READY TODAY.
REINVENTING TOMORROW.

GAS POWER **2021-2022**

ge.com/gas-power

2021 has been a year to challenge and change all of us as individuals and as a global society. But as the world begins to recover from the COVID-19 pandemic, two energy challenges are clear: the world's demand for electricity is growing rapidly, while simultaneously our need to combat climate change is very real. Electricity is accelerating economic growth and prosperity globally, while the necessity to produce it more sustainably has become imperative.

As a father, a global citizen, and an environmentalist, I recognize that the energy-related challenges around the globe appear daunting. Approximately 800 million people are without access to reliable and affordable electricity today—and global electricity demand is projected to grow by 50% in the next two decades. We face the very real threat of climate change and a power sector that must be both strengthened and decarbonized at the same time.

GE is taking a leadership role in an energy transition that powers the future and protects our planet. Because we believe no one can be left behind, we are working hand-in-hand with governments, emerging markets, and marginalized communities everywhere to build out infrastructure where it either doesn't exist or is insufficient to meet demand.

Just as energy is a human right, so is ensuring a stable and healthy climate for each of us and for all future generations. We can and must act now to protect our planet. The power sector currently produces about 40% of global CO_2 emissions, the largest of any sector. Decarbonizing electricity—as we are rapidly working to do—will deliver tremendous returns for the climate. We recognize this work begins with you: our customers.

Together as an industry, we need to dramatically move the needle every single day with the technology we have. The products available in this catalog will continue to evolve as we invest in the technologies of the future, and our hope is that they are well-suited both to your unique circumstances as a power provider, as well as your ambitions to decarbonize now and in the future.

By working together, we can build a safer, cleaner, and more secure future for all. The GE team is committed to working in partnership with countries, companies, and citizens at every stage of the energy transition to meet their goals and secure our collective future. By working together and acting now, I am confident that we can secure the human right of access to energy...for everyone. We are eager to continue this work with you, let's begin.

Scott Strazik, Chief Executive Officer, GE Gas Power

WELCOME TO TOMORROW'S ENERGY—TODAY

Access to affordable, reliable, flexible and sustainable power is fundamental to modern life. As the world shifts toward a lower carbon future, natural gas can play an important role in powering the world—both today and tomorrow.

Serving as a model for other industries around the world, the power sector has a responsibility—and the technical capability—to take significant steps to quickly reduce greenhouse gas emissions, starting now.

SPEED AND SCALE—A POWERFUL COMBINATION

Renewable energy supported by gas power can contribute to an energy future with less carbon emissions. The complementary nature of renewables and gas offers tremendous potential to help cut carbon emissions with the speed and scale the world requires.

BUILDING A WORLD THAT WORKS—TOGETHER

As a global leader in gas power technology, services and solutions, GE engineers cleaner and more accessible energy the world depends on. We collaborate with our customers to deliver the relentless innovation that powers growth and prosperity.

Whether you're generating power for entire cities, electrifying your own operations, or facing an emergency electricity shortage, we stand ready to quickly provide a range of versatile and proven gas power solutions.

Across 150 countries and six continents, GE collaborates with you to apply a safety-driven, lean culture, on and off site. With the world's largest installed base of gas turbines, we offer advanced technology backed by unmatched experience to build, operate and maintain leading gas power plants—sharing and applying our 125+ years of OEM experience and expertise from newly built gas generation to life-long services.

Together, we can work to make a lower carbon world a reality.
Together, we can build a world that works.

CONTENTS

GAS POWER

“

WE ENGINEER CLEANER, MORE ACCESSIBLE ENERGY THAT PEOPLE DEPEND ON, POWERING GROWTH AND PROSPERITY EVERYWHERE

”

WHAT WE DO:

WE ENGINEER

20,000 EMPLOYEES
in > 80 countries

HA technology capable of **>64%** net combined-cycle efficiency

Helped deliver 2 world records **FOR EFFICIENCY**

More than **9,000 PATENTS** in 5 years

CLEANER

Contributed **~40%** of the total

33% CO_2 reduction in the US power sector since 2007

ENABLING FASTER RENEWABLES GROWTH through flexibility to accommodate intermittency

Many GE turbines capable of running on **100% HYDROGEN** today

MORE ACCESSIBLE ENERGY

AFFORDABLE Lowest dollars per kilowatt of generation technologies

A N D

FAST
- Mobile power on line in weeks
- Simple cycle capacity on line in 12-18 months
- Combined cycle on line in 24-36 months

THAT PEOPLE DEPEND ON

Available when other technologies aren't, independent of weather or time of day

PLUS

Real time response to minute-by-minute change – HA can go from zero to full power in under 30 minutes

POWERING GROWTH & PROSPERITY EVERYWHERE.

The world's LARGEST **INSTALLED BASE WITH**

7000 + GAS TURBINES & **600 +** MILLION OPERATING HOURS

25% of power added in the next decade will be gas power

"I FIND OUT WHAT THE WORLD NEEDS. THEN I GO AHEAD AND TRY TO INVENT IT."

– Thomas Edison

INDUSTRY OVERVIEW

A POWER INDUSTRY IN TRANSITION

The power industry is undergoing one of the most fundamental and dramatic transitions in its history. There has never been as much pressure on incumbent fuels for power generation, and there has never been as immediate and apparent a threat to our environment as climate change caused by greenhouse gas emissions.

Too often, however, the dialog around climate change can be mired in defining and debating an ideal future state and the timeline by which society would achieve that end-state. In the meantime, insufficient global progress is being made with each passing day. Paraphrasing an old adage, "Perfection is the enemy of progress."

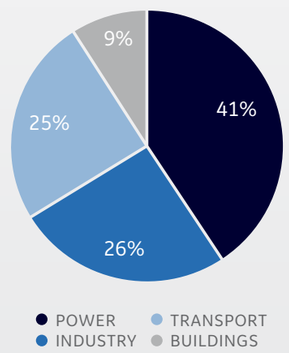
CO_2 makes up the largest portion of climate-changing greenhouse gases, and the power sector is the largest single producer of CO_2 emissions, but to combat climate change, reductions in CO_2 emissions are required across all sectors. As the largest CO_2 producer, the power industry has a responsibility—and the technical capability—to take significant steps to quickly reduce greenhouse gas emissions and help address climate change at scale. GE believes that accelerated and strategic deployment of renewables and gas power can change the trajectory for climate change, enabling substantive reductions in emissions quickly while, in parallel, continuing to advance the technologies for low or near zero-carbon power generation.

One challenge facing the world today is that affordable, reliable, and sustainable energy is critical to growing economies and is fundamental to the quality of life in the modern world. According to the International Energy Agency (IEA), roughly 770 million people lack access to reliable electricity today. As the world's population grows, and more people enter the middle class with an expectation of access to energy-intensive products such as air conditioners, refrigerators, and the internet, the "energy trilemma" of providing affordable, reliable and sustainable electricity becomes more acute.

Each country is at a different point in its energy transition journey, and each country must make decisions and establish policies that balance the often-competing elements of the energy trilemma. GE believes that decarbonization† actions will be determined locally, based on resource availability, policy, current infrastructure, and demand for power. In many regions, gas power can be a key enabler to further renewables penetration, specifically in areas with high current gas capacity and/or substantial dependence on coal. In those regions, gas power can serve as a backbone for greater renewables penetration and accelerate the retirement of coal assets, both of which will have significant positive impact on overall emissions.

†Decarbonization as used herein is intended to mean the reduction of carbon emissions on a kilogram per megawatt hour basis.

CO_2 EMISSIONS BY SECTOR (33.7 GT TOTAL)



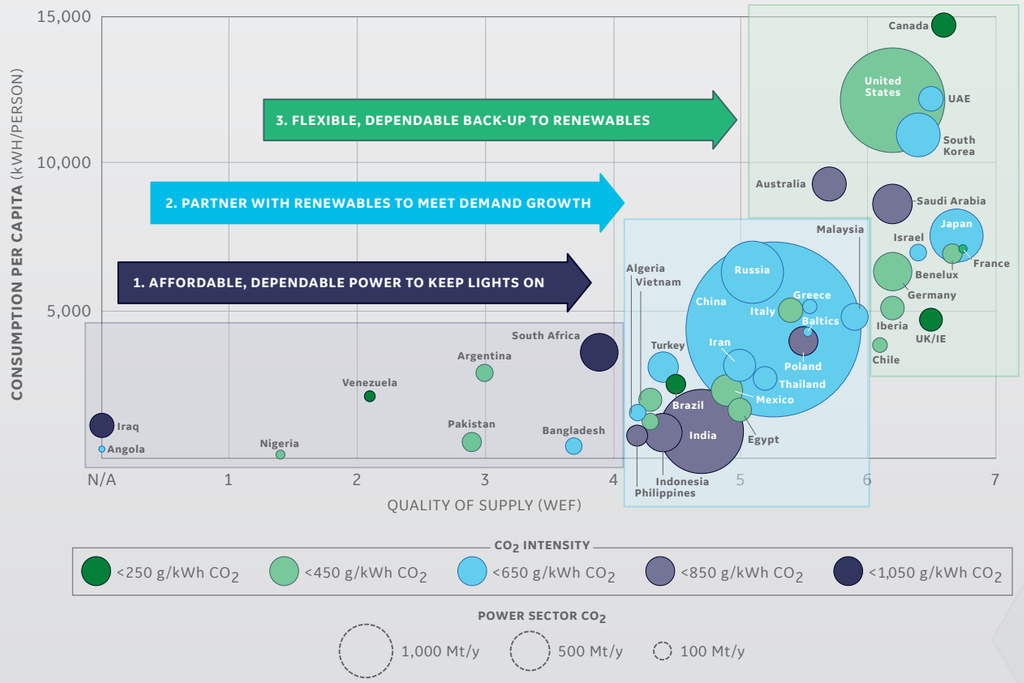
Source: IEA WEO 2020

"ADDRESSING CLIMATE CHANGE MUST BE AN URGENT GLOBAL PRIORITY, REQUIRING GLOBAL ACTION, NATIONAL COMMITMENTS, AND CONSISTENT POLICY AND REGULATORY FRAMEWORKS."

IT'S A MULTI-SPEED WORLD

The figure below is a plot of the World Economic Forum's Quality of Supply metric on the horizontal axis and average electricity consumption per capita on the vertical axis for a sampling of countries/regions around the world. Countries toward the right of the figure tend to have adequate power infrastructure to supply factories and businesses, while also supplying households with the power needed to run home appliances, air conditioning systems, computers, etc. As countries address Quality of Supply by moving to the right, they want to add additional generating capacity to support economic growth, moving upwards on the chart. A country like India, for example, has a reasonable Quality of Supply (4.6) and a growing middle class, and will need to add capacity to move upwards.

The size of the bubble on the chart represents the total power sector CO_2 emissions and the color of the bubble represents the power sector carbon intensity (g/kWh). Countries that have navigated to the right of the chart and are starting to move upwards may now be in a better position to address the climate change problem. Gas power can provide an important role in this transition as it balances CO_2-free, but variable renewable generation with dependable and flexible power that prevents sliding to the left as a country adds variable renewables and retires CO_2-intensive, but dispatchable coal. Additional gas power can help a country like Bangladesh (3.7 Quality of Supply rating) move to the right today and help it move up as its economy grows. This may reduce its need for planned coal additions and enable them to add renewables to reduce their overall power sector emissions intensity.



A LOOK BACK, AND A LOOK FORWARD

Coal has been the single largest fuel source for electric power generation since the beginning of the industry in the late 19th century. Today, coal fuels about 37% of the electricity produced globally. In some countries such as China, that number is much higher at 65%, while some countries such as Brazil produce only about 4% of their electricity using coal. Despite well publicized retirements of coal-fired capacity in the United States and Western Europe, more than 2,000 GW of coal power are still installed globally, making up nearly 30% of global installed capacity, and nearly 400 GW in the United States and Western Europe alone.

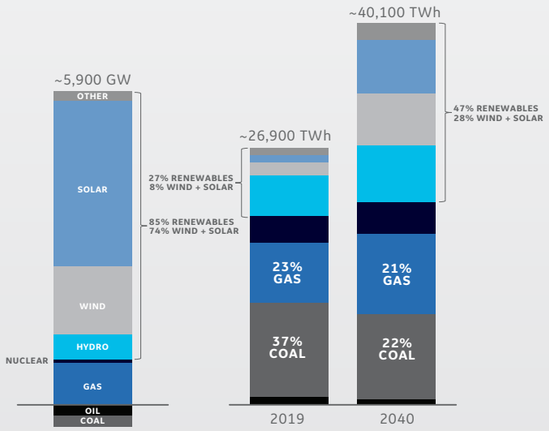
Global CO_2 emissions from coal power have been increasing for decades, but they likely have reached their peak for a number of reasons: the leveling off of coal power generation due to coal-to-gas switching, increased renewables generation, reduced operation and retirement of coal power plants, policy mandates, and the impact on demand due to the COVID-19 pandemic.

According to the IEA's Stated Policies Scenario, renewables are expected to account for approximately 85% of net capacity additions between now and 2040, led by wind and solar at nearly 75%. This explosive growth has been driven primarily by cost reductions, technology advancements to improve capacity factors, favorable policies and positive public sentiment around zero-carbon energy. In some locations with abundant wind and solar resources, renewable technologies have become cost-advantaged relative to thermal power generation on a Levelized Cost of Electricity (LCOE) basis. The biggest perceived drawback of wind and solar, the fact that they are variable, is mitigated by the fact that with modern weather forecasting methods they are largely predictable.

Despite the rapid growth and significant investment in wind and solar PV postulated by the IEA, their combined generation contribution only increases to 28% of the global total in 2040, and they are roughly on par with coal at 22% and gas power at 21%. In fact, coal is expected to remain the largest single source of electricity globally in 2040.

The resulting emissions from coal are inconsistent with the goal of reducing global warming. More aggressive actions are needed, including deployment of carbon capture, utilization and storage (CCUS) at coal power plants, increased utilization of existing gas power, and increased deployment of new gas power and renewables.

CAPACITY ADDITIONS FORECAST AND RESULTING GENERATION EVOLUTION



Net capacitity additions and resulting change in electricity generation 2019 to 2040. Despite aggressive renewables net additions, they are insufficient to result in a meaningful reduction in absolute global coal generation by 2040.

> "COAL GENERATION IS DOWN ONLY ~10% AND GAS GENERATION IS UP ~33% THROUGH 2040."

Source: IEA WEO 2020

GAS POWER AND RENEWABLES…A POWERFUL COMBINATION

Although renewables are the fastest growing source of both new capacity and generation, their deployment is simply not occurring at the pace and scale needed to effectively reduce CO_2 emissions from the power sector. More is needed to dramatically reduce the amount of coal generation globally.

New sources of abundant and affordable natural gas have driven the economic shift from coal to gas in several regions. Natural gas-fired combined cycle power plants are the lowest emitting fossil fuel power plants, whether measured based on CO_2, SOx, NOx, particulate matter, or mercury. With less than half the CO_2 emissions of coal, natural gas is already contributing significantly towards decarbonization.

Viewed separately, renewables and gas generation technologies each have merits and challenges as a means to address climate change, and optimum solutions will differ regionally. Such solutions will depend upon factors such as fuel availability and security, land use constraints, renewable resource availability, and the emphasis a particular region places on climate change. Together, their complementary nature offers tremendous potential to help address climate change with the speed and scale the world requires.

	WIND, SOLAR and STORAGE	GAS POWER
FUEL	Limitless, free fuel that is variable	Flexible, dispatchable power whenever needed, utilizing abundant, affordable natural gas or LNG
CO_2	Carbon-free generation	Less than half the CO_2 of coal generation with a pathway to future conversion to low or near-zero carbon with hydrogen and carbon capture and sequestration (CCS)
COST	Competitive Levelized Cost of Electricity (LCOE) with no lifecycle uncertainty (mostly CAPEX)	Competitive LCOE with lowest CAPEX, providing affordable, dependable capacity
DISPATCH	Dispatches first in merit order… extremely low variable cost	Most affordable dispatchable technology… fills supply/demand gap
PEAKING	Battery storage economical for short duration peaking needs (<8 hour, intraday shifting)	Gas economical for longer-duration peaking needs (day-to-day and weather-related extended periods)
CAPACITY FACTORS	25%–55% capacity factors based on resources (wind and solar often complementary)	Capable of >90% capacity factors when needed, runs less based on variable costs and renewables
LAND	Utilizes abundant land with good renewable resources (multi-purpose land use); offshore wind is not land constrained	Very small physical footprint for dense urban areas with space constraints
HYBRID SOLUTIONS	Extends renewable energy to align with peak demand	Carbon-free spinning reserve peaking plants using onsite battery storage

GAS POWER ENABLES MORE RENEWABLES

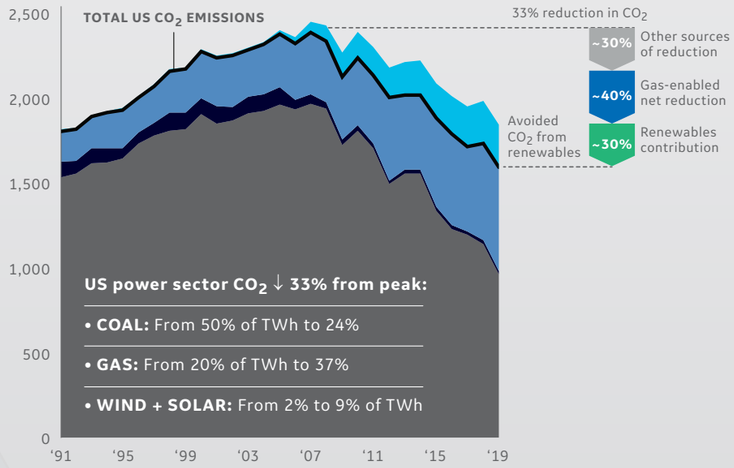
Natural gas-fired power generation is flexible and dispatchable. Plants can come online quickly, adjust power output level, and turn down to a very low output level to balance supply and demand as needed. They can deliver more power or less as supply and demand for electricity vary throughout the day, over the course of a week or month, and seasonally—whenever required. This flexibility is especially important to maintain grid stability as more non-dispatchable wind and solar resources are deployed.

Gas-fired power plants are available regardless of the time of day or weather conditions, providing dependable capacity as long as needed, whether for minutes, hours, days or weeks at a time. Wind and solar power are available when the wind is blowing or the sun is shining. The availability of wind and solar resources does not always coincide with demand. Because electricity supply and demand must always be in balance, renewables require dispatchable backup power such as natural gas power plants or batteries to help ensure system reliability.

GE believes in and promotes additional renewables capacity, augmented where needed with natural gas generation to provide system flexibility and dependable capacity, as the most effective near-term action to help decarbonize the energy sector. Despite the massive deployment of wind and solar capacity in recent years, increases are not occurring at the pace or scale needed to decarbonize the electricity sector and help meet the goals of the Paris Agreement.

The United States is a powerful example of the pace and scale that renewables and gas power can be deployed in decarbonizing a power sector that was heavily dependent on coal. Since the peak in 2007, power sector CO_2 emissions in the United States have dropped 33% while total electricity generation remained constant at approximately 4,300 TWh. During this time, coal generation dropped roughly in half, from 50% to 24%, gas generation increased from 20% to 37%, and wind and solar grew from less than 1% to 9%. The emissions reduction attributed to coal-to-gas switching was greater than that from any other fuel source.

US POWER SECTOR CO_2 (million metric tons)



Source: US Energy Information Administration, Monthly Energy Review, June 2020

> "GIVEN THE TIME IT TAKES TO DEPLOY NEW RENEWABLES AND TO IMPLEMENT ENERGY EFFICIENCY IMPROVEMENTS, COAL-TO-GAS SWITCHING REPRESENTS A POTENTIAL QUICK WIN FOR EMISSIONS REDUCTIONS."

Source: IEA Special Report, The Role of Gas in Today's Energy Transitions, July 2019

On a global scale, replacing coal with a combination of variable renewables and batteries plus dispatchable gas yields greater carbon reduction than renewables alone. An analysis done by GE and summarized in the figure below considers the real-time balancing of power supply and demand using a hypothetical coal plant as an example.

Because of the variable nature of wind and solar energy, and lower capacity factors for these technologies, a direct replacement of coal with wind and solar would eliminate approximately 25% to 45% of the coal CO_2 emissions. That said, the coal plant would still need to provide energy, and thereby emit CO_2, when wind and solar are not available.

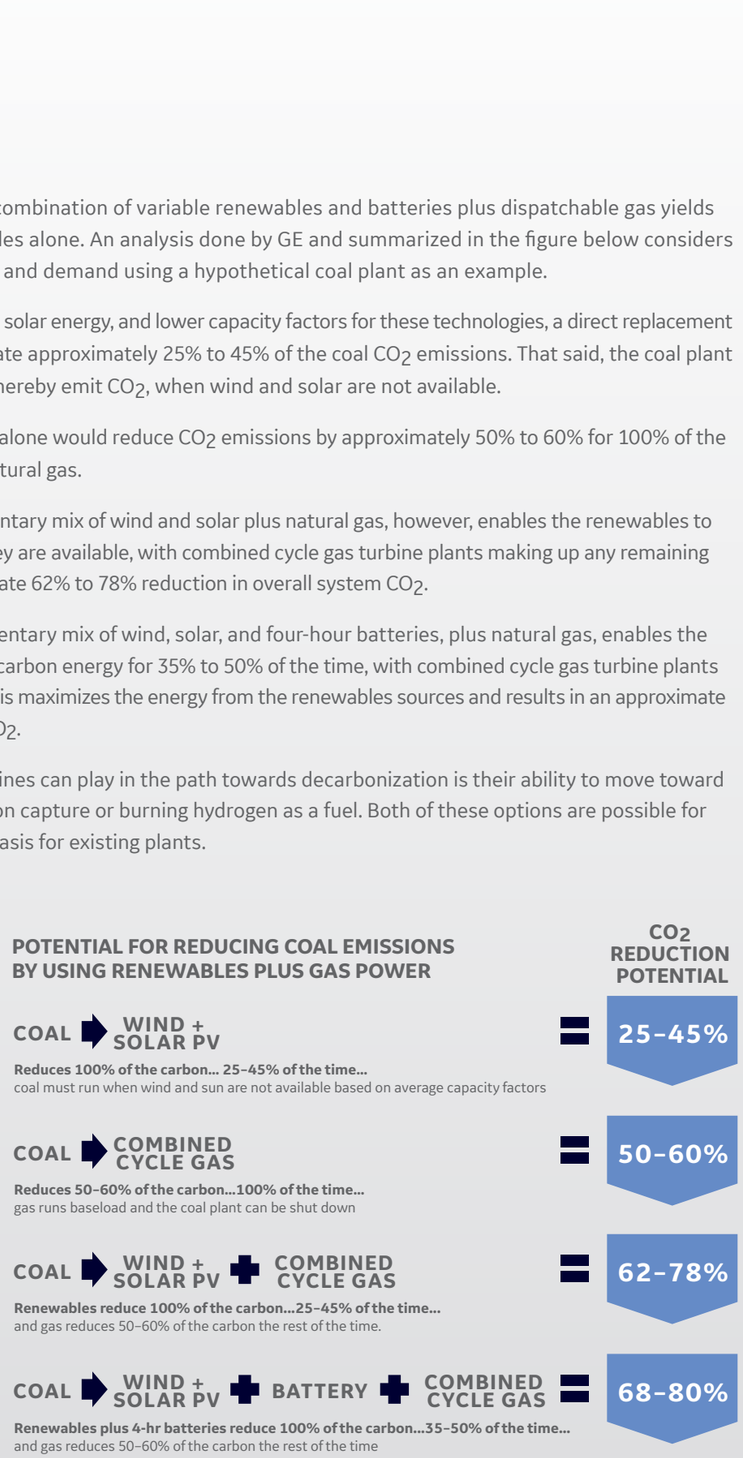
Replacing the coal plant with natural gas alone would reduce CO_2 emissions by approximately 50% to 60% for 100% of the time due to the lower CO_2 intensity of natural gas.

Replacing the coal plant with a complementary mix of wind and solar plus natural gas, however, enables the renewables to provide zero-carbon energy whenever they are available, with combined cycle gas turbine plants making up any remaining energy needs. This results in an approximate 62% to 78% reduction in overall system CO_2.

Replacing the coal plant with a complementary mix of wind, solar, and four-hour batteries, plus natural gas, enables the wind, solar and batteries to provide zero-carbon energy for 35% to 50% of the time, with combined cycle gas turbine plants making up any remaining energy needs. This maximizes the energy from the renewables sources and results in an approximate 68% to 80% reduction in overall system CO_2.

Another key element of the role gas turbines can play in the path towards decarbonization is their ability to move toward low or zero CO_2 emissions through carbon capture or burning hydrogen as a fuel. Both of these options are possible for new-build power plants or on a retrofit basis for existing plants.

> “ON A GLOBAL SCALE, REPLACING COAL WITH A COMBINATION OF VARIABLE RENEWABLES AND BATTERIES PLUS DISPATCHABLE GAS YIELDS GREATER CARBON REDUCTION THAN RENEWABLES ALONE.”



Replacing baseload coal with a combination of renewables and gas yields the quickest carbon reduction at scale.
Note that CAPEX and required land are not addressed in the above analysis.

GETTING THE MOST FROM THE GLOBAL INSTALLED BASE OF GAS TURBINES

The global installed base of power generating capacity currently contains approximately 1,200 GW of combined cycle and 300 GW of simple gas turbine-based power plants. The average global capacity factor for this fleet is less than 40%. This underutilized resource can be a tremendous enabler to reduce coal-fired power generation and accelerate the increased deployment of renewables while balancing the often-competing energy trilemma goals of affordability, reliability and sustainability. Ignoring for a moment the specific location of these assets around the world, simply running this global installed fleet of lower carbon emitting natural gas-fueled power plants at a capacity factor closer to 50% could displace approximately 700 million tons of CO_2 emitted annually by the coal-fueled fleet.

Barriers to running some of the installed gas power fleet harder could include degradation due to the age of the assets, relatively lower efficiency associated with older technology, and the lack of flexibility features in the plant because the need for flexibility wasn’t evident when the plants were built. However, there are numerous opportunities to service and improve the performance of these assets and enable them to operate more hours, with improved performance and flexibility, thereby enabling a greater contribution towards the decarbonization of the power sector.

Upgrades to existing assets may include improvements in efficiency or heat rate, increased output, reduced emissions, extended life, or enhanced reliability. These improvements may help to preserve or even improve an asset’s position in the dispatch stack, enabling it to run economically for more hours each year.

As an example of the magnitude of this potential, over the past three years, upgrades to GE’s fleet have added approximately 2,400 MW of additional capacity, reduced CO_2 emissions by roughly 2 million tons, and resulted in annual estimated fuel savings of $125 million for our customers globally†.

Flexibility improvement packages can also be incorporated that provide more value to the overall system in terms of an asset’s ability to start faster, ramp power levels more quickly, or turn down to lower power levels while maintaining emissions compliance. All of these improvements become more important as more variable renewables are deployed and existing coal and nuclear power plants are retired.

Gas turbines currently running on natural gas or other fuels can be converted to operate on a wider range of fuels including hydrogen, for near-zero emissions. Providing this fuel flexibility enables operators to utilize fuels that have a lower delivered cost and/or lower CO_2 emissions. Many of these existing natural gas power plants can also be retrofitted with carbon capture systems capable of reducing carbon emissions by as much as 95%.

GE offers a wide range of customizable services options that can be tailored to an individual asset and a specific customer’s needs to deliver improved performance, enhanced operational and fuel flexibility, or extended life in order to ensure gas-fueled generating assets remain relevant contributors to the energy transition. These solutions are available for implementation and can help to reduce greenhouse gas emissions immediately by enabling deployment of more renewables and reducing coal-fired generation while maintaining the security and reliability of the grid.

†Based on F-class AGPs + GT13E2 upgrades in last 3 years and an assumed 5,000 hours of operation per year.

THE POWER INDUSTRY'S OPPORTUNITY TO LEAD

Solving the climate change challenge requires cooperation across national boundaries, economic sectors, and the political spectrum. As stated by Fatih Birol, executive director of the IEA, it calls for a "grand coalition encompassing governments, investors, companies and everyone else who is committed to tackling climate change."

Renewables and gas power have the capability to quickly make meaningful and long-lasting reductions to CO_2 emissions from the power sector. Neither will be as effective alone at decarbonization at the pace and scale needed to avoid raising average global temperatures by less than 2° C as outlined in the Paris Agreement.

The power industry has a responsibility, and the technical capability, to take significant steps to quickly reduce greenhouse gas emissions. The solution for the power sector is not an either/or renewables or natural gas proposition. It requires a multi-pronged approach to decarbonization, with renewables and natural gas power at its core.

Recommended steps for the power industry include:

- Invest in a combination of wind, solar, batteries and gas-fired power at scale and with urgency
- As coal-fired generation declines, replace this capacity with renewables supported by gas power
- Advocate for policies that align with the goals of the Paris Agreement to reduce CO_2 emissions, while ensuring a safe, affordable and reliable electricity sector. Such policies should: 1) incentivize reductions in power sector carbon intensity with an emphasis on both near-term actions that drive the greatest reductions sooner and a long-term vision of ambitious carbon reductions, 2) be transparent and predictable, and allow lifecycle economics to drive investment decisions, and 3) promote marketplace structures that value energy, flexibility and dependable capacity separately in order to encourage the optimum mix of technologies
- Increase funding in research & development and incentive mechanisms to: 1) continue the cost decline and performance improvements in renewables, 2) develop renewables hybrid and storage technology, and 3) accelerate cost-effective CCUS, hydrogen, small modular reactors, and other potential low or zero-carbon technologies for dependable capacity to complement renewables
- Advocate for producers and users of methane to employ the best available methane capture technology
- Encourage cross-sectoral cooperation for CO_2 emissions reductions such as providing green hydrogen produced from zero-carbon energy for use in the transportation sector

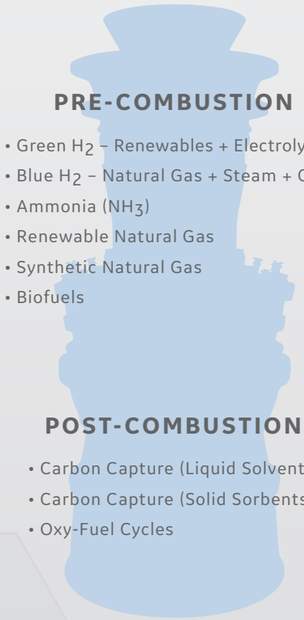
> "ADDRESSING CLIMATE CHANGE MUST BE AN URGENT GLOBAL PRIORITY, REQUIRING GLOBAL ACTION, NATIONAL COMMITMENTS, AND CONSISTENT POLICY AND REGULATORY FRAMEWORKS."

DECARBONIZING GAS TURBINES

GAS TURBINES…TO ACHIEVE LOWER CARBON?

In order to combat man-made climate change, there is a global need for deep decarbonization†, and all sectors that produce carbon dioxide (CO_2) must play a role. In 2019, global CO_2 emissions from fossil fuels amounted to 33.7 gigatons, with 41 percent of that coming from the power generation sector, and the remainder from the transportation, industrial, and building sectors. There is a lot of work to be done and time is against us. According to the Intergovernmental Panel on Climate Change's (IPCC) 2018 special report "Global Warming of 1.5 °C", we had 580 gigatons of CO_2 in our remaining carbon budget if the globe were to have a 50-50 chance of keeping global warming to 1.5 °C compared to pre-industrial levels. Bring that forward from 2018 to 2020, and if we continue on our current path of emissions, we have only 15 years left before the budget runs out.

The good news is that there are solutions available today to enable the power generation sector's rapid reduction in carbon intensity and allow the world to buy more time. These solutions include: 1) increased deployment of renewable energy resources, 2) a speedy reduction in coal power production with a speedy reduction in coal power production and replaced with high efficiency gas turbines, and 3) arming gas turbines with alternative fuels, such as hydrogen, or post-combustion carbon capture technologies to enable further decarbonization.



PRE-COMBUSTION

- Green H_2 – Renewables + Electrolyzer
- Blue H_2 – Natural Gas + Steam + CCUS
- Ammonia (NH_3)
- Renewable Natural Gas
- Synthetic Natural Gas
- Biofuels

POST-COMBUSTION

- Carbon Capture (Liquid Solvents)
- Carbon Capture (Solid Sorbents)
- Oxy-Fuel Cycles

There are currently two ways to systematically approach the task of turning high efficiency gas generation into a zero or near zero-carbon resource: pre and post-combustion. Pre-combustion refers to the systems and processes upstream of the gas turbine. The most common approach today to tackle pre-combustion decarbonization is simple: change the fuel. The vast majority of gas turbines burn natural gas, or methane (CH_4), to release energy which ultimately produces the electricity we use at home or for industrial use. An advantage of gas turbines is that they are able to operate on many other fuels besides natural gas. Some of these fuels, such as hydrogen (H_2), do not contain carbon in the first place, and will therefore not emit CO_2 once combusted. Furthermore, H_2 can be introduced to new gas turbines and existing gas turbines alike, reinforcing the concept that solutions are available today to decarbonize assets already in the field and those waiting to be installed. The possibility of burning hydrogen in a gas turbine avoids the potential "lock-in" of CO_2 emissions for the entire life of the power plant.

On the other side of the gas turbine, or post-combustion, there is a tool chest of different technologies that can remove CO_2 from the flue gases in a process that is commonly referred to as carbon capture. The general concept of carbon capture involves introducing a specialized chemical into the plant exhaust stack which has an engineered affinity to carbon. Once the CO_2 and the agent bond, the CO_2 is processed and taken to compression tanks as pure CO_2. This CO_2 is then transported to either a geologic formation deep underground for permanent sequestration, or re-used in industrial process, thus completing the process of Carbon Capture and Utilization or Sequestration (CCUS). Similar to introducing hydrogen to a plant, CCUS can be applied to both new and existing gas power plants, again avoiding lock-in of CO_2 emissions for the life of the power plant.

> "THE TOOLS TO DECARBONIZE GAS TURBINES ARE AVAILABLE TODAY, AND HAVE BEEN FOR SOME TIME."

In order for the power sector to rapidly decarbonize while maintaining high levels of reliability, both pre and post-combustion decarbonization options for gas turbines are viable tools today. Both hydrogen and CCUS have their own merits and ideal areas of application.

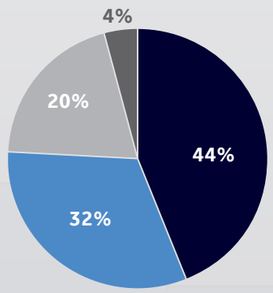
HYDROGEN…EN VOGUE, BUT NOT NEW

Hydrogen, or H_2, is the most abundant element in the universe, yet it does not exist on earth as a standalone molecule. H_2 must be made by cracking the compounds it is a part of, which are most commonly found on Earth as methane (CH_4) and other hydrocarbons, or water (H_2O). Hydrogen has been separated from methane for many decades, for use in various industrial processes, refining and fertilizer production. In some industries, H_2 is a by-product of the process and has been used as a power generation fuel. In fact, GE has more experience incorporating hydrogen and other low-Btu fuels in gas turbines than any other OEM, with **more than 100 turbines** operating on these fuels and **more than 8 million operating hours**†.

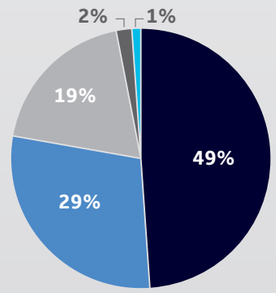
Use of H_2 as we traditionally know it has been around for decades, but the way in which the H_2 is produced is what is changing. Today, almost all hydrogen is produced in a process called steam methane reforming (SMR), where a CH_4 molecule is split, capturing the H_2 component, and releasing the CO_2 into the atmosphere. This is known as "grey" hydrogen. Forms of "blue" H_2 (steam methane reforming with CCUS) and "green" H_2 (electrolysis powered from renewables energies) are necessary in order to decarbonize the full supply chain and make H_2 a truly a cleaner fuel.

As the H_2 supply chain grows in volume and becomes increasingly green, GE gas turbines stand ready to take on changing fuel requirements. In fact, gas turbines that are already in operation, recently purchased, or soon to be purchased, all have the capability to burn blends of hydrogen and natural gas. The ratio of those blends can also be increased in the future with relatively low-impact modifications to assets as the cost of hydrogen and need for increased decarbonization warrants higher blending rates.

H_2 FUELS (BY MW)‡



H_2 FUELS (BY UNIT COUNT)‡



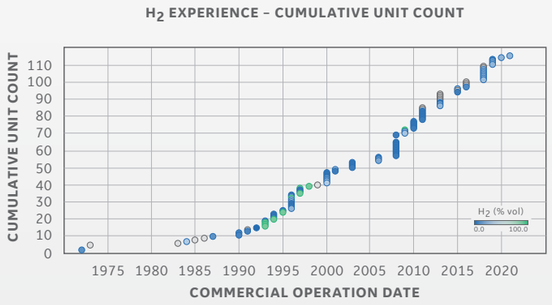
GE OEM 1 OEM 2 OEM 3 OEM 4

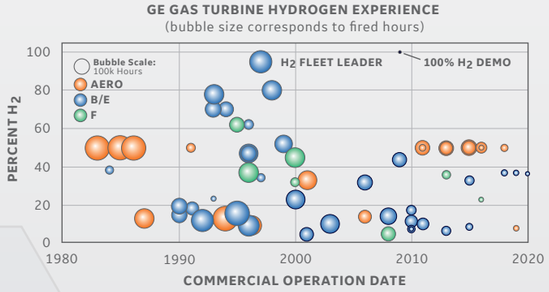
† Decarbonization as used herein is intended to mean the reduction of carbon emissions on a kilogram per megawatt hour basis.

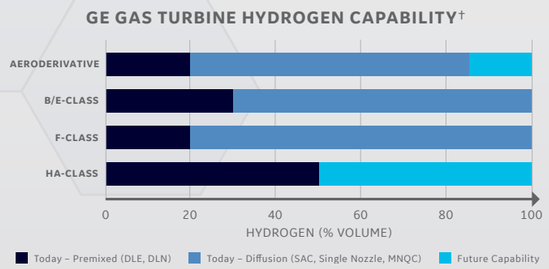
†Includes GE's experience on both heavy duty and aeroderivative gas turbines.

‡ Per McCoy Power Reports, 1980-2019; Hydrogen containing fuels include BFG, COG, COREX, H_2, refinery gas, and syngas.

GE GAS TURBINES H_2 EXPERIENCE and CAPABILITY







† GE has combustion technologies that are capable of operating on a wide range of hydrogen concentrations up to ~100% (by volume).

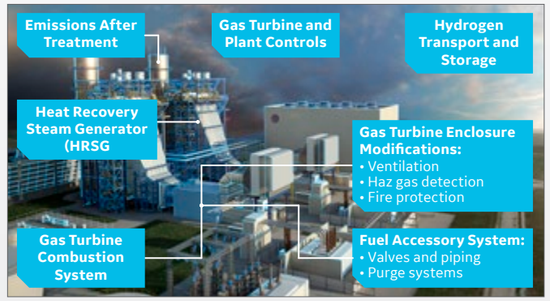
GE currently has more than 30 years of experience operating with fuels that contain hydrogen. This experience includes E, F, and Aeroderivative gas turbines that have operated in 19 countries and have generated more than 500 TWh of electrical energy. GE demonstrated operation on 100% hydrogen and GE's hydrogen fleet leader has over 180,000 hours operating on a fuel that has contained up to 95% (by volume) hydrogen.

GE's gas turbines have a range of hydrogen capability that depend on the gas turbine model, combustion system, and plant configuration. Dry low NOx (DLN) combustion systems provide increased performance but are more limited in the allowable hydrogen content due to operability risks with a highly reactive fuel. Diffusion combustion systems (SAC, Single Nozzle, MNQC) offer higher hydrogen capability.

These combustion systems can be applied to new gas turbines as well as via an upgrade to an existing unit.

> "GE'S EXPERIENCE WITH HYDROGEN AND OTHER LOW-BTU FUELS INCLUDES MORE THAN 100 TURBINES IN OPERATION AND OVER 8 MILLION HOURS ON THESE FUELS."

H_2 IMPACT TO POWER PLANT SYSTEMS COULD INCLUDE:



These modifications/upgrades can be implemented at both new and existing power plants.

GE's industry leading experience with hydrogen and similar low heating value fuels has provided key knowledge about the impact of this fuel on gas turbine power plant systems. Retrofitting power plants for hydrogen capability requires alterations to fuel blending equipment, reconfiguration to help ensure fuel flow rates are adequate, and upgrading seals to accommodate for the smaller hydrogen molecules.

Other impacts to consider when retrofitting plants for hydrogen are the increased NOx emissions that come from burning hydrogen, which may require alterations to the SCR system, changes to the combustor to account for high flame speeds, and increased safety and protection systems around the plant.

GE GAS TURBINES COMBUSTION TECHNOLOGY: ROADMAP TO 100% HYDROGEN

HEAVY DUTY GAS TURBINE COMBUSTION SYSTEMS

Premixed Combustors
Max H_2 ~20–30%

Diffusion Combustors
Max H_2 ~70–100%

Advanced Premixer
Max H_2 ~50%

AERODERIVATIVE GAS TURBINE COMBUSTION SYSTEMS

Premixed Combustors
Max H_2 ~10%

Diffusion Combustors
Max H_2 ~30–85%

Advanced Premixer
Max H_2 ~50%

GE offers both lean premixed (DLE, DLN) as well as diffusion combustion (SAC, MNQC, Single Nozzle) systems for most gas turbines.

- Diffusion combustion systems offer high hydrogen capability but with reductions in performance due to the injection of NOx control diluent, typically water or steam
- DLE/DLN systems offer improved performance but with a limited hydrogen window

New technology being developed by GE will offer the performance of DLE / DLN systems with the fuel flexibility of the traditional diffusion combustors. This includes the development of new F-class Advanced Combustor Technology being sponsored by the US Department of Energy. These new systems are expected to be capable of operating on higher concentrations of hydrogen without diluent.

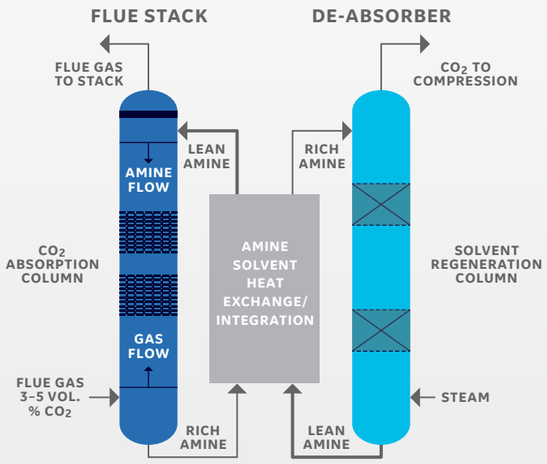
CARBON CAPTURE AND SEQUESTRATION (CCS)

Capturing carbon from flue gas has been deployed across various applications, including industrial assets and coal power plants. Often the CO_2 is utilized in industrial processes such as cement manufacturing and enhanced oil recovery. As the need to capture and sequester CO_2 becomes more critical, the same technologies can be deployed at other stationary emitters, such as a gas power plant, to contribute meaningful reductions in atmospheric CO_2.

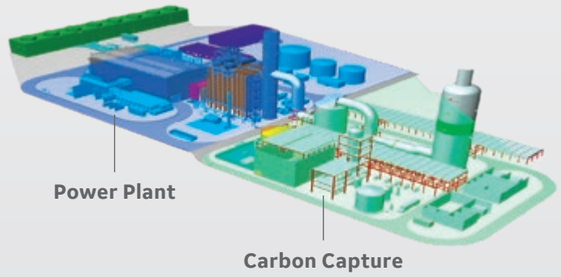
The most mature option today is a post-combustion technology called Amine Carbon Capture, but many options exist and are also being developed. In a standard amine-based application, the amine liquid is rained down through the exhaust stream, absorbing the CO_2 from the exhaust. That CO_2-rich liquid is then moved to a second vessel, where it is heated to drive off pure CO_2. That CO_2 can then be compressed and transported to a sequestration or industrial site.

