have a working life of 30 years or more. During this time, improvements in technology enable designs of greater efficiency, reliability and flexibility. However, because large generation assets are difficult to replace, operation often is extended, and additional reliability issues arise.

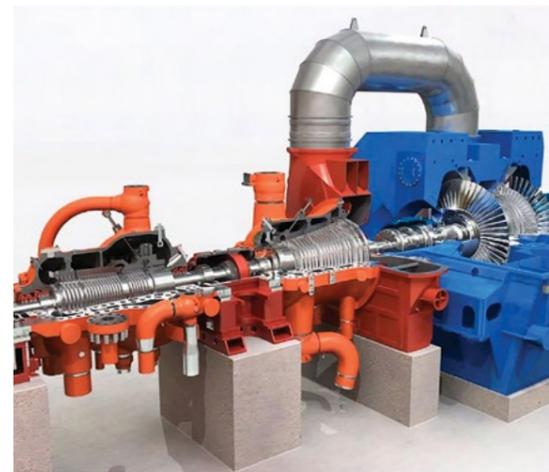
Many of the advantages of new technology can be applied by replacing major components on an existing machine. This alleviates plant changes, as well as related civil engineering work. Upgrades involving a new rotor, known as retrofits, can be applied to individual cylinders, or the entire turbine. The following projects can be executed within a typical major outage period:

- Efficiency improvement
- Output improvement
- Life extension
- Reliability and availability improvement
- Reduced maintenance

We also provide a full range of outage planning, management and execution activities. We can implement the above improvements on steam turbines from GE or from other OEMs.

Outage Applicability

Major	Minor
✓	



Technical Data

Efficiency improvement	Output improvement
Up to 10% (depending on cylinder)	Up to 10% (depending on cylinder)

Steam Turbine Services

GREATER OUTPUT, EFFICIENCY AND OPERATING LIFE

Expand the output and efficiency capabilities of your GE steam turbine equipment without sacrificing reliability or asset life.

In addition to improving reliability and extending asset life, we provide a complete range of cost-effective steam turbine solutions spanning inspections to complete flange-to-flange upgrades for industrial, fossil, and nuclear steam turbines from 5 MW to 1,700 MW. With more than 110 years of experience in the manufacturing, installation and maintenance of steam turbines, GE has a global installed base of more than 5,000 steam turbines. Our team has performed more than 1,000 conversions, modifications, and uprates while responding to thousands of planned and emergent outages.

Regardless of your needs, GE has the capability to support planned and unplanned outages. Understanding the criticality of reducing downtime, our team can help you extend equipment running time between planned maintenance outages; eliminate unplanned outages with our digital solutions for monitoring and diagnostics; and reduce the duration of necessary outages. Our steam turbine services offer the following benefits:

- Short cycle (less than 10 days)
- Advanced thermal balance capability
- Execution of services onsite or at a regional certified GE repair shop



Dense Pack* Advanced Steam Path (ASP) Upgrade

IMPROVE EFFICIENCY ON MATURE ASSETS



Outage Applicability

Major



Minor

Improve the efficiency of your mature steam turbines, enhance plant profitability and competitiveness, and extend the life of your assets with Dense Pack steam path re-configuration technology. This upgrade solution can help decrease aerodynamic losses and leakages within the steam path to help drive better efficiency across your entire power plant cycle. These upgrades are available for high-pressure (HP) or high-pressure/intermediate-pressure (HP/IP) sections of fossil units—typically 300 MW or larger—that are scheduled for an outage within the next three or more years, or that have extensive maintenance needs. Our upgrades provide:

- Advanced aerodynamic buckets and nozzles
- Various coatings that help your steam turbine last longer between outages, with less damage caused by solid particle erosion (SPE)
- Advanced sealing technologies (such as brush seals, elliptical packing, and improved clearances)
- Modern mechanical technology (such as rugged control stage buckets and Gen2 integral covered buckets)



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ASP Upgrade for Fossil LP Rotor

IMPROVE TURBINE OUTPUT AND PARTS RELIABILITY



Outage Applicability

Major	Minor
✓	

Extend your parts and component reliability, even as your steam turbine experiences different load levels, with GE's fossil LP rotor replacement and upgrade. Delivering up to a 2.5% improvement in turbine output—due to recovered aging losses, increased annulus area, and better steam path flow—this upgrade can reduce outage duration by 21 days compared to rotor FineLine* weld repairs during unplanned outages. This upgrade is available for large fossil steam turbines with a double-flow LP that would benefit from an increased annulus area.

The LP rotor replacement is applicable to all units that are experiencing reliability issues due to SCC or other similar phenomena. The upgraded LP rotor mentioned above makes reference to a larger annulus. This LP rotor has limited application space if not replacing the LP inner casing. The fossil LP rotor upgrade:

- Offers advanced steam path technology
- Provides longer latter stage buckets and diaphragms
- Includes advanced brush seals
- Provides integral cover buckets
- Increases annulus area
- Provides improved reliability to mitigate SCC

Fossil Plant Solutions for Regulatory Compliance

IMPROVE EFFICIENCY AND OPERABILITY



Outage Applicability

Major	Minor
✓	✓

In August 2015, the US Environmental Protection Agency implemented section 111 (d) of the Clean Air Act, which focuses on reducing greenhouse gas emissions from existing coal-fired plants. The regulation will drive coal-fired plants to achieve a 2-4% total plant heat rate improvement. To extend asset life, GE has developed a suite of offerings to meet your fossil unit needs.

Efficiency solutions:

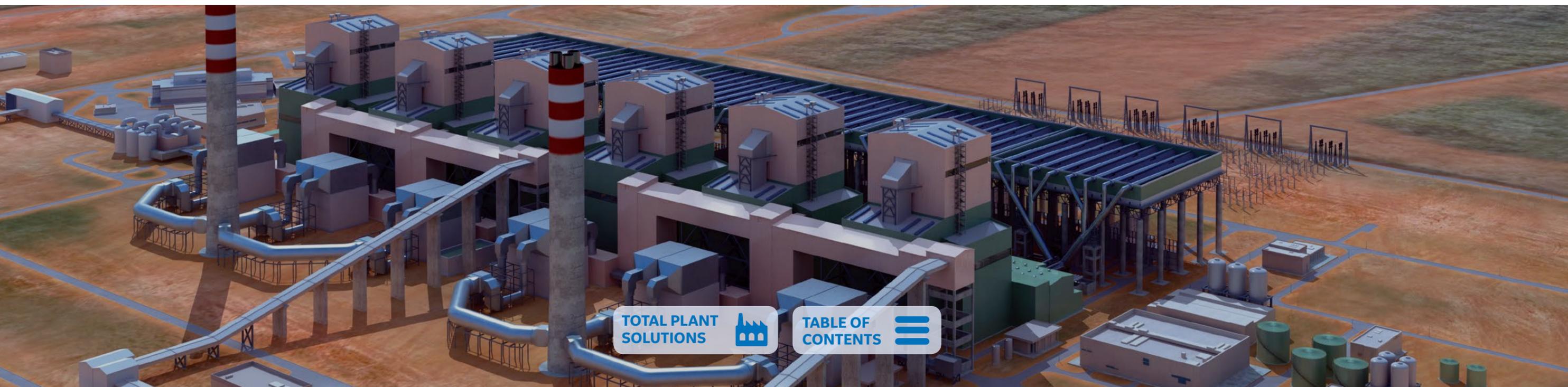
- The Heat Rate Improvement Package offers an LP section upgrade with advanced last-stage bucket technology, providing up to 2% improved heat rate.
- The Horizontal Joint Leak Mitigation applies an abrasion-resistant coating to the horizontal joints to minimize leakage, providing up to 0.5% improved heat rate.
- The Dense Pack Cylinder Retrofit—applicable to medium-sized units—offers ASP technology to improve HP/IP turbine efficiency.

Operability solutions:

- The Fossil ST Agility provides operational flexibility for starting and stopping.
- The Shell Warming System improves start time by maintaining a desirable shell temperature.

Environmentally friendly solutions (with zero waste to landfills):

Our environmental solutions allow for asset reapplication for units with remaining life.



TOTAL PLANT SOLUTIONS

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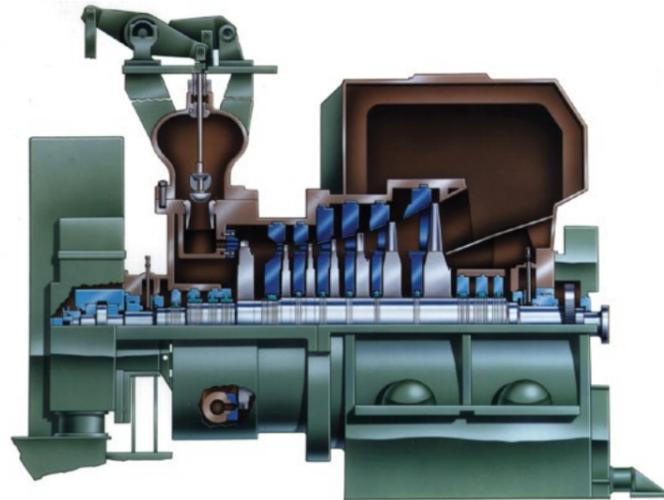
ASP Upgrade for Small Steam Turbines

IMPROVE EFFICIENCY AND OUTPUT



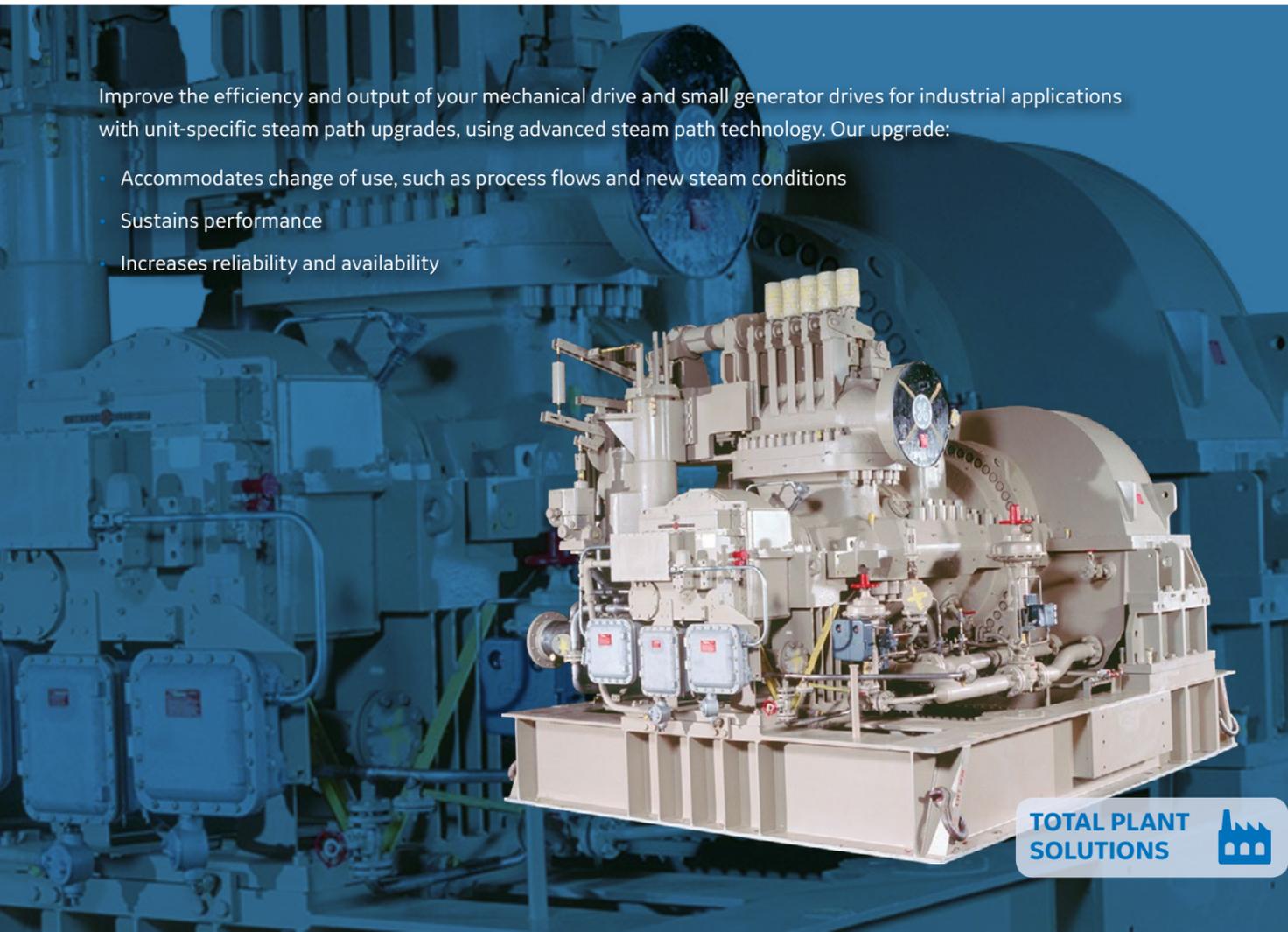
Improve the efficiency and output of your boiler and reactor feed pump turbines with advanced steam path technology. Our small steam turbine upgrade:

- Addresses pump degradation or replacement
- Sustains performance
- Increases reliability and availability by addressing TIL 1206



Improve the efficiency and output of your mechanical drive and small generator drives for industrial applications with unit-specific steam path upgrades, using advanced steam path technology. Our upgrade:

- Accommodates change of use, such as process flows and new steam conditions
- Sustains performance
- Increases reliability and availability



TOTAL PLANT SOLUTIONS

ASP Upgrade for Nuclear Steam Turbine

ENHANCE EFFICIENCY AND RELIABILITY



A number of “built-up” rotors have experienced SCC in key ways in nuclear and supercritical steam environments. To address these SCC issues, GE offers LP monoblock rotors and LP section upgrades. Both of these solutions increase reliability by eliminating shaft and wheel bore crevices where harmful SCC contaminants can concentrate, and by reducing wheel stresses. The LP section upgrade offers incremental performance benefits by applying high-efficiency buckets and diaphragms, an advanced steam guide, enhanced sealing, low-stress dovetails, integral covered buckets, and a modern 43-inch last stage bucket.

The LP Monoblock Rotor offers the following benefits:

- Significantly reduces SCC susceptibility in the wheel dovetails
- Reduces rotor in-service inspection scope due to boreless rotor
- Improves output and heat rate for units with the 43-inch L-0, resulting in up to 1% improvement in output

The LP section upgrade offers the following benefits:

- Significantly reduces SCC issues through new low-stress dovetail configuration
- Improves turbine output and heat rate:
 - 38- to 43-inch L-0 stage bucket delivers up to 4.5% in output improvement
 - L-0 stage bucket delivers up to 3.5% in output improvement
- Delivers reduced inspection requirements and an extended rotor inspection interval of 10 years

Outage Applicability

Major	Minor
✓	

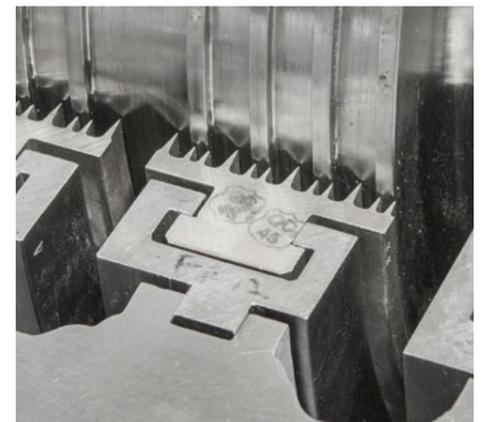


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Shell Warming System

IMPROVE START TIME AND LOADING

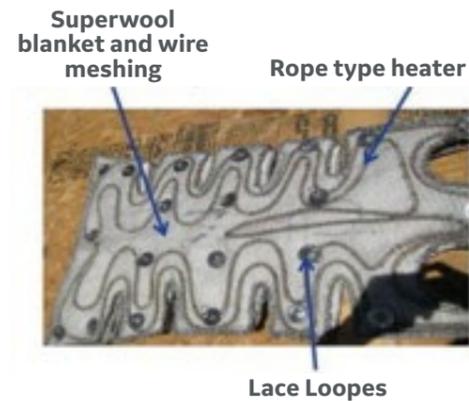


Unit availability and component reliability of the steam turbine fleet are key focus areas for owners. Reducing top-to-bottom shell temperature differentials greatly lessens the likelihood of rub-induced vibration events. GE has developed a robust system that delivers startup flexibility by ensuring temperature uniformity across shells. This upgrade is intended for the HP/IP shell (single-shell configuration), and enables the unit to maintain a set temperature for the turbine shell while reducing transient shell deflections. These deflections target reduced seal wear, which corresponds to longer sustained HP/IP section efficiencies. When combined with GE's Agility* offering, start times (cold, warm, and hot) are reduced. Our shell warming system:

- Provides faster steam turbine start times; helps eliminate cold starts
- Delivers improved cyclic life expenditure improvements. Cold starts have the potential to incur largest cyclic life debits
- Provides better sustained performance. There are fewer vibrations/rubs, and less seal wear during starts and stops
- Further improves start time when combined with Agility software

Outage Applicability

Major	Minor
✓	✓



Back End Optimization

IMPROVE OPERATION LIMITS



To maintain proper steam turbine function, expert operators must adjust control settings to meet original configuration limits. A well-integrated system control approach provides automation to reach optimal conditions and reduce operator involvement and variability.

GE's Back End Optimization upgrade is a comprehensive system solution made to take advantage of an increased operating space, based on years of operating experience and test programs. The new alarm and trip limits expand the safe operating space, particularly for sites that have experienced operating limitations on hot summer days due to limitations of air cooled condensers. The upgrade includes custom control setting changes based on the operating data from your plant. Our Back End Optimization upgrade:

- Allows the steam turbine/gas turbines to maintain higher loads
- Increases operating space prior to backpressure alarm
 - 38- to 43-inch L-0 stage bucket delivers up to 4.5% in output improvement
 - L-0 stage bucket delivers up to 3.5% in output improvement
- Delivers reduced inspection requirements and an extended rotor inspection interval of 10 years

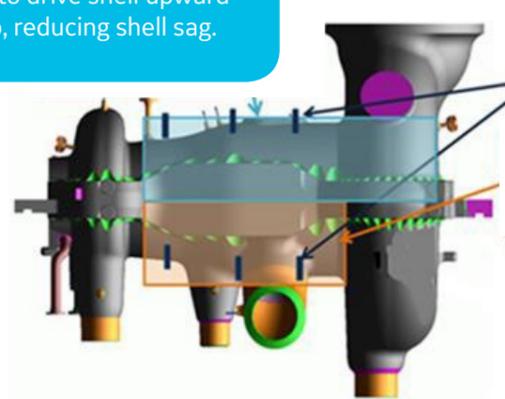
Outage Applicability

Major	Minor
✓	✓

Electric heating blankets installed on upper half in between HP and IP exhaust bowl to drive shell upward during startup, reducing shell sag.

Add top and bottom inner and outer thermocouples.

Electric heating blankets are installed on lower half in between HP and IP to minimize upper to lower shell delta T's during shutdown cooldown.



Valve Upgrades

IMPROVE LIFE, EFFICIENCY AND CONTROL FLEXIBILITY

After many years of operation, steam chests and valves begin to suffer from end-of-life issues such as thermal cycling damage and the interaction of creep and fatigue. These problems may be compounded by demands for more flexible operation. Older valve technologies may also feature less than optimum flow paths and poor control precision.

GE has a wealth of experience in upgrading valves on many fleets and machine types. The most common way to achieve significant benefits is to upgrade the parts to improved, modern technologies. These can be adapted to the geometry, layout and interfacing systems of the unit under consideration. Our valve upgrades offer the following benefits:

- Lifetime extension
- Efficiency improvement
- Control improvement



Outage Applicability

Major	Minor
✓	



Control System Upgrades

RELIABILITY AND PRECISION TO MEET MODERN EXPECTATIONS

Steam turbines depend on the reliability, accuracy and flexibility of their control systems. Modern electricity grids demand ever more stringent levels of control that cannot be met by older systems, particularly those that preceded modern digital electronics.