In addition to the benefit of applying CCUS to existing assets, it can also be deployed as a modular solution, solving for incremental amounts of carbon reduction with each additional module. This translates to greater optionality for plant owners, taking either a phased approach by deploying carbon capture systems over years and spreading out the capital expenses over a longer period, or an immediate approach by building out the carbon capture system to full capacity in one go.

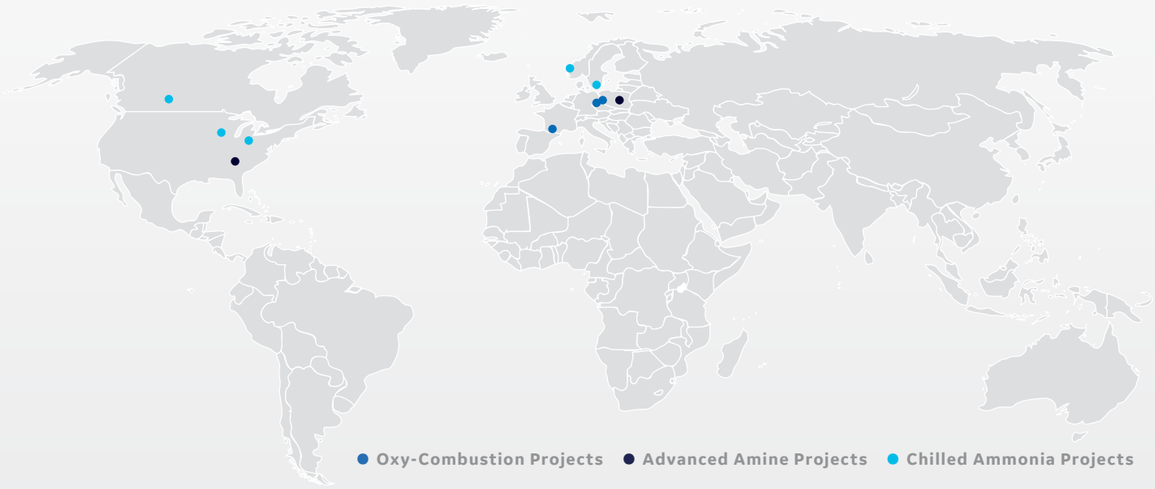
A carbon capture plant helps de-risk future carbon regulations that impact the decision to build a gas-fired power plant today. Furthermore, retrofits can significantly extend the lifetime of operating assets, extending their economic viability and even deferring costly decommissioning expenses that occur with forced retirements.



Post-combustion carbon capture process diagram



“GE HAS EXPERIENCE IN VARIOUS CARBON CAPTURE TECHNOLOGIES AT OVER 1.1 GW OF ASSETS.”



MISSION CRITICAL: INTEGRATING CCS WITH THE GENERATION PLANT

GE continues to carry out Research and Development (R&D) programs to help meet the technological and economic challenges of capturing CO_2 generated from natural gas combustion for electricity production. This R&D builds upon GE's CCS demonstrations at several sites around the world, ranging from a variety of post-combustion capture applications (amines, chilled ammonia, etc) to oxy-combustion processes on over 1.1 GW of power assets. Thus, GE is able to offer innovative and competitive solutions for integrating carbon capture systems with generating assets.

Since the post-combustion carbon capture process needs heat to separate CO_2 from a capture agent (solvent regeneration process), a source of thermal energy is needed. Steam is very attractive as a heat source for the solvent regeneration not only because it is readily available in a combined cycle power plant (or from an auxiliary boiler), but also because it can be highly predictable for heat transfer equipment sizing and control.

However, the steam extracted for the CO_2 desorption process reduces the flow of steam in the steam turbine, which reduces the net output of the combined cycle plant. In addition to other utilities needed for the CCS plant, each individual plant has a unique operating profile. This translates into increased importance on the integration of the generation asset with the carbon capture plant. As a result, GE's experts in steam cycles look to extract steam at conditions that will fulfill the requirements of the CCS system in order to help reduce the penalty on the power plant performance.

“GE BELIEVES CCS IS A STRONG ECONOMIC CHOICE FOR ADDRESSING CLIMATE CHANGE AT SCALE.”

GE GAS POWER MILESTONES

1901:
GE offers the first large steam turbine for sale at 5000 kW.

1949:
GE's first gas turbine, a 3.5 MW Frame 3 with 17% efficiency, begins delivering power at Oklahoma Gas and Electric Co.'s Belle Isle Station.

1951:
GE installs the first two-shaft derivatives of the Frame 3 gas turbine in 5 MW power plants in Rutland, VT.

1968:
The J79 turbojet, an aircraft gas turbine, first flown in 1955 is reconfigured as the LM1500, an aeroderivative turbine with industrial and marine uses. The first LM1500 is 13.3 MW.

1970:
The MS7000 Frame 7 is developed, rated at 47.2 MW. The 50Hz Frame 9 soon follows.

1971:
The first E-Class, a 7E, runs at National Grid's Shoreham plant in New York.

1978:
The first 6B is installed at Montana-Dakota Utilities' Glendive Station.

1987:
The first GT13E is commissioned at the UNA Hemweg facility in the Netherlands.

1988:
The LM6000 is launched, derived from the aircraft engine CF6-80C2.

1990:
The first F-Class gas turbine, a 147 MW 7F, begins operating at Virginia Electric & Power Co.'s Chesterfield Power Station.

1991:
The first B/E DLN system upgrade of a 7E was at Anchorage Municipal Light & Power.

1992:
The first 9F begins operating in simple cycle at an EDF site in Paris.

1993:
The first F DLN system upgrade of a 7F was at Florida Power & Light – Martin Station.

1995:
The first 7E was used in mechanical drive LNG application at the Petronas – DUA site.

1996:
GE's TM2500, a trailer-mounted portable aeroderivative, is unveiled.

1997:
6B fuels upgrade to operate at 90+% Hydrogen as the primary fuel at the Hanwha Total Petrochemical – Daesan site.

2003:
The first H-Class system, a 50 Hz 480 MW 9H, starts at Baglan Bay Power Station in Wales.

The first F2F† replacement upgrade (7F.01 to 7F.03) at Korea Western Power Company - Seoincheon site.

2005:
The first B/E sub-5ppm DLN system upgrade was a 7E at the Dow Freeport site.

2010:
The first F-class (7F) AGP upgrade was at Iberdrola Tamazunchale.

2013:
The first E-class AGP upgrade was a 9E at Dubal Aluminum.

2014:
GE launches the 9HA and 7HA air-cooled H-Class gas turbines.

2016:
The HA is recognized with a world record for efficiency (62.22%).

The first 9E Max (9E.04) F2F upgrade was at the TEPCO – Futtsu site.

2017:
The LM9000 is introduced, an aeroderivative gas turbine derived from the GE-90 aircraft engine fitted on a Boeing 777.

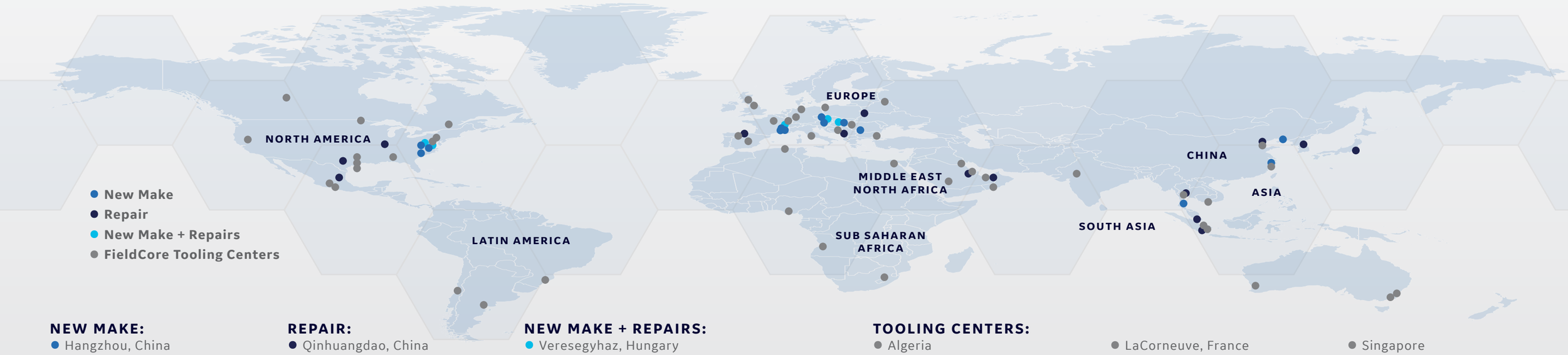
2021:
GE's experience incorporating hydrogen and other low-Btu fuels totals more than 100 gas turbines and more than 8 million operating hours.

† flange-to-flange

GE GAS POWER WORLDWIDE FOOTPRINT

SERVING OUR CUSTOMERS GLOBALLY and LOCALLY

17	32	14M	52	165	39
COUNTRIES	FACTORIES	FACTORY SQ. FT.	WAREHOUSES	OFFICE SITES	TOOL CENTERS



NEW MAKE:
- Hangzhou, China
- Belfort, France
- Bourogne, France
- Chonas, France
- Szazhalombatta, Hungary
- Changwon, Korea
- Elblag, Poland
- Allentown, PA, United States
- Parsippany, NJ, United States
- Dung Quat, Viet Nam

REPAIR:
- Qinhuangdao, China
- Karlovac, Croatia
- Bandung, Indonesia
- Yokohama, Japan
- Morelia, Mexico
- Bucharest, Romania
- Dammam, Saudi Arabia
- Andoain, Spain
- Singapore
- Jebel Ali, United Arab Emirates
- Houston, TX, United States
- Richmond, VA, United States
- Phu My, Viet Nam

NEW MAKE + REPAIRS:
- Veresegyhaz, Hungary
- Wroclaw, Poland
- Birr, Switzerland
- Bangor, ME, United States
- Greenville, SC, United States
- Schenectady, NY, United States

TOOLING CENTERS:
- Algeria
- Angola
- Buenos Aires, Argentina
- Perth, Australia
- Maitland, Australia
- Taubaté, Brazil
- Edmonton, Canada
- Montreal, Canada
- Quillota, Chile
- Tianjin, China
- Shanghai, China
- Karlovac, Croatia
- Egypt
- Rugby, England
- Belfort, France
- LaCorneuve, France
- Mannheim, Germany
- Berlin, Germany
- Gujarat, India
- Livorno, Italy
- Kuwait
- Port Klang, Malaysia
- Morelia, Mexico
- Calabar, Nigeria
- Elblag, Poland
- Qatar
- Bucharest, Romania
- Rybinsk, Russia
- Saudi Arabia
- Glasgow, Scotland
- Singapore
- Jet Park, South Africa
- Bilbao, Spain
- Griñón, Spain
- Bangkok, Thailand
- Istanbul, Turkey
- Dubai, United Arab Emirates
- Atlanta, GA, United States
- Bakersfield, CA, United States
- Cincinnati, OH, United States
- Houston, TX, United States
- Minneapolis, MN, United States
- Rotterdam, NY, United States
- Syracuse, NY, United States

POWER PLANTS

Technology, experience, and people—this combination is what allows GE to aim to deliver the highest value simple cycle and combined cycle power plants anywhere in the world. Our technology provides low life-cycle cost of converting fuel to electricity; our experience spans 125+ years and includes countless impactful innovations and technology improvements; and our people work every day to create and aim to deliver ground breaking solutions for customers, partners, and communities around the world.

Our simple and combined cycle power plants are flexible in their operation and include features such as fast start and load ramping, low turndown, and high full- and part-load efficiencies. This flexibility, associated with key component engineering and construction features such as turbine packaging and power island systems modularization, help to deliver improved plant economics, including:

- Reduced capital costs
- Reduced operation and maintenance costs
- Shorter installation times, reduced installation costs, and fast revenue production
- Improved reliability and availability

EQUIPMENT ONLY TO FULL TURNKEY

With decades of experience and component know-how, GE extracts maximum value out of every piece of equipment we deploy. Whether we work directly with you or through an engineering, procurement, and construction (EPC) contractor, our scopes of supply are configured to help meet individual procurement strategies and risk profiles. GE's integrated approach to plant development means that, from planning through commissioning, we consider individual components as well as balance-of-plant systems in each decision we make with our customers.

GE offers as little or as much as you need—from equipment only to full turnkey solutions. Moving beyond equipment only solutions enables more comprehensive performance and operability guarantees and reduces the risk of gaps in scope between suppliers and contractors. With a turnkey solution, customers may be able to obtain more favorable financing and insurance terms.

EXTENDED SCOPE OF SUPPLY

EQUIPMENT ONLY (EO)

> *GE Supplies: Any combination of gas turbines, steam turbines, generators, HRSGs + accessories + controls*

> *GE Guarantees: Equipment performance and equipment delivery*

ENGINEERED EQUIPMENT PACKAGE (EEP)

> *GE Supplies: Gas turbine + steam turbine + generator + HRSG + controls + emissions monitoring + critical control valves + condenser*

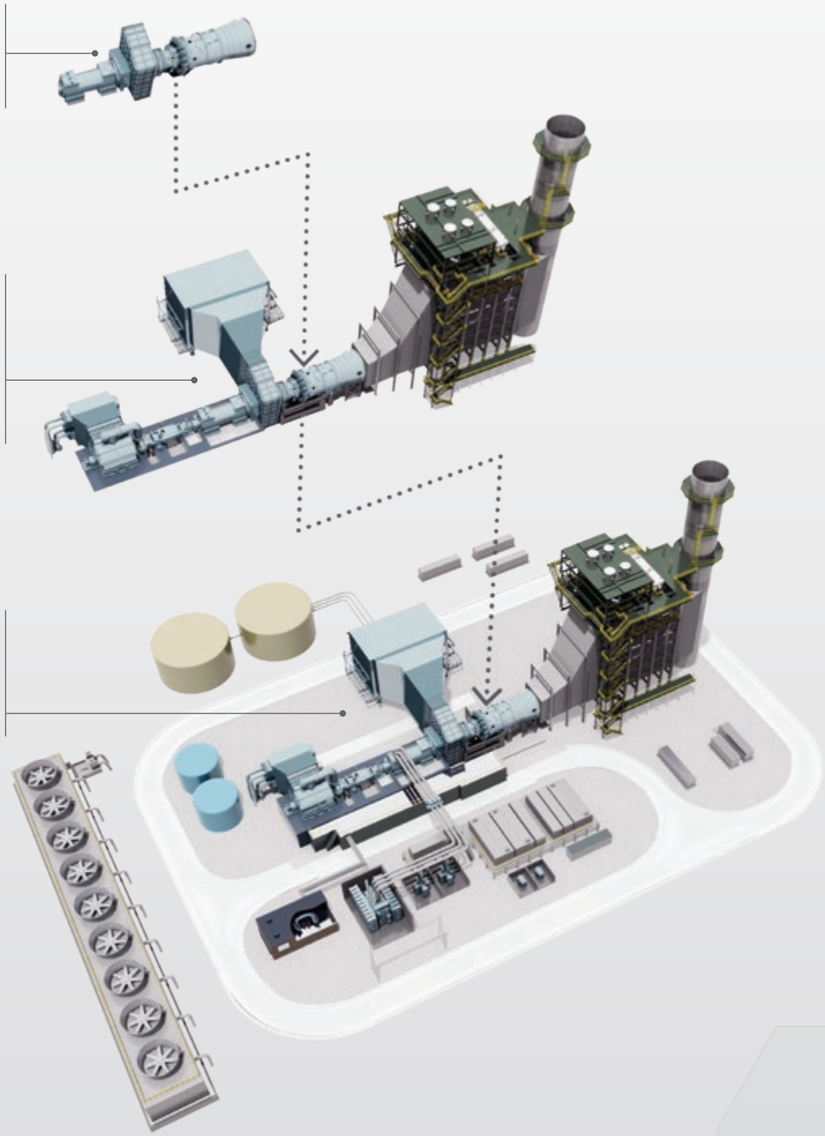
> *GE Guarantees: Combined cycle performance, operability, power island emissions, near-field acoustics, equipment delivery*

TURNKEY PLANT (TK)

With partner or self-implement

> *GE Supplies: Various scope from EEP to total plant solution*

> *GE Guarantees (depending on partner scope split): Combined cycle performance, operability, plant emissions, far-field acoustics, commercial operation date*



SOLUTIONS TAILORED TO YOUR NEEDS

It is uncommon to find two plants perfectly alike, which is why you'll find GE working hand-in-hand with customers to develop and build custom-engineered solutions to match unique business and operational needs. Whether the project requires a single gas turbine generator set or a multi-unit turnkey solution, GE has readily available product configurations to help meet critical power needs quickly.

GE also has a team of experienced application engineers around the world to support economic analysis and off-specification performance of our products to satisfy any special application, operational, or environmental need. We are committed to defining the best solution with our customers from the foundation of our product performance to other levels of support, whether through customized long-term service agreements, financing solutions, or additional product solutions and services.

Customization starts with product configuration and understanding the right scope of supply that customers and partners need from GE.

CONFIGURATIONS THAT PERFORM

Every power plant is unique and depends on numerous customer-specific requirements such as land availability, grid access constraints, funds availability, grid access constraints, and expected operating profile. The following table lists the three gas plant configurations and their respective attributes to guide your choice of simple cycle or combined cycle single-shaft or multi-shaft that best fit your project specific wants and needs.

	SIMPLE CYCLE	COMBINED CYCLE SINGLE SHAFT	COMBINED CYCLE MULTI-SHAFT
APPLICATIONS	• Peaking power • Emergent power demands (can later be converted to combined cycle) • Mechanical drive	• Mid-merit to baseload • Grid connected, utility scale • Combined Heat and Power (CHP)	• Mid-merit to baseload • Grid connected, utility scale • Combined Heat and Power (CHP)
ADVANTAGES	• Lowest CAPEX • Shortest construction cycle • Easily scalable for growth	• Smallest footprint/highest power density (MW/m^2) • Easily scalable for growth • Lower CAPEX and lower $/kW compared to multi-shaft	• Redundancy • Phased construction flexibility • Can accommodate large steam extractions
DISADVANTAGES	• Lower efficiency compared to combined-cycle • Higher specific emissions	• Longer construction time than simple cycle	• Higher CAPEX and higher $/kW compared to single shaft

LESS SITE TIME, LESS RISK

Time is precious, so meeting plant construction milestones is critical to project success. To help promote ease of constructability in all our projects, we have infused our offerings with features that support less on-site work, driving process efficiency and alleviating associated risk.

The main focus is how we assemble the gas turbine and accessories onsite. GE's HA, 9F.05, 6F.03 and 6F.01 gas turbine enclosures feature a modular architecture with valves, piping, and electrical systems packaged into stackable modules with segregated work zones. These zones allow for simultaneous installation of electrical, piping, and mechanical systems and reduce safety concerns and delays due to interfering tasks. With significantly more room for maintenance than the previous F-Class, this enclosure—called our prime package—reduces installation time and cost while offering simpler and faster serviceability.

PLANT MODULARIZATION

For our customers looking for shorter construction schedules (notice to proceed to commissioning date) with less risk, increased quality and flexibility, enabling reduced total installed cost, GE offers a full set of plant modularized packages. These shop prefabricated and transportable modules are designed to facilitate site construction and easy installation with packages such as HRSG auxiliary modules (i.e. HP drum module), condenser modules, mechanical BoP and electrical BoP modules.

SERVICE TAILORED TO YOUR NEEDS

Through our innovative technology we are increasing the lifetime and competitiveness of your power plant assets with new and refurbished parts, spares, upgrades, and software solutions. Our technologies can boost reliability and flexibility, reduce the environmental footprint and cut cost of production by increasing efficiency, and the intervals between inspections.

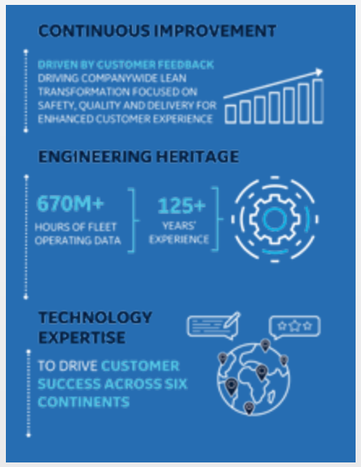
You can benefit from working closely with a single service provider that analyzes your plant's entire operation to fully harness the performance of all power plant equipment: GT/HRSG/ST/generator and balance-of-plant; a provider that can forecast the impacts even the most advanced technologies – and unpredictable operating demands - can have on your overall plant profile.

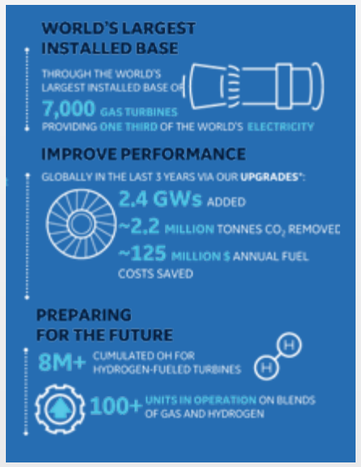
Working with the original equipment manufacturer can be invaluable in a dynamic industry environment. The team that originally built and installed the machine can provide unique insights and access to the latest innovations. With our worldwide team of experts, their in-depth knowledge, engineering and operational capabilities, we are committed to our customers' success, working to help them stay competitive in our industry today and in the future.

Our services team can install upgrades that can improve plant flexibility with faster ramp-up, better turn-down, or increased efficiency to help ensure that power generating assets are in a competitive position to maximize life-cycle value and utilization. Moving beyond our abilities to serve you today, we are committed to preparing you for a future with near-zero carbon power generation by combining pre-and post-combustion solutions: upgrading existing fuel systems for Hydrogen, and adding Carbon Capture systems.

With the world's largest installed base of 7,000 gas turbines and 16,000 combined-cycle power generation assets, we offer advanced technology and a level of experience that is unmatched in the industry to build, operate, and maintain gas power plants. We are committed to working alongside you by providing services throughout your plant's full lifetime to keep you competitive today, while preparing your assets for a future with less carbon emissions.

As a learning organization, we are driven by customer feedback. We are committed to continuous improvement by putting lean management into action focused on safety, quality and delivery for enhanced customer experience. To distill this message down, when we embark on a services project, we deliver on three core values: Purpose. Partnership. Power. To put these core values into practice across 150 countries and six continents, we work with our customers to jointly apply a safety-driven, lean culture, on-and-off site.





Steam Turbine
- ~10% of steam turbine solutions are performed on cross-fleet assets

Generator
- GE services all generator OEM brands (15+)

HRSG
- Installations completed on 30+% of the world's fleet

OUTPUT
When a customer approached GE for an upgrade to expand capacity, a solution integrating HRSG steam turbine valve and balance-of-plant technologies delivered a **10+%** increase in plant output.

RELIABILITY/ AVAILABILITY
In Mexico, a GE gas plant upgrade ncluding the gas turbine, steam turbine bypass system and HRSG slashed start up time by **up to one hour**.

EFFICIENCY
By packaging multi-faceted upgrades, GE can help customers expand gas plant efficiency by **3+%** at base load.

FLEXIBILITY
Advanced GE gas turbine technologies enable turndown to less than **25%** on some gas turbines.

EMISSIONS REDUCTION
GE can help slash gas plant emissions, including CO and NO_2, up to **40%** with system-level technology upgrades.

PREDICTABILITY
Asset performance management digital solutions can help our customers save up to **$1 billion** over the next decade.

APPLICATIONS

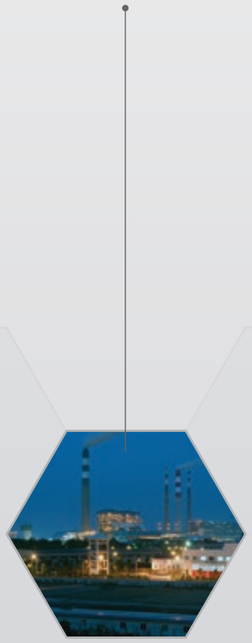
Electric power is a fundamental necessity for utilities and independent power providers, cooperatives and municipalities, industrial operators (like chemical, mining, and steel production) and commercial buildings and facilities (like data centers and airports).

UTILITY POWER GENERATION

Utilities, independent power providers, municipalities, and cooperatives around the world develop and run power plants that meet consumer-electricity needs. Operators seek the most cost-effective and reliable plant offerings to serve their local grid and service territory demands. Whether it's base-load power, cyclic generation, or peaking power, GE as the manufacturer of one of the leading gas turbine portfolios—from a 24 MW LM2500 to a 1600+ MW 2x1 9HA.02 —generates the high-performing power that helps your plant operate dependably and efficiently.

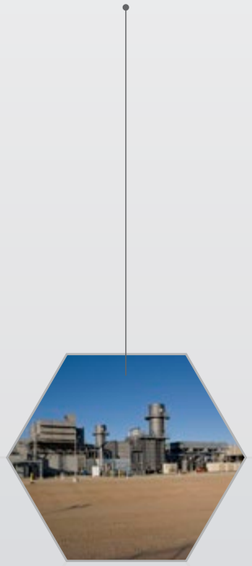
INDUSTRIAL POWER GENERATION

Industrial power generation refers to applications where customers are seeking to reduce utility expenses by locally generating electricity (and sometimes heat) for their operations. Equally important to remote installations is the requirement that power sources be of ultra-high reliability, as a loss of power to certain processes (such as aluminum smelting) can cause enormous disruptions, surprise expenses, and even catastrophic results. GE's vast portfolio offers tested solutions to keep electrical infrastructures strong and predictable for industries like food processing, cement, mining, chemicals, and more.



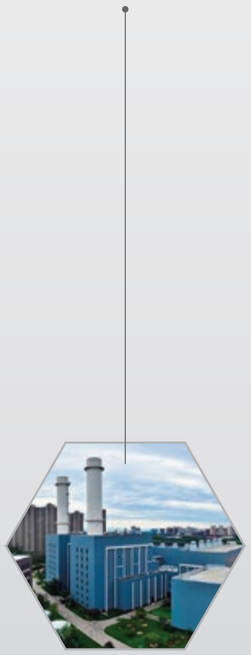
COMMERCIAL BUILDINGS and FACILITIES POWER

It's a simple idea: If you can't get to the power source, bring the power source to where you need it the most—on site. With GE's power-generation products, you benefit from intelligent on-site combined heat and power (CHP) generation anywhere you need it, like municipal districts, manufacturing plants, hospitals, airports, malls, data centers, arenas, universities, hotels, office buildings, and many more commercial facilities in need of such energy agility.



COMBINED HEAT and POWER

From manufacturers to universities and hospitals, facilities using combined heat and power (CHP) can derive electricity and thermal energy from a common fuel. Captured thermal energy (steam or hot water) can be channeled for high-efficiency heating, cooling, and industrial power. With combustion and steam turbines, GE is uniquely positioned to complement a CHP approach, reducing energy costs, increasing reliability, and decreasing carbon emissions.

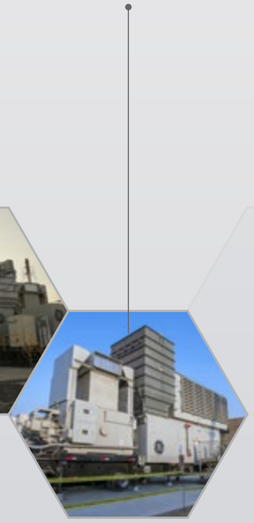


EMERGENCY POWER

Whether power suppliers across the globe are dealing with natural disasters, health emergencies, plant shutdowns, or cyber-incidents, GE can provide emergency temporary power when getting the lights back on is essential. Proven with over 6 million hours of operating experience, GE's TM2500 aeroderivative mobile gas turbine features up to 36 MW of power potential. With a turnkey, fuel-flexible configuration, the TM2500 can ramp up to full production within just five minutes—providing quick power when you need it most.

FAST POWER

Unlike emergency power for short-term needs, GE fast power provides base-load bridge-to-permanent installations for a reliable and efficient grid. Power production can be rife with pitfalls like failing infrastructure, extreme weather conditions, and rapid urbanization. But, GE's mobile power plants are configured with modular, turnkey efficiency, making it possible to ramp up to full power in 5-15 minutes once installed. The portable, compact units feature dual-fuel capability without water consumption—and added peace of mind through our on-call advisory service for performance and maintenance support.



GRID FIRMING

While renewable resources' benefits include the lowest operational costs and fewest greenhouse gas emissions, they can cause potential challenges when integrated into the grid. It's a game of balance between traditional and greener resources, and GE's grid firming helps keep that balance. Grid firming—also known as nameplate capacity firming, capacity firming, or renewable firming—is widely used to keep the grid stable in the face of potential wind, solar, and hydro variability. GE's aeroderivative gas turbines bridge the variability of renewables, helping you meet power supply and demand—and adding the system reliability that avoids power outages and disruptions. With installation as short as 11 days, GE aeroderivative gas turbines reserve capacity, and reduce your emissions, fuel consumption, and operational costs.

GAS TURBINES

“

THE HEART OF EVERY COMBINED CYCLE POWER PLANT IS THE GAS TURBINE

”

9HA

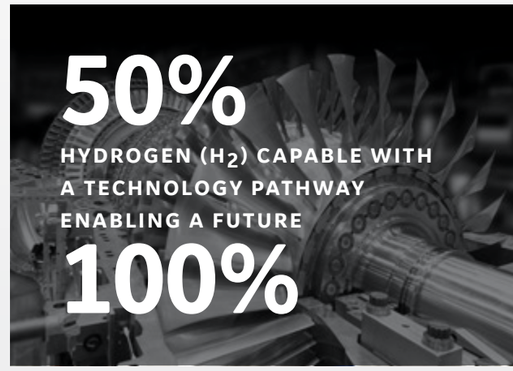
HEAVY DUTY GAS TURBINE

50HZ

448-571 MW SIMPLE CYCLE OUTPUT

>64% COMBINED CYCLE EFFICIENCY

OUTSTANDING COMBINED CYCLE EFFICIENCY >64% FOR REDUCED CUSTOMER CARBON FOOTPRINT.



		9HA.01	9HA.02
SC PLANT PERFORMANCE	SC Net Output (MW)	448	571
	SC Net Heat Rate (Btu/kWh, LHV)	7,960	7,740
	SC Net Heat Rate (kJ/kWh, LHV)	8,398	8,166
	SC Net Efficiency (%, LHV)	42.9%	44.0%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	680	838
	CC Net Heat Rate (Btu/kWh, LHV)	5,356	5,320
	CC Net Heat Rate (kJ/kWh, LHV)	5,651	5,613
	CC Net Efficiency (%, LHV)	63.7%	64.1%
	Plant Turndown – Minimum Load (%)	33.0%	33.0%
	Ramp Rate (MW/min)	65	88
	Startup Time (RR Hot†, Minutes)	<30	<30
2X CC PLANT PERFORMANCE	CC Net Output (MW)	1,363	1,680
	CC Net Heat Rate (Btu/kWh, LHV)	5,345	5,306
	CC Net Heat Rate (kJ/kWh, LHV)	5,639	5,598
	CC Net Efficiency (%, LHV)	63.8%	64.3%
	Plant Turndown – Minimum Load (%)	15.0%	15.0%
	Ramp Rate (MW/min)	130	176
	Startup Time (RR Hot†, Minutes)	<30	<30

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

Marrying sheer power with record-breaking efficiency, the 9HA gas turbine provides reliable and dependable capacity for demanding customer economics. It offers the most cost-effective conversion of fuel to electricity as well as industry-leading operational flexibility for increased dispatch and ancillary services revenue. The 9HA gas turbine is at the heart of the world's most efficient combined-cycle power plants in commercial operation today and is a key element in the path to decarbonization.

≪ Track 4A Power Plant, Southern Power Generation Sdn Bhd (SPG), Pasir Gudang, Johor, Malaysia

9HA CUSTOMER STORIES

9HA.02 – TRACK 4A POWER PLANT

LOCATION: Pasir Gudang, Johor, Malaysia

OUTPUT: 1,440 MW

GE SCOPE: 2 9HA.02 gas turbines
2 STF-D650 steam turbines
2 W88 generators
2 once through HRSGs

COD: 2021

CHALLENGE

Steady economic growth in Malaysia has called for a steady increase in power capability. GE partnered with Southern Power Generation (SPG) in the city of Pasir Gudang, Johor to meet this energy challenge for the Track 4A power plant—as well as to address the country's spreading decarbonization effort.

SOLUTION

Southern Power Generation's Track 4A power plant runs on GE's 9HA.02 combined-cycle power plant, an industry-first in commercial operation. It consists of two blocks, each equipped with a 9HA.02 and a STF-D650 steam turbine driving a W88 generator in single shaft configuration—and another first for an H-Class plant, GE also installed its once through Heat Recovery Steam Generator. Track 4A received POWER magazine's 2021 Plant of the Year.

"FROM A LONGSTANDING RELATIONSHIP WITH GE, WE TRUST ITS HA TECHNOLOGY AND ARE PROUD TO SEE HARD WORK AND EFFICIENCY ACHIEVE THE START OF GE'S FIRST-EVER COMMERCIAL-OPERATION 9HA.02 GAS TURBINES, DESPITE THE COVID-19 PANDEMIC, WITHOUT HAVING TO COMPROMISE ON HEALTH AND SAFETY."

– Dato' Haji Nor Azman bin Mufti, Chairman of SPG

9HA.01 – OROT RABIN POWER PLANT

LOCATION: Hadera, Israel

OUTPUT: 1,260 MW

GE SCOPE: 2 9HA.01 gas turbines
2 STF-D650 steam turbines
2 W88 generators
2 Three pressure level, RH drum HRSGs

COD: 2022

CHALLENGE

As part of an existing plan to convert the Orot Rabin coal-fired power plant to gas generation, The Israel Electric Corporation (IEC) ordered a first 9HA turbine in 2019. IEC's focus on modernizing its plants, announced in 2018, comes as a result of a law passed by the Government of Israel's Clean Air Law 2011. In the latest order, GE will also provide a steam turbine, generator, heat recovery steam generator and balance-of-plant equipment—as well as a 15-year multi-year services agreement.

SOLUTION

Once operational, the Orot Rabin combined-cycle gas turbines are expected to be the largest and most efficient gas-fired power units in Israel, delivering up to 1,260 MW, more than 8% of Israel's current total power generation capacity.

GE's 9HA.01 gas turbines are expected to have a net efficiency of more than 61% using natural gas as the primary fuel and fuel oil as secondary fuel. Each of GE's 9HA.01 units is expected to produce 630 MW to replace the production from four of the existing coal-fired units when the plant enters commercial operation for the first unit in 2022.

"ADDING A SECOND 9HA.01 GAS TURBINE FROM GE FOR OUR MODERNIZATION PROJECT FURTHER HELPS ENSURE WE ARE INVESTING IN INDUSTRY-LEADING TECHNOLOGY TO HELP MEET THE GROWING NEEDS OF THE BUSINESSES AND CITIZENS IN ISRAEL. OUR EFFORTS WILL CHANGE THE WAY POWER IS DELIVERED IN THE COUNTRY."

– Ofer Bloch, President and CEO, Israel Electric Corporation

7HA

HEAVY DUTY GAS TURBINE

60HZ

290-430 MW SIMPLE CYCLE OUTPUT

>64% COMBINED CYCLE EFFICIENCY

A 7HA COMBINED CYCLE PLANT, NOW CAPABLE OF >64% EFFICIENCY, PROVIDES A 60% REDUCTION IN CO_2 EMISSIONS VS. A SIMILAR SIZE COAL FIRED ASSET.

50%

HYDROGEN (H_2) CAPABLE WITH A TECHNOLOGY PATHWAY ENABLING A FUTURE

100%

		7HA.01	7HA.02	7HA.03
SC PLANT PERFORMANCE	SC Net Output (MW)	290	384	430
	SC Net Heat Rate (Btu/kWh, LHV)	8,120	8,009	7,884
	SC Net Heat Rate (kJ/kWh, LHV)	8,567	8,450	8,318
	SC Net Efficiency (%, LHV)	42.0%	42.6%	43.3%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	438	573	640
	CC Net Heat Rate (Btu/kWh, LHV)	5,481	5,381	5,342
	CC Net Heat Rate (kJ/kWh, LHV)	5,783	5,677	5,636
	CC Net Efficiency (%, LHV)	62.3%	63.4%	63.9%
	Plant Turndown – Minimum Load (%)	33.0%	33.0%	33.0%
	Ramp Rate (MW/min)	55	60	75
	Startup Time (RR Hot†, Minutes)	<30	<30	<30
2X CC PLANT PERFORMANCE	CC Net Output (MW)	880	1,148	1,282
	CC Net Heat Rate (Btu/kWh, LHV)	5,453	5,365	5,331
	CC Net Heat Rate (kJ/kWh, LHV)	5,753	5,660	5,625
	CC Net Efficiency (%, LHV)	62.6%	63.6%	>64.0%
	Plant Turndown – Minimum Load (%)	15.0%	15.0%	15.0%
	Ramp Rate (MW/min)	110	120	150
	Startup Time (RR Hot†, Minutes)	<30	<30	<30

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

Today, more than 50 7HA gas turbines have been installed around the globe. These units support base load, load following, peaking, and cogeneration for district heating applications. The 7HA gas turbine will be a key enabler as the energy transition progresses and we move towards a world with less carbon emissions, providing the reliable and flexible power generation needed to complement renewable energy sources.

≪ Towantic Power Plant, CPV Towantic Energy Center, Oxford, CT, USA

7HA CUSTOMER STORIES

7HA.03 – HSINTA COMBINED CYCLE POWER PLANT

LOCATION: Yongan, Kaohsiung, Taiwan

OUTPUT: 3.9 GW

GE SCOPE: 6 7HA.03 gas turbines
3 STF-D650 steam turbines
9 H65 generators
6 once through HRSGs

COD: 2023-2025

CHALLENGE

Owned and operated by state-owned Taiwan Power Company, the Hsinta power station complex houses a 2.1 GW coal-fired plant comprised of four units commissioned in the 1980s and a 2.4 GW natural gas-fired combined-cycle facility equipped with five units that were commissioned between 1998 and 1999.

The Hsinta power station renewal project includes three new gas-fired combined cycle units for a total capacity of 3.9 GW to replace the old gas-fired and coal-fired units of the Hsinta power plant complex in Kaohsiung, Taiwan.

SOLUTION

GE was awarded a contract to deploy its latest gas turbine technology, the 7HA.03, with its matching steam turbine, generators and HRSGs. The 7HA.03 is GE's latest technology aiming to strike the optimal balance for power output, efficiency and maintainability.

"BUILDING ON A PROVEN TRACK RECORD OF DELIVERING AND COMMISSIONING PROJECTS IN TAIWAN, GE IS PROUD TO SUPPORT TAIWAN POWER COMPANY IN THEIR ENERGY TRANSITION PROGRAM TO INCREASE ELECTRICITY PRODUCTION CAPACITY WITH MORE EFFICIENT TECHNOLOGIES, AND BRING FAST, FLEXIBLE POWER TO TAIWAN."

– Ramesh Singaram, President and CEO of GE Gas Power Asia

7HA.02 – LONG RIDGE ENERGY TERMINAL

LOCATION: Hannibal, Ohio, USA

OUTPUT: 485 MW

GE SCOPE: 1 7HA.02 gas turbine
1 STF-D650 steam turbine
1 H84 generator
1 Three pressure level, RH drum HRSG

COD: 2021

CHALLENGE

To change the course of climate change, the world must act quickly with an aim to decarbonize every aspect of modern life, from transportation to power. This requires a global effort built on cooperation and coordination.

SOLUTION

In October 2020, Long Ridge Energy Terminal, located in Hannibal, Ohio, announced plans to transition its 485 MW combined-cycle power plant to run on carbon-free hydrogen. In collaboration with New Fortress Energy and GE, Long Ridge intends to begin providing lower carbon power to customers as early as 2021 by blending hydrogen in the gas stream—**with the first HA gas turbine to operate on a hydrogen blend**—and transitioning the plant to be capable of burning 100% green hydrogen over the next decade.

"WE ARE THRILLED TO WORK WITH THE LONG RIDGE AND NEW FORTRESS ENERGY TEAMS ON THIS FIRST-OF-ITS KIND GE HA-POWERED PROJECT THAT WILL DRIVE A CLEANER ENERGY FUTURE BY UTILIZING HYDROGEN TO ULTIMATELY PRODUCE CARBON-FREE POWER. AS A LEADER TOWARDS DECARBONIZATION IN THE GAS TURBINE INDUSTRY AND THE OEM WITH THE MOST FLEET EXPERIENCE IN USING ALTERNATIVE LOW HEATING VALUE FUELS INCLUDING HYDROGEN, WE LOOK FORWARD TO APPLYING MORE THAN 80 YEARS OF EXPERIENCE TO HELP LONG RIDGE ACHIEVE ITS GOAL OF PROVIDING RELIABLE, AFFORDABLE, AND LOWER-CARBON POWER TO ITS CUSTOMERS."

– Scott Strazik, CEO, GE Gas Power

9F

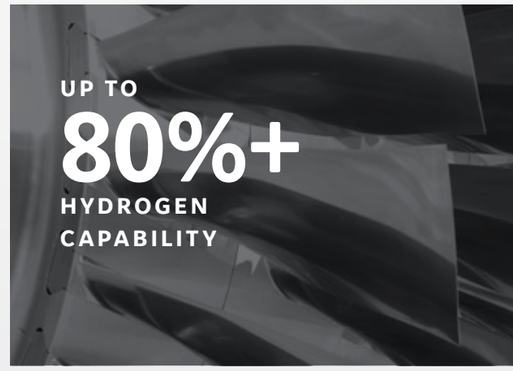
HEAVY DUTY GAS TURBINE

50HZ

288-314 MW SIMPLE CYCLE OUTPUT

>60% COMBINED CYCLE EFFICIENCY

THE 9F.05 HEAVY DUTY GAS TURBINE PROVIDES COMBINED CYCLE EFFICIENCY OF MORE THAN 60% WITH LOW 15 PPM NOx EMISSIONS.



		9F.04	9F.05
SC PLANT PERFORMANCE	SC Net Output (MW)	288	314
	SC Net Heat Rate (Btu/kWh, LHV)	8,810	8,846
	SC Net Heat Rate (kJ/kWh, LHV)	9,295	9,333
	SC Net Efficiency (%, LHV)	38.7%	38.6%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	443	493
	CC Net Heat Rate (Btu/kWh, LHV)	5,666	5,619
	CC Net Heat Rate (kJ/kWh, LHV)	5,978	5,928
	CC Net Efficiency (%, LHV)	60.2%	60.7%
	Plant Turndown – Minimum Load (%)	48.0%	43.0%
	Ramp Rate (MW/min)	22	26
	Startup Time (RR Hot†, Minutes)	30	30
2X CC PLANT PERFORMANCE	CC Net Output (MW)	889	989
	CC Net Heat Rate (Btu/kWh, LHV)	5,649	5,603
	CC Net Heat Rate (kJ/kWh, LHV)	5,960	5,911
	CC Net Efficiency (%, LHV)	60.4%	60.9%
	Plant Turndown – Minimum Load (%)	22.0%	20.0%
	Ramp Rate (MW/min)	44	52
	Startup Time (RR Hot†, Minutes)	39	39

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

With over 450 units deployed to more than 40 countries, GE has the largest operating and most experienced 50 Hz F-Class fleet in the world. Our 9F gas turbine delivers consistent performance and accommodates a diverse range of fuels, making it ideal for a variety of combined cycle and CHP applications. The simple and robust air-cooled architecture is designed for longer parts durability and extended service inspection intervals, making the 9F an ideal choice for life-cycle value.

≪ Arcos de la Frontera Grupo III Combined-Cycle Plant, Iberdrola, S.A., Cadiz, Spain

9F CUSTOMER STORIES

9F – GREAT YARMOUTH POWER STATION

LOCATION: Norfolk, England

OUTPUT: +21 MW, + 2% efficiency

GE SCOPE:
- Dry Low NOx 2.6+ combustion system
- Advanced Gas Path solution
- Asset Performance Management
- Advanced digital solution Mark* VIe integrated control system
- Associated gas and steam turbine and generator maintenance

COD: 2021

CHALLENGE

When it was first commissioned in 2002, RWE's Great Yarmouth facility was one of the U.K.'s most efficient power stations, but with the growth and evolution of the power industry since then, it's no longer as reliable and efficient as some newer plants. With energy consumption continuing to rise in the region, and coal consumption declining in favor of natural gas, Great Yarmouth knew it needed to make some improvements.

SOLUTION

The modernizations agreed upon by RWE and GE will include a gas turbine upgrade as well as major inspections of the steam turbine and generator with replacements of key components in the steam turbine. The upgrades also include GE's Dry Low NOx 2.6+ combustion system, Advanced Gas Path solution, Asset Performance Management, advanced digital solution, Mark VIe integrated control system, and associated gas and steam turbine and generator maintenance.

> AT RWE, WE CONTEMPLATED MULTIPLE OPERATING SCENARIOS FOR OUR GREAT YARMOUTH PLANT. ULTIMATELY, WE DECIDED TO IMPLEMENT GE'S TECHNOLOGIES AND DIGITAL SOLITONS TO IMPROVE PLANT PERFORMANCE, OUTPUT, EFFICIENCY AND FLEXIBILITY IN A COST-EFFECTIVE MANNER.
>
> *– Steve Glover, Director of Hard Coal and Gas Power Plant U.K., RWE*

9F – KHULNA POWER PROJECT

LOCATION: Khulna, Bangladesh

OUTPUT: 375 MW

GE SCOPE: 1 9F.04 gas turbine
1 STF-A650 steam turbine
1 H53 generator
1 A39 generator

COD: 2021

CHALLENGE

Bangladesh has tremendous focus to establish high-capacity power plants to meet their growing power demand. The Khulna 375 MW combined-cycle power project is owned by Bangladesh Power Development Board (BPDB). Their objective was to equip the power plant with technology that can meet emission norms and still provide high efficiency.

SOLUTION

BPDB wanted to have dual-fuel technology and during the technology selection phase equal emphasis on both liquid fuel and natural gas had to be given. GE was selected to supply the equipment—using proven Emulsion Technology—to meet the project requirements and provide high efficiency.

> THE TECHNOLOGY SUPPLIED FOR THIS PROJECT IS FIRST-OF-ITS-KIND OFFERING BY GE IN SOUTH ASIA.

7F

HEAVY DUTY GAS TURBINE

60HZ

201-239 MW SIMPLE CYCLE OUTPUT

>60% COMBINED CYCLE EFFICIENCY

THE 7F.05 IS A FLEXIBLE, EFFICIENT, AND RELIABLE SOLUTION TO PARTNER WITH THE DYNAMIC OPERATING DEMANDS OF RENEWABLE ENERGY.

		7F.04	7F.05
SC PLANT PERFORMANCE	SC Net Output (MW)	201	239
	SC Net Heat Rate (Btu/kWh, LHV)	8,873	8,871
	SC Net Heat Rate (kJ/kWh, LHV)	9,362	9,359
	SC Net Efficiency (%, LHV)	38.5%	38.5%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	309	379
	CC Net Heat Rate (Btu/kWh, LHV)	5,716	5,667
	CC Net Heat Rate (kJ/kWh, LHV)	6,031	5,979
	CC Net Efficiency (%, LHV)	59.7%	60.2%
	Plant Turndown – Minimum Load (%)	58.0%	46.0%
	Ramp Rate (MW/min)	30	40
	Startup Time (RR Hot†, Minutes)	28	25
2X CC PLANT PERFORMANCE	CC Net Output (MW)	622	762
	CC Net Heat Rate (Btu/kWh, LHV)	5,675	5,640
	CC Net Heat Rate (kJ/kWh, LHV)	5,987	5,951
	CC Net Efficiency (%, LHV)	60.1%	60.5%
	Plant Turndown – Minimum Load (%)	27.0%	22.0%
	Ramp Rate (MW/min)	60	80
	Startup Time (RR Hot†, Minutes)	28	25

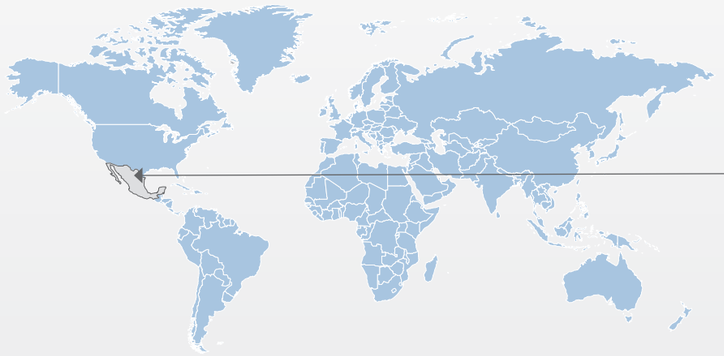
NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

The first 7F gas turbine started commercial operation in 1990 and is still operational and producing electricity today. With more than 950 installed units producing ~175 GW of power in 11 countries, the 7F is the workhorse of the F-Class fleet. The 7F has been relevant for 30 years and continuous technological innovations and investments have ensured it is still an industry leading solution.

≪ Fort St. Vrain Generating Station, Xcel Energy, Platteville, CO, USA

7F CUSTOMER STORIES

7F.04 – TECHINT NORTE III POWER STATION



LOCATION: Chihuahua, Mexico
OUTPUT: 907 MW
GE SCOPE: 4 7F.04 gas turbines
4 H33 generators
COD: 2020

CHALLENGE

In 2015, Mexico's Federal Electricity Commission (CFE) commissioned the development of a combined-cycle power plant in the State of Chihuahua, Mexico, to help meet the growing need for electricity in the region. The Chihuahua region was identified in Mexico's 15-year electricity infrastructure development program as a "deficient node," given its expected growth in the next decade.

SOLUTION

The Norte III combined cycle plant supports this growth with the help of the 7F gas turbine, along with a full spectrum of digital solutions, directly supporting the GE O&M team in achieving the guaranteed capacity outcome.

"WE CHOSE GE TO COLLABORATE WITH US ON THE NORTE III PLANT BECAUSE OF ITS RELIABLE TECHNOLOGY AND TOTAL PLANT-SERVICE SOLUTIONS. WE BELIEVE THIS IMPORTANT PROJECT WILL ALLOW THE CONSORTIUM TO LEVERAGE OUR COLLECTIVE GLOBAL EXPERTISE IN INFRASTRUCTURE, ENERGY AND PROJECT FINANCING TO SUPPORT THE EXPECTED GROWTH IN THE CHIHUAHUA REGION."

– Alejandro Maluf, CEO Techint North America

7F.05 – WAAD AL SHAMAL HYBRID POWER PLANT

LOCATION: Turaif, Saudi Arabia
OUTPUT: 1,390 MW
HARDWARE: 4 7F.05 gas turbines
1 STF-D600 steam turbine
4 A63 generators
1 H84 generator
4 Three pressure level
RH drum HRSGs
COD: 2021

CHALLENGE

GE won the contract for Saudi Electricity Company (SEC)'s Waad Al Shamal project, which also includes 50 MW of solar power, in late 2015. All four GE 7F gas turbines at the plant can now operate in simple cycle configuration. Combined cycle commissioning works are ongoing and once complete, the facility will be able to generate up to 1,390 MW of power, the equivalent electricity needed to supply over 500,000 Saudi homes.

SOLUTION

For Waad al Shamal, GE is providing turnkey services, including engineering, procurement and construction (EPC) works, and supplying four GE 7F gas turbines, one steam turbine and four heat recovery steam generators (HRSGs), as well as other equipment for the project. One of the turbines at the site is the first GE gas turbine rolled out locally in the Kingdom from GE Saudi Advanced Turbines (GESAT) - a joint venture (JV) between Dussur and GE.

Additionally, GE has dedicated site leaders, staff training programs and its own internal audits to implement and monitor EHS standards at the Waad Al Shamal project.

"AT SEC, WE CONTINUOUSLY ASSESS PROGRESS AGAINST STRICT MEASURES MEANT TO HELP ENSURE OCCUPATIONAL SAFETY AND HEALTH ACROSS ALL OUR OFFICES, EXISTING FACILITIES AND PROJECTS. WE ARE DELIGHTED TO WORK WITH AN INDUSTRY LEADER SUCH AS GE THAT HAS DEMONSTRATED A CLEAR COMMITMENT TO UPHOLDING STRICT EHS STANDARDS AND CONGRATULATE THEM ON THIS 5-STAR RATING."

– Fahad H. Al-Sudairi, President and CEO, SEC

9E

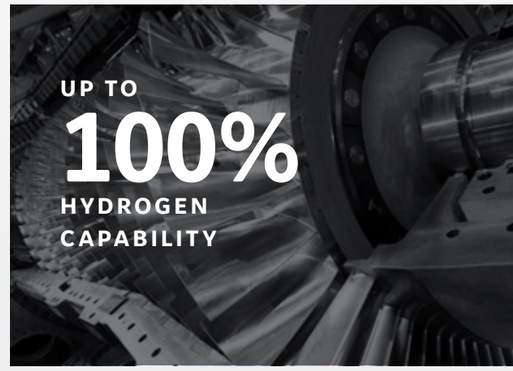
HEAVY DUTY GAS TURBINE

50HZ

132-147 MW SIMPLE CYCLE OUTPUT

>55% COMBINED CYCLE EFFICIENCY

GE'S 9E CAN RUN ON MORE THAN 52 TYPES OF FUEL WHILE DRASTICALLY REDUCING EMISSIONS WITH PROVEN DLN COMBUSTION TECHNOLOGY.



		9E.03	9E.04
SC PLANT PERFORMANCE	SC Net Output (MW)	132	147
	SC Net Heat Rate (Btu/kWh, LHV)	9,960	9,238
	SC Net Heat Rate (kJ/kWh, LHV)	10,508	9,747
	SC Net Efficiency (%, LHV)	34.3%	36.9%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	205	218
	CC Net Heat Rate (Btu/kWh, LHV)	6,421	6,203
	CC Net Heat Rate (kJ/kWh, LHV)	6,775	6,545
	CC Net Efficiency (%, LHV)	53.1%	55.0%
	Plant Turndown – Minimum Load (%)	45.0%	46.0%
	Ramp Rate (MW/min)	50	29
	Startup Time (RR Hot†, Minutes)	38	38
2X CC PLANT PERFORMANCE	CC Net Output (MW)	412	439
	CC Net Heat Rate (Btu/kWh, LHV)	6,372	6,166
	CC Net Heat Rate (kJ/kWh, LHV)	6,723	6,505
	CC Net Efficiency (%, LHV)	53.5%	55.3%
	Plant Turndown – Minimum Load (%)	22.0%	22.0%
	Ramp Rate (MW/min)	100	58
	Startup Time (RR Hot†, Minutes)	38	38

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

The 9E is a robust, proven platform that helps deliver high availability, reliability, and durability. The 9E.04 represents the most recent addition to the 9E family, delivering more power and performance with a new 4 stage turbine module that fits within the same footprint as an already installed 9E gas turbine unit. A strong performer in a variety of applications, the 9E provides a wide range of fuels capability, and can even switch fuels while running under full load.

≪ West Damietta Power Project Phase II, East Delta Electricity Production Company (EDEPC), Dumyat, Egypt

9E CUSTOMER STORIES

9E.04 – AMANDI POWER PLANT

LOCATION: Aboadze, Ghana

OUTPUT: 192 MW

GE SCOPE: 1 9E.04 gas turbine
1 SC2-26 steam turbine
1 A38 generator
1 A34 generator
1 drum type two pressure non-reheat HRSG

COD: 2021

CHALLENGE

Ghana in Sub Saharan Africa has increasing demand for power driven by population growth. However fuel access is a challenge for which the country needs a flexible solution to provide reliable electricity to the population.

SOLUTION

The plant is powered by GE's 9E.04 gas turbine with tri-fuel capabilities. Initially fueled by light crude oil for the first years of operation, the switch will be made to indigenous gas from Ghana's offshore Sankofa natural gas field once it becomes available. The plant will help to add reliable and efficient capacity to the grid to tackle Ghana's increasing demand for power. With completion of construction, the new facility is one of the most efficient power plants in Ghana and GE's Fuel Flexible Power Plant brings a vital boost energy to support Ghana's development.

> GE'S FUEL CAPABILITIES ARE UNMATCHED. HAVING A TURBINE THAT IS ABLE TO SWITCH BETWEEN FUELS CAN PROVIDE INCREASED PLANT OPERABILITY ALLOWING FOR POWER GENERATION MONTHS BEFO RE THE INDIGENOUS GAS SUPPLY WOULD OTHERWISE BE AVAILABLE,THIS IS CRUCIAL IN HELPING GHANA MEET ITS GROWING POWER NEEDS.
>
> *– Boaz Lavi, GM for Amandi Energy Ltd, Ghana*

9E – CALABAR / SAPELE POWER PLANTS

LOCATION: Calabar / Sapele, Nigeria

OUTPUT: 360 MW

GE SCOPE: 3 9E gas turbines
Bucket changeouts
Combustion inspections

COD: 2023

CHALLENGE

Niger Delta Power Holding Company (NDPHC) needed to reduce the risk of unplanned downtime at their three power plants in Calabar and Sapele, Nigeria. This enabled the plants to reliably secure and restore the supply of up to 360 MW of electricity to the national grid, the equivalent electricity needed to power approximately two million Nigerian homes.

SOLUTION

Despite the challenges posed by the COVID-19 pandemic, GE and NDPHC worked together to swiftly implement safety procedures aiming to help ensure a safe and on-time execution.

The outages involve stage three bucket changeouts on three 9E gas turbines as well as additional combustion inspections. Engineers from GE and FieldCore worked together and in close collaboration with NDPHC to implement additional safety measures and reduce the risk of exposure to COVID-19, including frequent disinfections at the site, physical distancing, standard passive and active temperature screenings for personnel, and the use of personal protective equipment such as masks and gloves.

> BEING NIGERIA'S LARGEST ELECTRICITY GENERATING COMPANY, WITH A TOTAL INSTALLED CAPACITY OF 4.0 GW, REPRESENTING ABOUT 35% OF NIGERIA'S GENERATING CAPACITY, WE ARE COMMITTED TO STRENGTHENING NIGERIA'S POWER SECTOR, DESPITE THE UNEXPECTED LOGISTICAL CHALLENGES OF THE COVID19 OUTBREAK.
>
> *– Chiedu Ugbo, Managing Director, NDPHC*

GT13E2

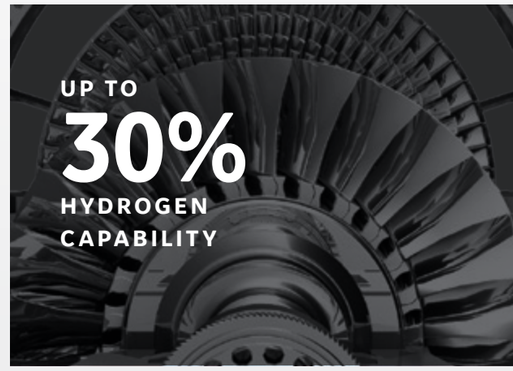
HEAVY DUTY GAS TURBINE

50HZ

195-210 MW SIMPLE CYCLE OUTPUT

>55% COMBINED CYCLE EFFICIENCY

THE GT13E2 HAS TWO OPERATING MODES TO PRIORITIZE EITHER OUTPUT OR AVAILABILITY, AND CAN OPERATE IN EXTREME CONDITIONS FROM -50°C TO +55°C.



		GT13E2-190	GT13E2-210
SC PLANT PERFORMANCE	SC Net Output (MW)	195	210
	SC Net Heat Rate (Btu/kWh, LHV)	8,872	8,980
	SC Net Heat Rate (kJ/kWh, LHV)	9,361	9,474
	SC Net Efficiency (%, LHV)	38.5%	38.0%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	280	305
	CC Net Heat Rate (Btu/kWh, LHV)	6,172	6,189
	CC Net Heat Rate (kJ/kWh, LHV)	6,512	6,530
	CC Net Efficiency (%, LHV)	55.3%	55.1%
	Plant Turndown – Minimum Load (%)	28.0%	40.0%
	Ramp Rate (MW/min)	12	14
	Startup Time (RR Hot†, Minutes)	30	30
2X CC PLANT PERFORMANCE	CC Net Output (MW)	563	613
	CC Net Heat Rate (Btu/kWh, LHV)	6,137	6,153
	CC Net Heat Rate (kJ/kWh, LHV)	6,475	6,492
	CC Net Efficiency (%, LHV)	55.6%	55.5%
	Plant Turndown – Minimum Load (%)	14.0%	19.0%
	Ramp Rate (MW/min)	24	28
	Startup Time (RR Hot†, Minutes)	30	30

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

With over 190 gas turbines installed and more than 14 million operating hours in a wide range of environmental and operational conditions, the GT13E2 gas turbine has the versatility to fit a wide range of power plant applications. With two complementary models, the GT13E2 is available for operators who require power and performance or those who want to maximize turbine availability while reducing their operating cost. The GT13E2 can reliably operate with a wide range of fuel compositions, including high hydrocarbon fuels, without hardware changes, and can also operate with up to 30% hydrogen.

≪ Al-Samra III Electric Power Generating Station, Samra Electric Power Company (SEPCO), Al-Hashemiya, Jordan

GT13E2 CUSTOMER STORIES

GT13E2 – AZITO PHASE IV POWER PLANT

LOCATION: Abidjan, Côte d'Ivoire
OUTPUT: 253 MW
GE SCOPE: 1 GT13E2 gas turbine
1 STF-A200 steam turbine
1 two pressure level drum HRSG
1 A74 generator
COD: 2021

CHALLENGE

After a decade of instability, Côte d'Ivoire's quality of life and economy are both bouncing back, and the government has committed to providing reliable, affordable electric power for the country's residents.

SOLUTION

Under this contract, GE will supply its GT13E2 gas turbine in combined-cycle configuration, one heat recovery steam generator, one steam turbine generator, condenser and associated systems and maintenance services for 20 years. The extension of the power plant is expected to generate 253 MW and will play a significant role in supporting the country's energy plan.

"WE HAVE A LONG-STANDING RELATIONSHIP WITH GE AND ARE THRILLED THAT THE AZITO PHASE IV POWER PLANT WILL ALSO BE ONE OF THE MOST EFFICIENT POWER PLANTS IN THE REGION AND WILL SERVE AS A MODEL FOR THE DEVELOPMENT OF SIMILAR POWER PROJECTS IN AFRICA. PROVIDING RELIABLE AND SUSTAINABLE POWER IS A PRIORITY FOR US. OUR PLANT MAKES USE OF CÔTE D'IVOIRE'S SUPPLIES OF NATURAL GAS AND WITH THIS EXPANSION, WE WILL CONTINUE TO CONTRIBUTE SIGNIFICANTLY TO THE COUNTRY'S ENERGY SECURITY AND STABILITY."

– Luc Aye, Managing Director, Azito Energie S.A.

GT13E2 – ADNOC RUWAIS REFINERY

LOCATION: Ruwais, Abu Dhabi, UAE
OUTPUT: +10.7 MW, + 1.5% efficiency
GE SCOPE: MXL2 upgrade on
1 GT13E2 gas turbine
COD: 2020

CHALLENGE

With the goal of enhancing the efficiency and performance of the Ruwais plant, GE committed to an MXL2 upgrade on a GT13E2 gas turbine. Planning and executing this upgrade typically takes up to 18 months.

SOLUTION

The project was completed within six months, despite significant challenges posed by the outbreak of COVID-19. The technology upgrade has increased the total output of the turbine by 10.7 MW, using the same amount of fuel.

"AT GE, WE ARE COMMITTED TO SUPPORTING OUR CUSTOMERS POWER THROUGH EVERY CHALLENGE AND WERE HONORED TO COLLABORATE WITH ADNOC REFINING ON THIS PROJECT. AS ORGANIZATIONS AROUND THE WORLD EXPLORE OPTIONS TO BALANCE THE GROWING NEED FOR ELECTRICITY AGAINST CLIMATE CHANGE CONCERNS, UPGRADE SOLUTIONS OFFER AN EFFECTIVE AND AFFORDABLE MEANS TO INCREASE POWER OUTPUT AND LOWER EMISSIONS PER MEGAWATT GENERATED."

– Joseph Anis, President & CEO of GE Gas Power in the Middle East, North Africa and South Asia

7E

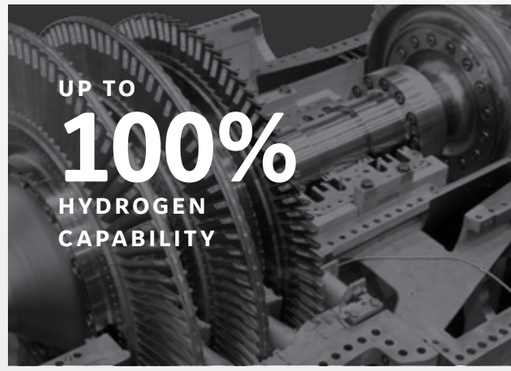
HEAVY DUTY GAS TURBINE

60HZ

90 MW SIMPLE CYCLE OUTPUT

>52% COMBINED CYCLE EFFICIENCY

THE 7E ACCOMMODATES A FULL RANGE OF FUEL OPTIONS WHILE DELIVERING BETTER RELIABILITY AND LOWER EMISSIONS THAN OTHER TECHNOLOGIES IN ITS CLASS.



		7E.03
SC PLANT PERFORMANCE	SC Net Output (MW)	90
	SC Net Heat Rate (Btu/kWh, LHV)	10,107
	SC Net Heat Rate (kJ/kWh, LHV)	10,664
	SC Net Efficiency (%, LHV)	33.8%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	140
	CC Net Heat Rate (Btu/kWh, LHV)	6,514
	CC Net Heat Rate (kJ/kWh, LHV)	6,873
	CC Net Efficiency (%, LHV)	52.4%
	Plant Turndown – Minimum Load (%)	45.0%
	Ramp Rate (MW/min)	40
	Startup Time (RR Hot†, Minutes)	35
2X CC PLANT PERFORMANCE	CC Net Output (MW)	283
	CC Net Heat Rate (Btu/kWh, LHV)	6,454
	CC Net Heat Rate (kJ/kWh, LHV)	6,809
	CC Net Efficiency (%, LHV)	52.9%
	Plant Turndown – Minimum Load (%)	22.0%
	Ramp Rate (MW/min)	80
	Startup Time (RR Hot†, Minutes)	35

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

When reliability and availability are critical, customers turn to GE's 7E gas turbine. Whether providing raw horsepower to drive industrial and petrochemical processes, or steady, reliable output for CHP operation, the 7E delivers. Known for its world-leading fuel handling equipment and combustion system options, the 7E includes tri-fuel capability, which allows fuel switching while running or shutdown.

≪ Air Liquide's Gas Production Facility in La Porte, Texas, USA

7E CUSTOMER STORIES

7E.03 – PENAL POWER STATION

LOCATION: Penal, Trinidad
OUTPUT: 236 MW
GE SCOPE: 2 7E.03 gas turbines
COD: 2017

CHALLENGE

In 1985, the Penal Power Station in Trinidad & Tobago commissioned its natural gas-fired combined cycle power plant featuring two GE 7E gas turbines. After 30+ years of operation, the gas turbines' rotors and other components were nearing the end of their operational life. Faced with increasing maintenance costs, the Power Generation Company of Trinidad and Tobago Limited (PowerGen Ltd.) decided to replace the two turbines during a scheduled maintenance outage.

SOLUTION

Satisfied with three decades of GE performance, PowerGen Ltd. chose to replace the turbines with two new GE 7E gas turbine units, that run on natural gas. It was the first flange-to-flange gas turbine replacement in the Latin America/Caribbean region for GE. The new turbines improved plant efficiency, increased output by 26 MW, improved heat rate by 2.25 percent, and added an expected 25 to 30 years of gas turbine life to the site.

"REPLACING THE EXISTING GAS TURBINES WILL IMPROVE OUR POWER GENERATION EFFICIENCY AND PROVIDE ADDED VALUE IN TERMS OF GREATER AVAILABILITY BY ESTABLISHING LONGER INTERVALS BETWEEN SCHEDULED MAINTENANCE OUTAGES."

– Surindranath Ramsingh, General Manager, PowerGen Ltd.

7E.03 – BAYPORT COGENERATION REDEVELOPMENT

LOCATION: La Porte, Texas, USA
OUTPUT: 300 MW/1,300 tons of steam per hour
GE SCOPE: 4 7E.03 gas turbines
COD: 2016

CHALLENGE

Air Liquide's gas production facility in La Porte, Texas, USA blends and packages pure industrial gases such as oxygen, nitrogen, hydrogen, and specialty gases. These gases serve customers in a range of industries, aiding in research, analysis, process control, and manufacturing. The facility is one of two located within the Bayport Industrial District, an 88-acre complex that's central to Air Liquide's extensive Gulf Coast Pipeline System. A long-term contract renewal with the Bayport Industrial District prompted Air Liquide to invest in facility upgrades.

SOLUTION

Four GE 7E gas turbines at Air Liquide's La Porte cogeneration facility were upgraded to increase production capacity and extended unit life. The facility now produces 300 MW of electricity and more than 1,300 tons of steam per hour with minimal waste heat. Prior to the upgrades, Air Liquide consumed some of the produced steam, but sold most of it to a neighboring chemical manufacturer and top customer. The redevelopment project positions Air Liquide to better serve the growing needs of its customers and provides additional steam capacity to sell to other customers in the region.

"THE REDEVELOPMENT OF OUR BAYPORT FACILITY, WHICH IS AIR LIQUIDE'S LARGEST INDUSTRIAL COMPLEX IN NORTH AMERICA, HAS POSITIONED US TO BETTER SERVE THE GROWING NEEDS OF OUR CUSTOMERS IN THIS REGION IN A SAFE, RELIABLE, AND EFFICIENT WAY."

– Sue Ellerbusch, CEO of Air Liquide USA

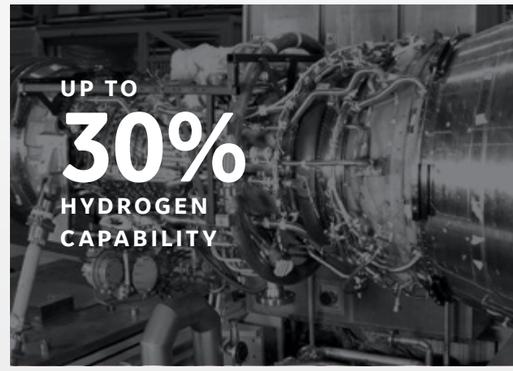
LMS100

AERODERIVATIVE GAS TURBINE 50/60HZ

116 MW SIMPLE CYCLE OUTPUT

>42% SIMPLE CYCLE EFFICIENCY

THE SYNCHRONOUS CONDENSING THAT THE USE OF A CLUTCH CREATES REQUIRES ZERO FUEL USE AND ENABLES AN 8 MINUTE RETURN FROM REACTIVE TO 100% REAL POWER GENERATION.



		LMS100 PA+ (50 Hz)	LMS100 PA+ (60 Hz)	LMS100 PB+ (50 Hz)	LMS100 PB+ (60 Hz)
SC PLANT PERFORMANCE	SC Net Output (MW)	113.0	115.8	106.5	107.5
	SC Net Heat Rate (Btu/kWh, LHV)	7,935	7,773	8,017	7,977
	SC Net Heat Rate (kJ/kWh, LHV)	8,371	8,201	8,458	8,416
	SC Net Efficiency (%, LHV)	43.0%	43.9%	42.6%	42.8%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	134.5	135.3	127.0	128.2
	CC Net Heat Rate (Btu/kWh, LHV)	6,641	6,661	6,684	6,648
	CC Net Heat Rate (kJ/kWh, LHV)	7,006	7,027	7,052	7,014
	CC Net Efficiency (%, LHV)	51.4%	51.2%	51.0%	51.3%
	Plant Turndown – Minimum Load (%)	13.0%	13.2%	13.0%	13.0%
	Ramp Rate (MW/min)	50	50	50	50
	Startup Time (RR Hot†, Minutes)	30	30	30	30
2X CC PLANT PERFORMANCE	CC Net Output (MW)	269.7	271.3	255	257.3
	CC Net Heat Rate (Btu/kWh, LHV)	6,621	6,641	6,658	6,627
	CC Net Heat Rate (kJ/kWh, LHV)	6,986	7,007	7,025	6,992
	CC Net Efficiency (%, LHV)	51.5%	51.4%	51.2%	51.5%
	Plant Turndown – Minimum Load (%)	6.0%	6.0%	6.0%	6.0%
	Ramp Rate (MW/min)	100	100	100	100
	Startup Time (RR Hot†, Minutes)	30	30	30	30

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

If it's efficiency you're looking for, search no more. Our LMS100 aeroderivative gas turbine is currently the highest simple cycle efficiency gas turbine in the world. Its intercooled gas turbine system provides rapid startup, with an 8 minute start to full load and emergency ramp speeds of up to 500 MW/minute. In high renewable penetration areas like California, our LMS100 gas turbines are providing 2.8 GW of generation with more than 1400 MW/minute of ramping capability.

≪ Pueblo Airport Generating Station, Black Hills/Colorado Electric Utility Company, Pueblo, CO, USA

LMS100 CUSTOMER STORIES

LMS100 – SENTINEL ENERGY CENTER

LOCATION: Desert Hot Springs, California, USA
OUTPUT: 800 MW
GE SCOPE: 8 LMS100 gas turbines
COD: 2017

CHALLENGE

To offset the intermittency of Coachella Valley's 700+ MW of wind power capacity, Competitive Power Venture (CPV) set out to build a natural gas-fired power plant capable of providing efficient and reliable summer peaking and backup power. Unique operating requirements for the plant included: varying capacity, flat efficiency curve, rapid start, and load changes.

SOLUTION

At 800 MW, CPV constructed the world's largest facility utilizing GE's intercooled LMS100 aeroderivative gas turbine. The turbine was selected for its rapid start and ramp rate (greater than 10 MW per minute) capabilities. Eight total turbines provide a wide range of dispatch loads—from 50 MW to 800 MW—and a variety of ancillary services, like spinning- and non-spinning reserve, to help stabilize the grid and support intermittent renewable power sources.

> "DESPITE SITE LOCATION CONSTRUCTION CHALLENGES—INCLUDING WIND, HEAT, AND EXTREME DRY CONDITIONS—THE PROJECT EXECUTION TEAM DEMONSTRATED ALL REQUIRED OPERATING AND PERFORMANCE CRITERIA 103 DAYS AHEAD OF SCHEDULE."

LMS100 – SHAJIBAZAR POWER STATION, BANGLADESH

LOCATION: Shahjibazar, Bangladesh
OUTPUT: 100 MW
GE SCOPE: 1 LMS100 gas turbine
COD: 2021

CHALLENGE

Bangladesh is undergoing a rapid transformation, and to support a growing economy, the government is fast tracking projects to add power generation capacity to the grid. Flexibility is key to these projects, as the Bangladesh Power Development Board (BPDB) is also focused on improving grid stability in an otherwise variable grid environment. Among their projects is a 100 MW simple cycle natural gas-fired power plant in Shahjibazar.

SOLUTION

Jiangsu Etern Co. Ltd., the company designated by BPDB to provide the turnkey solution, selected GE's highly efficient LMS100 aeroderivative gas turbine to power the Shahjibazar plant. Ideally suited to help meet fluctuating grid conditions, the LMS100 enables plant operation in three modes: base, peak, and swing. The added flexibility of dual fuel operation allows the turbine to operate on both natural gas and LPG with zero fuel transition cost.

> "THE SHAHJIBAZAR PROJECT MARKS BPDB'S FIRST EPC CONTRACT FOR AN AERODERIVATIVE GAS TURBINE IN THE BANGLADESH POWER SEGMENT."

6F.03

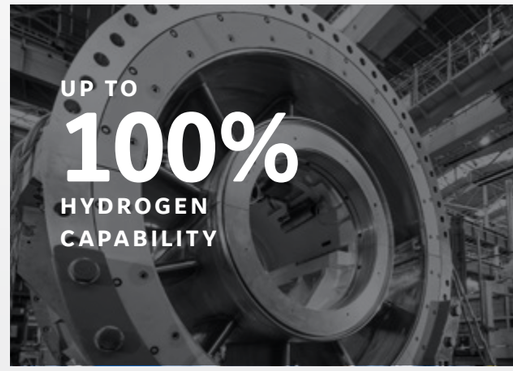
HEAVY DUTY GAS TURBINE

50/60HZ (geared)

88 MW SIMPLE CYCLE OUTPUT

>57% COMBINED CYCLE EFFICIENCY

GE'S 6F.03 INCLUDES GE'S LATEST IN COMBUSTION TECHNOLOGY FOR SUPERIOR TURNDOWN, FLEXIBILITY AND FUEL PERFORMANCE.



		6F.03
SC PLANT PERFORMANCE	SC Net Output (MW)	88
	SC Net Heat Rate (Btu/kWh, LHV)	9,277
	SC Net Heat Rate (kJ/kWh, LHV)	9,788
	SC Net Efficiency (%, LHV)	36.8%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	135
	CC Net Heat Rate (Btu/kWh, LHV)	5,998
	CC Net Heat Rate (kJ/kWh, LHV)	6,328
	CC Net Efficiency (%, LHV)	56.9%
	Plant Turndown – Minimum Load (%)	44.0%
	Ramp Rate (MW/min)	7
	Startup Time (RR Hot†, Minutes)	45
2X CC PLANT PERFORMANCE	CC Net Output (MW)	272
	CC Net Heat Rate (Btu/kWh, LHV)	5,944
	CC Net Heat Rate (kJ/kWh, LHV)	6,271
	CC Net Efficiency (%, LHV)	57.4%
	Plant Turndown – Minimum Load (%)	21.0%
	Ramp Rate (MW/min)	13
	Startup Time (RR Hot†, Minutes)	35

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

Performance and versatility in a powerful package, the 6F.03 draws on the best of GE's F-class technology to address a wide range of applications, from small scale power and industrial cogeneration to floating and island installations. With over 240 units sold and 11 million operating hours on the fleet, the 6F.03 is a proven and dependable gas turbine, incorporating scaled F and H class technology and segment-leading 32k maintenance intervals.

≪ Vasilikos Power Station, Electricity Authority of Cyprus, Larnaca, Cyprus

6F.03 CUSTOMER STORIES

6F.03 – BHOLA POWER PLANT

LOCATION: Bhola, Bangladesh
OUTPUT: 220 MW
GE SCOPE: 2 6F.03 gas turbines
1 A34 generator
2 HRSGs
COD: 2021

CHALLENGE

With a growing population, as well as a move away from coal power, Bangladesh needs more power than ever.

SOLUTION

GE will supply the full suite of engineered equipment package (EEP) for the project, including two 6F.03 gas turbines, two heat recovery steam generators (HRSG), one steam turbine generator, condenser and associated control systems.

Once completed, the project will result in supplying the equivalent power needed to provide electricity to 200,000 homes in Bangladesh. Bhola will be one of the fleet leaders for GE's heavy duty 6F.03 gas turbine, expected to deliver higher levels of efficiency, flexibility and reliability typically only seen in large capacity power plants.

"THE BHOLA POWER PROJECT WILL BE AN IMPORTANT MILESTONE FOR THE SHAPOORJI PALLONJI GROUP IN BANGLADESH, CONTRIBUTING TOWARDS INCREASING THE COUNTRY'S POWER GENERATION CAPACITY. GE'S TECHNOLOGICAL PROWESS AND ON-THE-GROUND LOCAL MARKETPLACE EXPERTISE PROVED TO BE A HUGE ADVANTAGE FOR OUR TEAMS... WE WOULD BE HAPPY TO CONTINUE OUR COLLABORATION WITH GE ON OTHER POWER PROJECTS GLOBALLY AS WELL."

– Mitesh Soni, Business Head - Power Business, Shapoorji Pallonji Group

6F.03 – JEJU LNG COMBINED CYCLE POWER PLANT

LOCATION: Jeju Island, Korea
OUTPUT: 250 MW
GE SCOPE: 2 6F.03 gas turbines
1 STF-A100 steam turbine
2 two pressure level drum HRSGs
4 generators
COD: 2018

CHALLENGE

The Korea Midland Power Company (KOMIPO) was seeking a small block, high efficiency power solution to burn imported LNG on Korea's Jeju Island. The island, a top tourist destination, is building its energy self-reliance with power projects that have relatively low environmental impact. The region's small power grid cannot accommodate large H-class or F-class technology, even when burning LNG.

SOLUTION

Featuring two 6F.03 gas turbines, GE's power island solution delivers 250 MW of power at more than 55 percent efficiency. Minimal greenhouse gas emissions and a low LCOE serve KOMIPO's long-term operational needs.
The Jeju LNG combined cycle power plant supplies about 20 percent of the total power demand to the Jeju region.

"GE'S STATE-OF-ART TECHNOLOGY AND FULL SOLUTION CAPABILITIES MADE THEM THE RIGHT CHOICE FOR OUR PROJECT NEEDS. THE 250 MW JEJU POWER PLANT WILL PROVIDE RELIABLE AND EFFICIENT ELECTRICITY TO ADDRESS JEJU ISLAND'S INCREASING POWER NEEDS AND CONTRIBUTE TO ITS FURTHER GROWTH."

– Mr. Changkil Chung, President and CEO, KOMIPO

LM9000

AERODERIVATIVE GAS TURBINE

50/60HZ

>72 MW SIMPLE CYCLE OUTPUT

>40% SIMPLE CYCLE EFFICIENCY

WITH OVER 15 YEARS OF COMMERCIAL SERVICE, THE GE90-115B AVIATION ENGINE HAS RACKED UP MORE THAN 65 MILLION FLIGHT HOURS AND HAS 99.97% DEPARTURE RELIABILITY.

		LM9000 (50 Hz)	**LM9000** (60 Hz)
SC PLANT PERFORMANCE	SC Net Output (MW)	72.3	72.7
	SC Net Heat Rate (Btu/kWh, LHV)	8,370	8,386
	SC Net Heat Rate (kJ/kWh, LHV)	8,830	8,847
	SC Net Efficiency (%, LHV)	40.8%	40.7%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	95.7	95.9
	CC Net Heat Rate (Btu/kWh, LHV)	6,301	6,328
	CC Net Heat Rate (kJ/kWh, LHV)	6,648	6,677
	CC Net Efficiency (%, LHV)	54.1%	53.9%
	Plant Turndown – Minimum Load (%)	37.0%	37.0%
	Ramp Rate (MW/min)	50	50
	Startup Time (RR Hot†, Minutes)	30	30
2X CC PLANT PERFORMANCE	CC Net Output (MW)	192.8	193.3
	CC Net Heat Rate (Btu/kWh, LHV)	6,254	6,278
	CC Net Heat Rate (kJ/kWh, LHV)	6,598	6,623
	CC Net Efficiency (%, LHV)	54.6%	54.4%
	Plant Turndown – Minimum Load (%)	19.0%	19.0%
	Ramp Rate (MW/min)	100	100
	Startup Time (RR Hot†, Minutes)	30	30

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

Harnessing the engineering heritage of GE's jet engines, the LM9000, launched in 2017, takes the world's most powerful jet engine, the GE90-115B, and transforms it into a highly reliable, fast-start, simple cycle power generation offering. Ideal for peaking applications the LM9000 can go from cold metal to full power in less than 10 minutes. A power dense package with a DLE 1.5 combustor provides dual fuel capability while the combustor's reengineered diffuser and resized premixer helps meet low emission requirements and generate the desired MW of power. The LM9000 features a modular package configuration that enables shorter manufacturing cycles and faster installation, with lower installed and operational costs than field-erected units. This contributes to the LM9000's compact footprint, which helps meet stringent space requirements, especially for retrofits or smaller new plants, and greatly simplifies balance-of-plant requirements.

6F.01

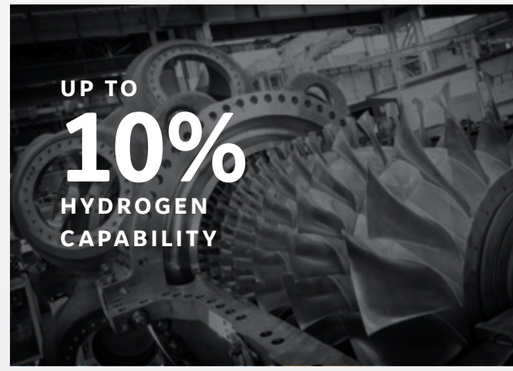
HEAVY DUTY GAS TURBINE

50/60HZ(geared)

57 MW SIMPLE CYCLE OUTPUT

>57% COMBINED CYCLE EFFICIENCY

OFFERING RELIABILITY AND EFFICIENCY, THE 6F.01 IS A PROVEN CHOICE FOR PERFORMANCE IN SMALL POWER AND INDUSTRIAL CHP APPLICATIONS.



		6F.01
SC PLANT PERFORMANCE	SC Net Output (MW)	57
	SC Net Heat Rate (Btu/kWh, LHV)	8,975
	SC Net Heat Rate (kJ/kWh, LHV)	9,469
	SC Net Efficiency (%, LHV)	38.0%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	84
	CC Net Heat Rate (Btu/kWh, LHV)	5,980
	CC Net Heat Rate (kJ/kWh, LHV)	6,309
	CC Net Efficiency (%, LHV)	57.1%
	Plant Turndown – Minimum Load (%)	39.0%
	Ramp Rate (MW/min)	12
	Startup Time (RR Hot†, Minutes)	30
2X CC PLANT PERFORMANCE	CC Net Output (MW)	170
	CC Net Heat Rate (Btu/kWh, LHV)	5,932
	CC Net Heat Rate (kJ/kWh, LHV)	6,259
	CC Net Efficiency (%, LHV)	57.5%
	Plant Turndown – Minimum Load (%)	19.0%
	Ramp Rate (MW/min)	24
	Startup Time (RR Hot†, Minutes)	30

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

The 6F.01 gas turbine is a compact yet powerful driver of combined-cycle and cogeneration plants, with a versatile configuration offered in either cold end drive for enhanced output, or hot end drive for repowering existing 6B power plants. The 6F.01 gas turbine has over 180,000 hours and 1800 starts of fleet operating experience over the past four years, with over 99% fleet reliability.

≪ Kemalpasa Power Plant, Izmir, Turkey

6F.01 CUSTOMER STORY

6F.01 – HUANENG GUILIN ENERGY PROJECT

LOCATION: Guilin, Guangxi Zhuang Autonomous Region, China
OUTPUT: 210 MW
GE SCOPE: 3 6F.01 gas turbines
COD: 2017

CHALLENGE

The City of Guilin is a popular tourist destination with a growing industrial district. The Huaneng Guilin Gas Distributed Energy Co. Ltd. was seeking a solution to provide heat and power to nearby industries as well as heat and cooling to surrounding public, commercial, and residential areas. As gas is increasingly being viewed as a reliable, more efficient, and cleaner alternative to coal and oil, China's 13th Five-Year Plan, unveiled in March 2016, calls for adding 50 GW of gas-fired capacity to the grid. To jump start these projects, gas infrastructure and incentives have gradually been put into place.

SOLUTION

The Huaneng Guilin Distributed Energy Project employs three natural gas-fired 6F.01 gas turbines, features an innovative combined cooling, heating, and power (CCHP) configuration, and generates 210 MW of output. This is the first ever gas power project for the city of Guilin, and with 81.15 percent fuel efficiency, the project serves as a new model of high efficiency energy use for the city. The project is expected to replace 300,000 tons of standard coal; emissions benefits include an expected annual reduction of up to 527 tons of SO_2, 1,560 tons of NO_2, an 85 percent drop in dust, and a 70 percent drop in CO_2.