Based on many years of experience in turbine manufacturing and servicing, GE has developed a range of control upgrade solutions, both for our own machines and those of other manufacturers. These solutions are tailored to meet your specific requirements and may incorporate other plant areas or improvements to valve actuators. Our control system upgrades offer:

- Operational flexibility
- Lifetime extension
- Improved reliability and availability
- Reduced O&M costs



Outage Applicability

Major	Minor
✓	



Generators



100+ years of experience

- 700+ rewinds over the last decade
- **1.7+ MW** of generator uprates



World-class **response time** for emergent needs

- Strategically placed inventory of long lead critical parts
- Large pool of highly trained, safe, and experienced generator specialists and winders



Continuous investment in upgrade and repair technology



Comprehensive portfolio of solutions built around critical needs of any type or make of generator



Leading online monitoring solutions to support condition-based maintenance

Key Programs:

- Monitoring
- Robotic Inspection
- Stator Rewind
- Rotor Rewind
- Replacement Generator
- Auxiliary Systems Upgrades

- Stator Rewind
- Rotor Rewind
- Replacement Generator



Generator Health Monitoring

HIGHEST LEVEL OF ASSURANCE



GE's remote Generator Health Monitoring provides a comprehensive service to any operator to assess the health of the generator by supplying key information for condition-based maintenance and to help prevent unplanned downtime and losses.

For the highest level of assurance, opt for remote continuous online monitoring and benefit from weekly checks and in-depth reports from our experts.

GE's Generator Health Monitoring provides the following benefits:

- Early fault identification
- Extended outage intervals
- Fewer unplanned outages
- More accurate planning and execution of outage work

Outage Applicability

Generator Closed - Visual	Generator Open Rotor In - Minor	Generator Open Rotor Out - Major
✓	✓	✓



Technical Data

Available Modules
Partial Discharge
Rotor Flux
Rotor Shaft Voltage
End Winding Vibration
Stand-alone Boxes
Collector Health Monitor
Stator Leakage Monitoring System

GOLD* Service

ECONOMIC CONDITION MONITORING FOR YOUR GENERATOR



Our periodic online monitoring service allows you to cost-effectively assess the condition of your generator, for any original equipment manufacturer (OEM). It involves the installation of permanent sensors, followed by twice-yearly measurements and an expert report, allowing you to make informed decisions about your planned maintenance.

GOLD Service benefits include:

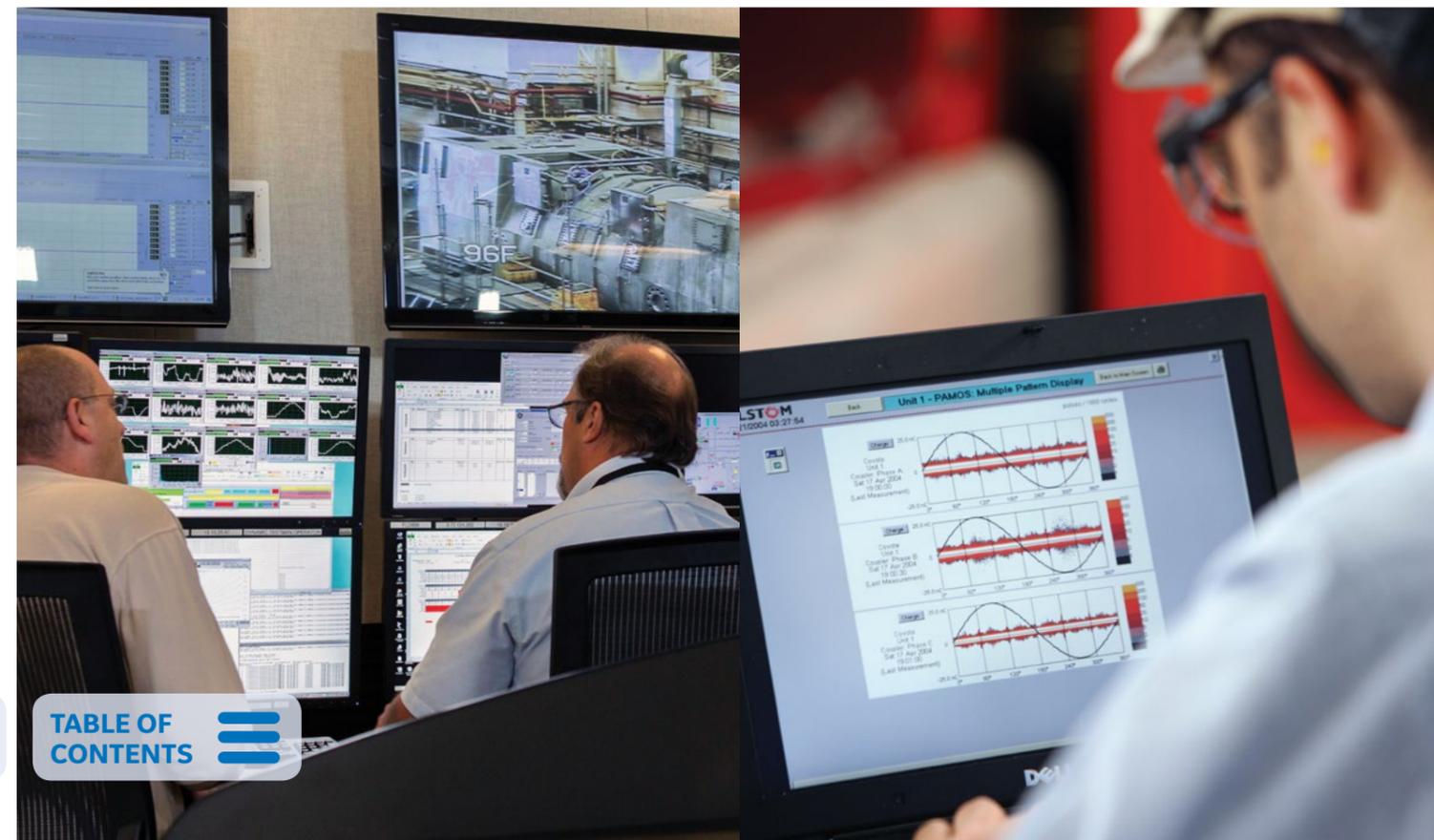
- Extended outage intervals
- Fewer unplanned outages
- More accurate planning and execution of outage work

Outage Applicability

Generator Closed - Visual	Generator Open Rotor In - Minor	Generator Open Rotor Out - Major
✓	✓	✓

Technical Data

Available Modules
Partial Discharge
Rotor Flux
Rotor Shaft Voltage



Generator Offline Inspection, Rotor In-Situ (Air-Gap)

GREATER OPERATIONAL CONFIDENCE BETWEEN MAJOR OUTAGES



GE's offline inspection solutions include the latest robotic tool technology that can perform a complete air gap inspection program with the rotor installed.

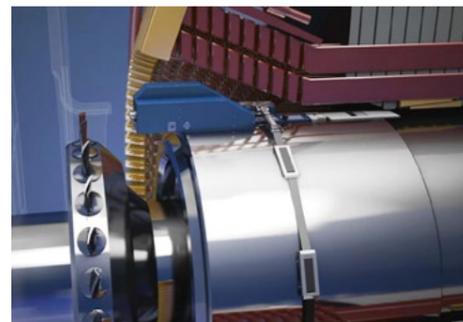
Combining GE's robotic inspection technology and field service expertise, we can help provide an increased level of operational confidence between major outages. In-situ offline inspections are fully embedded in GE's modular condition assessment portfolio, and can enhance outage duration and reduce risks related to rotor removal. Combine the air gap inspection with an in-situ retaining ring inspection to get even more from your outage time.

Benefit from:

- Reduced downtime
- Reduced risk—rotor stays in place
- Lower workforce costs due to reduced dismantling requirements

Outage Applicability

Generator Closed - Visual	Generator Open Rotor In - Minor	Generator Open Rotor Out - Major
	✓	



Technical Data

Base Scope	Extended Scope
Visual Inspection	DC High Voltage Test
Robotic Slot Wedge Assessment	Leakage Current Measurement
Robotic Low Flux	Up to 60% Time Savings with In-Situ Inspections
Insulation Resistance Measurement	
Up to 40% Time Savings with In-Situ Inspections	

Generator Offline Inspection, Retaining Ring

DELIVERING GENERATOR RELIABILITY



GE's retaining ring scanner is a robotic inspection tool made for detecting stress corrosion cracks without the need to remove the retaining rings. The dismantling requirements are reduced and the inspection can be carried out with the rotor in-situ or removed.

Enhance your outage time and increase the level of assurance between major outages by carrying out an air gap inspection in parallel with your retaining ring offline inspection.

Benefit from:

- Reduced downtime
- Lower workforce costs due to reduced dismantling requirements
- Enhanced accuracy related to characterization and location of defects

Outage Applicability

Generator Closed - Visual	Generator Open Rotor In - Minor	Generator Open Rotor Out - Major
	✓	✓



Generator Offline Inspection - Rotor Ex-Situ

DELIVERING GENERATOR AVAILABILITY



GE's Test and Inspection Program is a set of modular solutions to thoroughly assess the condition of your generator during a major outage. Based on decades of experience across one of the largest installed fleets, our diagnostic experts will provide you with a detailed analysis and recommendations for reliable operation.

Example tests include:

- Generator endwinding vibration testing (Bump Test): Determines if additional support is required for the endwindings.
- Generator stator cooling water flow test (UT Flow): Pinpoints individual bars with rates that are lower than average low flow that can lead to higher stator bar temperature and accelerated ground wall insulation aging and an eventual forced outage. This test is performed during a major outage.

Outage Applicability

Generator Closed - Visual	Generator Open Rotor In - Minor	Generator Open Rotor Out - Major
		✓

CUPROPLEX*

REMOVES COPPER OXIDES FROM GENERATOR STATOR BARS



CUPROPLEX is a proven service to remove copper oxide build-up from stator bars and the cooling water system to restore cooling efficiency and avoid overheating damage.

It is the only process that can be applied while the generator is online and in normal operation.

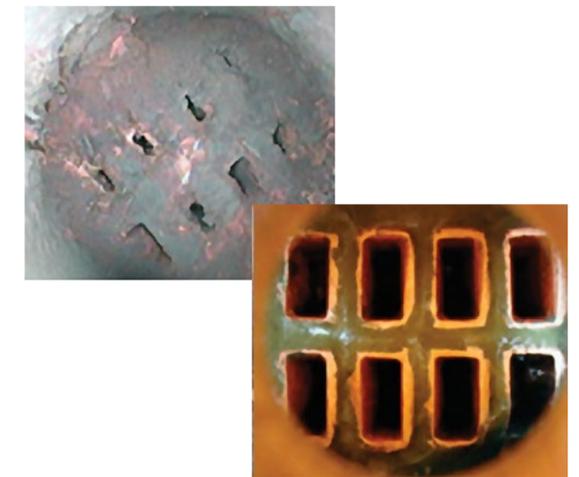
For heavily flow restricted bars we have developed CUPROPLEX-S.