> “THE HUANENG GUILIN DISTRIBUTED ENERGY PROJECT IS CLEANER, MORE STABLE, AND SAFER WITH STRONG PEAK LOAD DISPATCHING OPERATION. IT PROVIDES A NEW MODEL OF HIGH EFFICIENCY ENERGY USE FOR THIS CITY.”
>
> *– Li Xiaodong, General Manager, Huaneng Guilin Gas Distributed Energy Co. Ltd.*

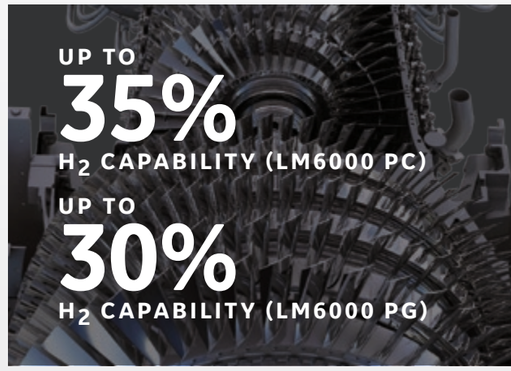
LM6000

AERODERIVATIVE GAS TURBINE 50/60HZ

>53 MW SIMPLE CYCLE OUTPUT

>40% SIMPLE CYCLE EFFICIENCY

GE'S FIRST GAS TURBINE TO BE PAIRED WITH A BATTERY ENERGY STORAGE SYSTEM. FOUR UNITS ARE ALREADY IN OPERATION, AND THE TECHNOLOGY IS EXPANDING TO CREATE A NEW "HYBRID" PRODUCT LINE.



		LM6000 PC	LM6000 PF+
SC PLANT PERFORMANCE	SC Net Output (MW)	46.6	53.9
	SC Net Heat Rate (Btu/kWh, LHV)	8,533	8,357
	SC Net Heat Rate (kJ/kWh, LHV)	9,002	8,817
	SC Net Efficiency (%, LHV)	40.0%	40.8%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	60.3	72.4
	CC Net Heat Rate (Btu/kWh, LHV)	6,571	6,170
	CC Net Heat Rate (kJ/kWh, LHV)	6,932	6,510
	CC Net Efficiency (%, LHV)	51.9%	55.3%
	Plant Turndown – Minimum Load (%)	19.0%	37.0%
	Ramp Rate (MW/min)	50	50
	Startup Time (RR Hot†, Minutes)	30	30
2X CC PLANT PERFORMANCE	CC Net Output (MW)	121.1	145.6
	CC Net Heat Rate (Btu/kWh, LHV)	6,541	6,134
	CC Net Heat Rate (kJ/kWh, LHV)	6,902	6,472
	CC Net Efficiency (%, LHV)	52.2%	55.6%
	Plant Turndown – Minimum Load (%)	19.0%	18.0%
	Ramp Rate (MW/min)	100	100
	Startup Time (RR Hot†, Minutes)	30	30

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

Over 40 million operating hours and more than 1,320 units shipped makes GE's LM6000 aeroderivative gas turbine a leader in the +40 MW space. The LM6000 offers greater than 99 percent start and operational reliability and greater than 98 percent availability. Its 5-minute fast start allows operators to differentiate their dispatch capability while a simple two-spool configuration results in lower overall maintenance costs. Universal and modular packaging gives the LM6000 a smaller footprint and allows for faster installation and commissioning.

≪ Pueblo Airport Generating Station, Black Hills/Colorado Electric Utility Company, Pueblo, CO, USA

LM6000 CUSTOMER STORIES

LM6000 – TERMOYOPAL POWER PLANT

LOCATION: Yopal, Casanare, Colombia
OUTPUT: 200 MW
GE SCOPE: 3 LM6000 gas turbines
COD: 2021

CHALLENGE

Around every four years El Niño causes the Pacific Jet Stream to flow south of Colombia and spread east, diminishing rainfall. The resulting dry season disrupts the hydropower production that the nation relies on for 75% of its electricity.

Termoyopal Power—a natural-gas-fired plant—produces 2% of Colombia's power and 10% percent of its thermal power. With the eventuality of such little rain, Termoyopal Power Plant needed a flexible alternative to hydropower.

SOLUTION

Adding to the 50 MW power of two pre-existing units, GE modernized and expanded Termoyopal Power Plant with three 50 MW LM6000 aeroderivative gas turbines, for a new installed output of 200 MW.

In replacing aging equipment, the LM6000 units won't only reduce noise; their advanced dry low emissions pre-combustors can help cut carbon emissions by 40%, without needing water or steam injection.

"THIS PLANT PLAYS A CRUCIAL ROLE IN SUPPORTING THE DIVERSIFICATION OF ENERGY SOURCES. TERMOYOPAL POWER GENERATION REPRESENTS 2 PERCENT OF THE NATIONAL POWER, AND 10 PERCENT OF OUR THERMAL POWER. THIS SHOWS THE RELEVANCE OF TERMOYOPAL PLANT AND ITS IMPACT ON OUR ENERGY SYSTEM TRANSFORMATION."

– Iván Duque, President of Colombia

LM6000-PF – DS SMITH LUCCA PAPER MILL

LOCATION: Lucca, Italy
OUTPUT: 100 MW
GE SCOPE: 2 LM6000-PF gas turbines
7-year MSA
COD: 2020

CHALLENGE

In 1998, DS Smith Paper Italia built a 100 MW paper mill in the Tuscan province of Lucca. The mill was equipped with two of GE's LM6000PB aeroderivative gas turbines. As the years went by, the company realized they had to modernize to keep up with demand.

SOLUTION

In July 2020, DS Smith decided to double down on the LM6000, selecting another aeroderivative unit—this one a PF—along with a seven-year service agreement.

GE's LM6000PF includes the latest configuration of GE's dry low emissions (DLE) technology. The LM6000PF offers higher power output than Lucca's older LM6000PB model with increased efficiency, while significantly reducing emissions.

"AS A LEADING GLOBAL MANUFACTURER OF SUSTAINABLE CORRUGATED CASE MATERIALS AND SPECIALTY PAPERS, WE ARE COMMITTED TO CREATING HIGH-QUALITY, HIGH-PERFORMING PRODUCTS, PROVIDING THE SOLUTIONS THAT OUR CUSTOMERS AND SOCIETY DEMAND. WE DECIDED TO RELY ON GE'S PROVEN AERODERIVATIVE GAS TURBINE TECHNOLOGY TO IMPROVE THE EFFICIENCY, POWER OUTPUT AND LIFETIME OF OUR POWER GENERATION ASSETS, WHILE REDUCING THE COST OF ELECTRICITY AND IMPROVING OUR PLANT'S PROFITABILITY."

– Stefano Andreotti, Project Director for DS Smith

6B

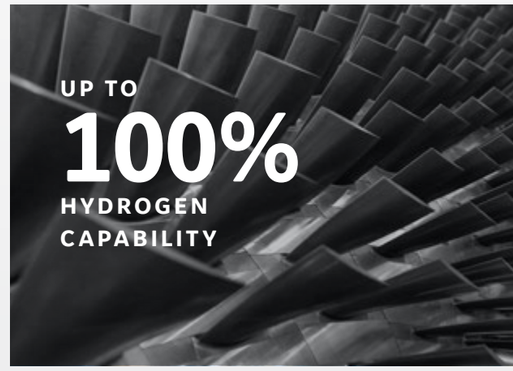
HEAVY DUTY GAS TURBINE

50/60HZ(geared)

45 MW SIMPLE CYCLE OUTPUT

>52% COMBINED CYCLE EFFICIENCY

THE 6B OPERATES ON A WIDE RANGE OF GASEOUS AND LIQUID FUELS, INCLUDING UP TO 100% HYDROGEN, ALLOWING FOR USE OF THE MOST ECONOMICAL AND CARBON-SENSITIVE FUELS AVAILABLE.



		6B.03
SC PLANT PERFORMANCE	SC Net Output (MW)	45
	SC Net Heat Rate (Btu/kWh, LHV)	10,216
	SC Net Heat Rate (kJ/kWh, LHV)	10,779
	SC Net Efficiency (%, LHV)	33.4%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	70
	CC Net Heat Rate (Btu/kWh, LHV)	6,578
	CC Net Heat Rate (kJ/kWh, LHV)	6,940
	CC Net Efficiency (%, LHV)	51.9%
	Plant Turndown – Minimum Load (%)	41.0%
	Ramp Rate (MW/min)	20
	Startup Time (RR Hot†, Minutes)	30
2X CC PLANT PERFORMANCE	CC Net Output (MW)	141
	CC Net Heat Rate (Btu/kWh, LHV)	6,515
	CC Net Heat Rate (kJ/kWh, LHV)	6,874
	CC Net Efficiency (%, LHV)	52.4%
	Plant Turndown – Minimum Load (%)	20.0%
	Ramp Rate (MW/min)	40
	Startup Time (RR Hot†, Minutes)	30

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

Rugged, versatile, and reliable is the best way to describe plants utilizing GE's 6B.03 gas turbine. The turbine can ramp to 20 MW in less than five minutes and accommodate nearly every non-standard fuel in cogeneration and industrial power operations. Capable of black starts on volatile grid environments, the 6B.03 remains a preferred solution for remote installation and extreme operation conditions. Pre-installed gas turbine packaging means easier transport and faster site installation—as quick as six months from order to operation. GE has built more than 1,100 6B units, and the platform has exceeded 90 million running hours.

<< Map Ta Phut Industrial Estate, PTT Global Chemical Public Co. Ltd., Rayong, Thailand

6B CUSTOMER STORIES

6B.03 – OLD HARBOUR COMBINED CYCLE POWER PLANT

LOCATION: St. Catherine, Jamaica
OUTPUT: 190 MW
GE SCOPE: 3 6B.03 gas turbines
3 A30 generators
COD: 2019

CHALLENGE

Jamaica Public Service Company Ltd. (JPS), Jamaica's sole distributor of electricity, is working to update power infrastructure, including replacement of obsolete power stations that run on heavy fuel oil. With low natural gas prices, JPS was seeking to build a new dual fuel combined cycle power plant that could provide between 180 MW and 200 MW of reliable and efficient output.

SOLUTION

JPS selected GE's 6B gas turbine as the workhorse of the Old Harbour combined cycle power plant because it meets all the requirements for reliability and efficiency. The turbines run primarily on imported LNG and feature DLN1 combustion, which saves more than 300 kJ/kWh versus traditional STD combustion. With an already existing fleet of 6Bs, JPS is familiar with the turbine's robust operation and GE's commitment to technical excellence.

"THIS IS THE FIRST COMBINED CYCLE POWER PLANT IN JAMAICA TO RUN ON LNG; THE OLD HARBOUR PLANT HAS ADDED ~15% CAPACITY TO THE COUNTRY'S GRID."

6B – JABABEKA INDUSTRIAL ESTATE

LOCATION: Cikarang, Bekasi,
West Java, Indonesia
OUTPUT: 180 MW
GE SCOPE: 4 6B gas turbines
COD: 1996

CHALLENGE

The Jababeka Industrial Estate was established in 1989 as the "first modern Indonesian eco-industrial estate." Early growth was limited due to a restricted supply of reliable power. The estate turned to independent power producer PT Cikarang Listrindo to provide a new reliable supply of electricity. With interest in the estate increasing, the plant had to guarantee a certain level of reliable output at each phase of expansion.

SOLUTION

The original Jababeka Industrial Estate gas-fired power plant was constructed in 1993, engineered to provide 60 MW of output with two GE 6B gas turbines. In 1996, PT Cikarang Listrindo added four 6B units to increase output to 180 MW.

"THE JABABEKA INDUSTRIAL ESTATE SPANS 5,600 HECTARES (ALMOST 14,000 ACRES) AND IS HOME TO MORE THAN 1,650 MULTINATIONAL COMPANIES."

LM2500XPRESS*

AERODERIVATIVE GAS TURBINE 50/60HZ

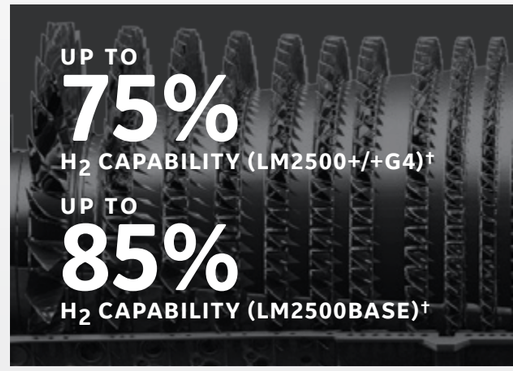
>37 MW SIMPLE CYCLE OUTPUT

>39% SIMPLE CYCLE EFFICIENCY

THE LM2500XPRESS HAS A COMPACT CONFIGURATION WITH A FASTER INSTALL TIME, INCREASED MODULARITY, AND FEWER INTERCONNECTS FOR WHEN SPEED OF POWER IS CRITICAL.

		LM2500XPRESS+G4 UPT DLE	LM2500XPRESS+G5 UPT DLE
SC PLANT PERFORMANCE	SC Net Output (MW)	34.3	37.1
	SC Net Heat Rate (Btu/kWh, LHV)	8,749	8,711
	SC Net Heat Rate (kJ/kWh, LHV)	9,230	9,190
	SC Net Efficiency (%, LHV)	39.0%	39.2%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	47.8	51.9
	CC Net Heat Rate (Btu/kWh, LHV)	6,223	6,178
	CC Net Heat Rate (kJ/kWh, LHV)	6,566	6,518
	CC Net Efficiency (%, LHV)	54.8%	55.2%
	Plant Turndown – Minimum Load (%)	35.0%	35.0%
	Ramp Rate (MW/min)	30	30
	Startup Time (RR Hot†, Minutes)	30	30
2X CC PLANT PERFORMANCE	CC Net Output (MW)	96.4	104.6
	CC Net Heat Rate (Btu/kWh, LHV)	6,174	6,129
	CC Net Heat Rate (kJ/kWh, LHV)	6,514	6,467
	CC Net Efficiency (%, LHV)	55.3%	55.7%
	Plant Turndown – Minimum Load (%)	18.0%	18.0%
	Ramp Rate (MW/min)	60	60
	Startup Time (RR Hot†, Minutes)	30	30

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start



With up to 95% assembly in the factory, the LM2500XPRESS was created for speed and simplicity. The LM2500XPRESS comes pre-packaged in 10 simplified modules for easy installation and features 27 electrical interconnects vs. 130+ for a traditional plant, as well as greatly reduced mechanical interconnects. Module systems flushing is completed at the factory, so customers don't need to flush on-site. For customers who need power in days, not weeks, the LM2500XPRESS can be installed in about 14 days by 20 people. Its plug and play nature lets you get power to the grid quickly and efficiently, or provides industrial companies the ability to get up and running fast.

† Engine capability only

« Veresegyhaz, Hungary – GE Gas Power Manufacturing Test-Line

LM2500XPRESS CUSTOMER STORIES

LM2500XPRESS* – MARTIN DRAKE POWER PLANT

LOCATION: Colorado Springs, Colorado, USA
OUTPUT: 200 MW
GE SCOPE: 6 LM2500XPRESS gas turbines
COD: 2022

CHALLENGE

In accordance with Colorado's statewide greenhouse gas emissions roadmap, the Colorado Springs Utilities Board moved to retire its coal-fired Martin Drake Power Plant by 2022—12 years earlier than planned. In its aim for grid stability and renewables growth, the Colorado Springs Utilities Board turned to GE.

SOLUTION

GE's recently debuted LM2500XPRESS power plant technology is quick to install and saves costs on coal-to-gas transition. It enables integration of variable renewable resources and will allow the early retirement of the Martin Drake Power Plant. The six GE units put Colorado Springs Utilities on a path to reduce CO_2 by at least 80% by 2030, from 2005 levels.

"THESE NATURAL GAS UNITS WILL HELP US BETTER INTEGRATE RENEWABLE ENERGY SOURCES, FURTHER REDUCE CO_2 EMISSIONS, AND ACCELERATE THE RETIREMENT OF OUR MARTIN DRAKE POWER PLANT."

– Aram Benyamin, Colorado Springs Utilities CEO

LM2500XPRESS* – BIBLIS GRID RESERVE PLANT

LOCATION: Biblis, Germany
OUTPUT: 300 MW
GE SCOPE: 11 LM2500XPRESS gas turbines
11 A03 generators
Grid connection
COD: 2022

CHALLENGE

Germany is generating record amounts of renewable energy in the north, but its grid is challenged to transport all the power down to load centers in the south and it repeatedly faced critical situations, with imports arranged on short notice from surrounding countries required to stabilize the grid. The use of renewable energy sources is continuously being expanded but the grid infrastructure still requires highly efficient gas turbine technology to help ensure stability and support of the grid.

SOLUTION

GE's new LM2500XPRESS power plant will comprise 11 GE LM2500XPRESS aeroderivative gas turbines, generators, fuel supply system, grid connection and auxiliary equipment. It is 95% factory assembled into simplified modules for fast and easy site installation. RWE's new 300 MW plant will be built just south of the company's current nuclear power plant site in the region. The plant will not be available to the open electricity marketplace; instead, it will only be operated upon the request of the system.

"THE EXCELLENT EXISTING INFRASTRUCTURE THERE AND OUR RELIABLE AND FLEXIBLE CONCEPT FOR THE PLANT HAVE WON OUT. WE WILL THUS BE ABLE TO MAKE AN IMPORTANT CONTRIBUTION TOWARDS SECURITY OF SUPPLY IN SOUTHERN HESSE. "WE HAVE A LONG-STANDING RELATIONSHIP WITH GE AND WE'RE PROUD TO WORK TOGETHER TO INSTALL THE WORLD'S FIRST LM2500XPRESS.

– Roger Miesen, CEO of RWE Generation

LM2500

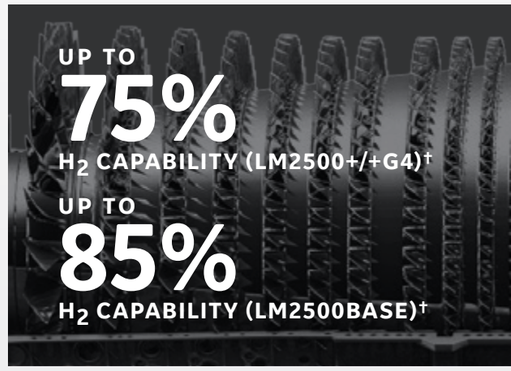
AERODERIVATIVE GAS TURBINE

50/60HZ

>34 MW SIMPLE CYCLE OUTPUT

>38% SIMPLE CYCLE EFFICIENCY

IDEAL FOR PEAKING AND CHP APPLICATIONS, THE LM2500 DELIVERS POWER WITH RELIABILITY GREATER THAN 99 PERCENT AND AVAILABILITY GREATER THAN 98 PERCENT.



		LM2500 DLE	LM2500+ DLE	LM2500+G4 DLE
SC PLANT PERFORMANCE	SC Net Output (MW)	22.9	31.4	34.1
	SC Net Heat Rate (Btu/kWh, LHV)	9,557	8,959	8,827
	SC Net Heat Rate (kJ/kWh, LHV)	10,083	9,452	9,312
	SC Net Efficiency (%, LHV)	35.7%	38.1%	38.7%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	33.5	44.0	48.0
	CC Net Heat Rate (Btu/kWh, LHV)	6,510	6,441	6,253
	CC Net Heat Rate (kJ/kWh, LHV)	6,869	6,597	6,597
	CC Net Efficiency (%, LHV)	52.4%	54.6%	54.6%
	Plant Turndown – Minimum Load (%)	34.0%	35.0%	35.0%
	Ramp Rate (MW/min)	30	30	30
	Startup Time (RR Hot†, Minutes)	30	30	30
2X CC PLANT PERFORMANCE	CC Net Output (MW)	67.7	88.8	96.5
	CC Net Heat Rate (Btu/kWh, LHV)	6,447	6,210	6,215
	CC Net Heat Rate (kJ/kWh, LHV)	6,802	6,551	6,558
	CC Net Efficiency (%, LHV)	52.9%	53.4%	54.9%
	Plant Turndown – Minimum Load (%)	17.0%	18.0%	18.0%
	Ramp Rate (MW/min)	60	60	60
	Startup Time (RR Hot†, Minutes)	30	30	30

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

The LM2500's high efficiency helps reduce operating costs, plant emissions, and reliance on the local grid. With its dual fuel capability, including singular annular combustor (SAC) or DLE technology, the LM2500 delivers performance with low emissions in a variety of situations and water availability scenarios. It features high reliability with control system redundancy, along with multiple options for configuration, making it a great choice for customers who need a more tailored power generation solution. The LM2500's cycling capability allows multiple daily starts and stops, providing a strong solution for grids with penetration of renewable generation. Its open configuration allows for faster accessibility, easier maintenance, and increased speed of engine removal/replacement.

† Engine capability only

≪ Sabine Pass LNG Terminal, Cheniere Energy, Cameron Parish, LA, USA

LM2500 CUSTOMER STORIES

LM2500 – BOGUE POWER STATION

LOCATION: Montego Bay, Jamaica
OUTPUT: 140 MW
GE SCOPE: 1 LM2500 gas turbines
Conversion to dual fuel
COD: 2016

CHALLENGE

With half of Jamaica's electricity generation infrastructure more than 30 years old, the country is seeking ways to modernize its plants and decrease oil dependency.

SOLUTION

In 2016, Jamaica Public Service Company Ltd. (JPS)—the company responsible for generating, transmitting, and distributing electricity on the island—introduced LNG into the fuel mix. With a goal of improving plant operations and increasing output, JPS teamed with GE to modernize its Bogue Power Station's generation equipment. The project started with the 120 MW combined cycle plant's conversion to dual fuel operation and continued with a 20 MW expansion provided by a GE LM2500+ aeroderivative gas turbine, which will contribute up to 15% of JPS's total power production.

"OUR TEAM IS PREPARED TO HELP MEET YOUR INDUSTRY-SPECIFIC REQUIREMENTS AND PROVIDE MORE RELIABLE AERODERIVATIVE GAS TURBINE SERVICES WHETHER YOU'RE LOOKING FOR PEAKING POWER, FLEXIBLE RESPONSE TO IMMEDIATE GRID DEMANDS, OR SIMPLY TO KEEP YOUR OPERATION UP AND RUNNING AT UP TO A 99% RATE OF RELIABILITY."

LM2500 – COVE POWER STATION EXPANSION

LOCATION: Lowlands, Tobago
OUTPUT: 20 MW
GE SCOPE: 1 LM2500 gas turbine
COD: 2018

CHALLENGE

The 140-acre Cove Eco-Industrial and Business Park in the Cove Estate in Lowlands, Tobago, is attracting new and developing businesses to the island. The park draws its power from the Cove Power Station, a 64 MW, dual fuel capable facility run by the Trinidad and Tobago Electricity Commission (T&TEC). If one of the power station's four 16 MW units is offline, the reliability of the system can be greatly reduced. Tobago was put on notice that additional projects requiring power were on the horizon. These included a large hotel development, expansion of the airport and a desalination plant. To alleviate this issue and to accommodate future growth, funding was made available by the government for T&TEC to expand the facility.

SOLUTION

Reliable and available power is a must for Tobago, and, given its growth potential, the size of the additional units was increased to meet current and future demands. T&TEC selected GE's LM2500 aeroderivative gas turbine to power its expansion due to the turbine's Industry record of proven reliability. With 20 additional megawatts of clean and efficient energy, the Cove Power Station expansion project is a great step in the right direction for the island's goal of energy independence.

"THE COVE ECO-INDUSTRIAL AND BUSINESS PARK INCLUDES A $3.7-MILLION SOLAR STREET LIGHTING SYSTEMS THAT FEATURES 79 LIGHTING UNITS THROUGHOUT THE PARK†."

† Government of the Republic of Trinidad and Tobago. http://www.news.gov.tt/content/tobagos-eco-friendly-industrial-park#.WZEKjVWGPIU.

TM2500

AERODERIVATIVE GAS TURBINE

50/60HZ

32 MW AT **30°C**

HOT-DAY PERFORMANCE

SWITCHING FROM A DIESEL ENGINE AND ELECTRIC GENERATOR (DIESEL GENSET) TO A TM2500 BURNING LIQUEFIED PETROLEUM GAS (LPG) CAN SAVE UP TO $7 MILLION PER YEAR IN OPERATING COSTS.

		TM2500 (50 Hz)	TM2500 (60 Hz)
SC PLANT PERFORMANCE	SC Net Output (MW)	34.6	37.0
	SC Net Heat Rate (Btu/kWh, LHV)	9,783	9,333
	SC Net Heat Rate (kJ/kWh, LHV)	10,321	9,846
	SC Net Efficiency (%, LHV)	34.9%	36.6%
1X CC PLANT PERFORMANCE	CC Net Output (MW)	49.2	51.1
	CC Net Heat Rate (Btu/kWh, LHV)	6,870	6,753
	CC Net Heat Rate (kJ/kWh, LHV)	7,248	7,125
	CC Net Efficiency (%, LHV)	49.7%	50.5%
	Plant Turndown – Minimum Load (%)	35.0%	36.0%
	Ramp Rate (MW/min)	30	30
	Startup Time (RR Hot†, Minutes)	30	30
2X CC PLANT PERFORMANCE	CC Net Output (MW)	99.2	103.1
	CC Net Heat Rate (Btu/kWh, LHV)	6,814	6,698
	CC Net Heat Rate (kJ/kWh, LHV)	7,189	7,067
	CC Net Efficiency (%, LHV)	50.1%	50.9%
	Plant Turndown – Minimum Load (%)	35.0%	35.0%
	Ramp Rate (MW/min)	60	60
	Startup Time (RR Hot†, Minutes)	30	30

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
† Rapid Response/Hot Start

The TM2500 is ideal for providing a baseload bridge to permanent power installations or for generating backup power in the wake of a natural disaster, plant shutdowns, or grid instability. Our complete solutions, including a trailer-mounted gas turbine generator set and containerized balance-of-plant, can put power on the grid within as little as 30 days of the contract signature. This fast power provides the greatest power density among gas turbine trailer-mounted offerings.

≪ Lombok Mobile Power Plant, Perusahaan Listrik Negara (PLN), Lombok Island, Indonesia

TM2500 CUSTOMER STORIES

TM2500 – BLUE HILLS POWER PLANT

LOCATION: Nassau, Bahamas
OUTPUT: 34 MW
GE SCOPE: 1 TM2500 gas turbine
COD: 2020

CHALLENGE

Solar energy has always been a source of green power for the Bahamas, but in order to make it efficient, it requires a very stable grid to connect to. In the current situation, where the grid is at its limit and the frequency is not stable, the GE gas turbine can help bringing more stability to the system. Additionally, hurricanes and inclement weather can make access to reliable power challenging.

SOLUTION

The new TM2500 aeroderivative gas turbine unit will supply up to 34 MW, enough energy to power the residential consumption of between 12,000 and 18,000 customers, and may potentially help stabilize the country's grid. Even more impressive, the installation and commissioning of the equipment was completed in only 42 days.

> THE HIGHEST PEAK OF ENERGY CONSUMPTION DURING SUMMER IN NEW PROVIDENCE IS 250 MW AND IN WINTER GOES DOWN TO 160-170 MW. HAVING AN ADDITIONAL OF UP TO 34 MW IS SIGNIFICANT FOR OUR OPERATION AND WILL ALLOW US TO AIM TO DELIVER A BETTER SERVICE TO OUR CUSTOMERS AND TO THE MILLIONS OF TOURISTS WHO VISIT US EVERY YEAR. ON TOP OF THAT, THIS KIND OF TECHNOLOGY COULD ENABLE US TO RESPOND MORE QUICKLY TO NATURAL DISASTERS LIKE HURRICANE DORIAN.
>
> *– K. Quincy Parker, Director of Public Relations of BPL*

TM2500 – CFENERGIA, BAJA CALIFORNIA SUR

LOCATION: La Paz, Baja California Sur, Mexico
OUTPUT: 115 MW
GE SCOPE: 4x TM2500 gas turbines
COD: 2021

CHALLENGE

The region of Baja California Sur in Mexico faced a drastic need for more power, particularly during the hot summer months. In 2021, more capacity was urgently needed to meet the growing demand and avoid the power cuts which occurred during previous summer peaks. As one of the largest tourist destinations in Mexico, the region had to quickly expand its generation capacity to address its energy security challenges and to provide long-term solutions to the emerging power needs.

SOLUTION

GE worked with CFEnergia to deploy 4x TM2500 units to provide power in 2 different sites near La Paz. The TM2500 are dual fuel capable and provide the needed versatility and flexibility to manage smaller loads while maintaining high efficiency and hence significantly reducing blackouts and allowing for increased penetration of renewable solar and wind energy into the grid. The project delivered on its commitment to help improve the provision of reliable, affordable, and environmentally friendly power generation to the region.

> THE UNITS WILL ADDRESS THE REGION'S GROWING POWER NEEDS, ONE OF THE FASTEST IN MEXICO, IN A TIMELY, SUSTAINABLE AND COST-EFFECTIVE MANNER.

GAS TURBINE UPGRADES

“

GE’S COMPREHENSIVE SUITE OF GAS TURBINE UPGRADES PROVIDES THE CAPABILITY AND FLEXIBILITY TO POSITION YOUR PLANT FOR A SUCCESSFUL FUTURE

”

HEAVY DUTY GAS TURBINE UPGRADES

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.

CURRENT UNIT UPGRADES

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

Upgrade	6B	6F†	7E	GT13E	9E	7F	9F
Flange-to-Flange/ Repower	A EF EM F L OM O R	A EF EM F L OM O R	A EF EM F L OM O R	A EF EM F L OM O R	A EF EM F L OM O R	A EF EM F L OM O R	A EF EM F L OM O R
9EMax Turbine Module					A EF F L O R		
AGP or MXL2/MC2	A EF F L OM O R	A EF F L OM O R	A EF F L OM O R	A EF F L OM O R	A EF F L OM O R	A EF F L OM O R	A EF F L OM O R
Performance Improvement Package	A EF OM O R		A EF OM O R				
Enhanced Capacity	EF F O		F O	EF F O	EF F O		
Enhanced/Robust Compressor Package	R	A O R	R		R	A O R	A O R
Flared/Upflow/High Output Compressor		O R	O R	O		O R	O R
Axial Fuel Staging (AFS)			EF EM F O		EF EM F O	EF EM F	
DLN Combustion Upgrade (B/E 1.0+ F 2.6+)	A EM F	A EM F L	A EM F		A EM F	A EM F L	A EM F L
Fuel Flexibility (H2, etc)	A EM F L R	A EM F L R	A EM F L R	A EM F L R	A EM F L R	A EM F L R	A EM F L R
EV-Alpha Burner				EM F			
AEV Burner				EM F			
Valve Reliability			A OM R			A OM R	A OM R
Instrumentation Reliability	A OM R	A OM R	A OM R	A OM R	A OM R	A OM R	A OM R
Liquid Fuel Reliability Solutions		A OM R	A OM R		A OM R		
Robust Exhaust Frame						R	R

† 6F = 6F.03 only

LEGACY UNIT UPGRADES

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

Upgrade	GT8	GT9	GT11D	GT11N	GT11N2	GT13D	GT24	GT26
High Efficiency (HE)								EF F O
Advanced Performance Package (APP)								A EF F O R
MXL2							A EF F L OM O	
XL/XP Turbine and Compressor				A EF F L OM O				
XL/XP Turbine				A EF F L OM O				
XL Turbine	A L OM							
M					A EF F L OM O			
Turbine			EF OM O			A EF F L OM O		
Performance Improvement Package		A EF F L OM O						
Compressor			OM O	OM O				
EV-Alpha Burner	EM F			EM F		EM F		
Low Part Load							EM OM	EM OM
Low Load Operation							EM F	EM F
Fast Start	F	F	F	F	F	F	F	F
Combustion Fuel Flexibility	A EM F L R	A EM F L R			A EM F L R		A EM F L R	

HEAVY DUTY GAS TURBINE UPGRADES

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

FLANGE-TO-FLANGE REPLACEMENT

The flange-to-flange upgrade is a full replacement of an existing gas turbine engine, giving you all the benefits of today's technology and engineering innovation within the footprint of your existing asset.

A EF EM F L OM O R

APPLICABLE TURBINE MODELS:
6B|6F|7E|GT13E|9E|7F|9F

INSPECTION TYPE:
Major

What can upgrading do for you?

- Address multiple asset improvements in one single upgrade
- Boost your output and lower your fuel costs immediately
- Reduce emissions to comply with recent regulations
- Extend your maintenance intervals with newer, more durable components

REPOWER UPGRADE

The 6B repower upgrade can advance performance in both gas turbine and combined-cycle operation—all without sacrificing the unit's renowned reliability or fuel flexibility.

A EF EM F L OM O R

APPLICABLE TURBINE MODELS:
6B

What can upgrading do for you?

- Output increase up to 25% (combined-cycle operation)
- Efficiency improvement up to 5 points (simple and combined-cycle operation)
- Turndown as low as 40%
- NOx reduction as low as 15 ppm
- Fits into the existing 6B footprint

9EMAX TURBINE MODULE

Slash OpEx without sacrificing reliability with our 9E four-stage turbine module. The 9EMax can help cut annual fuel costs and unlock significant revenue—all within the same footprint as your existing 9E gas turbine.

A EF F L O R

APPLICABLE TURBINE MODELS:
9E

TIME TO INSTALL:
10-20+ Days

INSPECTION TYPE:
Major

9EMax technology innovations

With the 9EMax turbine, you can reduce fuel costs by running up to 37% efficiency in simple cycle, and up to 54% in combined cycle. Annual fuel costs could shrink by as much as $5 million, while creating the potential for up to $6 million in additional revenue.

MXL2

The power of additive manufactured performance (AMP) technology is the driving force behind the newest upgrade solution for GE's GT13E2 gas turbine fleet, delivering better operating performance and hardware durability.

A EF F L OM O R

APPLICABLE TURBINE MODELS:
GT13E2

INSPECTION TYPE:
C-Inspection

What can upgrading do for you?

The MXL2 with AMP drives advanced performance for gas power producers in regions that demand more output, efficiency and reliable operation.

- Up to 21 MW increase
- Up to 1.6% efficiency increase
- Up to 48,000-hour maintenance intervals
- Up to $3 million in additional gas plant revenue annually
- Up to $2 million in fuel savings annually

ADVANCED GAS PATH UPGRADE(AGP) FOR 9F GAS TURBINES

Increase output, efficiency and availability, while reducing fuel consumption and extending your 9F gas turbine assets with GE's Advanced Gas Path (AGP).

A EF F L OM O R

APPLICABLE TURBINE MODELS:
9F

TIME TO INSTALL:
10-20 Days

INSPECTION TYPE:
Hot Gas Path/Major

ADDITIONAL INFO:
Outage Required

What can upgrading do for you?

GE's 9F AGP portfolio is a collection of evolved hot gas path upgrades that help to deliver industry leading performance and operational flexibility, driven by increased output, efficiency, and availability.

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

ADVANCED GAS PATH UPGRADE (AGP) FOR 9E GAS TURBINES

Increase output, efficiency and availability, while reducing fuel consumption and extending the life of your gas turbine assets with GE's AGP upgrade for 9E gas turbines.

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:	ADDITIONAL INFO:
9E	**10-20 Days**	**Hot Gas Path/Major**	**Outage Required**

What can an AGP upgrade do for your 9E gas turbine?

GE's AGP upgrade increases output and reduces heat rate in both simple cycle and combined-cycle applications and increases exhaust energy for cogeneration or combined-cycle applications, when compared to prior 9E gas turbine technology. The AGP benefits of this upgrade translate to lower fuel costs and improved revenues for 9E gas turbine customers.

As a result of GE's AGP 9E upgrade, customers can expect an annual savings from fuel expenses of US $1,180,000 and additional annual revenue from power generation of US $395,000.†

- Hours/year operation: 5000
- Fuel cost (US$/mmBtu): 7.00
- Power price (US$/mWhr): 80.50
- Power benefit (MW): 7
- Heat rate benefit (Btu/kWhr): 260
- Simple cycle analysis, ISO Ambient Conditions

†Based on fleet-wide average values

ADVANCED GAS PATH UPGRADE (AGP) FOR 7F GAS TURBINES

Increase output, efficiency and availability, while reducing fuel consumption and extending your gas turbine assets with GE's AGP upgrade for 7F gas turbines.

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:	ADDITIONAL INFO:
7F	**3-5 Days**	**Hot Gas Path/Major**	**Outage Required**

What can upgrading do for you?

- Up to 6% increase in output
- Up to a 2% increase in fuel efficiency
- Up to 32,000-hour gas path maintenance intervals, which can extend outage intervals up to 33%
- Extension of gas turbine assets and parts life out to as much as 96,000 hours
- Up to 50% reduction in startup time and fuel consumption; significantly reduced start time variation
- Up to 50% reduction in start-up emissions
- Up to 3% additional output increase in cold conditions through enhanced combustion operation
- Turndown to as low as 35% load

ADVANCED GAS PATH (AGP) UPGRADE FOR 6F.03 GAS TURBINES

Increase output, efficiency and availability, while reducing fuel consumption and extending your gas turbine assets with GE's AGP upgrade for 6F.03 gas turbines.

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:	ADDITIONAL INFO
6F.03	**10-20 Days**	**Hot Gas Path/Major**	**Outage Required**

What can an AGP upgrade do for your 6F.03 gas turbine?

- Increases simple cycle and combined-cycle MW output by up to 8.2% and 8.0%, respectively. Also increases exhaust energy by up to 4.5%
- Reduced baseload fuel consumption per MWh by improving full-load simple cycle and combined-cycle heat rate up to 1.8% and 1.6%, respectively
- Able to achieve up to 32k FFH and 1,350 FFS

ADVANCED GAS PATH UPGRADE (AGP) FOR 6B GAS TURBINES

Increase output, efficiency and availability, while reducing fuel consumption and extending your gas turbine assets with GE's AGP upgrade for 6B gas turbines.

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:	ADDITIONAL INFO:
6B	**10-20 Days**	**Hot Gas Path/Major**	**Outage Required**

What can an AGP upgrade do for your 6B gas turbine?

The 6B AGP builds on the proven rugged reliability the fleet has demonstrated for over 40 years while allowing customers to remain competitive.

This upgrade utilizes proven E, F, and H-class developments to increase firing temperature. The 6B AGP enables higher output and exhaust energy, lowers fuel consumption, and increases maintenance inspection intervals.

MC2 UPGRADE

The GT13E1 MC2 upgrade combines a host of evolutionary improvements on the turbine, compressor, and combustor parts into one package that can significantly improve performance and adds 50% more life between inspections.

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
GT13E	**10-20+ Days**	**Major**

What can upgrading do for you?

- Increase performance: up to 10 MW of power output and 0.7% of combined-cycle efficiency (absolute)
- Extend lifetime: inspection interval of up to 36,000 hours
- Up to 0.7% increase in combined-cycle efficiency (abs)
- Improve availability, fewer C-inspections

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

MXL2 UPGRADE

Engineered to be compatible with all installed GT13E2 units, the GT13E2 MXL2 upgrade combines GE's latest technology developments and over 10 million operating hours of GT13E2 fleet experience.

A EF F L OM O R

APPLICABLE TURBINE MODELS: GT13E2

INSPECTION TYPE: **C-Inspection**

What can upgrading do for you?

A quantum leap in power output, efficiency, and lifetime:

- Increased performance: up to 15 MW of power output and 1.5% of combined-cycle efficiency (absolute)
- Extended lifetime: inspection intervals of up to 48,000 hours
- Up to 1.5% increase in combined-cycle efficiency (abs)
- Improve availability, fewer C-inspections

PERFORMANCE IMPROVEMENT PACKAGE

Improve performance and extend the hot gas path component life of your B-/E-class gas turbine units with GE's performance improvement package (PIP).

A EF OM O R

APPLICABLE TURBINE MODELS: 6B|7E

INSPECTION TYPE: **Major**

What can upgrading do for you?

- Increase output and enhance heat rate through improved materials and airflows, reducing clearances and leakages, and enabling firing temperature increases
- Increase availability and lower maintenance costs by extending maintenance intervals between hot gas path inspections to as much as 32,000 hours
- Increase parts life up to 96,000 hours

ENHANCED CAPACITY UPGRADE

Increase your capabilities and energy revenue with GE's range of 7E gas turbine upgrades. You can see payback within 18–24 months with cost-effective upgrades that take advantage of your unit's full potential.

F O

APPLICABLE TURBINE MODELS: 7E

TIME TO INSTALL: **Minor (<5 days)**

Increase the capability and efficiency of your 7E unit

As your 7E gas turbine gets older and maintenance budgets get smaller, the daily challenges of operating a power plant can increase significantly. Let GE help balance performance versus maintenance as your business case changes—with customizable water injection, software adds, firing temperatures, and more.

ADVANCED COMPRESSOR

This upgrade can fit in the same footprint as current 7F.01/.02/.03/.04 compressors, and can be replaced as either a module or a full flange-to-flange upgrade.

A O R

APPLICABLE TURBINE MODELS: 7F

TIME TO INSTALL **10-20+ Days**

INSPECTION TYPE: **Major**

What can upgrading do for you?

- Improve output by up to 16% above an Advanced Gas Path (AGP)-equipped unit, and efficiency up to 3% when matched with an AGP tech HGP and DLN2.6+ combustor
- Achieve ~210 MW at ISO conditions and improve hot day and high altitude performance
- Displaces HRSG duct-fired generation at a far better incremental heat rate for CC plant heat rate improvements up to 5%
- Improve maintainability and reduce outage time with field-replaceable blades that can be stocked and replaced on-site
- Helps shape an asset management strategy for aging assets, or if you're considering a compressor upgrade from unflared to flared
- Allows installation of GE's wet compression system to increase hot ambient GT capacity by an additional 12-20 MW†

†GT output increase depends on type of inlet conditioning system installed

ENHANCED COMPRESSOR SUITE

Based on years of compressor development and extensive testing, GE's suite of enhancements for F-class flared enhanced compressors are packaged according to your unit—and site-level risk.

A O R

APPLICABLE TURBINE MODELS: 6F|7F|9F

TIME TO INSTALL: **Varies, Depending on Package**

What can upgrading do for you?

- Reduce degradation effects and stresses
- Reduce fretting wear between the rotating blade and rotor interfaces
- Move natural frequencies for vibratory margin
- Improve rub characteristics
- Augment durability and longevity
- Improve loading and durability on the forward stage stator rings and the aft stage stator vanes

AXIAL FUEL STAGING (AFS)

Axial Fuel Staging (AFS) adds an additional fuel circuit to the DLN1/1+ combustion system allowing for increased emission compliant load flexibility in GT operations. Emission tuning can be done to increase the emission compliant turndown capability of the GT or increase the emission compliant peak MW output of the unit.

EF EM F O

APPLICABLE TURBINE MODELS: 7E|9E|7F

INSPECTION TYPE: **CI, HGP, or MI Inspection**

What can upgrading do for you?

- When combined with Inlet Bleed Heat, allows for emission compliant turndown to as low as 35% load
- Up to +8% output with emission-compliant peak operation

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

DLN 2.6+ COMBUSTION UPGRADE

GE's DLN combustion technology helps deliver industry-leading low emissions. For F class operators, we offer four DLN 2.6+ solutions. What you choose will ultimately depend on you and your plant's needs, but whichever DLN combustion system solution is right for you, rest assured that you'll get leading-edge expertise and the operational flexibility you need, helping you reduce emissions and start up faster than ever before.

A EM F L

APPLICABLE TURBINE MODELS:
6F|7F|9F

What can upgrading do for you?

DLN combustor systems not only provide flexibility, but also help meet the needs of increasing emissions regulations. This upgrade helps F-class plant owners and operators address the competing challenges of compliance with more stringent emissions regulations, changing operating profiles that go beyond a plant's original specification, and finding innovative ways to stay profitable.

DRY LOW NOX (DLN) 1/1+ COMBUSTION

Increase the operational flexibility of your 7E and 9E gas turbines with the Dry Low NOx (DLN) combustion upgrade equipped with the hardware and controls modifications, configured for either extended turndown or peak fire, while remaining emissions-compliant.