Benefits of this service include:

- No disassembly requirements
- Controlled process
- Reduced environmental impact—no hazardous liquid waste
- Return to full output in as little as two days

Outage Applicability

Generator Closed - Visual	Generator Open Rotor In - Minor	Generator Open Rotor Out - Major
✓	✓	✓



TOTAL PLANT SOLUTIONS

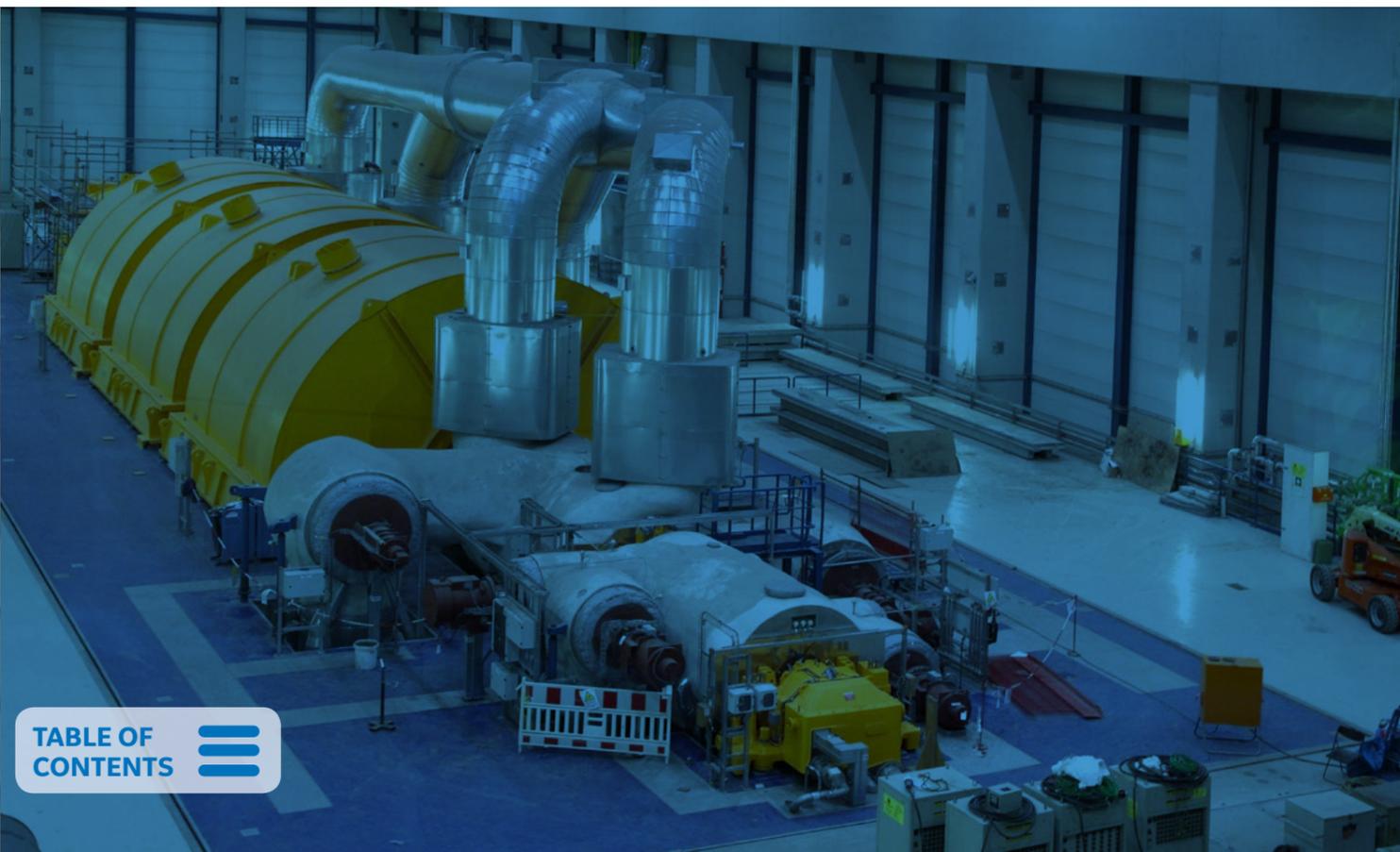


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Onsite Repairs

A REPAIR PORTFOLIO BUILT AROUND YOUR CRITICAL NEEDS



By drawing on decades of design and repair experience, we developed a wide range of onsite repair solutions to increase the reliability of your generator asset.

GE's onsite repair solutions include:

- **APLETEC* - Stator water box leakage repair**
Seal leaking water boxes by exposed coating, with only disconnecting the hydraulic hoses (no bar removal)
- **Metal spraying - Onsite rotor repair**
Rotor seal oil journals repair - Low coefficient of friction sprayed metal, reducing rubbing effects between the rotor and oil seal rings
- **On-site stator core repair**
Prosthesis - Alternative technology to partial stator core ends restacking



Outage Applicability

Generator Closed - Visual	Generator Open Rotor In - Minor	Generator Open Rotor Out - Major
	✓	✓



Workshop Repairs

A GLOBAL NETWORK OF FACILITIES FOR ANY KIND OF REPAIR

GE is at the forefront of continuous improvements. Our leading workshop facilities are equipped with the latest tools and equipment technology to repair any type and make of generator to restore full operational confidence.

GE is well positioned to deliver repair services where and when you need us by continually investing to develop local resources. Critical to managing this global presence, we've mastered the logistics to maintain reliable supply chains, coordinate resources, and comply with regional regulations.



Outage Applicability		
Generator Closed - Visual	Generator Open Rotor In - Minor	Generator Open Rotor Out - Major
	✓	✓

Global Repair Service Centers

GENERATOR REPAIR NETWORK



Repair capabilities by region:

	Generator GRSC							
	Americas		Europe		Asia		Middle East/Africa	
	Repair	New Parts	Repair	New Parts	Repair	New Parts	Repair	New Parts
Stator Bar Manufacturing		✓		✓				
Stator Winding	✓		✓		✓		✓	
Rotor Winding	✓		✓		✓		✓	
Generator Inspections	✓		✓		✓		✓	
Exciter Inspection & Rewind			✓				✓	
Rotor Manufacturing				✓				
Coil Manufacturing				✓				
Stator Stacking				✓				
Rotor High Speed Balancing	✓		✓				✓	
Motor/ Hydro Repair	✓		✓		✓		✓	

Generator Upgrades

FLEXIBLE SOLUTIONS TO MEET YOUR NEEDS



Select the best solution for you with help from GE's generator experts. Our investment into developing upgrade solutions—including electrical power systems, full train rotor dynamics, controls and heat exchangers—can have a big impact on your aging systems. GE's generator upgrade solutions include:

- **Capacity Upgrades:** Choose from options to uprate your generator up to 20% of current capacity.
- **Generator Replacements:** High-power density replacement generators can be tailored to meet your needs, with reduced plant impact. These solutions use the latest technologies to provide higher efficiency and reliability.
- **Generator to Condenser Conversion:** GE now offers engineered solutions that convert existing synchronous generators, powered by steam turbines, into synchronous condensers.

† Depending on generator type



Stator Upgrades

EXTEND LIFE AND INCREASE OUTPUT



No matter the type of generator you own, GE provides a comprehensive portfolio of stator upgrades including rewinds, midsections, and core restacks and replacements for any make of generator to improve reliability and availability. Our stator upgrades deliver the following key advantages:

- Increased output is achieved through the implementation of the latest technology insulation material and improved end-winding support systems.
- Reduced downtime results from the use of high-tech manufacturing processes, advanced tools, and standardized methods.

Outage Applicability

Generator Closed - Visual	Generator Open Rotor In - Minor	Generator Open Rotor Out - Major
		✓

Technical Data

Advantages
Up to 20% Output Increase†
18-day Stator Rewind†

† Depending on generator type



TOTAL PLANT SOLUTIONS

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Field Upgrades

EXTEND LIFE AND INCREASE OUTPUT

GE provides a comprehensive portfolio of field upgrades for any make of generator to provide the fastest return to service. Depending on your preference, we will rewind your field at site or in a workshop. For selected types we can provide you with an exchange field to reduce downtime.



Outage Applicability

Generator Closed - Visual	Generator Open Rotor In - Minor	Generator Open Rotor Out - Major
		✓

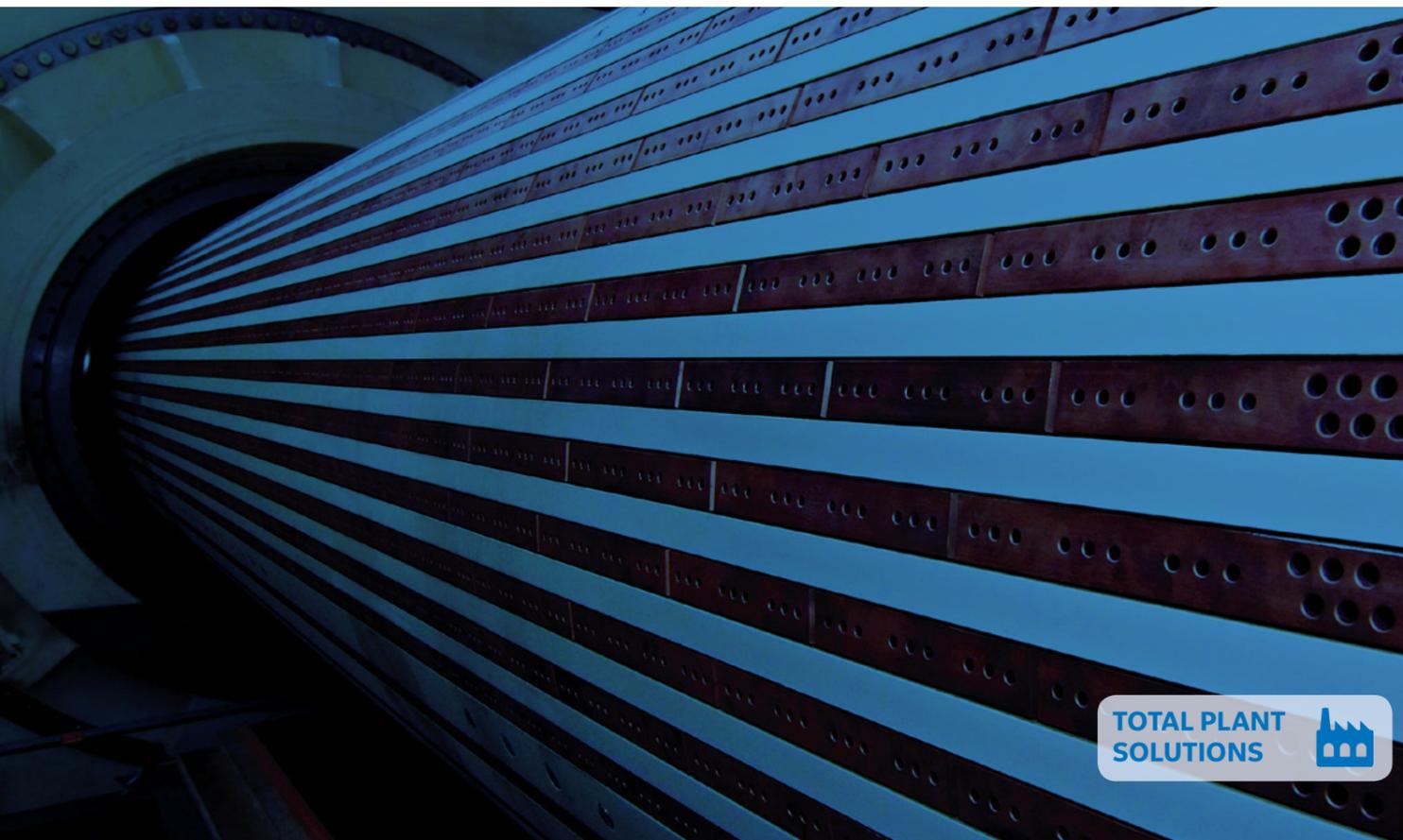
Technical Data

Advantages

18-day Rotor Rewind†

Up to 42 Days Time Saving†

† Depending on generator and upgrade type



Auxiliary Systems Upgrades

COMPLIANCE WITH TODAY'S SAFETY REGULATIONS



Outage Applicability

Generator Closed - Visual	Generator Open Rotor In - Minor	Generator Open Rotor Out - Major
	✓	✓

GE offers upgrades for generator auxiliary systems, including electrical systems from static excitation to brushless exciters.

From assessments to identify upgrade potentials, through partial modernizations, to replacements of complete systems, we address parts obsolescence, safety regulations, and redundancy or reliability requirements with our technology-driven solutions.



Boilers



A coal-fired tower boiler can be **550 ft. (167 m)** tall



GE has installed more than **1,000** fossil-fired utility boilers globally, not including HRSGs



The U.S. boiler team executes more than **40,000** replacement part line items each year



A 600 MW unit's boiler contains about **130 miles** of boiler tubing



Some boilers weigh **40,000 tons**, equal to the weight of about **20,000 cars**



Depending on the unit, water and steam saturate at **680°F (360°C)** and then are superheated to **1,000°F (538°C)** before they enter the steam turbine



Replacement Parts

GE offers a one-stop solution for all your boiler service needs. For GE, every part replacement is an opportunity to help keep your plant competitive and extend the service life of your equipment.

We serve the full spectrum of customer needs. Our in-kind replacements or upgraded parts include the latest technologies and materials for improved performance and extended time between outages. Or, should your operating strategy require end-of-life planning, we offer a range of economical solutions to cater to unit retirement needs.

To improve equipment reliability and reduce outage duration and frequency, we offer the following parts-related services for all major boiler manufacturers:

- Inventory management
- Equipment rebuild programs (US)
- Technical support
- Outage kits
- 24/7 emergency support and expedited components

PULVERIZERS

Replacement parts for all mill types - OEM and other OEM • advanced static and dynamic classifiers • grinding elements • vane wheels

PULVERIZER AUXILIARY EQUIPMENT

Gearboxes • feeders • stokers

PRESSURE PARTS

All boiler makes and models for small & large scale projects • boiler tubing – straight or fabricated • superheater • reheater • economizers • headers • panels • desuperheaters • drum internals • sootblowers • attachments

FUEL DELIVERY SYSTEMS

Oil guns • coal piping and elbows • riffle distributors • tips • nozzles • low NO_x burner upgrades • windboxes • dampers • tangential- and wall-fired burners

ELECTRONICS AND CONTROLS

LIMELIGHT* boiler electronic products • ignitors • flame spectrometers and scanners • control cabinets • process instruments • burner management systems

BOTTOM ASH AND FLY ASH SYSTEMS

Products and services for UCC, A-S-H and GE's bottom ash and fly ash systems • clinker grinder rebuilds • hoppers • seal skirts • waterboxes with weir piping • front enclosures • ash gates • E valves • airlocks • dry drag conveyors • pugmills • submerged scraper conveyors

Boiler Field Services

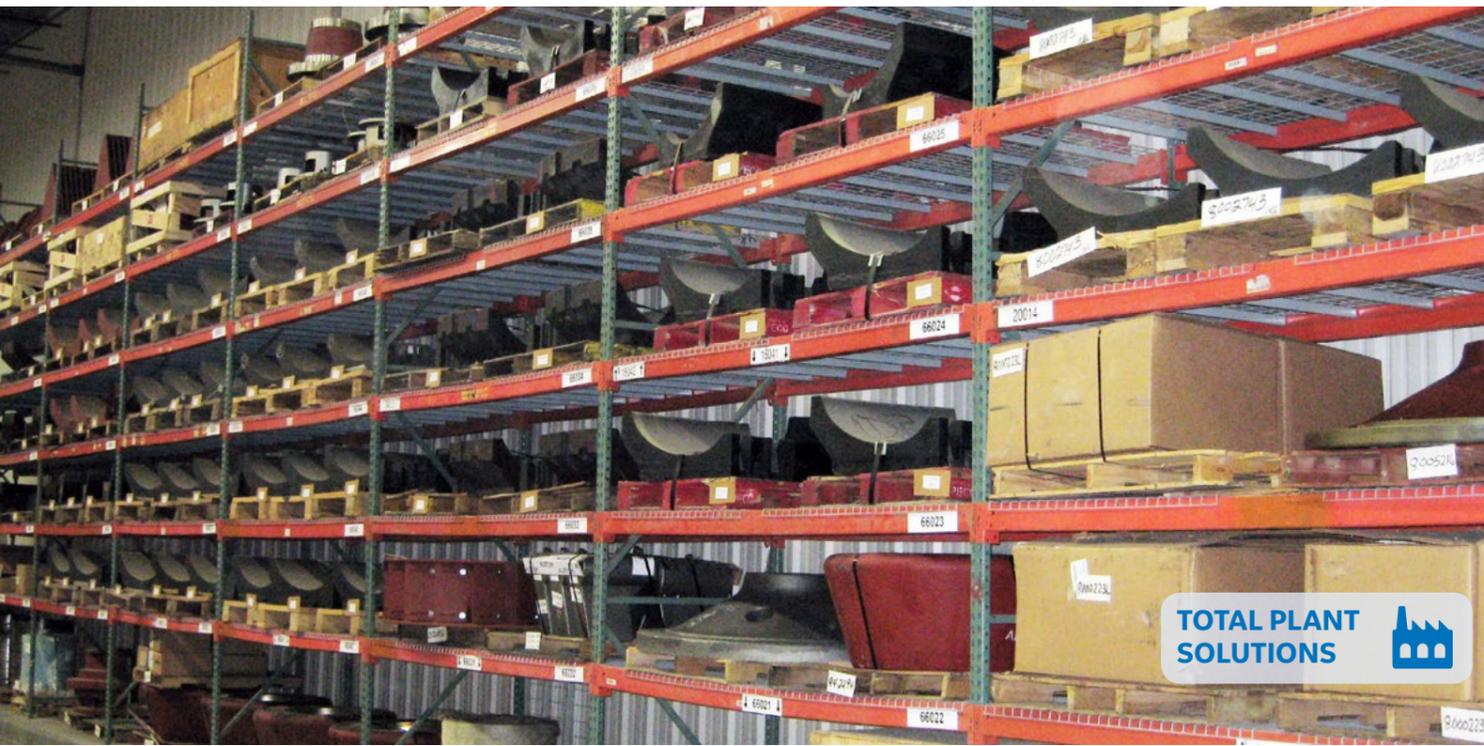
COMBINING CAPABILITIES AND EXPERIENCE TO ENHANCE PERFORMANCE



We enhance the performance of your boilers, pulverizers, air pollution control systems, ash handling systems, and auxiliary equipment.

Our expertise has been built over many years, with many customers, at many plant sites. We have solved common problems, and we have solved unique ones. Our experience has been gained across a variety of equipment types and brands, including service in utility, waste-to-energy, petrochemical, pulp and paper, and industrial sectors, and with all fuel types.

- Outage planning and inspections
- Commissioning
- Instruction/training/E-learning
- Reliability troubleshooting
- Root cause determination
- Equipment/systems testing
- Systems evaluations
- Operational reviews
- Condition assessment
- Performance improvement
- Dedicated engineer program
- Thermal spray claddings



TOTAL PLANT SOLUTIONS 



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AmStar Thermal Spray Cladding

DEPENDABLE AND PREDICTABLE WATERWALL PROTECTION



AmStar 888* thermal spray cladding provides dependable and predictable waterwall protection in boilers where high temperature gaseous corrosion and/or erosion may occur. Our proprietary metallurgy, surface preparation and high velocity continuous combustion (HVCC) application process resists cracking, spalling, and stress.

Benefits include:

- Cost effective method of extending life of tubes
- Significantly reduced equivalent forced outage rate (EFOR)
- Dependable and predictable tube protection
- Measurable and scalable
- Heat absorption of the tube not affected
- Reduced generation cost
- Corrosion prevented
- Repairable
- Applicable for any fuel type



TOTAL PLANT SOLUTIONS

Maintenance and Repair Services

BOILER EQUIPMENT REPAIR NETWORK



As a leading supplier of quality power plant equipment and replacement parts, GE offers one complete and cost-effective solution for maintaining and repairing boiler equipment. Our Global Repair Centers (GRC) combine our extensive experience and proven processes.