A EM F

APPLICABLE TURBINE MODELS:
6B|7E|9E

TIME TO INSTALL
10 - 20 Days

INSPECTION TYPE:
Major

What can upgrading do for you?

Turndown Configuration for E-Class Gas Turbines:

- Reduce NOx/CO-compliant turndown to 35% of baseload with inlet bleed heating, a 25% improvement from previous limits
- Improve baseload performance and emissions: 85% reduction in CO emissions combined with heat rate and output improvements of 0.25% and 0.4%, respectively, with no impact on exhaust energy
- Increase part-load simple-cycle efficiency: more than 2% reduction in heat rate at 70% gas turbine load

Peak Fire Configuration:

- Increase simple-cycle output by up to 7.6% by peak firing up to 100°F with no impact on NOx emissions or turndown, and with CO levels 70% lower than at baseload

COMBUSTION UPGRADE/FUEL FLEXIBILITY

You can accommodate a full range of fuel alternatives, as well as switch from one fuel to another while running under load or during shutdown, with GE's B-/E-class combustion systems.

A EM F L R

APPLICABLE TURBINE MODELS:
6B|7E|9E|7F|9F|GT8|GT9|GT11|GT11N2|GT13|GT24

TIME TO INSTALL:
10 – 20+ days

INSPECTION TYPE:
Major

What can upgrading do for you?

- **Standard combustion and Multi-Nozzle Quiet Combustor (MNQC)**
  Operate on more than 50 types of fuels—nearly the entire fuel spectrum. Gaseous fuels ranging from traditional natural gas to hydrogen to syngas, and liquid fuels ranging from light distillates to heavy fuel oil (HFO).
- **Dry Low NOx (DLN)**
  Reduce fuel costs with customized solutions that enable higher concentrations of process gas to be blended and burned diluent-free with natural gas in a DLN combustor.
- **Dual-fuel conversions**
  Liquid conversion kits: Operate on liquid fuels, providing start up fuel when you want to use non-standard fuels. Increase plant availability via emergency automatic fuel transfers when gas fuel becomes unavailable. Gas conversion kits: Switch to natural gas or liquid natural gas (LNG), resulting in lower emissions, longer inspection intervals, and longer hardware life compared to liquid fuels.

EV-ALPHA BURNER

Building on the proven features of GE's standard EnVironmental (EV) burner, GE's EV-Alpha Burner employs cutting-edge combustion technology—and reduces nitrous oxide (NOx) emissions by approximately 35%.

EM F

APPLICABLE TURBINE MODELS:
GT13E2

TIME TO INSTALL:
10-20 Days

INSPECTION TYPE:
Major

What can upgrading do for you?

- NOx emissions in upper part load range reduced by up to 35%
- NOx emissions at base load: 15 ppm
- Emissions compliant operation down to approximately 50% gas turbine relative load
- Unchanged or even improved pulsation behavior during steady-state and transient operations
- Enhanced combustion reliability due to improved pulsation behavior
- Dual fuel capability unaffected

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

AEV BURNER

Building on the proven features of GE's EnVironmental (EV) burner, the AEV burner employs a new continuous fuel variation concept as the basis for more flexible and reliable operation.

EM F

APPLICABLE TURBINE MODELS: GT13E2

INSPECTION TYPE: **C-Inspection**

What can upgrading do for you?

- Emissions-compliant operation down to as low as 10% of gas turbine relative load
- Eliminate switch-over/switch-back between pilot and premix operation
- Improve reliability, especially during fast transients
- 48 AEV burners instead of 72 EV burners
- Excellent NOx stability over a wide range of ambient temperatures
- High resistance to changes in fuel gas composition
- Burner sieve to prevent foreign objects entering the turbine

VALVE RELIABILITY

GE has developed a valve package to address plant reliability issues (failed starts, trips, forced outages), help prevent catastrophic failure, and potentially reduce ongoing insurance costs. These packages were developed to save on both cost and installation time.

A OM R

APPLICABLE TURBINE MODELS: 7E|7F|9F

INSPECTION TYPE: **CI, HGP, or MI Inspection**

What can upgrading do for you?

- Avoid 24-48 hours valve failure downtime, extending to a week, if spares are not available
- Trip risk greatly reduced as a result of software enhancement, no varnishing in GCV/IGV, no corrosion and moisture in CBV/system, steady pneumatic actuation pressure
- Avoid $10-50K in direct costs per failure, not including lost revenue
- Performance recovery: ~0.5% output or improved heat-rate
- Extended intervals / reduced O&M: 96,000 hours maintenance intervals for eGCV/eIGV ~$300K savings in hydraulic valve overhauls, plus reduce oil filters inventory; no servos to worry about
- Reduced fire risk: No high-pressure oil in GT compartment

INSTRUMENTATION RELIABILITY

GE has developed an instrumentation package to address plant reliability issues (failed starts, trips, forced outages), help prevent catastrophic failure, and potentially reduce ongoing insurance costs. These packages were developed to save on both cost and installation time.

A OM R

APPLICABLE TURBINE MODELS: 6B|6F|7E|GT13E|9E|7F|9F

INSPECTION TYPE: **CI, HGP, or MI Inspection**

What can upgrading do for you?

- Avoid 24-48 hours valve failure downtime, extending to a week, if spares are not available
- Trip risk greatly reduced as a result of software and logic enhancement, robust thermocouple and connector engineering
- Avoid $10-50K in direct costs per failure, not including lost revenue
- Performance recovery: ~0.5% output or improved heat-rate
- Reduced O&M cost: Thermocouple damage eliminated due to relocated connector. No maintenance costs for optical flame sensors, and no casing damage due to cooling water removal from GT compartment

LIQUID FUEL RELIABILITY SOLUTIONS

Upgrades the tubing of the liquid fuel oil, water injection, water cooling and purge systems for more reliability during operation and easier maintainability during outages. It also adds in a pressure monitoring on the purge system, depressurization system on the liquid fuel system and temperature logic on the EGT system for more robust unit protection.

A OM R

APPLICABLE TURBINE MODELS: 6F|7E|9E

INSPECTION TYPE: **CI, HGP, or MI Inspection**

What can upgrading do for you?

- Improve Liquid Fuel start and transfer reliability by avoiding coking or leaking
- Shorten CI outage cycle by reducing the number of tubing and connectors for each combustor

ROBUST EXHAUST FRAME

Upgrades the exhaust frame with lower-stress engineering features from the 7F.05 and HA frames that reduce both liner distortion and the need for field weld repairs at regular maintenance intervals.

R

APPLICABLE TURBINE MODELS: 7F|9F

INSPECTION TYPE: **MI Inspection**

What can upgrading do for you?

Reduces O&M costs for maintaining exhaust frame functionality over time.

HIGH EFFICIENCY

Blending F-class flexibility with H-class efficiency, this latest gas turbine upgrade will help GT26 customers remain competitive by providing both base-load and part-load efficiency improvements. This technology enables higher output capabilities for peak power periods, and longer maintenance intervals, which is especially relevant when operating a daily shifting profile.

EF F O

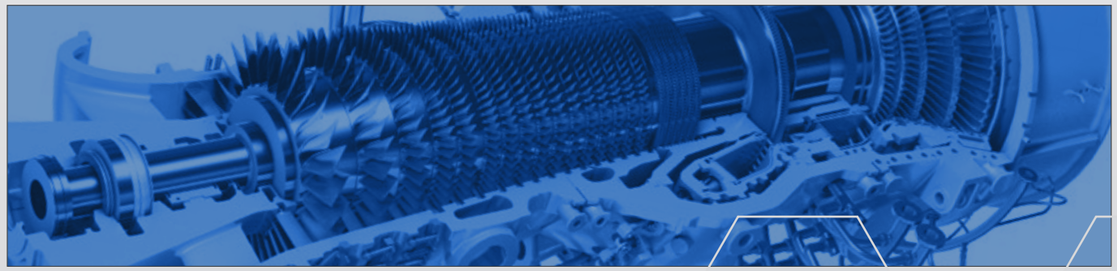
APPLICABLE TURBINE MODELS: GT26

INSPECTION TYPE: **C-Inspection**

What can upgrading do for you?

The key performance benefits the GT26 HE upgrade includes:

- Up to 2% pts. baseload efficiency and up to 1% pt. part load efficiency increase
- Up to 25 MW increase per unit plant output
- Maintenance inspection interval extension up to 32,000 hours
- Up to 5% CO_2 reduction



A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

ADVANCED PERFORMANCE PACKAGE

GT26 Advanced Performance Package (APP) builds on the platform's unique flexibility advantages to help deliver improved competitiveness that will help plant owners to stay relevant.

A EF F O R

APPLICABLE TURBINE MODELS:
GT26

What can upgrading do for you?

The GT26 APP features three operating modes conceived to turn today's evolving power industry segment challenges into profitable opportunities:

- XL-mode (eXtended Lifetime mode): Extend your C-Inspection cycle by up to 33% to save on maintenance costs and increase availability
- PK-mode (PeaK load mode): Boost your profit at times of increased power demand by benefiting from up to 6% additional capacity at a balanced maintenance factor
- F-mode (Flex mode): Reduce start to your maintenance costs at times of flexible generation demand

MXL2 UPGRADE

Provides class-leading flexibility by increasing performance and extending lifetime without affecting reliability. With online switching the turbine is ready to meet new grid challenges driven by growth of renewable technologies.

A EF F L OM O

APPLICABLE TURBINE MODELS:
GT24

INSPECTION TYPE:
C-Inspection

What can upgrading do for you?

- Up to 8000 operating hours, longer major inspection interval
- Up to 6% more combined cycle power output
- Up to 0.8% higher efficiency in combined cycle operation
- Online switch over between M and XL mode

XL/XP UPGRADE TURBINE/COMPRESSOR

The GT11NM XL/XP upgrade increases gas turbine performance as well as operational flexibility.

A EF F L OM O

APPLICABLE TURBINE MODELS:
GT11N

What can upgrading do for you?

- Flexibility: two operation modes for extra performance or extended lifetime
- Lower cost of electricity: gas turbine performance is improved up to +3.4 MW power and +0.9% (multiplicative) efficiency
- Reduced maintenance costs: extended service intervals of up to 32,000 equivalent operating hours
- Applies to GT11N gas turbines

XL TURBINE UPGRADE

Our blading upgrade for GT8C XL gas turbines offers performance neutrality and longer spans between C-inspection intervals from 24,000 to 32,000 hours. This results in less downtime and reduced maintenance costs.

A L OM

APPLICABLE TURBINE MODELS:
GT8

INSPECTION TYPE:
C-Inspection

What can upgrading do for you?

Improve the availability of your GT8C gas turbine by implementing the GT8C XL turbine upgrade. The upgrade features new blading which offers extended C-inspection intervals from 24,000 to 32,000 hours. This results in less downtime and reduced maintenance costs through:

- Performance neutrality
- Inspection interval extension +8,000 hours

M UPGRADE

The new GT11N2 M Upgrade bridges the gap between the latest technological developments and existing proven gas turbine engineering to keep your plant competitive.

A EF F L OM O

APPLICABLE TURBINE MODELS:
GT11N2

INSPECTION TYPE:
C-Inspection

What can upgrading do for you?

- Gas turbine performance increase up to 3.3 MW
- Flexibility: three switchable operating modes for enhanced extended lifetime or extra power output and efficiency
- Reduced maintenance costs: extended service intervals of up to 48,000 equivalent operating hours
- Performance: up to 14 MW power output and up to 1.9% (add.) gas turbine efficiency

TURBINE UPGRADE

The GT11DM turbine upgrade boosts gas turbine efficiency and helps to help ensure plant competitiveness in an ever-evolving technology industry.

EF OM O

APPLICABLE TURBINE MODELS:
GT11D

INSPECTION TYPE:
C-Inspection

What can upgrading do for you?

- Gas turbine performance increase of up to 4.2 MW
- Gas turbine efficiency increase of up to 3% (multiplicative)

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

PERFORMANCE IMPROVEMENT PACKAGE

The modular GT9D1x Performance Improvement Package has been introduced to address customer-specific requirements for increased performance and reduced maintenance costs.

A EF F L OM O

APPLICABLE TURBINE MODELS:
GT9

INSPECTION TYPE:
C-Inspection

What can upgrading do for you?

- Extended C-inspection intervals up to +16,000 hours
- Power output increase up to +4.4 MW
- Efficiency increase up to +3.3% (multiplicative)

COMPRESSOR UPGRADE

Field-proven since 2004, our GT11NMC compressor upgrade can provide a substantial boost in power output and a reduction of CO emissions for your operations.

OM O

APPLICABLE TURBINE MODELS:
GT11N

INSPECTION TYPE:
C-Inspection

What can upgrading do for you?

- Lower cost of electricity
- Proven reliability
- Improved flexibility and combined cycle part load efficiency: advanced variable inlet guide vanes concept for increased temperature after turbine
- Gas turbine power output is boosted 7.3% thanks to a new compressor airfoil construction
- Field-proven since 2004

EV ALPHA BURNER

The new EV-alpha burner for GT8, GT11N, and GT13D gas turbines with fuel gas is the result of our continuing research and investment towards achieving the best in burner technology.

EM F

APPLICABLE TURBINE MODELS:
GT8|GT11N|GT13D

INSPECTION TYPE:
C-Inspection

What can upgrading do for you?

- Significant emissions reductions down to low gas turbine relative loads
- NOx emissions at upper part load reduced by up to 40%
- NOx emissions at base load:
  — GT11N: < 10 ppm
  — GT13D: < 15 ppm
  — GT8: < 25 ppm
- Unchanged or even improved pulsation behavior during steady-state and transient operations
- Dry operation (no water/steam injection needed)
- Dual fuel capability unaffected
- Enhanced combustion reliability due to improved pulsation behavior

LOW PART LOAD

Take advantage of the GT24/GT26 sequential combustion engine architecture to allow your combined-cycle plant to achieve superlative turndown.

EM OM

APPLICABLE TURBINE MODELS:
GT24|GT26

INSPECTION TYPE:
C-Inspection

What can upgrading do for you?

- Increase load flexibility
- Increase turndown to as low as 30% combined-cycle load and maintain CO emissions < 100 ppm
- Reduce fuel costs at minimum environmental load (MEL)
- Larger spinning reserve
- Frequency response capability over the entire load range

LOW LOAD OPERATION

Park your GT26 fired combined-cycle plant at extremely low load while staying compliant in an ever-changing emissions landscape.

EM F

APPLICABLE TURBINE MODELS:
GT24|GT26

INSPECTION TYPE:
Extended A/B-Inspection

What can upgrading do for you?

- Increase load flexibility: LLO to base load in < 20 min
- Reduce fuel costs at lowest minimum environmental load: emission-compliant gas turbine combined-cycle relative load of < 20% at about 35% efficiency
- Maximum spinning reserve: spinning reserve of > 300 MW in < 20 min (> 600 MW for KA26-2)

FAST START

Get connected and generate power to the grid faster and more economically. With Fast Start for KA26, you can enhance different steps of the start-up sequence, e.g. GT synchronization, combined-cycle startup and GT/ST loading.

F

APPLICABLE TURBINE MODELS:
GT8|GT9|GT11D|GT11N|GT11N|GT11N2|GT13D|GT13E|GT24|GT26

INSPECTION TYPE:
C-Inspection

What can upgrading do for you?

- Improve startup reliability
- Improve availability:
  — 180 MW within 30 minutes (KA26-1, GT only, cold start)
  — 580 MW in 43 minutes (KA26-2, 2x GT only, cold start)
- Reduce startup costs:
  — From GT ignition to full CCPP load in 30 minutes (2x KA26-1) provides more than 30% fuel cost reduction
- Reduce cumulative emissions—especially CO_2

AERODERIVATIVE GAS TURBINE UPGRADES

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

Upgrade	LM1600	TM2500	LM2500	LM5000	LM6000	LMS100
4-Hour Gas Turbine Lockout Prevention		A	A		A	
Anti Icing Upgrade			A R		A R	A R
Asymmetric Diffuser – LM/TM2500		EF EM O	EF EM O			
Automatic Voltage Regulator Upgrade		A F R	A F R	A F R	A F R	A F R
Bentley Nevada 3500** Vibration System	A R	A R	A R	A R	A R	
Clutchless Synchronous Condensor Upgrade			F			
Controls Upgrade: Micronet Plus			A F L R		A F L R	
Direct Drive Ventilation Fan Upgrade			A R		A R	
Evaporative Cooler			EF F O		EF F O	EF F O
Fast Start for GT Base Fleet Turbines					F	
Fire Protection Panel Upgrade		A	A		A	A
Fuel Condition Monitoring			A L OM R		A L OM R	
Gas to Dual Fuel – LM2500			A F			
Gas to Dual Fuel – LM6000					A F	
Gas Turbine Alternative Fuel Retrofit Upgrade		A R	A R	A R		A R
Inlet Air Chilling System			EF F O		EF F O	EF F O
Liquid to Dual Fuel			A EM F R			
Liquid to Dual Fuel – LM6000					A EM F R	
LM/TM2500 Base to Plus/Plus G4		EM O	EM O			
LM2500/TM2500 SAC to DLE		A EF EM R	A EF EM R			

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

Upgrade (continued)	LM1600	TM2500	LM2500	LM5000	LM6000	LMS100
LM5000 to LM6000 Repower				A EF EM F O R		
LM6000 Fast Start Upgrade					F	
LM6000 Flange to Flange Replcement					A EF EM R	
LM6000 Hybrid EGT					A EF EM F L	
LM6000 Peak Performance Upgrade					O	
LM6000PC SAC Extended Life Combustor Upgrade					A	
LM6000PC Uprate Gas Turbine Upgrade					A EF EM O	
LMS100PA+ Upgrade						EF O
Primary Frequency Control Upgrade			A F		A F	A F
Remote VSV Monitoring		A EF	A EF			
S7 Fuel Control Upgrade					A EM F R	
SPRINT LM6000					O	
Sump Evacuation System					A R	
Super Polished High Pressure Compressor Blades					EF L OM O	
TDI Clutch Upgrade		A F R	A F R			
Thrust Balance Valve Removal					A R	
Variable Inlet Guide Vanes (VIGV) with EFS					EF O	
Water Injection for NOx Reduction			EM O		EM O	EM O
Xtend Hot Section Upgrade- SAC		A R	A R			
Xtend Hot Section Upgrade-DLE		A R	A R			

AERODERIVATIVE GAS TURBINE UPGRADES

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

PREVENT LOCKOUT AFTER LM2500/TM2500/LM6000 EMERGENCY SHUTDOWNS

Hardware and software upgrades to your LM2500/TM2500/LM6000 gas turbines can prevent the four-hour lockout period after a hot shutdown—reducing risk to your rotors, increasing machine safety, and protecting your uptime.

A

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|TM2500|LM6000	**7-10 Days**	**Medium**

Benefits of lockout prevention:

Reduce complications with gas turbine rotors and controls, protect uptime, see safer turbine inspection, and more, with:

- Increased uptime
- Elimination of up to 66% of shutdown conditions where the four-hour lockout can be avoided
- Faster starts with no maintenance penalty
- No six-minute limitation to solve non-critical faults
- Automatic confirmation of bowed rotor condition and prevention of system from starting
- Increased maintenance safety, as entry is not required to check rotor bow condition
- Reduced risk of HPC/HPT rubs and rotor bow
- Rotation verified by analog speed signal
- Avoidance of severe damage to your gas turbines

LM2500/LM6000/LMS100 ANTI-ICING UPGRADE

Inlet icing can occur on LM series turbines at temperatures less than 40 F° (4.4 C°) and humidity greater than 65%. Ice formation can lead to restrictions in the inlet system resulting in possible damage to package and turbine equipment.

A R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:
LM2500|TM2500|LM1600|LM5000|LM6000|LMS100	**<5 Days**

What can upgrading do for you?

- Anti-icing system prevents ice related internal damage to engine blades, reducing turbine downtime and repair times
- Anti-Icing system controls are automated to run only when ice is detected
- Increased efficiencies and power outputs

LM/TM2500 ASYMMETRIC DIFFUSER

Aeroderivative gas turbine generators face special footprint and space restrictions. GE's asymmetric diffuser has higher reliability with improved structural integrity—mitigating pressure losses downstream of the power turbine.

EF EM O

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|TM2500	**10-20+ Days**	**Major**

What can upgrading do for you?

- Reduced power turbine exhaust back-pressure
- Increased GT output
- Improved GT heat rate
- Increased output by up to 2%
- Improved heat rate by up to 2%
- Increased availability
- Decreased maintenance and operating costs

AUTOMATIC VOLTAGE REGULATOR UPGRADE

GE's EX2100e excitation control is an advanced platform for generator excitation systems. The EX2100e upgrade builds on the EX2100 experience of over 1,200 units in gas, steam, and hydro applications.

A F R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|TM2500|LM1600|LM5000|LM6000|LMS100	**<5 Days**	**Minor**

What can upgrading do for you?

- Enhanced reliability and less spare parts inventory, with redundant control and protection
- Better availability with improved diagnostics and online repair
- Improved performance with advanced algorithms, incorporating decades of fleet experience and the latest controls technology such as the power system stabilizer (PSS)
- Enhanced operability and maintenance, with a versatile software suite
- Reduced lifecycle support with common architecture, networks, and software suite
- More computing power for upgrades and simplified controller replacement
- An addition that's easy to program and modify

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

BENTLY NEVADA 3500 VIBRATION MONITORING SYSTEM

The Bently Nevada 3500 Vibration Monitoring System reduces non-critical trips, including noise-driven and transient vibration shutdowns and nuisance vibration alarms/trips during start-up.

A R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|TM2500|LM5000|LM6000	**7-10 Days**	**Medium**

What can the vibration monitoring upgrade do for you?

This latest vibration system from Bently Nevada provides continuous, online vibration monitoring for machinery-protection applications. Applicable gas turbine models include the LM6000, LM/TM2500, and the LM5000.

LM2500 CLUTCHLESS SYNCHRONOUS CONDENSER UPGRADE

Given the increased use of renewable energy, there's an increased need for reactive-power capability. Operators with GE's LM2500 gas turbines can improve their competitive edge with our clutchless synchronous condenser.

F

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500	**10-20+ Days**	**Major**

Advantages of clutchless synchronous condensing:

GE's clutchless synchronous condenser allows the generator to provide frequency and reactive-power support to the grid. Through controls-system enhancements, this upgrade foregoes the standard synchronous, self-shifting clutch that disengages the generator.

LM2500/LM6000 CONTROLS UPGRADE—MICRONET PLUS

GE's latest evolution of the MicroNet* control system—developed for Aero LM product lines— interfaces with existing field devices and on-engine hardware for core fuel control, package sequencing, and protection.

A F L R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|LM6000	**10-20+ Days**	**Major**

What can upgrading do for you?

The upgrade consists of replacing both the chassis and software of fuel controller and sequencer's new hardware and software for the MicroNet* Plus (Mark VI and Fanuc 90–70 to Woodward), and also includes:

- The latest fuel control software with associated improvements
- Powerful CPU for demanding applications
- Flexibility to use current configuration or different configurations, depending on your needs
- Real-time multi-tasking VxWorks operating system
- Improved control system hardware availability and reliability
- Exceptional accuracy, fast update rates, and high channel-to-channel isolation
- SNTP-compliant for time synchronization
- Eliminates transceiver module
- Increases communications capabilities (Ethernet and CANBUS ports)
- Time stamping sequence of events can be accomplished from 1–5 ms
- Increases expansion chassis options (8 or 14 slots)
- Offers a complete suite of software products for service interface

LM6000/LM2500 DIRECT DRIVE VENTILATION FAN UPGRADE

GE's direct drive ventilation fans eliminate belts and tensioning maintenance, which can cause over-tensioning, overloaded bearings, and fan failure.

A R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|LM6000	**<5 Days**	**Minor**

What can upgrading do for you?

These direct drive fans are engineered to replace your current fans with limited disruption. They're are a drop-in upgrade for belt-driven fans for GE packages and can:

- Eliminate the squealing belts on startup and the process of properly tensioning the drive belts
- Eliminate maintenance and replacement of fan belts
- Eliminate startup noise from belts slipping
- Eliminate pillow block bearings and their maintenance
- Feature external grease ports for quick and easy access (auto-lube kit optional)
- Provide improvement in generator enclosure pressure, lessening generator oil-leak potential, and differential pressure-alarm activation

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

EVAPORATIVE COOLER UPGRADE FOR LM2500/LM6000/LMS100

GE's evaporative cooling system provides a power output and efficiency increase for sites with high ambient temperatures and low relative humidity.

EF F O

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|LM6000|LMS100	**<5 Days**	**Minor**

What can upgrading do for you?

The modification includes the addition of dual-fuel manifolds with water injection capability, dual-fuel nozzles, metering valves, shutoff valves, liquid fuel boost skid, and control system updates as needed.

- Significantly increases turbine power output
- Increases thermal engine efficiency
- PLC integrated controls sample weather conditions every 30 seconds, allowing rapid adaptability to changing conditions
- PLC integrated controls system allows evaporative cooling system to work as a standalone unit, limiting control integration complexity. Only alarm systems need to be integrated
- Adaptable to extrinsic control systems
- Some units may have the evaporative cooler pre-installed while others will require the filter house to be opened
- To control the inlet chilling system, GE will provide a modular hardware style PLC

LM6000/LM2500/TM2500 FIRE PROTECTION PANEL UPGRADE

Update your outdated fire panel with GE's fire protection upgrade. The system is NFPA-compliant and mounted in the turbine control panel to closely monitor gas and flame sensors.

A

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|LM6000|TM2500	**<5 Days**	**Minor**

What can upgrading do for you?

Once the system is activated it will shut down the gas turbine generator, close fire dampers, release fire-suppression material, sound local notification devices, and signal outside assistance if enabled. It also accepts operator-initiated commands.

- Improves fire response notification methods
- Enables fire alarm and gas detection systems to utilize one control system
- Comes equipped with multi-alarm notification capability, enabling facility-wide and state/local fire department notification
- Engineered for a minimum end-user learning curve, with simplicity in both installation and operation

LM2500 and LM6000 FUEL CONDITION MONITORING

Rapid changes in fuel composition can lead to trips, high dynamics, and incipient lean blowout. Upgrade your existing LM2500 and LM6000 gas turbines with GE's fuel variability control for increased system response.

A L OM R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|LM6000	**7-10 Days**	**Medium**

Rapid fuel variability cuts operability

GE's fuel condition variability monitoring system uses a combination of GC, WIM, buffer volume, and a controls algorithm. This system provides early and quick detection of fuel variability in lower heating value (LHV) and specific gravity (SG) which otherwise may cause engine operability trouble (such as trips).

Eliminate the following under significant fuel condition changes:

- High acoustics
- Flameouts
- High emissions

LM2500 GAS TO DUAL FUEL

With GE's gas to dual-fuel upgrade, your LM2500 turbine can run on either gas or liquid fuel, with or without water injection for NOx control.

A F

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500	**10-20+ Days**	**Major**

What can upgrading do for you?

The modifications consider the addition of dual-fuel manifolds with water-injection capability, including metering, shutoff valves, boost skid and controls update as needed.

- Easily switch between fuels for increased site power-generation flexibility
- Enhance profitability by switching to a cheaper fuel depending on operating conditions
- Increase power output using the water-injection capabilities
- Switching to gas fuels lowers NOx emissions
- Gas fuels also have higher power outputs
- Can be used on multiple controls systems

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

GAS TO DUAL FUEL—LM6000

With GE's gas to dual-fuel upgrade, your LM6000 turbine can run on either gas or liquid fuel, with or without water injection for NOx control.

A F

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000	**10-20+ Days**	**Major**

What can upgrading do for you?

The modification includes the addition of dual-fuel manifolds with water injection capability, dual-fuel nozzles, metering valves, shutoff valves, liquid fuel boost skid, and control system updates as needed.

- Improved versatility of the package by allowing the LM6000 turbine to operate on either liquid fuel or natural gas
- Availability of the package can be maintained in the event of a disruption to natural gas fuel supply
- Increased operational flexibility—and profitability—introduced with the capability to switch from one fuel to another, even at full load. CDP air-cooling system is required for full load transfers

LM2500/TM2500/LM6000/LMS100 ALTERNATIVE FUEL RETROFITS

Easily burn non-standard fuels in your aeroderivative gas turbines. In addition to low Btu fuels like biomass syngas, landfill gas, and digester gas, our turbines can also burn various types of high-H_2 fuels, including but not limited to: refinery process gases, coke-oven gas, and blends of H_2 with methane.

A R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|TM2500|LM6000|LMS100	**10-20+ Days**	**Major**

What can upgrading do for you?

Easily burn non-standard fuels for better availability, reliability and cost savings.

LM2500/LM6000/LMS100 INLET AIR CHILLING SYSTEM

An inlet chilling system will cool the compressor intake air, increasing the air density and engine output. The chiller units can reject the heat via water-cooling towers or air-cooled heat exchangers.

EF F O

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|LM6000|LMS100	**<5 Days**	**Minor**

What can upgrading do for you?

- The inlet air-cooling system allows increased power output if operating at full power conditions, or allows for a reduction of engine load while maintaining constant power output
- Depending on ambient conditions, the gross power output can be increased by as much as 11 MW
- The chiller coils can be used for anti-icing in the winter—an excellent method to increase power year-round

LIQUID TO DUAL-FUEL LM2500

With GE's liquid to dual-fuel upgrade, your LM2500 turbine can run on either gas or liquid fuel, with or without water injection for NOx control.

A EM F R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500	**10-20+ Days**	**Major**

What can upgrading do for you?

The modifications consider the addition of dual-fuel manifolds with water-injection capability, including metering, shutoff valves, boost skid, and controls update as needed.

- Easily switch between fuels for increased site power-generation flexibility
- Enhance profitability by switching to a cheaper fuel depending on operating conditions
- Increase power output using the water-injection capabilities
- Switching to gas fuels lowers NOx emissions—and increases power outputs
- Use either Woodward, GE Mark* VI / Mark VIe, or RX3i controls systems

LM6000 LIQUID TO DUAL-FUEL

With GE's liquid to dual-fuel upgrade, your LM6000 turbine can run on either gas or liquid fuel, with or without water injection for NOx control.

A EM F R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000	**10-20+ Days**	**Major**

What can upgrading do for you?

The upgrade encompasses the addition of dual-fuel manifolds with water injection capability, dual-fuel nozzles, metering valves, shutoff valves, liquid fuel boost skid, and control system updates as needed.

- Vastly improves the versatility of the package by allowing the LM6000 turbine to operate on either liquid fuel or natural gas
- Improves operational flexibility by having the capability to switch from one fuel to another, and at full load with a CDP air-cooling system (if installed)

LM/TM2500 BASE TO +/+G4

GE's LM2500 and TM2500 models can be updated to the current LM2500+ or LM2500+G4 configuration for enhanced output and improved thermal efficiency.

EM O

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|TM2500	**10-20+ Days**	**Major**

What can upgrading do for you?

The upgrade can be performed through the following options:

- Convert existing engine with a modification kit so that it exhibits the same performance as the production +/+G4 model
- Replace the existing engine with a production LM2500 +/+G4

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

LM/TM2500 SAC TO DLE

Convert your LM/TM2500 SAC gas turbine to DLE technology and reach NOx levels as low as 15 ppm for some models; eliminate water consumption for NOx control; and improve thermal efficiency.

A EF EM R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|TM2500	**10-20+ Days**	**Major**

What can upgrading do for you?

- Triple annular configuration allows the combustor premix to operate over the entire power range, reducing emissions at lower power
- DLE system does not require water injection to lower NOx emissions, eliminating the possible maintenance impact of water and enhancing thermal efficiency compared to water-injected systems
- No water or steam injection leads to increased plant operations savings
- NOx emissions are guaranteed not to exceed 25 ppm when using natural gas fuel at full load. They can be guaranteed down to 15 ppm on the LM2500/LM2500+ models
- CO emissions are guaranteed not to exceed 25 ppm on natural gas fuel and full load

LM5000 TO LM6000 REPOWER

This upgrade replaces your existing LM5000 gas turbine with a newer model LM6000 that has higher simple cycle output and efficiency. For 60 Hz operation, the LM6000 is an economical replacement for the LM5000.

A EF EM F O R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM5000	**10-20+ Days**	**Major**

What can upgrading do for you?

- Greater reliability/availability
- Improved heat rate, up to 5%
- Higher power output, up to 3 MW additional power
- Improved global support structure

LM6000 FAST START UPGRADE

The Fast Start upgrade reduces turbine start time. Software and hardware modifications allow GE's LM6000 to reach full load at the user's choice of start-up speed: 5, 8, or 10 minutes.

F

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000	**<5 Days**	**Minor**

What can upgrading do for you?

Reduced start up times help meet peak turbine demands. With Fast Start for the LM6000, NOx water injection is enabled at synchronous idle speed—full SPRINT® power requires an additional 30 to 45 seconds.

Fast Start schedules are offered for three configurations:

- 10-minute start—no life impact
- 8-minute start—no life impact
- 5-minute start—possible life impact depending on a turbine assessment of installed parts

LM6000 FLANGE-TO-FLANGE REPLACEMENT

Your plant is still viable, but is it time to replace obsolete and inefficient equipment? GE's flange-to-flange upgrade for LM6000 gas turbines lowers OpEx, lowers emissions, and can reset asset life to zero.

A EF EM R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000	**10-20+ Days**	**Major**

Benefits of a flange-to-flange upgrade:

- 40–60 MW at 42% efficiency
- Fast start <5 minutes (GT only—0 minutes w/EGT)
- Flexible CC: 140 MW at +55% efficiency
- Boosted output and reduced fuel costs right away
- Lowered emissions to comply with regulations
- Extended maintenance intervals with newer, more durable components

LM6000 HYBRID EGT

GE's LM6000 Hybrid EGT integrates a battery energy storage system with the LM6000 gas turbine, enabling contingency (spinning) reserve without fuel-burn between demand events.

A EF EM F L

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000	**10-20+ Days**	**Major**

What can upgrading do for you?

The upgrade enables high-speed regulation, primary frequency response, and voltage support (-8 to +5 MVAR) with the combined response of the gas turbine and battery storage system:

- 50 MW+of green house gas free contingency reserve
- 50 MW+ of flexible capacity
- 50 MW+ of peaking energy
- 25 MW of high quality regulation
- 10MVA of reactive voltage support and primary frequency response when not online
- Zero fuel use and emissions between dispatch events while supporting ancillary services

LM6000PC PEAK PERFORMANCE UPGRADE

The peak performance software upgrade kit enables the LM6000PC to achieve up to 5% additional output over current nominal power through peak firing.

O

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000PC	**<5 Days**	**Minor**

What can upgrading do for you?

With the LM6000 peak performance upgrade kit, customers can see:

- Increases between 5% – 10% over current gas turbine performance have been achieved, providing viable economic benefits offsetting expected accelerated engine life
- Advanced monitoring algorithms to accurately track life impact, specifically logging: time, T48 temperature, SPRINT* flow, and NOx water flow

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

LM6000PC SAC EXTENDED LIFE COMBUSTOR UPGRADE

LM6000PC SAC extended life combustor features redesigned primary and secondary swirlers to alleviate issues with anti-rotation tabs and coating loss, extending the life of both the combustor and downstream components.

A

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000PC	**7-20+ Days**	**Medium** (exchange)/**Major** (service center)

What can upgrading do for you?

Replace jet-rad with rad-rad swirlers:

- Improved aerodynamics
- Reduced NOx water erosion
- Reduced floating mass

Dual skin venturi:

- Reduce thermal stress
- Eliminate flash boiling
- Reduce thermal gradient across thermal barrier coating (TBC) and base metal

T800 coated floating ferrule:

- Reduce bore wear
- Requires fuel nozzles with T800 wear coating and reworked flange (new bold lengths required for reworked flange)

RQM upgrade from rad-rad combustor (G48):

- Newly engineered combustor liners improve dilution characteristics by repositioning combustion location, lowering combustion area for lower emissions

LM6000PC UPRATE

GE's LM6000PC upgrade gives more power without the need for gearbox changes—all within the same package and engine footprint of the LM6000PC gas turbine.

A EF EM O

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000	**10-20+ Days**	**Major**

What can upgrading do for you?

- More power: Operate LM6000PC uprate with SPRINT* and increase output nominally 6% more than current LM6000PC SPRINT levels—54.5 MW output—simple cycle (T2 = 50 oF)
- Water savings: Eliminate SPRINT water and continue to exceed existing PC SPRINT output
- Extended life: Expected increase in the maintenance intervals of the combustor, hot section, and major overhaul compared to current LM6000PC
- Convert an LM6000PC engine to an LM6000PG engine, either by exchanging the existing engine or modifying selected components
- No reduction gearbox needed in 60Hz segment: LP speed = 3,600 RPM instead of the 3,930 RPM on standard LM6000PG packages
- Conversion kit configured to maintain same engine and package footprint
- Same NOx and CO emissions

LMS100PA+ UPGRADE

The first generation LMS100 delivers over 100 MW of power. But, as electricity consumption grows, so must the ability to deliver power without affecting the heat rate, emissions, or reliability.

EF O

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LMS100PA	**10-20+ Days**	**Major**

What can upgrading do for you?

The first generation LMS100 combines proven heavy-duty frame and aviation engine technology—and this upgrade increases airflow function into the gas turbine resulting in more power and higher efficiency.

- 3.4% increase in airflow function into the gas turbine
- Up to 9 MW more power
- Increase in efficiency by 0.4%
- A 0% change in emissions
- Includes upgrades to the latest controls software

PRIMARY FREQUENCY CONTROL UPGRADE FOR LM2500/LM6000/LMS100

GE's algorithm upgrade to your primary frequency control (PFC) is customized to meet specific grid requirements, enabling operation of plant equipment continuously between 47–52 Hz.

A F

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|LM6000|LMS100	**<5 Days**	**Minor**

What can upgrading do for you?

Primary frequency control (PFC) enables a frequency response to maintain grid stability. This PFC frequency response algorithm replaces the tuning of regular droop speed controls, which are standard on any turbine:

- Maintains correct frequency for turbine/generator by adjusting the total MW output
- Capability for the equipment to react immediately when system frequency is beyond dead band limits
- More accurate grid frequency measurements
- Continuously maintain required reserves in line with grid fluctuations
- Allows customer control on their reserve in line with the resultant deviations in the system frequency

A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

LM/TM2500 REMOTE VSV MONITORING UPGRADE

A linear variable differential transducer (LVDT) is installed that allows remote monitoring of the variable stator vanes (VSV) without having to enter the package and take manual readings during engine operation.

A EF

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|TM2500	**<5 Days**	**Minor**

What can upgrading do for you?

- VSV is present to enhance efficiency over a wide range of air speeds
- Proper monitoring of VSV position with LVDT allows the VSV to function more efficiently
- LVDT position allows remote monitoring and accurate position of VSV to be known at all times
- LVDT signal can be used for data or alarm processing

S7 FUEL CONTROL UPGRADE FOR LM6000

S7 is the latest fuel core that enables all previous and new software updates. These updates are engineered to improve the reliability, availability, and performance of your LM6000 gas turbine.

A EM F R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000	**<5 Days**	**Minor**

What can upgrading do for you?

The LM6000 S7 fuel core upgrade incorporates the following enhancements as compared to the S6 software block.

Cost savings:

- NOx water scheduling optimization for 2–3% water savings
- SPRINT water savings from heat rate improvement at lower power settings
- DLE mapping enhancements from reduced or eliminated seasonal mapping requirements

Trip reduction and reliability improvements:

- Robust flame-out detection improvements during start up, range expanded to N25 > 500 RPM, reducing the risk of hung starts
- HPC discharge temperature T3 and T48 regulator improvement
- Nuisance SPRINT alarm removal
- N25 MAX scheduling update helps reach sync idle quickly and reliably
- Improved alarm control logic that reduces false alarms
- Improved control logic that reduces turbine trips to help increase plant revenue and efficiency

S7 enables the following optional performance improvements:

- Primary frequency control (PFC) incorporates advanced frequency control algorithms to meet requirements from many different grid authorities, allowing a temporary 2 MW bump for grid stability
- Peak performance with throttle push, up to 5% higher output
- Fast Start capability with <10-minute start

SPRINT* SPRAY INTERCOOLING FOR LM6000 POWER AUGMENTATION

SPRINT (SPray INTercooling) increases the power output of the LM6000 gas turbine by cooling the combustion air, resulting in a higher mass flow through the low-pressure compressor (LPC) and the high-pressure compressor (HPC).

O

APPLICABLE TURBINE MODELS
LM6000

What can upgrading do for you?

- Increased gas turbine performance: up to 10 MW for LM6000PC turbines and 7 MW for LM6000PD or PF turbines
- As ambient temperature rises, the SPRINT system produces higher incremental output and better efficiency

LM6000 SUMP EVACUATION SYSTEM

The sump evacuation system (SES) restores the required differential pressure in the DE bearing sumps to vastly reduce or potentially eliminate oil leaks during low-power operation, engine load rejects, or trips from high power.

A R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000	**<5 Days**	**Minor**

What can upgrading do for you?

- Reduced oil leaks: Differential pressure is maintained across bearing sump oil seals to reduce leakage during low power operation or gas turbine trips
- Lowered maintenance costs: Oil leaks can lead to internal turbine rear frame (TRF) coking. By reducing the leaks, additional maintenance costs associated with TRF coking issues can be significantly reduced or eliminated
- Increased uptime

LM6000 SUPER-POLISHED HIGH-PRESSURE COMPRESSOR BLADES

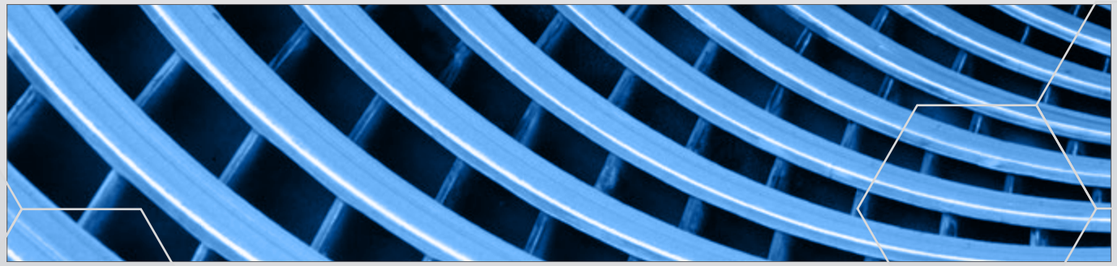
If you're struggling to maintain compressor performance over time as a result of blade fouling, GE's super-polished high-pressure compressor blades are configured to markedly reduce fouling rates and boost uptime.

EF L OM O

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000-PC|LM6000-PD|LM6000-PF	**10-20+ Days**	**Major**

What can upgrading do for you?

- Extending gas turbine compressor water-wash intervals
- Lower performance degradation between water washes
- Improvements in power output and heat rate



A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

LM/TM2500 TDI CLUTCH UPGRADE

This upgrade to the hydraulic starter clutch allows the existing starting system to operate with enhanced reliability and availability. It replaces the Hilliard† clutch with a new TDI sprag clutch.

A F R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|TM2500	**<5 Days**	**Minor**

What can upgrading do for you?

Our TDI* retrofit upgrade kit will allow your existing start system to operate with an improved reliability and availability.

- Reduce wear by over 400% through increased number of contact points (22 vs. 3)
- Increase starting reliability—multiple contact points reduce the requirement for precise ramping speeds for successful clutch engagement
- Improve safety with a more robust configuration
- Increase availability by extending maintenance intervals from 10,000 hours to 25,000 hours
- Reduce 60% weight over Hilliard clutch

LM6000 THRUST BALANCE VALVE REMOVAL

GE's upgrade replaces the thrust balance valve (TBV) with an on-engine tube and an in-line plate orifice. Corresponding control system software modifications can lessen mechanical failures associated with the TBV.

A R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000	**<5 Days**	**Minor**

What can upgrading do for you?

Replacing the thrust balance valve with the new thrust balance orifice system can eliminate the maintenance and oil leaks from the TBV, and can reduce trips related to TBV software. New software is installed for monitoring thrust balance cavity pressure and annunciates an alarm, if required.