Benefits include:

- All work done in a controlled environment using the latest technology
- All work done to engineering specifications
- Shorter lead times
- All work backed by GE's engineering experience and quality
- Certified rebuild technicians
- Documented procedures
- Inspection reports
- Warranty included



Repair capabilities by region:

Americas		
Capability	Repair	New Parts
Boiler Component Rebuild & Overhaul	✓	✓
Pulverizer Roll Hard Facing	✓	✓
Pressure Part Fabrication & Welding	✓	✓

Europe	
Capability	
Boiler repair solutions	

Americas Middle East/Africa Europe Asia

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Natural Gas Conversions and Co-Firing

UPGRADE MODIFICATIONS FOR STEAM BOILERS



Outage Applicability

Major	Minor
✓	

O&M Cost Reduction

Our installed base is one of the industry's largest, and we have more than 60 years of proven experience firing natural gas in utility and industrial fossil steam units. This experience includes firing natural gas as the main fuel, co-firing natural gas with multiple fuels, and adding gas firing to existing units. We have extensive experience converting both tangential-fired units as well as wall-fired units, for both GE and non-GE technologies.

Benefits include:

- Lower SOx, mercury, particulate, NOx, and ash. In the case of 100% conversion, no SOx, particulate or ash
- Higher turndown ratio (up to 10:1), depending on gas supply pressure at the burner front and equipment configuration
- Ability to balance fuel usage and leverage fuel suppliers



TOTAL PLANT SOLUTIONS

NOx Solutions

PRIMARY AND SECONDARY NOx REDUCTION TECHNOLOGIES



When a conventional SCR NOx reduction system is not practical due to space requirements, installation logistics or cost efficiencies, we offer a unique combination of technologies and engineering for cost-effective in-boiler NOx compliance.

Primary low NOx measures include our portfolio of cutting-edge low NOx burners. The low NOx concentric firing system (LNCFS*) for our OEM boilers and RSFC* and RoBTAS* burners for other manufacturers' boilers are commercially proven and cost-effective solutions for achieving significant NOx reductions, especially when combined with our overfire air systems.

A secondary reduction of up to 30 percent of NOx can be achieved with a selective non-catalytic converter (SNCR) system. This works by injecting urea or ammonia in the upper part of the furnace. At temperatures of 1500° to 2010°F, the NOx is reduced without the need for a catalyst. GE's Umbrella-SNCR (U-SNCR) is unique because the urea is sprayed within the furnace with a nozzle that is adjustable in height. The process uses cooled lances to carry flexible hoses arranged in the furnace. There are no boiler size constraints, and the technology is easy to control.

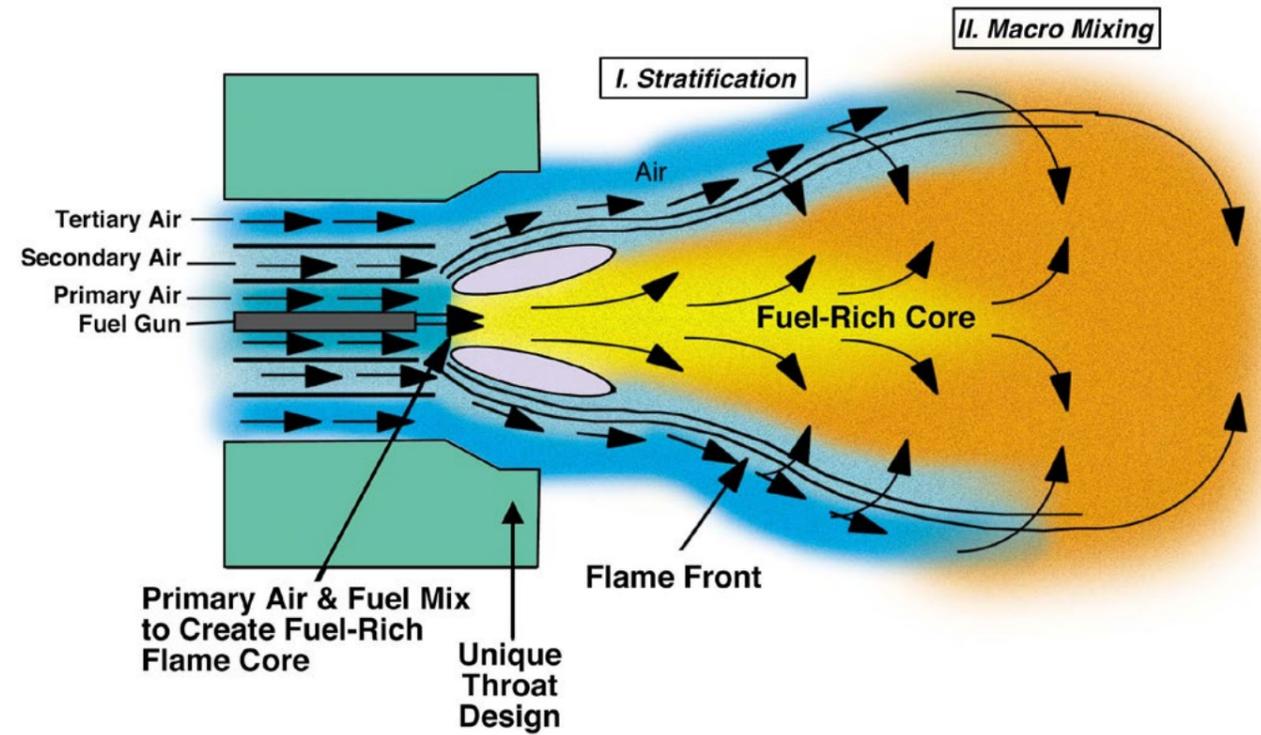


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T-PRO* Fuel Firing System

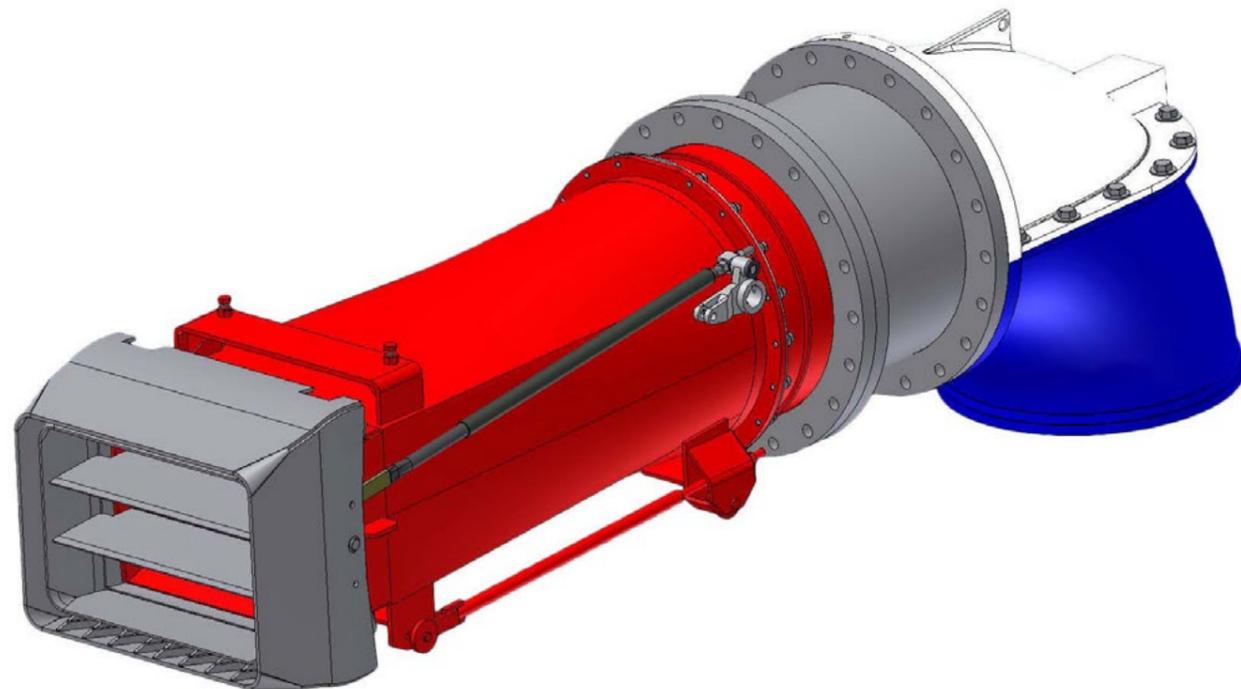
REDUCE EROSION AND EXTEND COMPONENT LIFE

The T-PRO Fuel Firing System reduces erosion and thermal stresses on units firing abrasive coal that can cause coal compartment components to fail. The T-PRO Fuel Firing System's innovative configuration and material selection ensures equipment reliability, longer operation between outages, and shorter outage durations.

- Increases coal nozzle and nozzle tip wear life
- Improves reliability and availability
- Increases operation time between outages and reduces outage duration
- Reduces maintenance and repair labor costs



Outage Applicability	
Major	Minor
✓	



FlexSuite for Boiler

LOW LOAD AND RAMP RATE PACKAGES



Today's steam plants must operate differently than in the past, and differently than they were designed for. As a total plant service provider and boiler original equipment manufacturer (OEM), GE offers packages that can improve the flexible operation of your boiler. The first step is to systematically assess the design and identify areas that would hinder operating the unit per your new operating parameters.

For improved ramp rate, areas that are prone to accelerated damage as a result of more frequent startups and shutdowns are identified and addressed. For low load, solutions allowing stable operations customized to your system design are identified and addressed. These solutions are applicable to all boilers, whether made by GE or other manufacturers.