VARIABLE INLET GUIDE VANES WITH EFS FOR LM6000

Variable Inlet Guide Vanes (VIGVs) regulate airflow into the Low-Pressure Compressor (LPC) to enhance turbine efficiency at part loads.

EF O

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM6000	**7-10 Days**	**Medium**

What can upgrading do for you?

- Increased power output by up to 3.25 MW
- Improved performance for simple and combined-cycle applications at part load and reduced turbine waste heat
- Lowered Variable Bypass Valve (VBV) flow, reducing associated flow noise
- LM6000PC SPRINT* turbines with EFS have an average power increase of 2 MW, more than a 2% fuel efficiency increase at 70% power, and an exhaust energy increase of 3%
- The VIGV closes during large power reductions to quickly reduce LPC flow to maintain stall margin

†Trademark of Hilliard Corporation.

WATER INJECTION FOR NOx REDUCTION IN LM2500/LM6000/LMS100

For non-dry low emissions (DLE) turbines without a NOx abatement system, a water injection system can be added that lowers NOx emissions to 25 ppm (gas fuel) or 42 ppm (liquid fuel).

EM O

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|LM6000|LMS100	**10-20+ Days**	**Major**

What can upgrading do for you?

This system injects demineralized water into the combustor through the fuel nozzles to regulate the combustor flame temperature and lower NOx emissions.

- Significantly reduced NOx emissions down to 25 ppm (gas fuel) or 42 ppm (liquid fuel)
- Higher power output while maintaining lower NOx emissions
- Reduced flame temperature

LM/TM2500 XTEND HOT SECTION UPGRADE—SAC

Applying advanced hot-section technology from the LM2500+G4, the Xtend* SAC has improved materials, coatings, and enhanced secondary cooling. The combustor and fuel nozzle kit is available for gas-only applications.

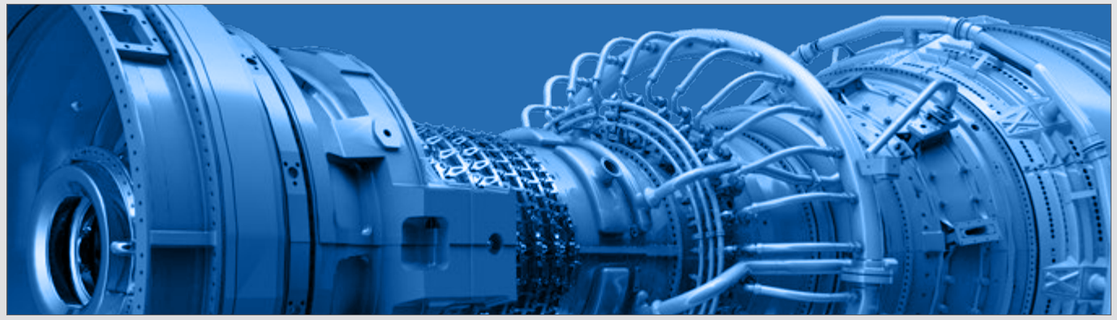
A R

APPLICABLE TURBINE MODELS:	TIME TO INSTALL:	INSPECTION TYPE:
LM2500|TM2500 Base SAC	**10-20+ Days**	**Major**

What can upgrading do for you?

GE's Xtend* upgrade for LM2500 and TM2500 Base SAC 1.0 engines increases the hot section life to 50,000 hours, reduces lifecycle costs, and increases site availability.

- Doubles anticipated LM2500 and TM2500 Base SAC hot-section life
- Reduces lifecycle cost 15% by eliminating one hot section repair/exchange in each MOH cycle
- Greater availability from avoided hot section replacement downtime—144 hours of operation over two MOH cycles
- Incorporates technology advancements from Xtend* SAC, including the deswirler
- OEM-approved life extension



A AVAILABILITY EF EFFICIENCY EM EMISSIONS F FLEXIBILITY L LIFE EXTENSION OM O&M O OUTPUT R RELIABILITY

LM/TM2500 XTEND HOT SECTION UPGRADE—DLE

Applying advanced hot-section technology from the LM2500+G4, the Xtend* DLE has improved materials, coatings, and enhanced secondary cooling. The combustor and fuel nozzle kit is available for gas-only applications.

A R

APPLICABLE TURBINE MODELS:
LM2500|TM2500 Base DLE

TIME TO INSTALL:
10-20+ Days

INSPECTION TYPE:
Major

What can upgrading do for you?

GE's Xtend* upgrade for LM2500 and TM2500 Base DLE 1.0 engines increases the hot section life to 50,000 hours, reduces lifecycle costs, and increases site availability.

- Doubles anticipated LM2500 and TM2500 Base DLE hot-section life
- Reduces lifecycle costs 15% by eliminating one hot section repair/exchange in each MOH cycle
- Greater availability from avoided hot section replacement downtime—144 hours of operation over two MOH cycles
- Incorporates technology advancements from Xtend* SAC, including the deswirler
- OEM-approved life extension

AERODERIVATIVE GAS TURBINE CROSS-FLEET REPOWERING

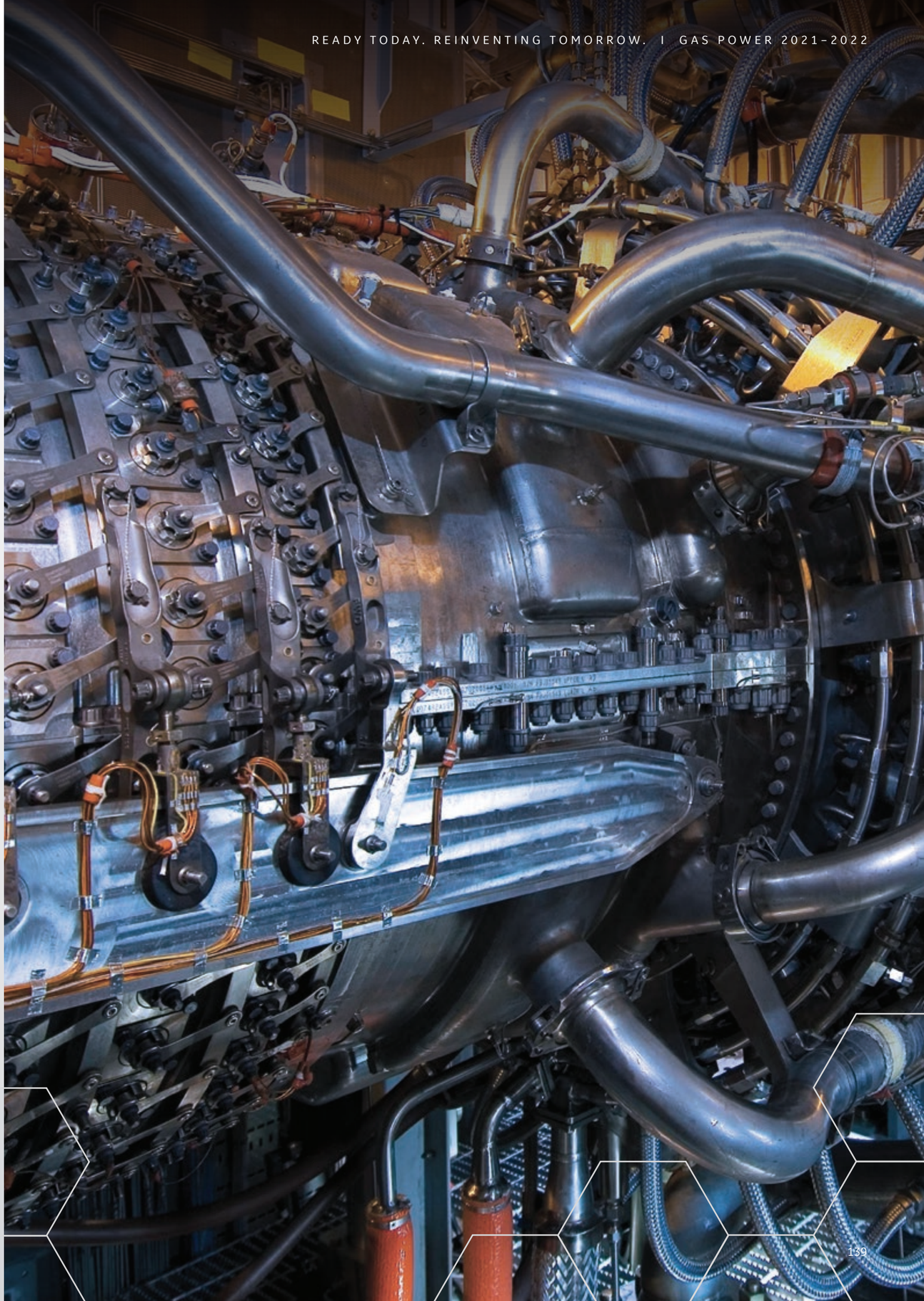
Regardless of your original equipment manufacturer, GE has the latest aeroderivative gas turbine repowering technology to make your units economically viable again.

A EF EM OM O R

APPLICABLE TURBINE MODELS:
Non-GE Aeroderivative Gas Turbines

Benefits:

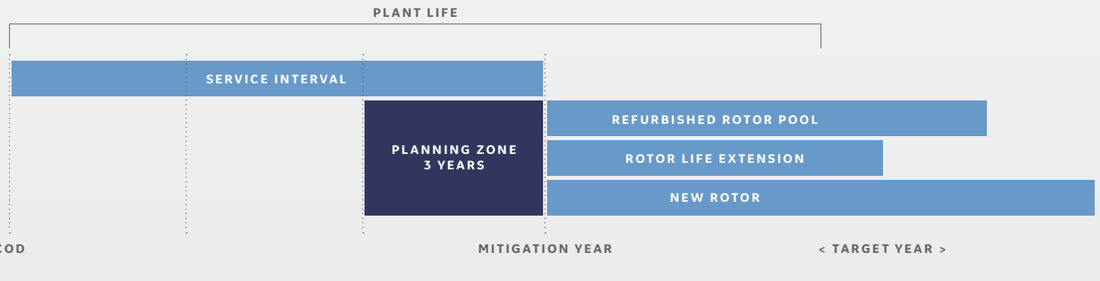
- 30% cost reduction compared with a new installation
- One-year OEM warranty and equipment performance guarantees
- Delivered in eight months or less
- Equipment selection and refurbishment plan driven by installed cost
- GE OEM certification can improve financing options and insurance premiums
- GE and WattStock co-located in Houston, TX service center



ROTOR LIFE MANAGEMENT

Planning for rotor life management begins with a few questions. Experience has shown that starting with the four questions below is a great way to initiate a dialogue around developing a plan:

1. WHAT TIME FRAME AM I TRYING TO MANAGE THE ROTOR THROUGH?
2. IN THIS TIME FRAME, WHAT ARE THE FUTURE OPERATIONAL EXPECTATIONS FOR MY UNIT AND/OR MY PLANT?
3. SHOULD THE ROTOR LIFE MANAGEMENT PLAN ENCOMPASS AN INDIVIDUAL UNIT OR EXTEND ACROSS A FLEET OF UNITS?
4. IN THIS TIME FRAME, WHAT OUTAGE CONSTRAINTS, SCOPE, OR TIMING WINDOW SHOULD BE CONSIDERED?



One of the most important things GE talks to customers about is planning early. Typically, our partnership with operators is the most successful when we start developing a plan three years before reaching the major outage where the rotor solution will be implemented. The first year revolves around understanding the future operational mission of the plant, time frame of the life of the plant, financial imperatives such as asset utilization, depreciation, risk management, then identifying options that most benefit the asset strategy of the plant. The second year is typically spent with customers acquiring various approvals. In the third year GE procures, manufactures, and tests items in preparation for delivery.

Typically we see operators start planning three years in advance of the need to install a solution. This allows a lot of flexibility to evaluate different types of options. There are a few factors that influence the timing of needing a rotor solution. The main drivers are the number of hours and starts run per year. As we have seen gas-powered plants moving toward a more cyclic operation, this can move the timing of rotor maintenance in or out in time.

Our most forward-looking customers have a maintenance and rotor management plan covering multiple time horizons. For example, sometimes their plans exceed 10 years and cover many outage cycles. Having a rolling 10-year perspective allows better decision-making throughout the life cycle of the plant. As the industry changes, the recommended solution may change, too.

Once the operator understands when a rotor solution is needed, it is helpful to analyze the long-term plans for the plant. In some cases, there may be some uncertainty in this area. However, in other cases the plant target year can be defined as the power purchase agreement term or a plant life extension. Understanding how long you need to run your rotor solution helps you make sure you pick an option that gives you the right amount of rotor life, not too much or too little.

Lifetime: GER 3620, Heavy-Duty Gas Turbine Operating and Maintenance Considerations, defines welded rotor minimum expected lifetime for each specific gas turbine type and rotor type. In order to achieve the minimum expected lifetime, visual inspections are performed during a standard C inspection. The specific lifetime is defined for each rotor individually. In addition to the implemented rotor life cycle management program, the specific condition and the planned future operation regime are taken into careful consideration for the individual recommendation.

Plan: Welded rotor life cycle management is based on regular rotor assessments performed during routine C-inspections. Based on a thorough prior review of the individual gas turbine rotor operation history, anticipated future operation regime and respective fleet data, a jointly agreed individual inspections schedule for creep and low cycle fatigue (LCF) assessment is defined.

Monitor: The execution of the on-site rotor assessment is aligned with other C inspection work and is carried out by certified GE non-destructive testing (NDT). Designed for purpose inspection probes, embedding advanced NDT technologies are developed and validated for each specific inspection task to help ensure the required measuring accuracy. In a continuously evolving best practice approach, the resulting measurement data combined with OEM design information and fleet data is analyzed to make reliable and risk controlled recommendations for further rotor use.

RECOMMENDATIONS:

Continue operation
If there are no LCF findings or creep elongation findings are well below the maximum allowable limits, a recommendation is to continue operation.

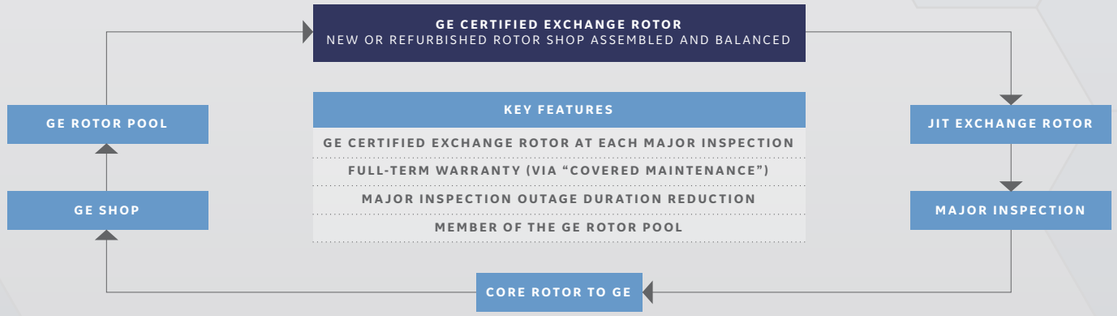
Monitoring
In case of linear indications which are below the maximum allowable depth, a recommendation may be given for further operation with specific monitoring recommendations or with operational limitations.

Repair
If the rotor has deteriorated beyond the serviceable limit or if particular features are damaged, a repair may be recommended.

Reconditioning/replacement
Technical or economic constrains may eventually lead to a replacement. If the rotor turbine section is approaching its end of life (LCF and/or creep deterioration), it is possible for certain rotor types to replace the turbine section by a new one.

KEY CUSTOMER BENEFITS

- Enhanced rotor lifetime without compromising safety and reliability
- Optimum planning for monitoring, repair and replacement
- OEM engineering support for specific assessments/recommendations
- Dedicated team of certified GE NDT specialists



BOTTOMING CYCLE

“

PROVIDING THE HIGHEST VALUE SOLUTION, INCREASING PLANT OUTPUT BY ~50% AND EFFICIENCY FROM ~40% TO +60%

”

STEAM TURBINE OFFERINGS

GE's highly efficient and reliable steam turbine portfolio has the breadth and depth to meet any project-specific need, integrating seamlessly with our gas turbines, HRSGs, and balance-of-plant equipment to help ensure operational success, satisfaction, and profitability for our customers across various applications.

A WORLD LEADER IN STEAM TURBINE TECHNOLOGY

For more than 125 years, GE has been one of the industry's leaders in steam turbine technology and innovations. Today, GE's steam turbines continue to be one of the few that lead the way, delivering efficiency and reliability to help ensure our customers' success. GE's steam turbines equip ~40% of the world's combined cycle steam turbine capacity. GE has more than 1,200 combined-cycle steam turbines operating in 80+ countries, generating more than 150 GW of power. Our steam turbines can be installed and operational in eight months or less for industry-leading commissioning.

STEAM TURBINES WITH HIGH AVAILABILITY AND RELIABILITY

- Our robust, reliable steam turbines are enhanced by the power of our digital and control solutions
- Our proprietary long-term testing program validates material behavior and improves steam turbine component reliability
- Advanced techniques during the engineering phase result in fewer maintenance intervals and increased turbine availability
- Hardware is thoroughly tested to make sure every machine meets the reliability and performance standards our customers demand

High-efficiency Steam Paths

- Industry-leading performance with high reaction 3-D blading engineered for high pressure (HP), intermediate pressure (IP) and low pressure (LP) steam turbine modules
- Our steam turbine engineering process provides precise control of radial clearances and throat areas to help ensure greater output and efficiency
- Last stage blades (LSBs) deliver 10% or more of total steam turbine output, making the blade one of the most critical components in the steam turbine. GE leads the industry with its last stage blade portfolio ensuring high efficiency, reliability and availability

ENHANCED OPERATIONAL FLEXIBILITY FOR STEAM TURBINES IN THERMAL POWER PLANTS

- Advanced life prediction methods provide reliable lifetime assessment of the steam turbine components and increased cycling capabilities
- Enhanced blade-to-rotor connection configuration reduces thermal stresses for increased rotor life

Welded Rotors

- With more than 80 years of welded rotor experience, we provide configurations that are proven and reliable
- GE uses welded and monobloc rotors providing our customers with an optimized solution ensuring longer life, and higher reliability and availability

Single bearing configuration

- Multi-casing steam turbines have a single bearing between each turbine section that enables avoidance of load shifting for higher reliability and reduced installation time due to efficient shaft alignment
- Shorter overall turbine shaft length for lower building costs

High-efficiency Last-stage Blades

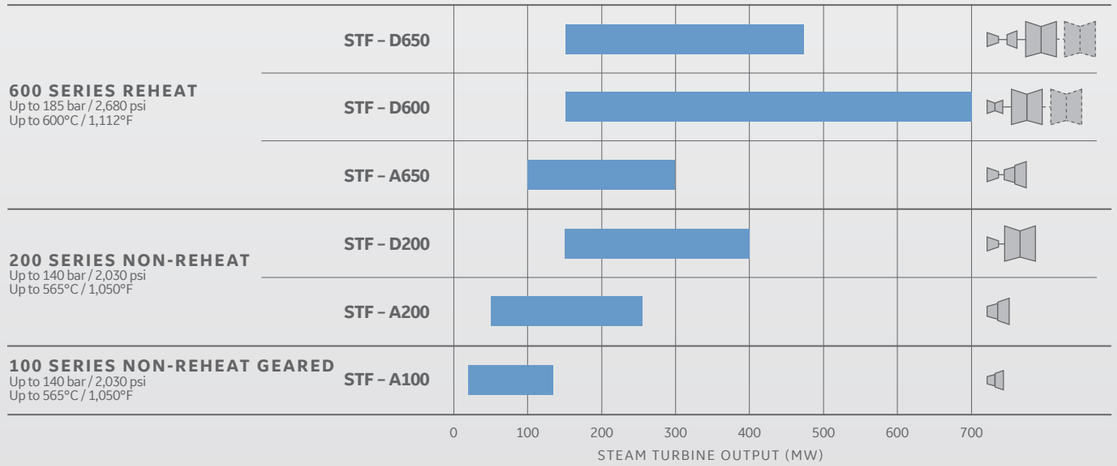
- Industry-leading back pressure capability allows for smaller air-cooled condensers, lowering overall plant cost
- Densely staggered last-stage blade sizes for project-specific cold-end conditions and increased efficiency—up to 60" for 50 Hz and up to 50" for 60 Hz
- Robust blade-to-rotor configuration with high cyclic life capability for high reliability and availability
- Features such as full tip shroud, enhanced tip section with low shock loss, aerodynamic part span connector, and increased root-reaction improve steam turbine performance
- Advanced radial vortexing improves performance and hood integration over a range of loads

Advanced Sealing Features

- Shaft and tip brush seals, developed in conjunction with our global research organization, improve leakage control when compared to more conventional sealing technology
- Abradable coatings on stationary seals enable the reduction of radial clearances, decreasing long-term performance degradation

Advanced Blading

- Modern, three-dimensional profile configuration that results in higher efficiency
- High pressure, intermediate pressure, and low pressure front stage blades that are milled from a single forging for excellent mechanical integrity and higher reliability



STF-600 Series Steam Turbines

GE's STF-A650, STF-D600, and STF-D650 combined-cycle reheat steam turbines provide industry leading efficiency, reliability, flexibility, and availability for today's combined cycle applications. The STF-A650, STF-D600, and STF-D650 reheat steam turbines have proven their value in combined cycle, combined heat and power (CHP), and industrial applications. They combine GE's unique shrink ring design with the flexibility of a modular turbine configuration.

Configuration Flexibility

The fully modular architecture allows configuring the steam turbines for even the most demanding applications. Options include multiple controlled extractions, and condensing, district heating or back pressure type exhausts.

Enabling Reduced Plant Total Installed Cost

Most of the steam turbine sections and components are factory assembled and pre-tested, reducing site installation time and improving schedule predictability. The configuration with an axial flow (STF-A650) or side flow (STF-D600 and STF-D650) exhaust configuration enables a lower centerline height, reducing total installed cost. The STF-D600 and STF-D650 steam turbines can also be configured with down flow exhaust , typically used where there are space constraints.

600 Series Product Specifications

	STF-A650	STF-D600	STF-D650
MAIN STEAM PRESSURE	185bar (2680psig)	185bar (2680psig)	185bar (2680psig)
MAIN STEAM / REHEAT STEAM TEMPERATURE	600°C / 600°C (1112°F / 1112°F)	600°C / 600°C (1112°F / 1112°F)	600°C / 600°C (1112°F / 1112°F)
FREQUENCY	50 Hz and 60 Hz	50 Hz and 60 Hz	50 Hz and 60 Hz
OUTPUT	100 – 300 MW	150 – 700 MW	150 – 475 MW

STF-200 Series Steam Turbines

GE's two-casing dual LP flow STF-D200 steam turbine and single-casing, axial exhaust STF-A200 steam turbine provide flexible configurations in 50 Hz and 60 Hz non-reheat applications in multi-shaft and single-shaft configurations, covering a wide range of industrial and utility applications.

Configuration Flexibility

The fully modular architecture allows configuring the steam turbine for even the most demanding applications. Options include throttling high pressure steam,the ability to have a combination of multiple controlled and uncontrolled extractions, and condensing, district heating or back pressure exhausts.

Enhanced for integration

The STF-A200 non-reheat steam turbine is available in a fully assembled, frame mounted configuration to reduce installation time. Both the STF-A200 and STF-D200 enable low centerline height installations and a simplified foundation interface further lowering the total installed cost.

200 Series Product Specifications

	STF-A200	STF-D200
MAIN STEAM PRESSURE / TEMPERATURE	140bar (2030psig) / 565°C (1050°F)	140bar (2030psig) / 565°C (1050°F)
FREQUENCY	50 Hz and 60 Hz	50 Hz and 60 Hz
OUTPUT	50-250 MW	150-400 MW

STEAM TURBINE SERVICES

1200+ installed units to date, more than 150 GW

More than **125** years of services experience from all major OEM fleets

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

UPGRADE SOLUTIONS

Steam Turbine

Advanced Steam Path (ASP) or Partial Steam Path (ASP Lite)

GE has a suite of customizable solutions to improve the reliability of the HP/IP module of your steam turbine. The Advanced Steam Path may be an attractive option that addresses multiple reliability concerns while providing improved performance. When faced with lengthy repairs, ASP can also significantly reduce outage scope and duration.

Key Benefits

- Reduced risk of unplanned outages and major emergent repairs during planned outages that are both costly and extend outage duration
- Increased steam turbine output based on recovery of aging losses and improved technology
- Enables combined cycle plant upgrades that increase steam flow
- Improves combined cycle heat rate

ASP Features

- Singlet* diaphragms in the HP and IP sections
- Modern N2 packing head configuration made of 9-Cr material with reduced axial loading and improved clearances
- Enhanced sealing features including HP tip and root J-seals, N2 packing head brush seals, IP tip brush seals
- The new steam path is designed to fit within the existing shell
- Phase 1:
  - — New monoblock rotor with impulse blading in the HP andIP sections
- Phase 2:
  - — New 3-piece welded rotor with 10-Cr material in the center section with reaction blading in the HP section and impulse blading in the IP section

ASP Lite Features (typical scope)

- New rotating blades for at least the first two stages of the HP and IP sections
- New singlet or refurbished diaphragms, to address dishing
- Modern seals with improved clearances
- New N2 packing head

Shell Upgrades

Benefits of HP-IP Shell Replacement

- Improved reliability and availability
- Utilize field experience and mechanical integrity analysis to improve casing geometry
- Option for 10-Cr material with superior creep resistance and LCF capability
- Life extension
- Reset the degradation to zero
- Opportunity to include life monitoring
- Opportunity to reduce outage duration with complete HP-IP module

Valve Upgrades

- GE's Next Gen Steam Turbine Valves

GE's Next Gen ST Valves provide our customers with replacement options for valves. Hardware solutions can enable minor outage interval extensions from 3 to 6 factored years. Advanced sensors and analytics are applied to move from reactive to proactive/predictive health monitoring.

Key Features

- Package 1: replaces only the internals on the main steam control valve (MSCV), with select internals on the combined reheat valve (CRV). This option principally applies to more modern guided outlet MSCV's and CRV's with Rexroth actuators
- Package 3: a full valve replacement option for the MSCV and an upgrade of critical components on the CRV internals and actuators

Key Benefits

- Valve health monitoring for extended maintenance interval recommendations (currently 3 yrs, up to 6 yrs possible)
- Reduces oxidation induced mechanical binding (i.e. sticking valves)
- Improved valve throttling stability margins with reduced solid particle erosion (SPE) rates
- Reduced valve testing requirements (daily to weekly)
- Improved pressure drop and longevity of the valve body while reducing the risk associated with performing, costly, life limiting repairs (Package 3 only)

Opflex* Steam Turbine Agility

Opflex Steam Turbine Agility is a comprehensive system solution to improve start times of combined cycle plants. It includes a combination of controls upgrades with expert plant-level operational analysis and recommendations to deliver significant improvements in combined cycle start performance.

Key Features

- One-button start
- Enhanced rotor stress control
- Flexible hot start
- Automatic temperature ramping
- Modified reverse flow
- Inlet Pressure Control (IPC) Setpoint Tracking

Key Benefits

- Up to a 57% reduction in steam turbine start time
- Up to $9,000 in fuel savings per start
- Potentially improve your position in the merit order
- Reduced start up emissions
- More predictable and repeatable combined cycle start times
- Reduced potential for missing generation during peak periods
- Improved balance between start time and steam turbine rotor life

Steam Path Warming

Heating Blankets

The shell warming system delivers a significant reduction in start times and rub induced vibration events while enabling longer sustained HP/IP section efficiencies. The offering consists of a heating blanket system, junction boxes, cabling, thermocouples, and a stand-alone control system. As a separate customer option, the system can also be connected to plant DCS for all the automated control functions in replacement of stand-alone control system. This integration will typically be performed by the customer with instructions provided by the thermal blanket system supplier.

Key Features

- Insulated heating blanket system
- Junction boxes
- Cabling and thermocouples
- Stand-alone control system

Key Benefits

- Faster start up times (e.g. 0.5 –1 hour reduction)
- Works with OpFlex*
- Longer sustained HP/IP section efficiencies
- Reduces likelihood of rub induced vibration

Heat Conservation

The Steam Turbine Heat Conservation System utilizes heated air as the medium for warm-keeping of the high temperature rotors during periods of standstill and prior to re-start. This solution reduces start-up times by eliminating cold start conditions as well as providing preservation of the steam turbine and condenser by maintaining humidity control when the unit is in stand-still mode.

Key Benefits

- Improved availability through reduced start up times
- Improved start-up efficiency
- Enhanced flexibility by shorter response time upon demands from grid
- Avoidance of penalties for late delivery to the grid
- Steam Turbine lifetime improvement
- Automated preservation of ST components and condenser by removing humidity
- Additional benefit: Controlled forced cooling capability for faster shut-downs and reduction of outage duration

Turbomax 7+ Stress Controller

The power generation industry is rapidly changing, and turbines originally manufactured for base-load operation are now required to respond quickly to grid demands. The modern requirements for steam turbine power plants (including combined-cycle installations) are faster and more frequent start-ups, combined with longer phases of low load operation (LLO).

Our solution for a new energy environment GE has developed a modern rotor stress controller called Turbomax* 7+, available for units running older versions of Turbomax* that is built around the following modules:

- **Steam Turbine Rotor Stress Calculation Model:** Calculates the thermal stresses for the steam turbine rotors based upon existing measurements typically available in the turbine supervisory instrumentation suite.
- **Lifetime Usage Indicator:** Accumulates lifetime consumption during operation caused by thermal low-cycle fatigue and creep. This indicator adapts to the changing use of the asset over time.
- **Steam Turbine Limiter and Control Functions:** Keeps the operation of the steam turbine within the permissible limits for protection of the asset.

Key Benefits

- Improved availability and reliability
- Improved flexibility
- Cost savings during start-up and load ramps
- Visibility of lifetime consumption
- Improved maintenance planning
- Enhanced optimization with digital add-ons

† Control system limitations may apply.

HRSG OFFERINGS

HRSG TECHNOLOGY is CRITICAL to COMBINED CYCLE EFFICIENCY

GE offers a variety of HRSG solutions that are tailored to help meet customers' operating flexibility and performance requirements. With over 100 years of boiler experience and more than 1,300 HRSGs installed worldwide, GE is one of the leading HRSG OEMs in the world.

Our portfolio of products and services brings the engineering and manufacturing of all major components in a combined cycle power plant in-house. GE's whole integrated system approach provides high power output and efficiency as well as improved plant operability.

GE's HRSG engineering provides reliable high-cycling duty due to the innovative single-row harp configuration in the front (hot) end of the HRSG, producing three times less stress than conventional multi-row harps and capable of fast starts, rapid response and low turndown.

Numerous integrated scope options are available, such as supplementary firing for peak power output, SCR, and CO catalysts for emissions control, accessories for noise abatement and exhaust gas bypass systems. In addition all configurations can be equipped with GE's Life Monitor System (LM) that provides operators the ability to monitor life consumption on key life limiting components online.

A choice of various modular construction options lets you choose the degree of prefabrication that best fits your specific project site requirements. GE provides four basic options of prefabricated Pressure Part Modules:

HARP BUNDLE	MODULES	C-FRAME	FULLY ASSEMBLED
• Limited infrastructure • Limited large crane availability • Low site labor costs	• Suitable for most sites • Fewer transportation restrictions • Large crane availability • Medium site labor costs	• Sites with good water access • Large crane availability • High site labor costs	• Sites with excellent water access and specialized transport • High site labor costs

In addition to these options and to reduce the total installed cost further, GE offers even more constructability options such as shop installed vents and drains, shop installed large bore valves, drum modularization, stack in cans, etc.

HRSG PRODUCT PORTFOLIO

Horizontal Drum
The flow of gas in this most popular HRSG type is horizontal while the water is heated in vertical tubes with natural circulation.

Horizontal Once Through (OT)
The horizontal once through has the same basic arrangement as the horizontal drum, but eliminates the high pressure drum, while using GE's in- house OT technology to increase flexibility, efficiency, and daily cycling capabilities.

Vertical Drum
With vertical gas flowing across horizontal tubes, this HRSG type is ideal when site space is limited. It is particularly well-suited for heavy fuel oil applications.

OT HRSG TECHNOLOGY

GE's proven inhouse Once Through (OT) HRSG technology is a key enabler in advanced water-steam cycles delivering higher combined cycle efficiency with high cyclic capability. GE's OT HRSG technology offers the following advantages:

- Proven experience with over 2.5 million operating hours
- Superior off configuration and part load performance due to the ability to vary feedwater flow resulting in increased combined cycle efficiency compared to drum type
- Increased combined cycle efficiency due to the ability to operate at higher HP steam pressures
- Stable operation from low load to baseload with superior cyclic operation and flexibility
- GE's Ultra-Pure Water (UPW) solution with the GE OT requires a small polisher (3%) for make-up water in lieu of a typical 50% condensate polisher required by competing offerings, inherently decreasing total plant cost
- As there is no continuous blowdown like on drum type, GE's OT has a smaller water footprint/less energy losses

THE GE ADVANTAGE

Capability

- A whole system approach helps ensure integrated engineering with other system components
- HRSGs can be configured and engineered for any type of gas turbine and steam cycle
- Various modular construction options aimed to meet Customer's specific project needs

Versatility

- Complete portfolio of horizontal and vertical HRSGs including in-house developed OT HRSG technology
- Capable of fast starts, rapid response, and low turndown

Reliability

- GE's HRSG configuration provides reliable high cycling duty due to innovative single-row harp configuration in the front (hot) end of the HRSG which produces three times less stress than conventional multi-row harps
- Increased quality assurance through in-house manufacturing of pressure part modules
- Access to a worldwide dedicated service organization

HRSG SERVICES

OEM EXPERTISE for MORE THAN 100 YEARS

GE has extensive HRSG expertise, with more than 1,300 HRSGs in operation to date. We offer a one-stop shop for HRSG users. Our product portfolio comprises inspections, repairs, cleanings, life management solutions and life time extension upgrades.

UPGRADE SOLUTIONS and PARTS

Replacement Pressure Parts

Supplying pressure parts for HRSG units requires large-scale facilities and extensive engineering, procurement and construction (EPC) experience. As an OEM with a global workshop network, GE can offer standard and tailor-made pressure parts for all major HRSG brands. No matter how extended the scope is and how complex the installation might be, we have a solution to streamline your maintenance and improve your unit availability.

Pressure Parts
- Harp assemblies
- Modules
- Tubing
- Dissimilar metal weld inserts
- Spacers, attachments, hardware
- Drum internals, liners, nozzles

Non Pressure Parts, Fabricated Parts
- Access doors
- Ducts, dampers
- Baffles, expansion joints
- Liner systems
- Casing, structural steel, platforming
- Drain lines, drains, vents

Valves and Other
- Safety valves
- Silencers
- Desuperheaters
- Instrumentation and controls

SITE SERVICES

Inspections, Repairs and Outage Support

With our knowledge, extensive experience, and commitment to safety, GE offers time-saving and value added inspections, repairs, replacements and outage support services for your HRSG and auxiliary systems, helping you increase availability and save costs before, during, and after your outage.

Planning
- Outage objectives, work scope, and priorities
- Material and parts requirements and logistics

Execution
- Detailed inspections, onsite modifications and repairs
- Condition assessments and remaining life assessments
- Construction services and supervision

HRSG Upgrade after a GT Upgrade

Combined cycle power plant operators typically implement gas turbine (GT) performance upgrades to improve competitiveness and profitability over the life cycle of a plant. GT upgrades typically lead to changes in exhaust gas temperature and mass flow at the inlet of the HRSG. If not properly managed, these changes may have an adverse impact on HRSG safety, reliability or performance. With an HRSG Upgrade Package, GE will review various areas of the unit to assess the impact of a GT upgrade and provide the products and services necessary for continued safe and reliable operation of the HRSG.

To assess the impact of a GT performance upgrade, GE employs proprietary software and creates a performance prediction model for the HRSG configuration. This software is capable of modeling any HRSG OEM design configuration and evaluating the critical parameters of performance and life for the HRSG components. Based on the software output, further analysis could be necessary to assess HRSG performance, pressure part materials, sound levels, piping design, environmental control equipment, attemperators, valves, and instrumentation.

In addition to proprietary software, GE draws on our service and operation experience from more than 1,300 HRSGs installed and operating worldwide. Our product and service expertise, combined with the latest monitoring and analytics capabilities, helps help ensure that an HRSG Upgrade Package will provide continued reliable operation of your HRSG over its lifetime.

HRSG UPGRADE PACKAGE FEATURES

Basic Scope
- Performance calculations
- Pressure part design review
- Review and provision of safety valves and silencers
- Review and provision of attemperators and control valves
- Code compliance assessment

Expanded Scope
- Feedwater/condensate pumps assesment
- Environmental control equipment
- Pressure part lifetime assessment
- Acoustic analysis

HRSG Remote Monitoring and Diagnostic Service

HRSGs must endure significant cyclic and long-term high temperature operation that can result in fatigue and potentially creep damage to certain components, potentially leading to cracking and failure of pressure parts. Certain events such as rapid cooling, improper drain operation, low load operation, or inadequate maintenance can produce significant temperature differentials and very high thermal stresses that are not detectable with normal plant DCS instrumentation. GE's HRSG remote monitoring and diagnostics service provides a significant value to the plant owner, delivering information that can be used to improve the life expectancy of the HRSG, or enhance the maintenance program.

PressureWave+* HRSG Cleaning

Deposits of iron oxide and ammonium bisulfate on the flue gas side can lead to tube fouling. This reduces the heat transfer efficiency and increases backpressure on an adjoining gas turbine. Additionally, it lowers the boiler and combined cycle efficiency, which can lead to higher operating costs.

GE offers innovative boiler cleaning tools such as PressureWave+, developed by BANG&CLEAN† Technologies AG, that uses pressure waves to penetrate deep into the tube bundle for a more effective and efficient boiler cleaning. Pressure wave cleaning is done with a special lance, which is inserted into the spaces between the tube bundles. A plastic bag at the end of the lance then is inflated with a mixture of combustible gases that are ignited remotely. The resulting pressure wave and tube vibrations dislodge and clean the deposits from the boiler without damaging the boiler tubing.

Pressure wave cleaning is much faster than traditional cleaning methods—it can be completed in about half the time—and requires no scaffolding. This tube cleaning technology is also much more effective at removing corrosion and sulfur deposits, as the pressure wave cleaning can reverberate into areas previously unreachable by other boiler cleaning methods.

Benefits Include:

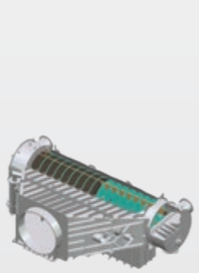
- Applies to all HRSG OEMs, vertical and horizontal type
- Requires no scaffolding
- Cleans deeper into the tube bundle, even in areas that cannot be reached by other technologies
- More effective than traditional CO_2/dry ice blasting methods
- Cleans in half the time compared to other methods, without damage to boiler tubing
- Mobilizes quickly
- Reduces gas turbine backpressure
- Improves heat transfer and increases plant performance
- Attractive ROI (return on investment)

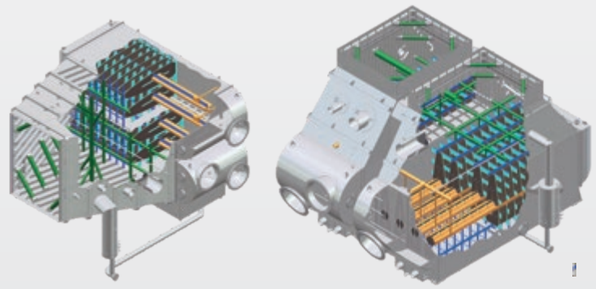
†Trademark of Bang&Clean Technologies AG.

WATER-COOLED CONDENSERS

GE offers high-performance deaerating water-cooled surface condensers for once through and cooling tower heat rejection systems. With decades of steam turbine and condenser manufacturing experience, we understand that your assets must harmonize to achieve sustained high power plant cold-end performance. Our water-cooled condensers are custom tailored to support specific project needs across a wide range of steam turbine applications—from small industrial-scale to large utility-scale units. Featuring uncomplicated and robust construction in pre-assembled modules, these condensers are easy to transport and install on site.

In addition to heat rejection and deaeration of condensate and make-up water, our condensers provide numerous critical safety functions. One critical operation mode involves full-flow desuperheated steam that bypasses the steam turbines and is admitted directly into the condenser. This is a particularly demanding operational mode for any condenser, but GE's configuration handles it safely and efficiently, without operational or lifetime restrictions.





INDUSTRIAL SCALE
50 MW Steam Turbine Power Output

UTILITY SCALE
>500 MW Steam Turbine Power Output

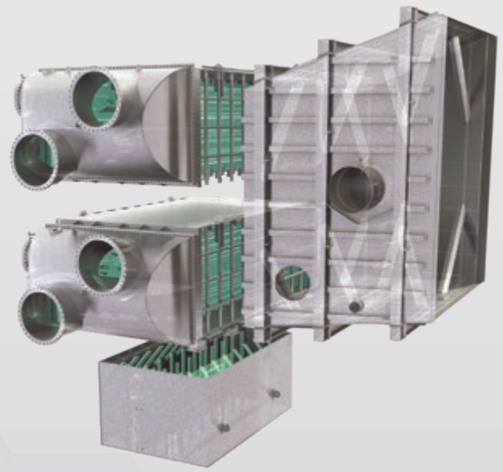
	CYLINDRICAL SHELL CONDENSERS	RECTANGULAR SHELL CONDENSERS
POWER RANGE	Up to approximately 50 MWe steam turbine output	From 50 MWe up to the largest steam turbine outputs
ARRANGEMENT	Downward, lateral or axial turbine exhaust	Downward, lateral or axial turbine exhaust
SURFACE AREA	1,000 m^2 (10,080 ft^2) up to 6,000 m^2 (640,600 ft^2)	3,000 m^2 (32,300 ft^2) up to 35,000 m^2 (38,000 ft^2) with single shell
TUBE LENGTH	5 to 14 m (16 to 46 ft)	Up to 18 m (60 ft)

KEY BENEFITS

- **Proven performance, high reliability:** GE's tube bundle has a 50-year track record of outstanding performance and unrivaled reliability in both original installations and retrofits.
- **Excellent effiency:** Our standardized tube bundles—each containing 870 to 7,300 tubes—are scaled to help meet the needs of any power plant, regardless of size.
- **Simplified integration, standardized interfaces:** Every GE condenser is supported by accurate thermal and 3D models to facilitate integration into your specific power plant. Our configuration eliminates all proprietary and non-standard interfaces, delivering industry standard connections for piping, instrumentation and foundation supports. This makes it easy to adapt to any type of steam turbine.
- **Reduced costs:** Floor-mounted axial or lateral condensers simplify construction of the turbine foundation, shortening civil work and construction durations. For a streamlined construction process, our condenser arrives on site in hydrotested and assembled modules with minimal welding requirements and accompanied by clear and concise interface and construction documentation.
- **Robust construction:** Built to handle turbine and steam generator overloads and variations in cooling water temperature, our condensers are resistant to impingement erosion and tube vibration. GE engineers also carefully select tube and tubesheet material based on cooling water specifications.
- **Deaerating performance:** GE's condensers reach extremely low oxygen content in the condensate by efficiently deaerating make-up water without the need for external steam sources.

OTHER HEAT EXCHANGER PRODUCTS

In addition to water-cooled condensers, GE offers high performance, reliable heat exchanger products developed in house, including district heaters, direct contact heaters and deaerators, feedwater tanks, and shell and tube closed cooling water coolers.



"GE's CONDENSER ENGINEERING GOES BEYOND THE HEAT EXCHANGE INSTITUTE (HEI) GUIDELINES FOR CONDENSER HEAT EXCHANGE AREA. THE RESULT IS A CONDENSER WITH SIGNIFICANTLY REDUCED AREA FOR THE SAME CONDENSER PRESSURE."