Typical packages that GE offers to enhance performance and lifetime profitability while making safety, reliability and environmental compatibility top priorities include a combination of the following solutions:

- Flame scanners
- Plasma burner
- Burner upgrade
- Smart mill
- Stability monitor
- Low load boiler package
- Auto tune

Benefits include:

- Increased flexibility
- Greater availability

Outage Applicability	
Major	Minor
✓	✓

Boiler Tuning

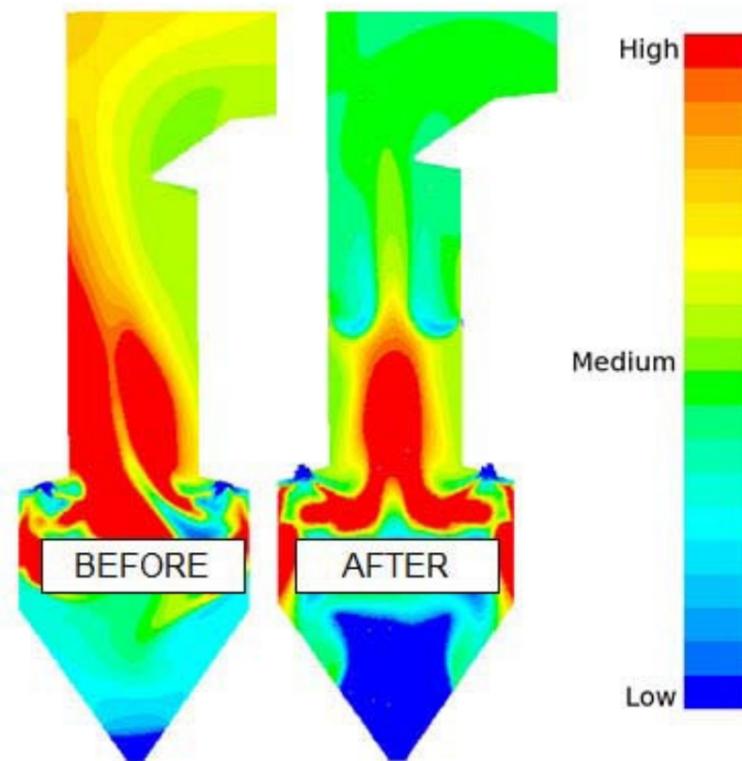
ACHIEVE ADVANCED BOILER PERFORMANCE



Outage Applicability

Major	Minor
	✓

GE is one of the world's largest power service providers, and our boiler specialists travel from plant to plant, troubleshooting issues and improving performance. Let us document and report the critical operating data necessary to help your plant go beyond tune-up compliance (NOx, CO) to achieve advanced boiler performance. Beyond tuning, services can include inspections and maintenance, performance testing, engineering, parts supply, and document storage.



Economizer Outlet Gas Temperature (EOGT) Control

UNIT FLEXIBILITY WITH EFFECTIVE SCR OPERATION



GE offers advanced boiler modifications and systems to control the gas temperature to the SCR so your plant can operate at low load and still comply with environmental restrictions. These systems are fully integrated with your boiler's control system (DCS) and are tailored to meet your plant's demands.

Based on your unit, we can customize the right solution to meet your operating requirements. Two examples for controlling gas temperatures are:

- **Subcritical boiler:** Our patented hot water recirculation system (HWRS) controls the EOGT by extracting a portion of the hot water from the boiler downcomers and mixing it with feedwater upstream of the economizer inlet.
- **Supercritical boiler:** Our patented economizer recirculation system (ERS) recirculates waterwall outlet fluid.

Benefits include:

- Easy to control gas temperatures to SCR at low loads
- Operation only during required loads; no parasitic power used at high loads
- Increased boiler flexibility
- Reduced wear and tear on boiler, since operating SCR at low loads avoids increased startup/shutdown cycles

Technical Data

Avoids increased startup/shutdown cycles by operating SCR at low loads
Depending on unit, turndown to as low as 35% per load

Outage Applicability

Major	Minor
✓	

O&M Cost Reduction ↓



TOTAL PLANT SOLUTIONS

PV-PRO* System

FINENESS, CAPACITY, AND OPERATIONAL FLEXIBILITY FOR COAL PULVERIZERS



We are the milling system experts, with a deep understanding of the industry and a full range of offerings across many mill types, including those from our legacy companies (including CE, EVT, Stein, and Alstom), B&W, BPI, Riley, Hitachi, and Foster Wheeler.

The PV-PRO* system is an integrated performance, recovery and optimization (PRO) system. Depending on your mill type, it includes an improved throat/air port, upgraded grinding zone, and an adjustable static or dynamic classifier.

Benefits include:

- Less pressure drop
- Improved efficiency and coal transport
- Reduced pulverizer wear for extended operations
- Better control of coal fineness

Technical Data

Down to 18% lower mill motor power consumption with PV-PRO system installation (at a U.S. power plant)
Down to 39% lower mill differential pressure due to PV-PRO system installation

Outage Applicability

Major	Minor
✓	

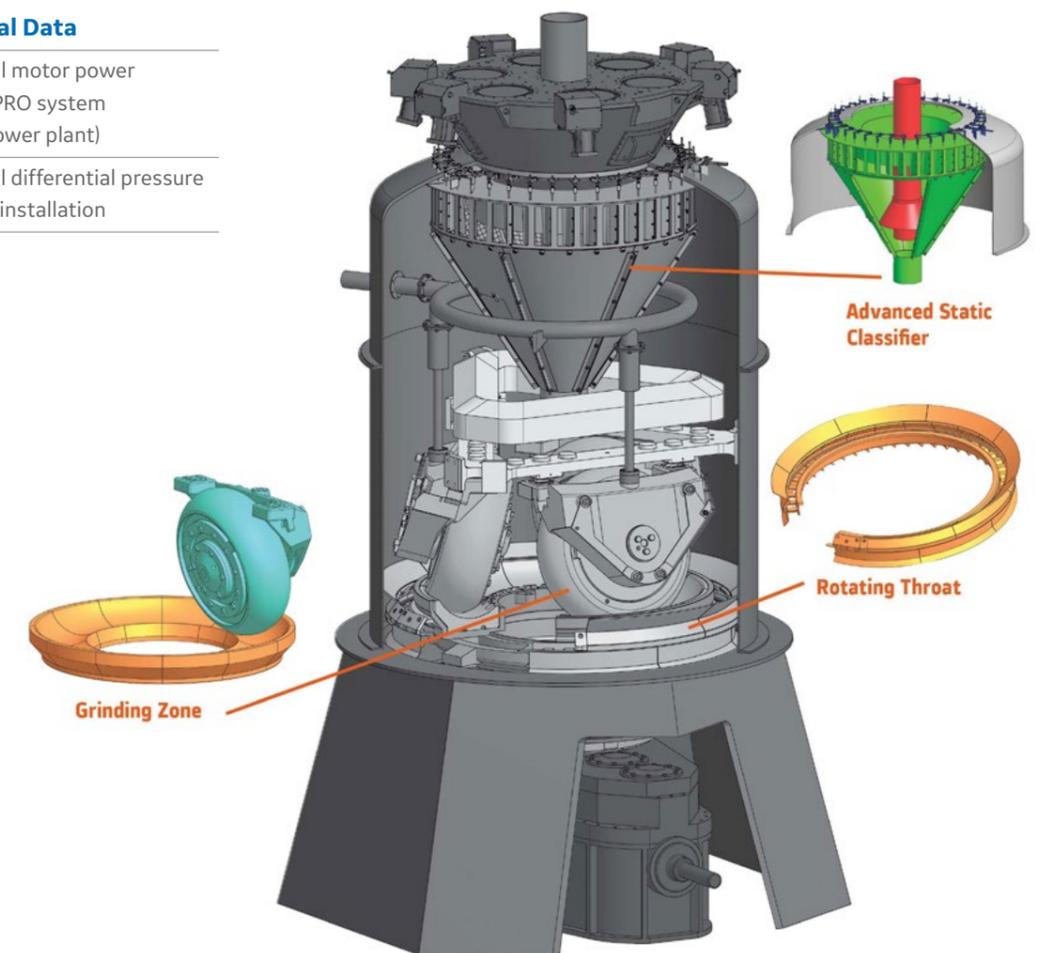


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Air Quality Control Systems (AQCS)



Over **100 years** of Environmental Equipment experience



Comprehensive product portfolio of **AQCS technologies**



Abating **> 155,000 tons** of particulates and **52 tons** of SO₂ through GE technologies. Particulate emission reduction of 99.97% and SO₂ emission reduction of 99%.



The world's largest **Electrostatic Precipitator** was built by GE and it is located at a plant in India



Widest offering for Mercury control-dependent upon the type of coal used and the level of Hg emissions required



1st to introduce the **Sulphite Analyzer** product to optimize power consumption of wet Flue Gas Desulfurization

TOTAL PLANT SOLUTIONS



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Replacement Parts



For original and custom-designed components such as electrostatic precipitators (ESP), fabric filters (FF) and dry and wet flue gas desulfurization (FGD), GE supplies a wide range of replacement parts and control systems. Our extensive original equipment manufacturer (OEM) knowledge and experience enables us to deliver high-quality and innovative components across the entire AQCS system. Our portfolio of parts offerings extends to cross fleet equipment. We offer an extensive range of upgraded parts for Lurgi, Rothemule, Joy and Buell ESPs and MHPS Wet FGDs

With our responsive and competitive spare parts management, you can benefit from our quick distribution, spare parts pooling and inventory programs. Based on more than 100 years of experience, GE's global supply chain responds to stringent quality requirements.

The benefits of using GE's spare parts include:

- Many years of operational experience with life cycle cost models and enhanced parts (ESP, FF, and wet and dry FGD)
- Dedicated research and development that delivers new technologies with increased performance
- Ability to build an appropriate and reactive supply chain for speed and cost savings
- Global sourcing with stringent quality requirements