ELECTRICAL CONVERSION

“

THE FINAL STEP IN SUPPLYING POWER TO THE GRID

”

GENERATOR PORTFOLIO

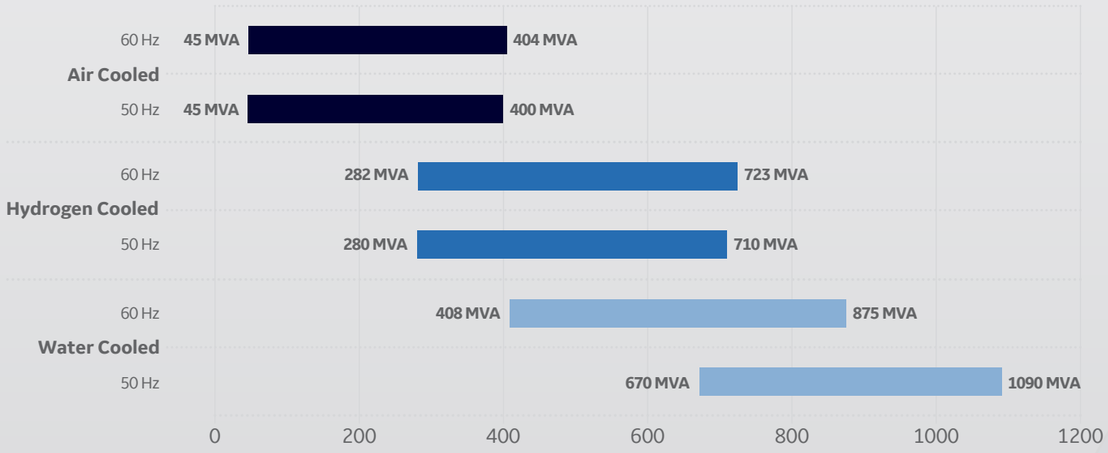
GE is bringing generator technology and performance to the next level. We engineer and build our generators to help meet the demanding specifications that keeps our customer on the leading edge of efficient, reliable electricity generation. Our equipment benefits from time-proven technology; it installs quickly, integrates easily, operates reliably and delivers more power. With an installed base of 12,200+ turbine generators, GE has accumulated more than a century of experience delivering innovative high voltage solutions in generation, transmission, and distribution networks. GE understands the world's challenges and is committed to provide solutions to help solve the global energy transition.

Our generators offer a complete range of configurations from small industrial applications to large power plants. GE generators are engineered for ease of installation, low maintenance, and incorporate extensive fleet experience to help support low cost, reliable operation. GE generators create a third of world's electricity, providing efficient and affordable power that you can depend on.

GE's generators can be configured for multi-shaft or single-shaft operation with project-specific variables like gas and steam turbine, desired output, regional fuel cost, and local environmental conditions ultimately driving product selection. GE generators share common characteristics that are proven, dependable, capable, versatile and cost effective.

GE's generator product line is divided into three categories based on cooling method:

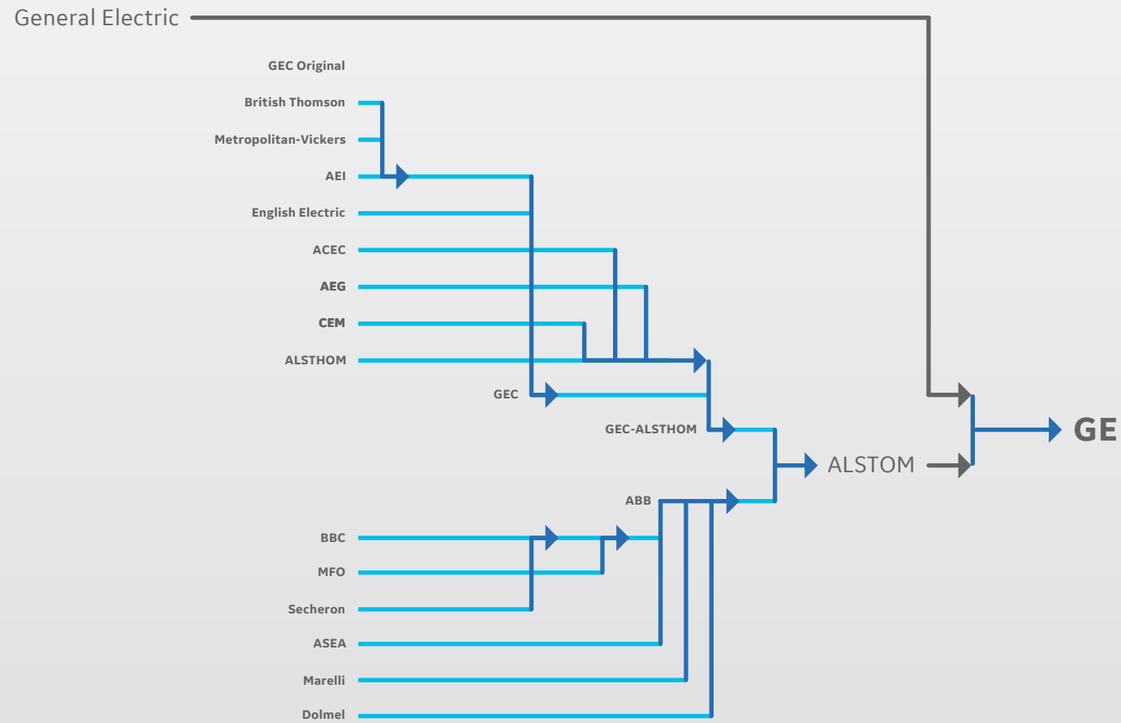
- **GEN-A:** Air-cooled generators are ideal for systems that demand simple, flexible operation. Prepackaged generator solutions arrive ready-to-install at site reducing project cycle time with increased reliability.
- **GEN-H:** Hydrogen-cooled generators feature low gas density, high specific heat, and high thermal conductivity, making them ideal for high efficiency applications. GE has developed technologies that increase the power output capability of the hydrogen cooled machine, as a cost effective alternative to historical applications that required direct water-cooled stator windings
- **GEN-W:** Water-cooled generators operate efficiently and reliably within a small footprint when high output requirements exceed the cooling capabilities of air-cooled or conventional hydrogen-cooled generators.



GE TECHNOLOGIES ARE:

Proven

GE generators leverage the best of many OEM technologies GE has acquired over time. Leveraging a rich heritage GE delivers a reliable, available, and efficient generator that helps meet our customers' needs. Derived from fleet experience, GE has invested in a state-of-the-art full scale rapid Thermal Cycling & Endurance validation test stand to help ensure all new prototypes meet the highest reliability and availability expectations. This capability accelerates testing to simulate extended operation, cyclic loading, and multiple machine start-stops. Every new product is subject to this testing to help ensure operability and performance prior to commercial production.



"GE GENERATOR TECHNOLOGY POWERS ONE THIRD OF THE WORLD."

Dependable

Utilizing vast fleet experience (more than 12,200+ fleet installation), GE generators incorporate engineering features that improve durability of the generator operating under cyclic duty operations. GE generators consistently perform above the industry average for reliability and availability.

- End-winding technologies such as the Tetraloc*, re-tightenable, and sliding axial systems, accommodate for cyclic thermal expansion and maintain mechanical integrity to drive lifelong reliability
- Advanced rotor cooling technologies that reduce thermal gradients between coils, reducing mechanical insulation wear features in rotors to improve robustness
- Advanced core suspension system technology, reducing stator core vibration, reducing noise and extending life

Capable

Air-, hydrogen- and water-cooled generators covering a broad range of generator output ratings from small industrial applications to large combined cycle power plants. GE generators strive for the highest power density in the world which lead to cost effective, high efficiency, grid friendly solutions.

- Advanced insulation (Micapal* III and Micadur*) enable higher power density with advanced voltage stress and thermal conductivity capabilities for greater armature performance

Versatile

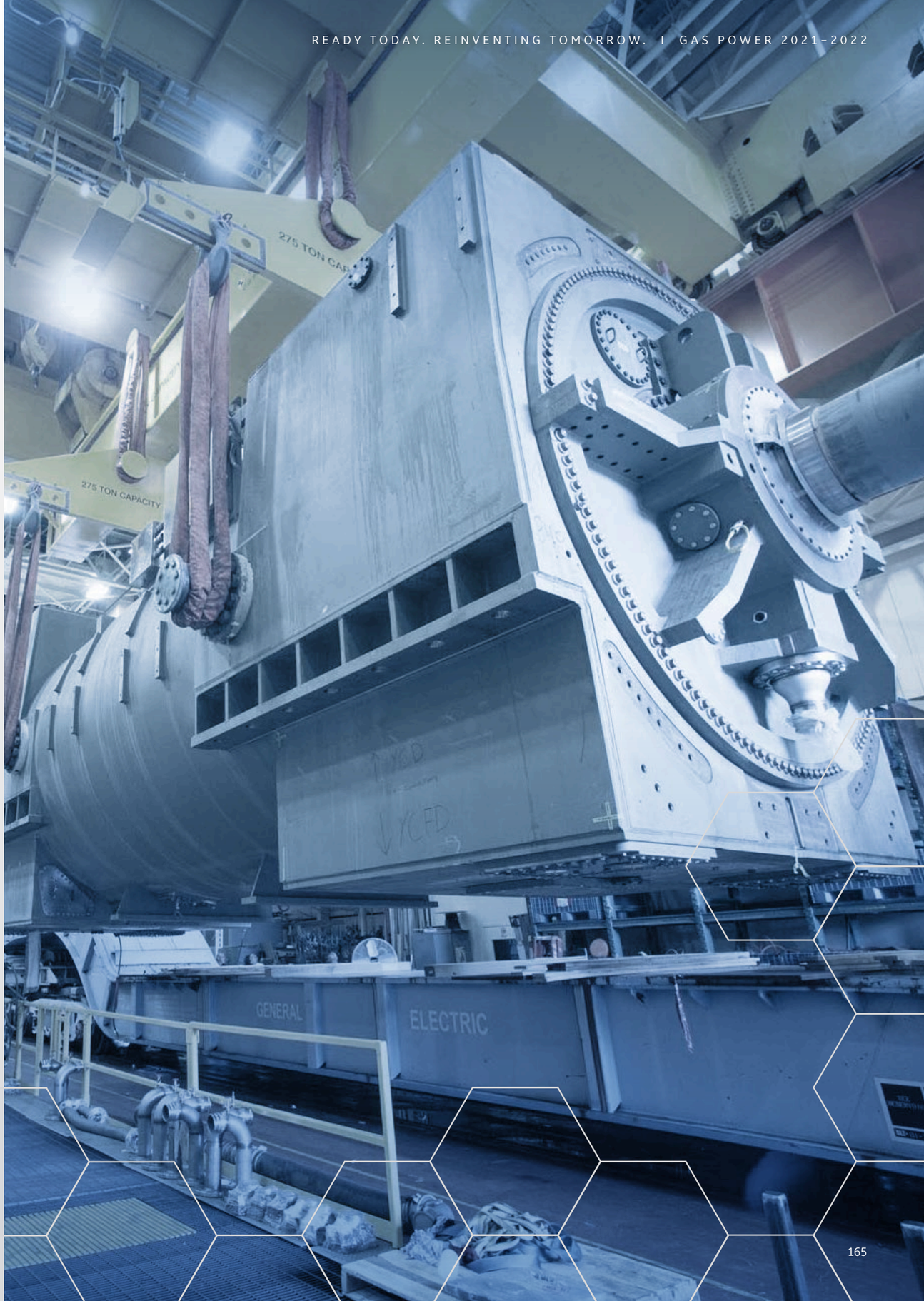
Flexible line lead configurations complementary with multiple exhaust configuration driving lower plant centerline, small turbine buildings and efficient use of plant maintenance equipment, resulting in millions in overall plant cost savings.

Cost Effective

Compact and flexible configurations to reduce total installed cost and footprint. High power density (small footprint, high output, lighter weight), longer maintenance intervals, and other features engineered to reduce operations and maintenance cost, enable more profitable power generation to the industry.

- Designed for borescopic and robotic (MAGIC*, DIRIS*, MAGI, MAGIC I) rotor-in inspections enabling lower maintenance cost
- Broad range of product offerings ship rotor installed to reduce transportation costs, reduce installation cycle, and ultimately reduce total installed cost of the generator
- Advanced long fin aero fan blades contribute to lower windage losses and reduced O&M costs
- Continuous online health monitoring systems to empower customers to manage scheduled maintenance, increase availability and reduce overall plant O&M costs

> “OUR GENERATORS OPERATE AT AN AVAILABILITY RATE THAT’S 0.38% ABOVE THE INDUSTRY AVERAGE.”



GENERATOR SERVICES

GE provides full generator life cycle support. Our Services team is here to extend life of generator, improve reliability and availability, and increase its capacity to deliver more profit to our customers.

GE provides a complete range of cost-effective generator services spanning from inspections to complete flange-to-flange retrofits for air, hydrogen, and liquid cooled generators rated from 20 to 1090+ MVA. GE has performed hundreds of rotor and stator rewinds and responded to thousands of planned and emergent outages with a global pool of generator specialists to serve customer needs.

SUMMARY:

- **125** years of experience
- **1,000+** rewinds over the last decade
- **1.7+** GW of generator uprates

World-class response time for emergent needs

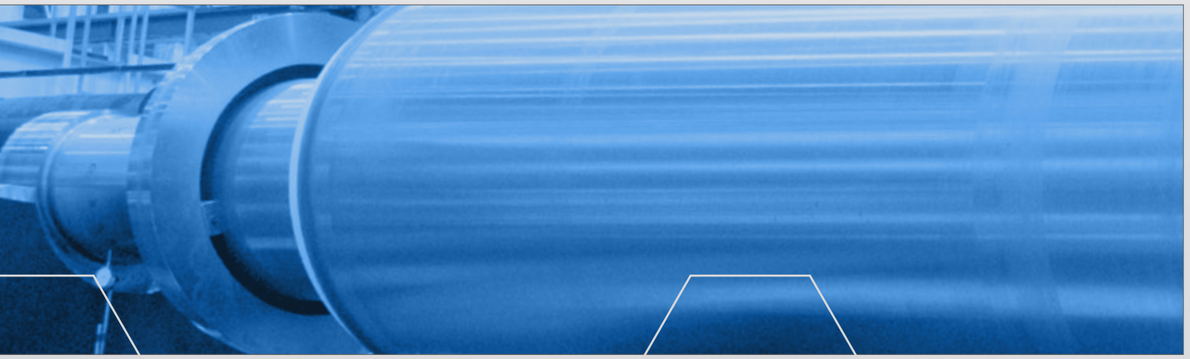
- Strategically placed inventory of long lead **critical parts** and common model exchange rotors
- Large pool of **highly trained**, safe, and experienced generator specialists and winders

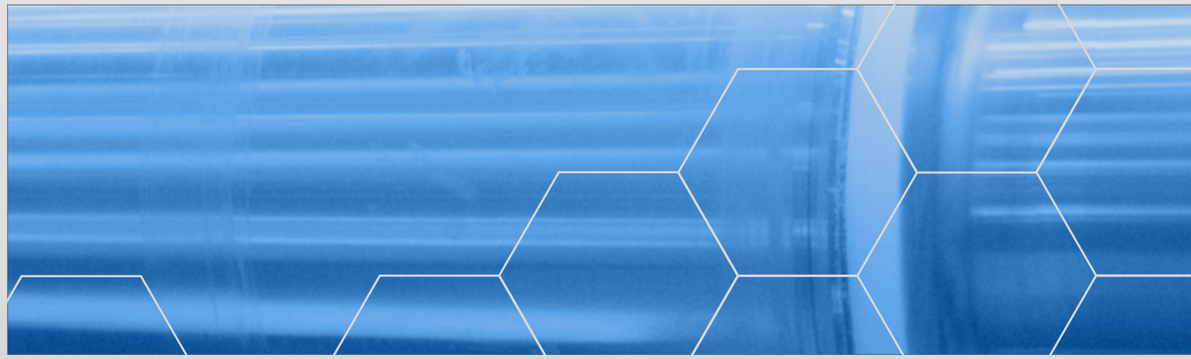
- **Continuous investment in upgrade and repair technology**
- **Focus on the quality and on time delivery embracing GE's lean processes**
- **Comprehensive portfolio of solutions built around critical needs of any type or make of generator**
- **Leading on-line monitoring solutions to support condition-based maintenance**

GENERATOR SERVICES SOLUTIONS

GE continues to invest in developing retrofittable solutions to help bring new life into aging systems, providing Full Life Cycle support which can have a big impact on entire life of a power plant. GE focuses on delivering customer value by improving output, efficiency, availability/reliability, and flexibility, extending generator life, increasing capacity, and reducing outage time all while adhering to the project budget.

	OUTPUT	EFFICIENCY	AVAILABILITY/ RELIABILITY	FLEXIBILITY
STATOR REWIND	X	X	X	
ROTOR REWIND/REPLACEMENT	X	X	X	
GENERATOR REPLACEMENT	X	X	X	
ADVANCED ROTOR FAN BLADES	X	X		
MAINTENANCE PROGRAM (Test/Robotic Inspection)			X	X
GENERATOR OFFLINE INSPECTION: Retaining ring, rotor in robotic, rotor out			X	X
GENERATOR HEALTH MONITORING (GHM)			X	X
STRATEGIC SPARE PARTS		X	X	X
AUXILIARY SYSTEMS UPGRADE			X	
EXCHANGE ROTOR	X	X	X	
STATOR FlexPACK			X	X
ROTOR FlexPACK			X	X





Generator Rotor Rewind

Rotor rewind typically consists of re-insulation of the existing copper coils. GE provides a number of rotor rewind options to fit your needs including new copper coils, retaining rings, collector rings, and more.

- Advanced end-winding blocking supports, advanced insulation materials, and patented copper finned ventilation ducts better support and cool the unit
- Advanced dovetail and rotor end-slot modifications help prevent crack propagation and improve cyclic duty durability
- Advanced repair technologies, such as retaining ring removal and installation automated skids, provide proven short cycle capabilities
- Off-the-shelf pre-wound high speed balanced exchange rotors or new replacement rotors that provide all the benefits of a rotor rewind while significantly reducing outage interval
- With the shift toward more cyclic operation in the fleet, GE offers the rotor flexpack to provide customers with a solution to reduce risk of forced outage, lower O&M costs and avoid premature rewinds

Generator Stator Rewind

- Advanced end-winding system support system and improved bar strand configurations
- More capability through the use of Micapal III*, MICADUR* and/or MICAREX* bar insulation material – proven industry leader in voltage endurance and dielectric strength capabilities
- Strand optimization and roebel bars to reduce eddy current losses and increase output by keeping the stator bar cooler
- Advanced repair technologies, such as stator bar loader and wedge tooling, provide proven record breaking short cycle capabilities
- Strategically placed inventory of long lead critical parts, provides shorter unplanned outage durations
- In the event inventory is not available, GE has provide stator bars quickly via in house copper mill capabilities and lean single piece flow lines, to reduce unplanned downtime
- With the shift toward more cyclic operation in the fleet, GE offers the stator flexpack to provide customers with a solution to reduce risk of forced outage, lower O&M costs and avoid premature rewinds

Capacity Uprates

All thermal, mechanical and electromagnetic limits are evaluated for stator windings, core ends and the rotor. GE then delivers options to uprate your generator up to ~20% of current capacity. Extensive factory and rotor tests, ongoing asset monitoring, and a robust, maintenance-free core engineering gives GE the confidence you need for a successful uprate.

Generator Replacements

GE's high power density replacement generators can be tailored to meet your needs, with minimal plant configuration impact. Designed to work within your existing generator's footprint, GE uses the latest technologies to provide higher efficiency and reliability. And, you can depend on GE's extensive experience in evaluating rotor train torsional lateral response to assist in avoiding catastrophic rotor component failures.

Generator to Condenser Conversion

When power plants are retired, there may be concerns that local electrical system voltage stability would be impacted. GE now offers engineered solutions that convert existing synchronous generators, powered by gas or steam turbines, into synchronous condensers with minimal disruption.

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

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 low flow rates which can lead to higher stator bar temperature and accelerated ground wall insulation aging

Stator and Rotor FLEXPACK*

With the shift toward more cyclic operation in the fleet, GE's undertook an enhancement program to provide customers with a solution to reduce risks of forced outage and premature rewinds with FLEXPACKs.

Rotor FLEXPACK features include:

- New end creepage block configuration that lowers coefficient of friction resulting in reduced thermal sensitivity
- New turn insulation layout which provides improved bonding and reduces coil end winding distortion
- Thermally compliant centering ring blocking to help prevent end winding distortion
- Slot exit relief at forging channel ends to improve slot armor abrasion protection and provide coil “windability” improvements

Stator FLEXPACK features include:

- Fixed axial supports replaced with two piece sliding supports to allow for uniform growth of the endwinding support system.
- The addition of flexible lead connections between connection rings and high voltage bushings. This allows axial movement of the connection rings without putting stress on the high voltage bushings.
  (Steam turbine driven H33 (7FH2) and H53 (324) generators have flexible leads as shipped)

Onsite Repairs

A PERFORMANCE PORTFOLIO BUILT AROUND CUSTOMER CRITICAL NEEDS

By drawing on decades of engineering 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 rotor and oil seal rings
- **On-site stator core repair**
  Horizontal core restack and prosthesis - Alternative technology to partial core ends restacking

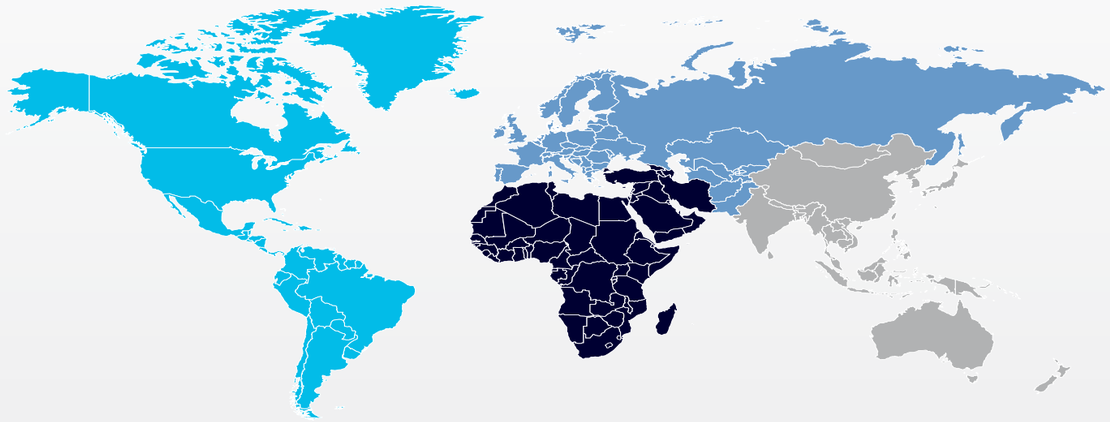
Workshop Repairs

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.



MIDDLE EAST/AFRICA (2 SERVICE CENTERS)	
CAPABILITY	REPAIR
STATOR WINDING	X
ROTOR WINDING	X
GENERATOR INSPECTIONS	X
EXCITER INSPECTION and REWIND	X
ROTOR HIGH SPEED BALANCING	X

AMERICAS (3 SERVICE CENTERS)		
CAPABILITY	REPAIR	NEW PARTS
STATOR BAR MANUFACTURING		X
STATOR WINDING	X	
ROTOR WINDING	X	
GENERATOR INSPECTIONS	X	
ROTOR HIGH SPEED BALANCING	X	
STATOR STACKING		X

EUROPE (4 SERVICE CENTERS)		
CAPABILITY	REPAIR	NEW PARTS
STATOR BAR MANUFACTURING		X
STATOR WINDING	X	
ROTOR WINDING	X	
GENERATOR INSPECTIONS	X	
EXCITER INSPECTION and REWIND	X	
ROTOR MANUFACTURING		X
COIL MANUFACTURING		X
STATOR STACKING		X
ROTOR HIGH SPEED BALANCING	X	

ASIA (2 SERVICE CENTERS)	
CAPABILITY	REPAIR
ROTOR WINDING	X
GENERATOR INSPECTIONS	X
STATOR WINDING	X

SERVICE SOLUTIONS

“

PURPOSE

Delivering cleaner, more accessible energy to the world

PARTNERSHIP

Providing services aiming to maximize life-cycle value and utilization

POWER

Delivering power for communities, industries, and livelihoods today and tomorrow

”

SERVICE AGREEMENTS

GE's customizable power plant services options provide better access to technology that will keep gas plants relevant in the future. Whether you're seeking advisory services to enhance your own operation or are looking for a full-service operator to perform all the daily activities associated with operating your site, GE can create an operational and planned gas plant maintenance contract with solutions to help meet your business goals.

By combining an operation and maintenance plan with GE's contractual service agreement (CSA) or multi-year maintenance program (MMP) programs, you'll be able to increase gas plant productivity, enhance profitability, and maintain the flexibility to adapt your operation over time as organizational needs and goals evolve. Best of all, you'll be able to take advantage of long-term financial predictability to realize the full potential of your gas plant.

CONTRACTUAL SERVICE AGREEMENTS (CSA)

Equipment must perform when called upon while operating in dynamic industry segments. GE's CSA for gas plants and turbines is designed to address these challenges by taking care of planned and unplanned maintenance. With a power plant CSA, GE shares the business risk and is devoted to helping you achieve your business goals.

MULTI-YEAR MAINTENANCE PROGRAM (MMP)

An MMP is a long-term power plant service agreement that gives you the flexibility to determine your maintenance scope while relying on GE to deliver high-quality gas turbine parts and services at preferential conditions, reducing administrative efforts and simplifying planning.

OPERATION AND MAINTENANCE AGREEMENTS

Our O&M gas plant agreements can give you the opportunity to let the experts behind your plant technology handle the operations of your gas plant. With over 1,400 plant O&M specialists, GE has the capabilities and skills of a full-service operator to perform all the daily activities associated with operating your site and help you define and run your maintenance strategy throughout the assets' operating lifecycle. By combining an O&M agreements with our CSA or MMP programs, you'll be able to increase your gas plant's performance , enhance your profitability and benefit from long-term financial predictability.

		CSA	MMP
MAINTENANCE SUPPORT	• PLANNED MAINTENANCE SCOPE	S	S
	• UNPLANNED MAINTENANCE	S	O
	• SERVICE BULLETIN (TIL) ITEMS	S	
	• DEDICATED GE POINT OF CONTACT	S	O
	• OUTAGE PLANNING	S	O
EQUIPMENT COVERAGE	• GAS TURBINE AND GENERATOR	S	S
	• STEAM TURBINE AND GENERATOR	O	O
	• HRSG and BoP	O	O
	• PLANT-LEVEL OPERATION and ROUTINE MAINTENANCE	O S	O S
	• OUTAGE PLANNING	S	S
FINANCIAL	• PERFORMANCE GUARANTEES	S	
	• BILLING CYCLE	QUARTERLY	TIME of SERVICE

S: INCLUDED in STANDARD
O: OPTIONAL

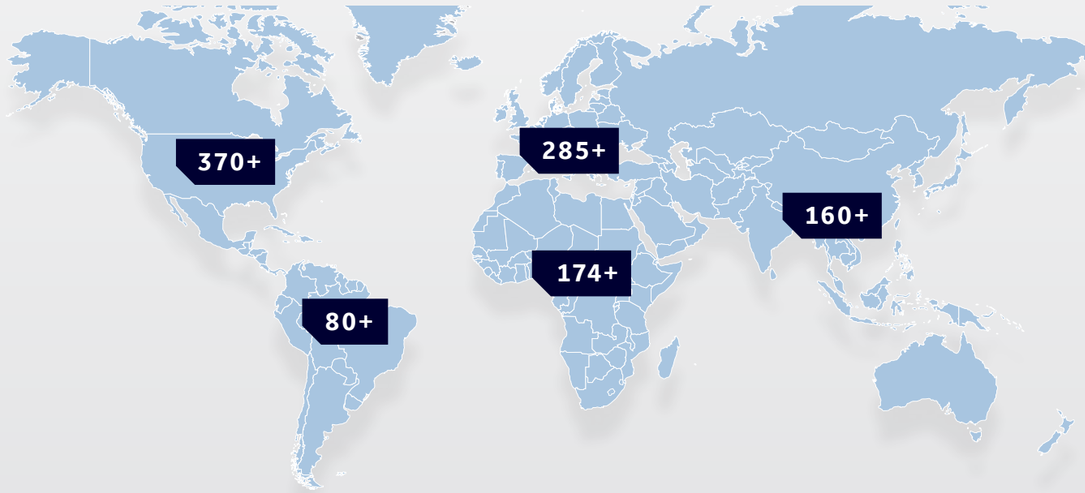
SERVICE AGREEMENTS

Proven Performance
Companies that have taken advantage of GE service agreements have seen significant performance and operational excellence results, including an availability advantage up to 1.04% and a reliability advantage up to 0.37%.

Maintenance Performance
Access to ~10,000 experts providing planned and unplanned operations and maintenance support with OEM quality gas turbine parts, repairs, and service. Gas plant operations and daily maintenance goes through GE's O&M support team.

Total Plant Guarantees
GE can offer a wide range of guarantees on both a plant and turbine basis, including unplanned events, outage duration, availability, reliability, emissions assurances, and maintenance performance guarantees.

GAS PLANTS WITH A SERVICE AGREEMENT



TECHNOLOGY	TOTAL ASSETS UNDER MANAGEMENT
Gas Turbines	3,000+
Steam Turbines	1,000+
Generators	2,500+

ORAP data 2015–2020

OUTAGE SERVICES

OUTAGE SERVICES and FIELDCORE

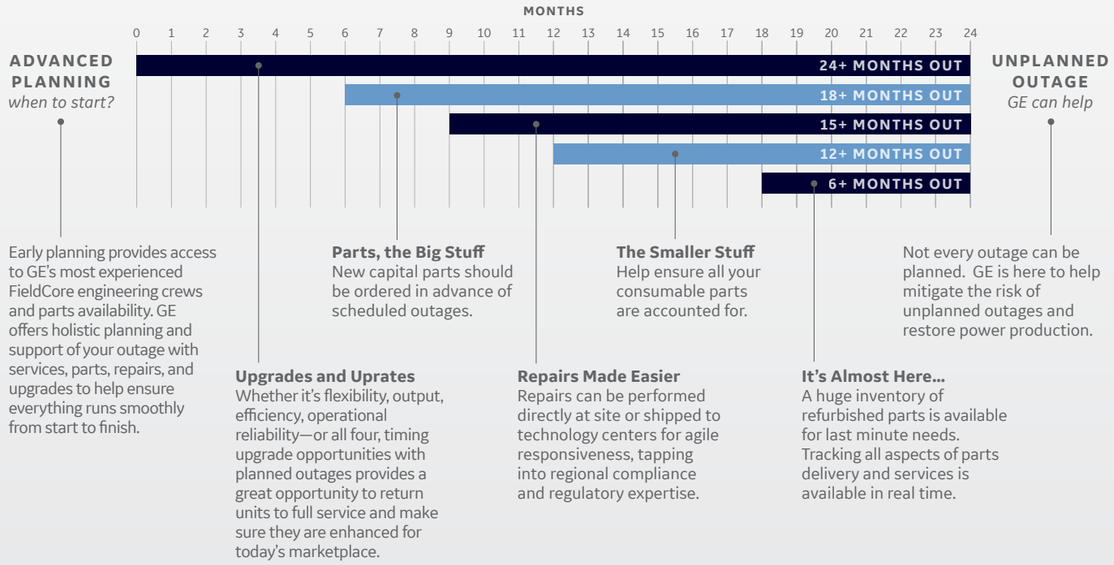
FieldCore, a GE company, is an independent, industrial field services organization focused on world-class execution across the power generation industry. Our team includes more than 10,000 of the foremost experts in field services all focused on one thing ... delivering excellent outcomes for our customers. Our Core Values of safety, integrity, quality and inclusion are the foundation of everything we do to empower the people who power the world. For more information visit our website www.fieldcore.com.

HEADCOUNT by REGION

- **~10,000** people in **60+** countries
- **800+** outages for Gas Power in 2020
  - — Large outages: Major Inspections (MI), C (Combustion) inspections, Majors and Hot Gas Path (HGP)
  - — Callouts, on site repair/machining, onsite GEN rewinds, Technical Direction of Installation (TDI), etc.
- Tooling:
  - — **296** people
  - — **39** tool centers in **30+** countries
  - — **125,000+** tools and **14,857** kits

Outage operations require years of focused planning and are a vital part of ensuring power plant efficiency, longevity, and stability. Outage events are one of our closest partnerships with our customers. It's critical to get it right the first time and GE understands that.

OUTAGE TIMELINE



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 slashing the length of your outages and decreasing downtime.

HEAVY DUTY GAS TURBINES

Customizable Outage Solutions

Our outage solutions offer the following key benefits:

- **Shorter gas turbine outages:** Detailed planning helps ensure that parts, upgrades, repairs, and experts are in place when you need them.
- **Reduced costs:** By limiting emergent maintenance needs, our outage services keep your costs down.
- **Increased performance:** We help you increase overall value and performance by focusing on upgrades that work with your whole system.
- **Increased safety:** Our services help ensure the safety of your people, your plant, and the environment.
- **Broad service range:** Rely on the same GE expertise and capabilities you know and trust for repairs on select non-GE turbines as well.

On-Site Services, Testing and Repair Offerings

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

GE's On-site Services (OSS) offers highly technical onsite inspections and premium repairs globally. We help ensure adherence to strict environment, health and safety (EHS), quality, technical, and operational standards while meeting and exceeding your scheduling and budgeting requirements. 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 only offered by GE.
- **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 enroute to required destinations around the world within hours of notification.

Major Inspections Without Rotor Removal

Save time, reduce costs and alleviate safety concerns with GE's rotor-in major inspection. Specialized tooling and techniques allow B/E/F-class major inspections to be performed without removing the turbine's rotor. Benefit from:

- Decreased outage durations—up to seven days shorter
- Reduced costs due to eliminating the crane, platform, and trucks required for loading and unloading parts, and the scaffolding needed for accessing bolted flanges
- Reduced labor and reworks that can occur during dismantling and installation
- Lower EHS risk due to fewer exposure opportunities associated with reduced work scope
- Simpler logistics due to fewer interfaces with other contractors, and a smaller footprint to store parts

Reconditioning and Repairs

Reduce costs by extending the lifetime and recovering the performance of your gas turbine components through our innovative reconditioning services. The reconditioning portfolio covers the full range of parts:

- **Turbine components:** Nozzles, blades, buckets, and shrouds
- **Compressor components:** Blades and vanes
- **Structural parts:** Shells, casings, and bearings
- **Combustion components:** Fuel nozzles, burners, liners, and transition pieces

Standardized repair processes help make every customer-specific job efficient and well-suited to help meet your operational needs. Backed by our Repair Development Centers and our Repair Technology Center of Excellence, GE invests $40 million annually to draw upon our engineering experience and the world's largest fleet and inspection database to continuously improve our repairs technology and lower your total cost of ownership.

Flexibility and Expertise to Help Meet Your Repair Needs:

- SMART repairs for customizable light/medium/heavy repair scopes
- Repair capability to service non-GE turbines, non-GE parts, and GE components previously repaired by a third party
- Global repair network

Zero Cycle Repair Options:

- Reduce repair cycle time to zero with refurbished parts
- Eliminate inventory costs
- Backed by GE's warranty for peace of mind

Technical Data

- More than 60% cost reduction through reconditioning, compared with new parts
- More than 30 years of reconditioning experience on well over 50,000 parts
- Delivery of full sets including replacement of fallout parts and assembly material
- Emergency stock for fast responses component history tracking

AERODERIVATIVE GAS TURBINES

GE's aeroderivative asset management solutions provide you with fast turnaround and true fixed-price maintenance with GE warranty. By delivering asset flexibility, speed, efficiency, and improvement, GE helps you benefit from improved outcomes: better output and performance, cost saving, and enhanced maintenance and availability.

Benefits of Repair by Engine Exchange

- New, fully refurbished and partial-life engines to help meet your diverse operation cycle requirements
- Reduced engine downtime with one 2–3 day outage
- Buyback value offered on exchanged unit
- Elimination of spare engine and lease engine

Benefits of Fast Turnaround Depot Repair by Module Exchange

- 50-day major overhaul and quick turnaround repair by exchange modules
- Fast return to service
- No change to engine serial number
- GE assumes cost risk for large engine parts and flow path airfoil replacement

Benefits of Onsite Repair by Module Exchange

- Enables onsite repair for your hot section, HPT rotor, HPT S1 and S2 nozzle, combustor and turbine mid-frame modules
- Eliminates the need for a depot visit
- Reduces your engine downtime to one 1–3 day outage
- Eliminates the need to stock spare module assembly

Benefits of Flexible Lease Program

- Lease membership: Use of lease assets during major repair and unplanned outages
- Backup lease membership: Use of lease assets as a stand-in for spare engines
- Long-term lease: Long-term use of lease assets with option to buy at the end of the lease
- Benefits of a spare or operating engine without the capital investment
- Reduced engine downtime with two 2–3 day outages
- Payment tailored to your operations: Fired-hour-based lease-asset usage fees

STEAM TURBINES

Steam Turbine Repairs

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 blades, including impulse and reaction technology. For last stage blades (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.

Part Stocking Program

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

- L-0 and L-1 blades for a broad range of sizes, including D11 blades
- Valve internals for common main stop and control valves
- Valve parts that support GE's next gen ST valves
- Refurbished D11 diaphragms
- Refurbished D11 rotors

Onsite Services

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 help you meet and exceed your expectations, on budget. 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:

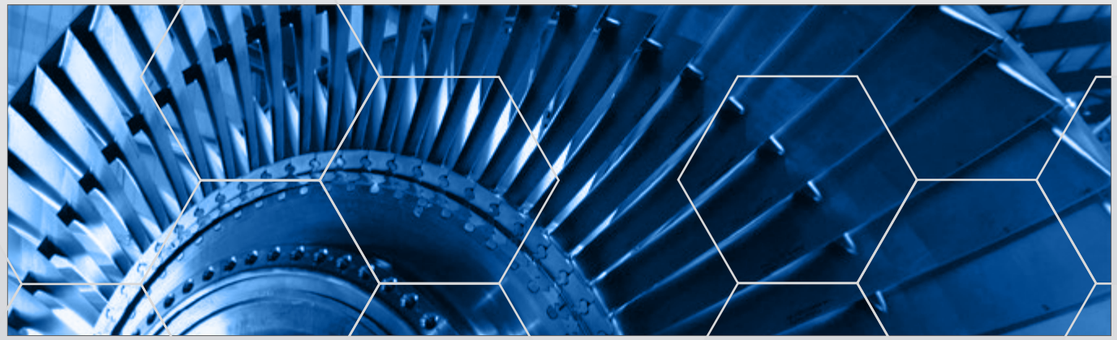
- Boresonic inspection of older bored rotors looks for indications of deterioration from the inside to the outside.
- Periphery ultrasonic testing for solid rotors examines the outside of the rotor for indications of potential issues.
- Phased array wheel dovetail testing looks for indications of stress 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
    - – Ultrasonic testing (UT) blade attachments (STG wheel dovetails)
    - – Magnetic particle testing (MT) blade 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

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.

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 blades 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 help ensure that maintenance is properly targeted and spare parts are always ready:



GENERATORS

Generator Health Monitoring

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

Available Technical Data Modules

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

GOLD* Service

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

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

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

Generator Offline Inspection

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 issues

Generator Test and Inspection Program

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.

CUPROPLEX*

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:

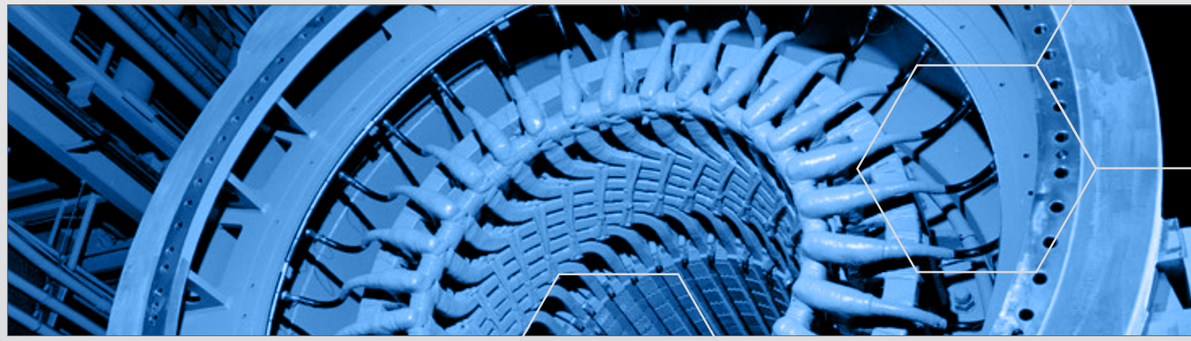
- No disassembly requirements
- Controlled process
- Reduced environmental impact—no hazardous liquid waste
- Return to full output in as little as two days

Onsite Repairs – A Repair Portfolio Built Around Your Critical Needs

By drawing on decades of configuration 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 of the sprayed metal, reducing rubbing effects between rotor shaft and oil seal rings
- On-site stator core repair Prosthesis – Alternative technology to partial core ends restacking



GAS TURBINE PARTS and REPAIRS

WHEN IT COMES TO REPLACEMENT PARTS, CUSTOMERS MAY HAVE MANY CHOICES. HERE'S WHY YOU SHOULD CHOOSE GE:

- **Genuine OEM-engineered and manufactured parts.** We supply top quality parts at a competitive price and delivery cycle. Current production parts are manufactured to our exacting OEM standards for installation into either new equipment or your existing equipment. We incorporate technology developments and improvements into each component while ensuring that each part fits into and functions integrally with existing GE equipment. We meet our own OEM standards through extensive analysis and testing, and by the continuous monitoring of raw materials, components, processes and systems.
- **Continuous innovation.** As the industry changes, so do our parts. We develop and deliver innovative solutions and upgrades that preserve or enhance the integrity of your asset. Every day, we work to develop new materials, coatings, controls, and technologies engineered to improve asset life and performance.
- **Expert knowledge and service.** Stay focused on your business objectives while our dedicated customer service professionals attend to your needs. With more than 100 years of technical expertise and fleet operability knowledge—including 8,600 installations—we know your equipment inside and out. And we maintain the component engineering drawings to prove it!
- **World-class support, everywhere.** Whether it's planned maintenance or an unplanned event, GE's trained professionals located nearby are ready to respond to your needs. Our global field service and engineering network can quickly access drawings, bills of material, and service records specific to your unit. Our experts can assist you with outage planning and recommend ways to improve reliability, availability, performance and emissions. And, we offer customized solutions that help you manage your operation and maintenance costs in a predictable, effective manner.
- **The part you need, when you need it.** Global facilities, a continuously replenished inventory of more than 10,000 individual parts, and a highly reliable supply chain mean GE can meet your demand like no other supplier. Using the latest logistics and information technologies, our service operations fulfills parts orders that are accurate, meet applicable requirements, and are delivered on-time.

With GE, you get the advantage and benefits of an OEM part. We can help improve your plant's performance, reliability, safety, and emissions and better control your operating and maintenance costs as your asset ages. Plus, you can incorporate technology improvements as we make them commercially available.

GAS TURBINE REPAIRS

With a vision of supporting one of the world's best running fleets, GE can keep your assets up and running with its standard repairs or, alternatively, you may choose our advanced repair technologies to extend component life or to improve maintenance intervals or efficiency.

GE's global network of repair shops is strategically located for agile responsiveness, tapping into regional compliance and regulatory expertise. Whether you are planning a major overhaul or simply need a minor replacement, GE's OEM advantage and expertise can help you more efficiently and effectively manage your repairs and inventory.