Inspections and Maintenance

ADVANCED TECHNOLOGY WITH LOCAL SERVICES

Field Services

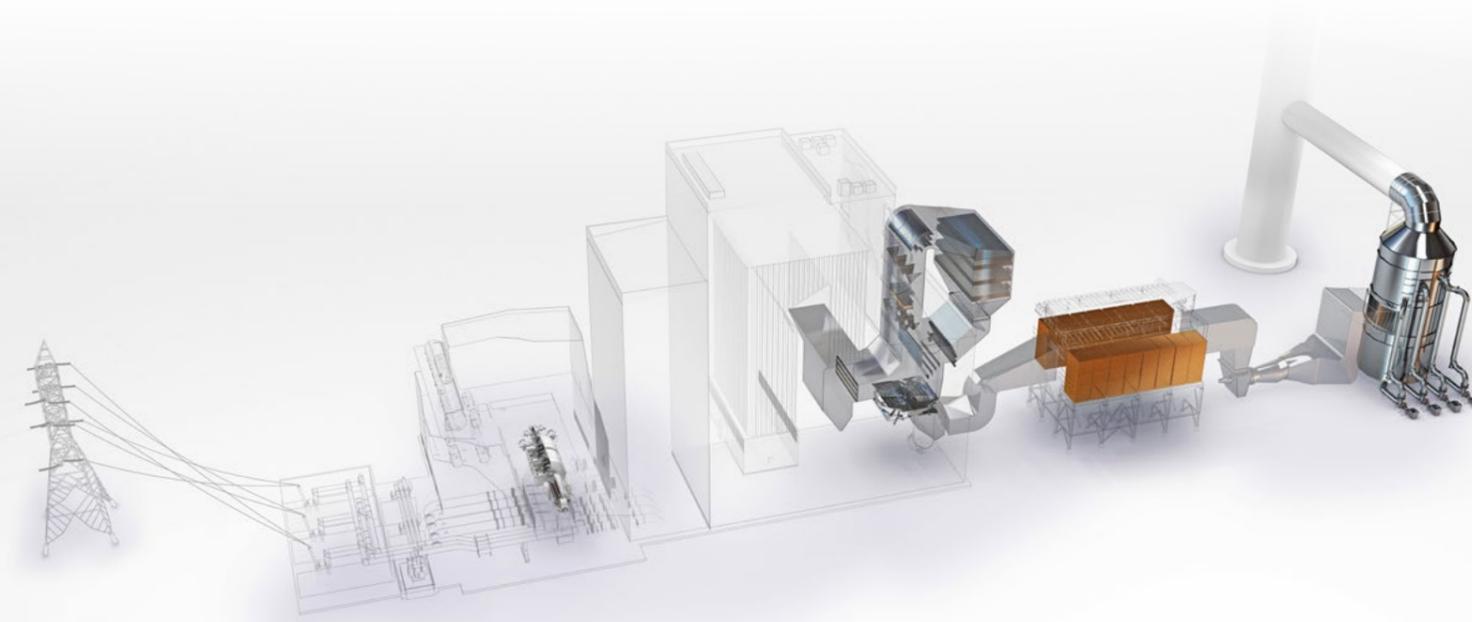
GE's global field service network has a strong local presence that supports you with the latest tools, technology, and engineering capabilities. We provide inspection services, maintenance management, field repairs, commissioning, construction, and supervision. Our vast technical and outage management experience allows us to service, retrofit, and upgrade your plant to improve the performance of both our equipment and other manufacturers' systems. With an absolute commitment to quality and EHS, GE's operational processes cover both planning and execution for on-time delivery.

Advice and Operational Support

GE's dedicated and experienced technical service and process engineers can provide excellent technical assistance and support to any equipment design. We help you choose the right solution to maximize your AQCS performance, availability, and reliability. Our large range of innovative services includes inspections, condition and lifetime assessments, outage management, ERP, monitoring and diagnostics, remote control and optimization (via proprietary systems ProMo and Predix*), and training.

Servicing other manufacturers' equipment

Following a series of acquisitions and mergers over the last century, GE provides expertise to a broad technical product portfolio, and we can service, upgrade, or retrofit a wide range of AQCS systems.



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Electrostatic Precipitator (ESP)

UPGRADES



ESP operators can benefit from upgrade solutions to extend lifetime and lower particulate matter (PM) emissions, parasitic losses, and maintenance costs. This enables you to increase the output of your plant while maintaining your AQCS equipment. As a one-stop shop, we work with you to conduct a thorough evaluation of your plant's technical and economic conditions and then help you select the right renovation and upgrade solutions. Upgrades can be of either Mechanical or Electrical scope or a combination of both.



Outage Applicability

Major



Minor



O&M Cost Reduction



Switched Integrated Rectifier (SIR)

HIGH FREQUENCY POWER SUPPLIES FOR ESPs



Our patented SIR technology reduces the particulate emission level and improves overall ESP performance without the need for costly extensions. With more than 4,500 SIR units in operation around the world, we offer a wide range of advanced high voltage power supplies for ESPs to meet your plant's requirements.



Benefits include:

- Reduces up to 70% particulate emissions compared to conventional technology, and reduces emissions levels down to below 10mg/Nm³ particulate emissions, when required
- Installs on new or existing ESPs from GE and other manufacturers
- Applies to ESPs in power and industrial applications, such as cement and pulp and paper
- Offers more than 95% electrical efficiency
- Avoids cost-intensive retrofit and longer outages

Outage Applicability

Major

Minor



TOTAL PLANT SOLUTIONS



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Electrostatic Precipitator Integrated Controller (EPIC)

ADVANCED ESP INTEGRATED CONTROLLER



Outage Applicability

Major

Minor



O&M Cost Reduction

GE's electrostatic precipitator integrated controller (EPIC) is an ESP bus-section controller for transformer rectifier sets (T/Rs), which includes basic functionalities, energy savings, current control, spark detection, and rapping efficiency. It uses software algorithms like electrostatic precipitator optimizing of charge (EPOQ) and opacity optimization (OpOpt) to obtain optimum performance from the ESP.

With EPIC well below 20mg/Nm3 particulate emissions can be achieved.



Optimization Algorithms - EPOQ & OpOpt

ESP OPTIMIZATION SOFTWARE FOR HIGHLY RESISTIVE FLY ASHES



Building on proven process experience in particulate matter control, GE's electrostatic precipitator optimizing of charge (EPOQ) software is an intelligent solution for improved ESP performance. Thanks to self-adjusting algorithms and individual bus-control, emissions can be decreased and power consumption improved when handling highly resistive fly ashes.

Outage Applicability

Major

Minor



TOTAL PLANT SOLUTIONS



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Fabric Filter (FF)

UPGRADES



FF upgrades, with higher removal efficiencies, are required to allow for further reductions in particulate matter (PM) emissions as well as to maintain the performance and availability of the entire plant throughout its life cycle. Operational costs also are optimized for a quick return of investment for the FF upgrade.

Outage Applicability

Major	Minor
✓	✓



Electronic Fabric Filter Integrated Control (EFFIC)

ADVANCED FF INTEGRATED CONTROLLER



A powerful controller, the electronic fabric filter integrated controller (EFFIC) can modernize control systems on new or existing units. This intelligent controller drives the pulse jet FF by using actual process conditions instead of traditional pressure drop methods.

Traditionally, the pulse control system must be programmed into the distributed control system (DCS). If an EFFIC is used as an interlink between the FF and DCS, the DCS programming is simplified, requiring the addition of only the most commonly used functions. The DCS will send a signal to the EFFIC, and the EFFIC automatically will control the entire array of FF functions and alarms.

The Benefits Include:

- Longer bag life
- Less emissions
- Controlled absorbent consumption

Outage Applicability

Major	Minor
	✓

O&M Cost Reduction ↓



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Flue Gas Desulfurization (FGD)

UPGRADES



More stringent environmental regulations require improved solutions for flue gases. GE offers a full set of wet or dry FGD service solutions to upgrade your equipment to a high-tech configuration for high performance, low energy consumption and reduced operating costs.

GE is committed to finding innovative solutions to existing FGD systems with upgrades for increased performance and energy savings. As every FGD system is unique, GE takes a tailored approach to determining the solution you need.

FGD upgrade options include:

- Spray headers for improved design for uniform flue gas coverage
- Nozzle types for optimal droplet diameter and dispersion
- Mist eliminators to prevent droplets carryover at reduced pressure loss
- Performance enhancing plates to increase gas-to-liquid contact
- Tray upgrades for optimal velocity with additional perforated tray
- Slurry preparation equipment of ball mills, mixers and pumps

Outage Applicability

Major	Minor	O&M Cost Reduction ↓
✓	✓	

SulfiTrac* Sulfite Analyzer

REDUCE POWER CONSUMPTION AND MERCURY RE-EMISSION IN REAL TIME OF WET FLUE GAS DESULFURIZATION



Our patented new SulfiTrac sulfite analyzer is the first online solution for continuous improvement of energy consumption while reducing mercury emissions. This is accomplished by measuring and controlling the sulfite ion concentrations within the wet flue gas desulfurization (WFGD) slurry.

With GE's sulfite analyzer hardware and software, you can reduce the power consumption of the oxidation air blowers by injecting only as much air as needed while maintaining gypsum purity.

Configured to cope with harsh environments in heavy industrial applications, the sulfite analyzer is suitable for most power plants or industrial processes with a WFGD.

Benefits includes

- Reduce power consumption and costs
- Improves air input rate according to boiler load and coal sulfur conditions
- Reduces mercury re-emissions and dissolved mercury in WFGD purge stream
- Eliminates the need for chemical additives for mercury re-emissions control
- Prevents sulfite blinding and maintains high gypsum quality
- Improves manganese solubility to reduce corrosion potential
- Maintains proper speciation of selenium in WFGD purge stream.
- Installs easily with low maintenance

Outage Applicability

Major	Minor	O&M Cost Reduction ↓
	✓	



TOTAL PLANT SOLUTIONS

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Mer-Cure*

ADVANCED MERCURY CONTROL TECHNOLOGY

Selective Catalytic Reduction System (SCR)



GE has developed an advanced, patented mercury control technology capable of high removal efficiencies. Mer-Cure* is an enhanced activated carbon injection system with unique attributes that improve mercury oxidation and subsequent mercury capture. The sorbent is injected into the duct upstream of the air heater, allowing enhanced use of the effective temperature range for oxidation and providing longer residence time for optimal mercury capture.

For additional mercury capture and reduced sorbent consumption, our patented activated carbon milling technology can add even greater mercury capture and reduced sorbent consumption.

Benefits include:

- Enhanced mercury (Hg) capture by up to 90%
- Reduced sorbent consumption by up to 50%
- Lowered OPEX
- Wider range of potential sorbent suppliers

Outage Applicability	
Major	Minor
✓	

More stringent environmental regulations also require improved solutions for the nitrogen oxides (NO_x) formed by the combustion process. With more than 30 years of experience with selective catalytic reduction (SCR) control technology for power generation and industry applications, GE has a wide portfolio of solutions to help customers reach their required performance levels.

Our proprietary IsoSwirl* mixing technology and specific ammonia injection grid design is an upgrade addressing the improved performance needed for today's high performance SCR's. The IsoSwirl* mixer technology ensures thorough and even mixing of injected ammonia with flue gas. The shape, quantity and in-duct location of the static mixing blades are tailored to customer's process conditions, ductwork arrangement and emissions requirement. This upgrade requires less tuning and is more flexible than conventional designs.

Benefits Include:

- Removal of up to 95% of NO_x from flue gas
- The quality of the mixing enables the system to meet applications with challenging NO_x emission requirements or varying operating environments.
- Lower ammonia to NO_x coefficient of variation than in equivalent conventional system
- Simpler design configuration which is easier to access, maintain, operate and control.

Outage Applicability	
Major	Minor
✓	✓



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