Heavy Duty Gas Turbine Offerings

PROGRAM	WHAT IT DOES	WHY GE?
PARTS EXCHANGE with an option for REFURBISHED PARTS	Exchange used GE parts for credit towards current or future purchase from GE for: • an upgrade or new spares • refurbished parts, pedigree backed by GE • exchange logistics managed by GE	• Reduce inventory costs • Enhance the value of part life • Flexibility... exchanged parts GE receives may be (A) fired or unfired or (B) repaired or unrepaired
ZERO-CYCLE REPAIRS	Steps to perform a zero-cycle repair are: 1. Specify the parts you want to be repaired 2. We quote replacement parts instead of repair 3. You send GE your parts to be repaired at the same time you buy and install the replacement parts	• Reduced inventory costs • Parts delivered just-in-time to meet your schedule • Capitalize your repairs • Enhance the value of part life
REPAIR OF THIRD-PARTY COMPONENTS	We may repair non-GE parts: 1. not originally manufactured by GE or 2. originally manufactured by GE that have been repaired by others	For your non-GE parts: • you have an option to obtain the value and quality of an OEM repair by GE
REPAIR FOR PERFORMANCE	Collaborate with GE to select the repair solution resulting in the performance outcome you want. We continually innovate and invest in repair technologies to provide you with different options.	• Improve part life and performance • Select an option that best fits your situation and needs

Aeroderivative Gas Turbine Offerings

PROGRAM	WHAT IT DOES	WHY GE?
ENGINE EXCHANGE	Exchange your engine with a new engine, a refurbished engine, or a partial-life engine right on your site. Save costs with GE's standard, condition-based overhaul work scope, where we bring down the premium price.	• Requires only a 2- to 3-day outage • Includes the largest engine exchange pool available • Offers a steady supply of new engines with the latest engineering improvements • Includes fully refurbished engines as a low-cost alternative • Offers an expanded partial life engine pool
MODULE EXCHANGE—ON-SITE REPAIR	Not near a GE service center or have a maintenance event that only involves limited modules? We exchange those modules right at your site or at a field service shop close to you.	• Lets you keep your engine to meet permitting requirements or to maintain the same engine serial number • Reduces outage duration (generally less than 5 days depending on the scope) • Supports both planned and unplanned repairs • Reduces your risk as GE assumes cost risk for large engine parts and flow path airfoil fall-out • Provides standard GE warranty coverage on hardware provided
MODULE EXCHANGE—SERVICE CENTER REPAIR	When on-site engine or module exchange is not an option, GE provides excellent turnaround time. Advance planning and scope definition are key to enhancing turnaround times using service center module exchange.	Delivers responsive turnaround times (60 days or less can be achieved with advance planning and supply chain alignment to help help ensure availability of parts and service center induction slots).
FIRM FIXED PRICE	If neither of the exchange options are suitable for you, and you prefer to keep your own engine and modules, we address any engine components that require repair or refurbishment. Firm-fixed price repair also covers the cost risk of airfoils, the more than 3,000 blades, vanes (or nozzles) and shrouds that are in the flow path of an engine. Airfoils have various levels of wear and tear, depending on many factors including age of the parts and the engine operation condition. Total prices for airfoils are in the multi-million US dollars. Replacing or repairing airfoils is always at the front and center of any engine overhaul or repair, largely impacting the total repair costs.	• Aims to improve your economics with firm-fixed price for the fastest possible turnaround time (based on scope) • Reduces your risk as GE assumes the full risk of large parts, removing your repair cost uncertainty
PARTIAL FIXED PRICE or TIME AND MATERIALS REPAIR	If you are not cost risk-averse and do not require a quick turnaround from the service center, time and material repairs may be right for you. Scrap risk is not transferred to GE and your final invoice is based on the actual time and material required to repair your engine. Because time and materials repair can lead to potential commercial and technical delays for negotiation and decision making during the event, GE also offers a partial firm-fixed price repair under some circumstances. Typically, the fixed price portion will cover a defined work scope with you assuming full responsibility for replacement of any unrepairable material, work scope expansion, and service bulletin compliance at time and material rates.	• Avoids some commercial and technical delays • Reduces turnaround times due to advance planning and scope definition • Smooths supply chain alignment as well as availability of parts and service center induction slots

REPOWER and RELOCATION SERVICES

REPOWER

With GE's RePower service, customers can achieve significant performance improvements in output and fuel efficiency and add years of profitability and life to a power plant by means of a gas turbine flange-to-flange upgrade. With more than 100 successfully completed projects across all frame sizes and on five continents, GE has the proven capability and experience to craft the right solution to keep a plant running at its peak potential. GE can RePower existing GE assets or non-GE assets much faster than the time it takes to install a new unit. The flange-to-flange upgrade is a full replacement of an engine within the footprint of an existing gas turbine, utilizing the existing balance-of-plant assets. Such enhancements can be undertaken within reduced outage times, allowing fleet managers to decrease overall downtime while:

- Addressing multiple asset improvements in one simple upgrade
- Reducing emissions to comply with the latest regulations
- Increasing profitability by improving your gas turbine and plant efficiency, reliability, availability, and output
- Retaining or even increasing existing levels of exhaust energy as needed for thermal load, such as with CHP (combined heat and power) and district heating customers
- Extending maintenance intervals with newer, more durable components
- Allowing owners the option to make additional changes, such as migrating to dual fuel or alternative fuel systems

PLANT REHABILITATION and RELOCATION

Plant rehabilitation and relocation provides operators with a fast track to reliable power supply, combining 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.

Aero TruePackage:

The only GE authorized certified pre-owned package offering in the industry. Aero TruePackage offers used/refurbished aeroderivative gas turbine packages improved by GE's engineered systems, components, upgrades and digital solutions.

GE and WattStock collaborate to select the best available equipment

GE selects the gas turbine to best meet your operating profile (new / fully overhauled)

Work scope adapted to help meet project needs

WattStock refurbishes package in accordance with GE standards

GE provides equipment certification and warranty

Advantages:

- 30% cost reduction compared with a new installation
- One-year OEM warranty and equipment performance guantees
- Delivered in eight months or less
- Equipment selection and refurbishment plan driven by installed cost
- OEM certification can improve financing options and insurance premiums
- GE and WattStock co-located in HoustonTX service center

CROSS-FLEET SERVICE SOLUTIONS

UNLOCK THE POTENTIAL OF YOUR PLANT WITH THE TECHNOLOGY, EXPERTISE AND RESOURCES OF A LEADING POWER GENERATION OEM, AVAILABLE FOR A WIDE RANGE OF EQUIPMENT BRANDS AND MODELS

- **125+** years of power generation services experience
- Plant solutions for **90+** OEM brands
- **5,500+** engineers globally
- **15+** repair shops in **10+** countries
- **3,200+** monitored gas plant assets across numerous OEMs
- **24/7** Monitoring and Diagnostics

GE CAN SUPPORT MAINTENANCE FOR MORE THAN 90 OEM BRANDS ACROSS ALL MAJOR PLANT ASSETS WITH UPGRADES AVAILABLE FOR SELECT NON-GE GAS TURBINES THAT PROVIDE OPPORTUNITY FOR SIGNIFICANT PERFORMANCE IMPROVEMENT:

Hardware/parts using GE proprietary coatings and alloys, engineered for reliability and performance and produced using established manufacturing infrastructure and supply chain

Experienced field execution teams performing work following GE standards and protocols for quality and safety

Access to GE's repair network, ensuring global reach and local presence

Digital solutions that harness insights from one of the world's largest fleets of monitored gas plant assets across multiple brands, and the analysis of 120+ million hours of operating data

Multi-year agreements (MYA) provide value and help you to manage risk over the lifetime of your assets, regardless of configuration or OEM asset mix

GAS TURBINE SOLUTIONS

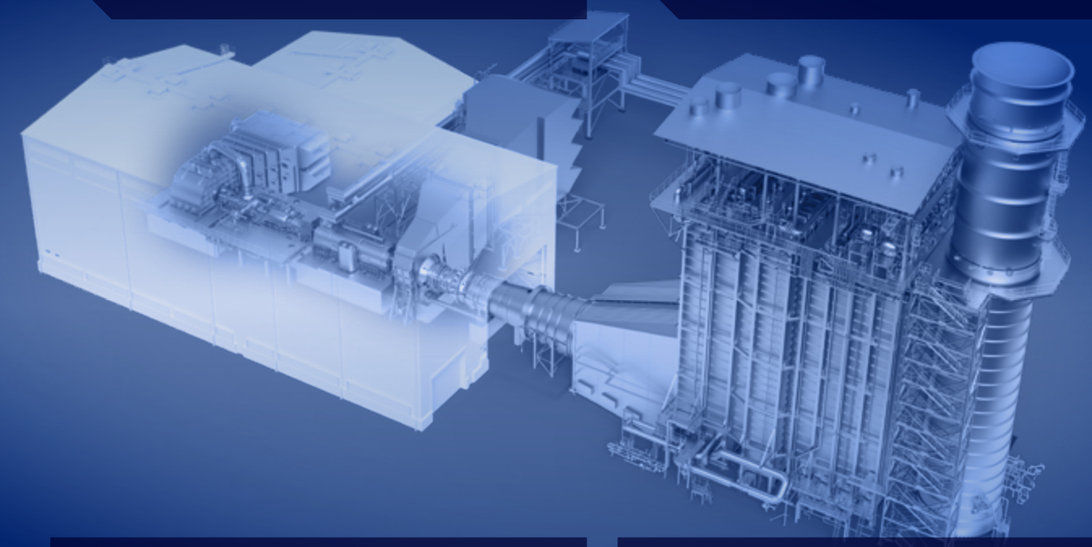
Gas turbine upgrades and comprehensive maintenance for SGT-800†, SGT6-5000F† and 501F‡ gas turbines

- Upgrades using patented and proprietary GE coatings, alloys and configurations that improve maintenance intervals, efficiency, and output
- Planned and unplanned maintenance supported by dedicated, experienced engineering and field support teams
- More than 25 outages completed over the past 5 years across various cross-fleet gas turbine configurations
- Localized repair services as part of the GE global network of repair facilities

STEAM TURBINE SOLUTIONS

Steam turbine upgrades for 80+ OEMs including: Siemens, KWU, Westinghouse, Toshiba, MHI, and LMZ

- Technical support through lifetime assessments and MYAs
- Field service for minor and major overhauls
- Parts solutions, including re-engineering, engineering improvements improvement, and supply
- Simple and complex repairs and mobile machining
- Balance-of-plant assessment and upgrades
- Advanced steam path and Next Gen Valve upgrades to replace the original equipment



GENERATOR SOLUTIONS

Service capability for generators across 30 OEM brands, including: Siemens, Ansaldo, BHEL, Brush, Dongfang, MHI, and Hitachi

- Sensor monitoring of equipment operation to support condition-based maintenance
- Robotic inspections—without the need for field removal—to reduce outage time and lower maintenance costs
- Stator and rotor rewinds for all conventionally cooled gas turbine generators within a C-inspection
- Zero cycle time maintenance with off-the-shelf parts
- Large generators upgrades to extend output and operating life at Combined Cycle power plants

HEAT RECOVERY STEAM GENERATOR (HRSG) AND BOILER SOLUTIONS

GE's HRSG solutions support all OEM brands, including Vogt, Babcock, CMI, Nooter Eriksen, Foster Wheeler, AC Boilers and Stork

- Pressure Parts replacement and non-Pressure Parts/ Hot Gas Path Upgrades
- PressureWave+* cleaning
- Inspection services and site Repairs
- HRSG Life Monitor and Anomaly Detection

† SGT-800 and SGT6-5000F are Trademarks of Siemens Corporation
‡ 501F is a Trademark of Mitsubishi Power Corporation

DIGITAL and CONTROLS

“

PROTECTING, CONTROLLING, AND MONITORING THE PLANT IS CRITICAL TO OPTIMIZING PERFORMANCE AND OPERABILITY

”

DIGITAL and CONTROL SOLUTIONS

A radically changing energy landscape is bringing a unique set of challenges and opportunities for power generators. The growth of renewables means changing operating models, as well as priorities, with an increased focused on generation agility and profitability pressures. How this shift towards more renewables impacts plants can depend on decisions in the control of utilities and independent power producers (IPP). A new normal for operations has emerged, one with more centralized operations centers and more remote workers, along with a rise in automation that demands a different skillset. Additionally, an evolving workforce means reshaping an approach to safety, priority, and productivity—and rethinking resourcing along the way. Indeed, optimal developments make it possible to maximize revenue in this dynamic environment. So, how can you survive and thrive in this new environment? We have answers!

A Complete Solutions Portfolio from GE

We understand the need to take a holistic and integrated approach to power generation success—covering assets, operations and people—and that's why our digital and control solutions are created to help you:

- Secure and operate critical equipment with confidence
- Enhance equipment reliability and O&M efficiency
- Increase operations flexibility and profitability
- Boost worker effectiveness and safety
- Reduce obsolescence risk with extended controls lifecycle

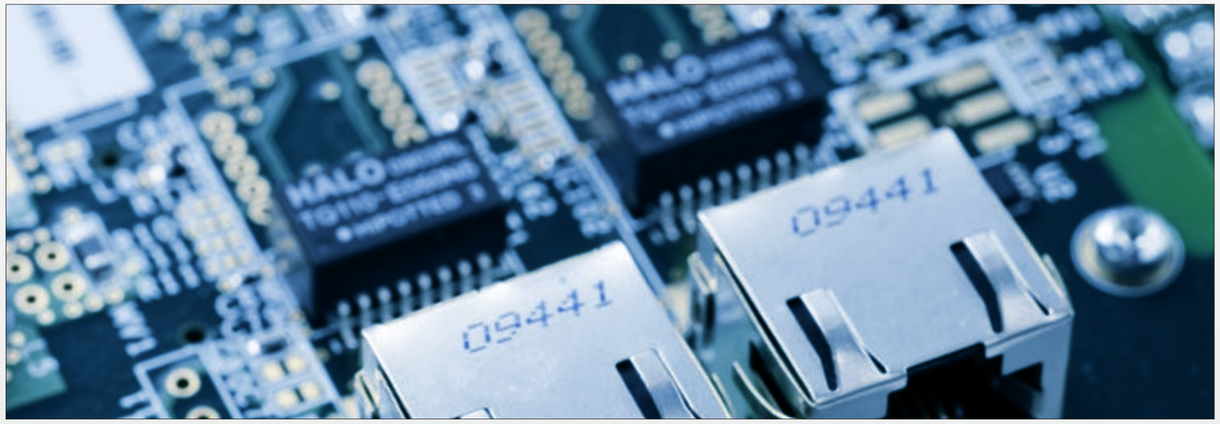
These solutions embody deep GE experience and extensive expertise culminating into a unique inter-operable solution stack for power plants. Building on a solid foundation of technology, Digital Twins and other advanced analytics from edge to cloud, GE offers a range of integrated solutions that are robust, flexible, and effective. We deliver solutions from the smallest sensors to mission-critical operator control systems, to a full suite of industrial software applications for your entire fleet.

OUR INTEGRATED CONTROL SOLUTIONS

Enhance your uptime and improve your output with our tightly integrated plant control solutions that deliver robust process control with seamless connectivity and real-time information management. And our industrial application software helps you monitor and optimize assets, operations, and people to address marketplace dynamics and challenges associated with the energy transition.

Mark* VIe Turbine Controls (Gas and Steam)

Downtime is one of the greatest detriments to power plant productivity and profitability. That's why it's imperative to have a system in place that provides high levels of system reliability and availability—all day, every day. To help meet the needs of today's connected industries, GE has combined our digital leadership with our rich history of process control to deliver the Mark VIe series of control systems.



OpFlex*

What if you could immediately improve the value of your plant's newly installed units, or boost the performance of your existing hardware without performing a major outage?

The OpFlex suite of software, takes advantage of state-of-the-art controls technology with advanced software algorithms to enhances operability, performance, insight, and control of new or existing assets so you can respond quickly and confidently to new opportunities and changing demand. With solutions targeting start-up agility, combustion versatility, load flexibility and system reliability, OpFlex can deliver whatever solution is needed to help keep your plant competitive in an ever-changing marketplace.

Generator Controls

GE's Excitation and Starter control systems enable customers to prepare for the energy transition with improved responsiveness and sensitivity to grid disturbances. Our advanced high-speed detection and control algorithms (EED) provide early event detection enabling generation assets with faster response to changing grid needs such as frequency swings or voltage dips. We offer a full range of solutions for generator excitation systems covering most generator sizes and types. From small automatic voltage regulator systems to large static exciters, our excitation solutions leverage more than 50 years of industry experience and an installed base of over 10,000 units in 70 countries across gas, steam, and hydro applications. We also offer static starters that can be used as the starting means for gas turbines. One starter can start multiple units or you can cross connect two starters to start your unit of choice.

Mark VIe Safety Controls

A convergence of increasing connectivity and improved safety, and the associated risks to infrastructure and processes, is occurring just as a generation of skilled workers is retiring. This combination of factors has resulted in more stringent safety regulations and system certification requirements as well as greater scrutiny of program and operator integrity. Our Mark VIeS Functional Safety System can help meet your need for a high-performance automation solution that also helps help ensure the safety and integrity of your process and equipment.

Distributed Control Systems

Helping to provide advanced performance, interoperability, and availability for today's connected plant, GE's distributed control system solutions are easily adapted to your constantly evolving requirements and integrate seamlessly to the gas, steam, and generator controllers for a total plant solution. With integrated plant and unit controllers, performance and operability can be maximized without operational complexity. In addition, this common data fabric provides a single source of truth, open communication protocols and common date/time stamping across the whole plant from turbine to generator to HRSG to BOP systems... making troubleshooting a breeze. O&M teams will benefit from common operator screens, historical data, and alarms all from one system.

HMI Solutions

Your plant is a huge investment that requires routine maintenance and upgrades to keep it running efficiently, safely, and profitably. If you're running an older HMI operating platform, your business is at risk of cyberattacks and the associated lost revenue. As the OEM for your existing HMI, GE knows your equipment. Our latest advanced HMI solution will provide advanced features such as alarm rationalization and action-oriented visualization to help operate your plant securely for many years to come.

OUR INTELLIGENT DIGITAL SOLUTIONS

GE provides a rich array of applications and solutions to help you maximize the performance and profitability of your assets, operations and people. Powered by unique Digital Twin analytics and built-in intelligence, these applications are supported by other foundational GE products and services to create a complete end-to-end solution.

Asset Performance Management (APM)

APM software helps generators optimize plant-wide equipment reliability and overall O&M efficiency. With built-in GE Twin analytics, a full view of asset health, activity tracking, and work process automation, APM is engineered to be the backbone of modern power generation operations and maintenance activities.

Operations Performance Management (OPM)

OPM software provides analytics-driven insights to drive profitable operations and planning decisions. Performance intelligence tools and optimizers help staff operate equipment more efficiently while production planning tools help managers drive profitability using real-time knowledge of plant capacity, schedules and fluctuating marketplace demands.

Industrial Managed Services (IMS)

The IMS organization provides a full range of services for APM and OPM customers. Services for 24x7 monitoring, issue triage and notification, remediation guidance, analytics management, and strategy consulting, are available with software purchase/subscription or as a turnkey outsourced offering. IMS teams monitor over 5000 assets around the globe, saving customers more than $1.5 Billion USD.

Remote Operations

Remote Operations software provides remote and mobile workers with secure and compliant access to plant control systems. Whether for monitoring, troubleshooting or full remote control, Remote Operations helps you help ensure operating continuity, enable worker location flexibility and benefit from the economies of centralized operations across the plant or entire fleet.

Outage Planning & Analytics (OPA)

OPA is a unified application to plan, schedule, and execute plant outages. Using comprehensive data, analytics and tools, cross-functional teams can build optimal programs that execute on time. OPA was developed jointly with a leading generation company to directly address the goals of minimizing outage costs, duration and revenue loss across the fleet.

Historian

Proficy Historian collects real-time industrial data, providing rich intelligence tools and supplying critical data to industrial applications. With a proven secure and scalable architecture, Proficy Historian is the foundation of plant digitization for thousands of customers worldwide.

Cybersecurity

For more than 70 years, GE has been working in power generation environments, developing an unmatched level of expertise to detect areas of vulnerability and identify where they can be secured. Our suite of cybersecurity solutions includes Baseline Security Center, which provides security controls and OT maintenance tools for both GE and non-GE control networks. Additionally, we can help with site assessments, training, and software packages that can deliver the security your plant needs.

Additional Digital Solutions

GE offers many additional products and services that may be part of your total solution. Our cloud products are available for data management, analytics, security and scalability.

APPENDIX

APPENDIX

HEAVY DUTY GAS TURBINES

		50/60 Hz (Geared)			50 Hz	
		6B.03	6F.01	6F.03	9E.03	9E.04
SC PLANT PERFORMANCE	SC Net Output (MW)	45	57	88	132	147
	SC Net Heat Rate (Btu/kWh, LHV)	10,216	8,975	9,277	9,960	9,238
	SC Net Heat Rate (kJ/kWh, LHV)	10,779	9,469	9,788	10,508	9,747
	SC Net Efficiency (%, LHV)	33.4%	38.0%	36.8%	34.3%	36.9%
GAS TURBINE PARAMETERS	Compression Pressure Ratio (X:1)	12.8	22.3	16.4	13.1	13.2
	Exhaust Temperature (°F)	1,041	1,136	1,151	1,022	1,016
	Exhaust Temperature (°C)	561	613	622	550	547
	Exhaust Mass Flow (lb/s)	319.9	295.9	482.4	929.3	925.1
	Exhaust Mass Flow (kg/s)	145.1	134.2	218.8	421.5	419.6
	GT Turndown Minimum Load (%)	30%	40%	35%	35%	35%
	GT Ramp Rate (MW/min)[1]	20	12	22	50	29
	NOx (ppmvd) at Baseload (@15%O_2)	4	25	15	25	15
	CO (ppm) at Min Turndown w/o Abatement	25	9	9	5	25
	Startup Time, Conventional/Peaking (Min)[2]	12/10	23/10	13/10	30/10	30/10
1X CC PLANT PERFORMANCE	CC Net Output (MW)	70	84	135	205	218
	CC Net Heatrate (Btu/kWh, LHV)	6,578	5,980	5,998	6,421	6,203
	CC Net Heatrate (kJ/kWh, LHV)	6,940	6,309	6,328	6,775	6,545
	CC Net Efficiency (%)	51.9%	57.1%	56.9%	53.1%	55.0%
	Plant Turndown Minimum Load (%)	41%	39%	44%	45%	46%
	Ramp Rate (MW/min)[1]	20	12	7	50	29
	Startup Time (RR Hot, Minutes)[3]	30	30	45	38	38
	Bottoming Cycle Type	2PNRH	3PRH	3PRH	2PNRH	2PNRH
	ST Configuration (Type)	STF-A100	STF-A100	STF-A200	STF-A200	STF-A200
2X CC PLANT PERFORMANCE	CC Net Output (MW)	141	170	272	412	439
	CC Net Heat Rate (Btu/kWh, LHV)	6,515	5,932	5,944	6,372	6,166
	CC Net Heat Rate (kJ/kWh, LHV)	6,874	6,259	6,271	6,723	6,505
	CC Net Efficiency (%, LHV)	52.4%	57.5%	57.4%	53.5%	55.3%
	Plant Turndown – Minimum Load (%)	20%	19%	21%	22%	22%
	Ramp Rate (MW/min)[1]	40	24	13	100	58
	Startup Time (RR Hot, Minutes)[3]	30	30	35	38	38
	Bottoming Cycle Type	2PNRH	3PNRH	3PNRH	2PNRH	2PNRH
	ST Configuration (Type)	STF-A200	STF-A200	STF-A200	STF-D200	STF-D200

50 Hz						
GT13E2-190	GT13E2-210	9F.03	9F.04	9F.05	9HA.01	9HA.02
195	210	265	288	314	448	571
8,872	8,980	9,020	8,810	8,846	7,960	7,740
9,361	9,474	9,517	9,295	9,333	8,398	8,166
38.5%	38.0%	37.8%	38.7%	38.6%	42.9%	44.0%
17.6	18.2	16.7	16.9	18.3	22.8	23.8
956	959	1,104	1,150	1,170	1,199	1,184
513	515	596	621	632	648	640
1,248.4	1,370.4	1,466.2	1,459.0	1,572.7	1,869.0	2,292.5
566.3	621.6	665.1	661.8	713.4	847.8	1,039.9
20%	30%	35%	35%	35%	25%	25%
12/24	14/36	22	23	26	65	88
15	15	15	15	25	25	25
25	25	24	24	24	9	9
25/15	25/15	23/20	23/20	25/25	23/	23/
280	305	412	443	493	680	838
6,172	6,189	5,778	5,666	5,619	5,356	5,320
6,512	6,530	6,096	5,978	5,928	5,651	5,613
55.3%	55.1%	59.1%	60.2%	60.7%	63.7%	64.1%
28%	40%	46%	48%	43%	33%	33%
12	14	22	22	26	65	88
30	30	30	30	30	<30	<30
2PNRH	2PNRH	3PRH	3PRH	3PRH	3PRH	3PRH
STF-A200	STF-A200	STF-D650	STF-D650	STF-D650	STF-D650	STF-D650
563	613	825	889	989	1,363	1,680
6,137	6,153	5,764	5,649	5,603	5,345	5,306
6,475	6,492	6,081	5,960	5,911	5,639	5,598
55.6%	55.5%	59.2%	60.4%	60.9%	63.8%	64.3%
14%	19%	21%	22%	20%	15%	15%
24	28	44	44	52	130	176
30	30	39	39	39	<30	<30
2PNRH	2PNRH	3PRH	3PRH	3PRH	3PRH	3PRH
STF-D200	STF-D200	STF-D650	STF-D650	STF-D650	STF-D650	STF-D650

[1] Ramp rates are Fast Ramp via AGC.

[2] Start times recognize purge credit. Turning gear to full speed, full load and synchronized to grid. Peaking maintenance factors may apply depending on the operating profile.

[3] Start times are based on rapid response technologies in hot start conditions with purge credit recognized. Simultaneous start sequence of gas turbine may apply depending on exact project configurations.

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
All performance figures based on once through condenser with 1.2" Hga condenser pressure. 2PNRH = Two pressure, non-reheat; 3PRH = Three pressure, reheat.

HEAVY DUTY GAS TURBINES (cont.)

60 Hz

		7E.03	7F.04	7F.05	7HA.01	7HA.02	7HA.03
SC PLANT PERFORMANCE	SC Net Output (MW)	90	201	239	290	384	430
	SC Net Heat Rate (Btu/kWh, LHV)	10,107	8,873	8,871	8,120	8,009	7,884
	SC Net Heat Rate (kJ/kWh, LHV)	10,664	9,362	9,359	8,567	8,450	8,318
	SC Net Efficiency (%, LHV)	33.8%	38.5%	38.5%	42.0%	42.6%	43.3%
GAS TURBINE PARAMETERS	Compression Pressure Ratio (X:1)	12.7	17.0	18.8	21.6	23.1	23.7
	Exhaust Temperature (°F)	1,018	1,158	1,205	1,158	1,202	1,217
	Exhaust Temperature (°C)	588	626	652	626	650	658
	Exhaust Mass Flow (lb/s)	644.0	1,028.6	1,163.9	1,293.7	1,609.4	1,718.0
	Exhaust Mass Flow (kg/s)	292.1	466.6	527.9	586.8	730.0	779.3
	GT Turndown Minimum Load (%)	35%	49%	43%	25%	25%	25%
	GT Ramp Rate (MW/min)[1]	40	30	40	55	60	75
	NOx (ppmvd) at Baseload (@15%O_2)	4	9	12	25	25	25
	CO (ppm) at Min Turndown w/o Abatement	25	9	9	9	9	9
	Startup Time, Conventional/Peaking (Min)[2]	23/10	21/11	21/11	21/10	21/10	21/10
1X CC PLANT PERFORMANCE	CC Net Output (MW)	140	309	379	438	573	640
	CC Net Heatrate (Btu/kWh, LHV)	6,514	5,716	5,667	5,481	5,381	5,342
	CC Net Heatrate (kJ/kWh, LHV)	6,873	6,031	5,979	5,783	5,677	5,636
	CC Net Efficiency (%)	52.4%	59.7%	60.2%	62.3%	63.4%	63.9%
	Plant Turndown Minimum Load (%)	45%	58%	46%	33%	33%	33%
	Ramp Rate (MW/min)[1]	40	30	40	55	60	75
	Startup Time (RR Hot, Minutes)[3]	35	28	25	<30	<30	<30
	Bottoming Cycle Type	2PNRH	3PRH	3PRH	3PRH	3PRH	3PRH
	ST Configuration (Type)	STF-A200	STF-D650	STF-D650	STF-D650	STF-D650	STF-D650
2X CC PLANT PERFORMANCE	CC Net Output (MW)	283	622	762	880	1,148	1,282
	CC Net Heat Rate (Btu/kWh, LHV)	6,454	5,675	5,640	5,453	5,365	5,331
	CC Net Heat Rate (kJ/kWh, LHV)	6,809	5,987	5,951	5,753	5,660	5,625
	CC Net Efficiency (%, LHV)	52.9%	60.1%	60.5%	62.6%	63.6%	>64.0%
	Plant Turndown – Minimum Load (%)	22%	27%	22%	15%	15%	15%
	Ramp Rate (MW/min)[1]	80	60	80	110	120	150
	Startup Time (RR Hot, Minutes)[3]	35	28	25	<30	<30	<30
	Bottoming Cycle Type	2PNRH	3PRH	3PRH	3PRH	3PRH	3PRH
	ST Configuration (Type)	STF-D200	STF-D650	STF-D650	STF-D600	STF-D600	STF-D650

[1] Ramp rates are Fast Ramp via AGC.

[2] Start times recognize purge credit. Turning gear to full speed, full load and synchronized to grid. Peaking maintenance factors may apply depending on the operating profile.

[3] Start times are based on rapid response technologies in hot start conditions with purge credit recognized. Simultaneous start sequence of gas turbine may apply depending on exact project configurations.

NOTE: All ratings are net plant, based on ISO conditions and natural gas fuel. Actual performance will vary with project-specific conditions and fuel.
All performance figures based on once through condenser with 1.2" Hga condenser pressure. 2PNRH = Two pressure, non-reheat; 3PRH = Three pressure, reheat.

AERODERIVATIVE GAS TURBINES†

		TM2500		LM2500 DLE		LM2500+ DLE		LM2500+G4 SAC	
	Frequency	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
SC PLANT PERFORMANCE	SC Net Output (MW)	34.6	37	22.2	22.9	30.5	31.4	34.4	37.2
	SC Net Heat Rate (Btu/kWh, LHV)	9,783	9,333	9,920	9,557	9,356	8,959	9,819	9,286
	SC Net Heat Rate (kJ/kWh, LHV)	10,321	9,846	10,466	10,083	9,871	9,452	10,359	9,797
	SC Net Efficiency (%, LHV)	34.9%	36.6%	34.4%	35.7%	36.5%	38.1%	34.8%	36.7%
GAS TURBINE PARAMETERS	Compression Pressure Ratio (X:1)	26.2	26.3	19.3	19.1	25.0	24.5	26.2	26.3
	Exhaust Temperature (°F)	978	962	1,033	1,012	998	975	978	962
	Exhaust Temperature (°C)	526	517	556	545	537	524	526	517
	Exhaust Mass Flow (lb/s)	206.2	205.9	150.2	149.6	195.8	192.6	206.2	205.9
	Exhaust Mass Flow (kg/s)	93.5	93.4	68.1	67.9	88.8	87.4	93.5	93.4
	GT Turndown Minimum Load (%)	50%	50%	50%	50%	50%	50%	50%	50%
	NOx (ppmvd) at Baseload (@15%O_2)	25	25	25	25	25	25	25	25
	CO (ppm) (@15%O2)[1]	58	58	25	25	25	25	58	58
	Startup Time, Conventional/Peaking (Min)	5	5	5	5	5	5	5	5
1X CC PLANT PERFORMANCE	CC Net Output (MW)	49.2	51.1	33.3	33.5	44.2	44.0	49.1	51.3
	CC Net Heat Rate (Btu/kWh, LHV)	6,870	6,753	6,581	6,510	6,441	6,253	6,884	6,727
	CC Net Heat Rate (kJ/kWh, LHV)	7,248	7,125	6,943	6,869	6,795	6,597	7,263	7,098
	CC Net Efficiency (%)	49.7%	50.5%	51.9%	52.4%	53.0%	54.6%	49.6%	50.7%
	Plant Turndown – Minimum Load (%)	35%	36%	33%	34%	34%	35%	35%	36%
	Ramp Rate (MW/min)	30	30	30	30	30	30	30	30
	Startup Time (RR Hot, Minutes)	30	30	30	30	30	30	30	30
	Bottoming Cycle Type	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH
	ST Configuration (Type)	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing
2X CC PLANT PERFORMANCE	CC Net Output (MW)	99.2	103.1	67.2	67.7	89.2	88.8	99.0	103.5
	CC Net Heat Rate (Btu/kWh, LHV)	6,814	6,698	6,528	6,447	6,386	6,210	6,829	6,676
	CC Net Heat Rate (kJ/kWh, LHV)	7,189	7,067	6,887	6,802	6,737	6,551	7,205	7,043
	CC Net Efficiency (%, LHV)	50.1%	50.9%	52.3%	52.9%	53.4%	54.9%	50.0%	51.1%
	Plant Turndown – Minimum Load (%)	35%	35%	17%	17%	18%	18%	18%	18%
	Ramp Rate (MW/min)	60	60	60	60	60	60	60	60
	Startup Time (RR Hot, Minutes)	30	30	30	30	30	30	30	30
	Bottoming Cycle Type	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH
	ST Configuration (Type)	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing

LM2500+G4 DLE		LM2500XPRESS+G4 UPT DLE		LM2500XPRESS+G5 UPT DLE		LM6000 PC	LM6000 PC SPRINT
50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50/60 Hz	50/60 Hz
33.0	34.1	33.9	34.3	36.3	37.1	46.6	51.1
9,291	8,827	8,861	8,749	8,884	8,711	8,533	8,576
9,802	9,312	9,348	9,230	9,373	9,190	9,002	9,048
36.7%	38.7%	38.5%	39.0%	38.4%	39.2%	40.0%	39.8%
25.5	25.0	25.0	24.9	25.6	25.8	31.4	32.7
1,023	994	996	989	1,026	1,018	831	846
550	534	535	532	552	548	444	452
204.7	201.3	200.8	200.3	204.3	205.8	282.3	289.0
92.9	91.3	91.1	90.9	92.7	93.3	128.1	131.1
50%	50%	50%	50%	50%	50%	11%	11%
25	25	25	25	25	25	25	25
25	25	25	25	25	25	89	89
5	5	5	5	5	5	5	5
47.9	48.0	47.7	47.8	51.2	51.9	60.3	66.5
6,368	6,253	6,250	6,223	6,241	6,178	6,571	6,607
6,719	6,597	6,594	6,566	6,585	6,518	6,932	6,971
53.6%	54.6%	54.6%	54.8%	54.7%	55.2%	51.9%	51.6%
34%	35%	34%	35%	34%	35%	19%	19%
30	30	30	30	30	30	50	50
30	30	30	30	30	30	30	30
2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH
Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing
96.7	96.5	96.2	96.4	103.3	104.6	121.1	133.6
6,315	6,215	6,200	6,174	6,192	6,129	6,541	6,579
6,662	6,558	6,542	6,514	6,533	6,467	6,902	6,941
54.0%	54.9%	55.0%	55.3%	55.1%	55.7%	52.2%	51.9%
17%	18%	17%	18%	17%	18%	19%	19%
60	60	60	60	60	60	100	100
30	30	30	30	30	30	30	30
2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH
Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing

[1] At baseload/minimum turndown without abatement

NOTE: Gas turbine ratings are at the generator terminals; 15°C (59°F), 60% relative humidity; unity power factor, natural gas, inlet, and exhaust losses excluded. Plant ratings are on a net plant basis; 15°C (59°F), 60% relative humidity; 0.8 power factor, natural gas, inlet, and exhaust losses included. Actual performance will vary with project-specific conditions and fuel. 2PNRH = Two pressure, non-reheat.

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AERODERIVATIVE GAS TURBINES (cont.)†

		LM6000 PG	LM6000 PG SPRINT	LM6000 PF	LM6000 PF SPRINT	LM6000 PF+	LM6000 PF+ SPRINT	LM9000		LMS100 PA+		LMS100 PB+	
	Frequency	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
SC PLANT PERFORMANCE	SC Net Output (MW)	56.0	57.2	44.7	50.0	53.9	57.1	72.3	72.7	113.0	115.8	106.5	107.5
	SC Net Heat Rate (Btu/kWh, LHV)	8,728	8,817	8,248	8,244	8,357	8,372	8,370	8,386	7,935	7,773	8,017	7,977
	SC Net Heat Rate (kJ/kWh, LHV)	9,208	9,302	8,702	8,697	8,817	8,832	8,830	8,847	8,371	8,201	8,458	8,416
	SC Net Efficiency (%, LHV)	39.1%	38.7%	41.4%	41.4%	40.8%	40.8%	40.8%	40.7%	43.0%	43.9%	42.6%	42.8%
GAS TURBINE PARAMETERS	Compression Pressure Ratio (X:1)	34.9	35.2	31.1	33.0	34.3	35.9	38.7	38.6	44.6	44.5	44.4	44.2
	Exhaust Temperature (°F)	893	896	864	864	930	912	879	877	786	777	789	786
	Exhaust Temperature (°C)	478	480	462	462	499	489	470	469	419	414	420	419
	Exhaust Mass Flow (lb/s)	306.9	307.9	279.6	290.5	309.2	319.8	440.9	437.5	500.1	498.5	499.4	498.6
	Exhaust Mass Flow (kg/s)	139.2	139.7	126.8	131.8	140.3	145.1	200.0	198.5	226.8	226.1	226.5	226.1
	GT Turndown Minimum Load (%)	9%	9%	50%	50%	50%	50%	50%	50%	16%	16%	50%	50%
	NOx (ppmvd) at Baseload (@15%O_2)	25	25	25	25	25	25	25	25	25	25	25	25
	CO (ppm) (@15%O2)[1]	59	59	25	25	25	25	25	25	85	83	200	200
	Startup Time, Conventional/Peaking (Min)	5	5	5	5	5	5	10	10	8	8	8	8
1X CC PLANT PERFORMANCE	CC Net Output (MW)	73.9	75.5	58.8	65.2	72.4	76.0	95.7	95.9	134.5	135.3	127.0	128.2
	CC Net Heat Rate (Btu/kWh, LHV)	6,603	6,670	6,242	6,305	6,170	6,280	6,301	6,328	6,641	6,661	6,684	6,648
	CC Net Heat Rate (kJ/kWh, LHV)	6,966	7,037	6,585	6,653	6,510	6,626	6,648	6,677	7,006	7,027	7,052	7,014
	CC Net Efficiency (%)	51.7%	51.2%	54.7%	54.1%	55.3%	54.3%	54.1%	53.9%	51.4%	51.2%	51.0%	51.3%
	Plant Turndown – Minimum Load (%)	19%	19%	37%	37%	37%	37%	37%	37%	13%	13%	13%	13%
	Ramp Rate (MW/min)	50	50	50	50	50	50	50	50	50	50	50	50
	Startup Time (RR Hot, Minutes)	30	30	30	30	30	30	30	30	30	30	30	30
	Bottoming Cycle Type	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH
	ST Configuration (Type)	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing
2X CC PLANT PERFORMANCE	CC Net Output (MW)	148.8	152.2	118.4	131.2	145.6	153.3	192.8	193.3	269.7	271.3	255.0	257.3
	CC Net Heat Rate (Btu/kWh, LHV)	6,563	6,623	6,197	6,265	6,134	6,228	6,254	6,278	6,621	6,641	6,658	6,627
	CC Net Heat Rate (kJ/kWh, LHV)	6,924	6,987	6,538	6,610	6,472	6,571	6,598	6,623	6,986	7,007	7,025	6,992
	CC Net Efficiency (%, LHV)	52.0%	51.5%	55.1%	54.5%	55.6%	54.8%	54.6%	54.4%	51.5%	51.4%	51.2%	51.5%
	Plant Turndown – Minimum Load (%)	19%	19%	19%	19%	18%	18%	19%	19%	6%	6%	6%	6%
	Ramp Rate (MW/min)	100	100	100	100	100	100	100	100	100	100	100	100
	Startup Time (RR Hot, Minutes)	30	30	30	30	30	30	30	30	30	30	30	30
	Bottoming Cycle Type	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH	2PNRH
	ST Configuration (Type)	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing	Condensing

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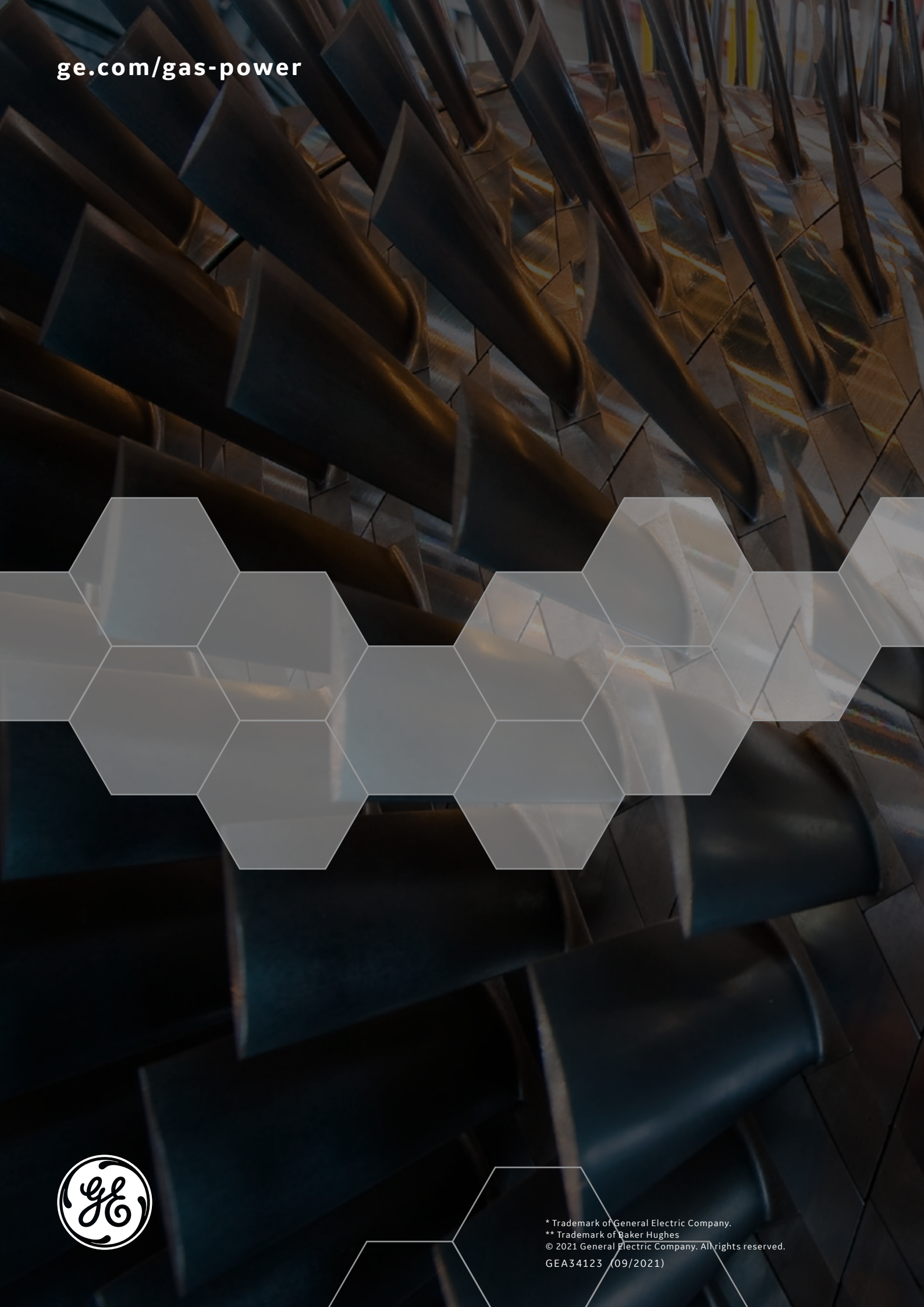

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