Rotating Machines

Modification and Upgrade Services
Outstanding services on synchronous and induction machines

Are electrical generators and motors crucial in your operation?

Having supplied thousands of electrical machines for well over a century, GE appreciates your equipment was a considerable investment that may have already exceeded its initial design life expectations. Keeping it well maintained in accordance with the recommended services schedule will prolong its life but what if you want more?

- More efficiency, lower fuel burn/reduced operating cost?
- More power, or lower starting requirements
- More reactive power to accommodate demand side loading
- More noise attenuation or revised code compliance
- A revised mix of attributes for altered circumstances

Already considering replacing your unit? As original equipment manufacturer, GE could go beyond your expectations, proposing a re-engineered solution improved by using current technology.

Modification or upgrade

Utilising our repository of design information, drawings and specifications alongside the insight that an original equipment manufacturer can provide, GE can not only assist in maintaining your equipment but can also support the re-engineering of components or assemblies – interchangeable with the original. These can deliver revised performance and a more economical route than complete machine replacement.

Rotors, stators and machines

The main assemblies of an electrical rotating machine are the rotor, the stator and the frame plus auxiliary equipment. Together we can explore the replacement of one or more of these components or assemblies to restore or even enhance the efficiency/power available to you.

At GE Power Conversion we have an integrated system approach, combining engineering expertise with our incomparable rotating machines knowledge base. Our fully engineered solutions can improve the power and/or efficiency of older machines. For both replacement machines and upgrades, we support you from start to finish with project management, application engineering, full design engineering, testing and technical direction of installation, commissioning and spare parts. The breadth of our experience spans most industries and sectors including marine, oil and gas, process, mining and metals, and power generation to name just a few. We can understand your application, appreciate your challenges and help get the highest performance possible from your equipment.

### Assembly | Typical options | Benefits
--- | --- | ---
Rotor | Integral tip rotor, Salient/solid pole, Laminated rotor, Squirrel cage | Inherently robust, High power density, High efficiency, Asynchronous choice
Stator | Vented stator, Pin vented stator | Older technology, Increased cooling/efficiency
Frame | Retain | Avoid unnecessary cost

It may even be possible to provide you with a revised temperature class of machine alongside rating changes.
Phased upgrades – Low risk, cost-effective

If you have installed GE equipment, our engineered solutions can enable a phased upgrade to next generation technology, without having to replace complete machines all at once. Benefits may include:

• Reduced total installed cost by saving the expense of purchasing, installing and commissioning an entirely new machine or system
• Reducing operating expense and increasing equipment reliability
• Extending life and mitigating obsolescence through phased installation and prolonged spare parts availability
• Reducing system operating downtime

Typical applications:
• Oil and Gas exploration, up-, mid- and downstream
• Marine - transport, offshore and naval
• Power generation – grid or island mode
• Power quality – synchronous condensers
• Industrial power generation or process operation
• Pulps and paper, paper machines, winders
• Metal lines e.g. roller table systems, process lines, mills
• Crane systems e.g. main hoists, gantry and trolley drives
• Mine winders and conveyors
• Hydro power schemes

A planned upgrade or modification can mitigate unplanned outages.

Rotor modification/upgrade

Rotor assembly replacement is the more straightforward of options. At a planned point, the replacement rotor can be swiftly substituted for the existing rotor using extraction equipment. The main machine bearings can be easily renewed at the same point in time.

A replacement rotor utilising today’s technology might be targeted towards providing higher efficiency (particularly important in “rotor limited” machines), a higher power/reactive power rating or even revised inertia. Over the years, technology improvements have been incorporated in rotor materials so the benefits can even include a revision of the rotor type, solid to laminated or vice versa.

Stator modification/upgrade

Stators may have the greatest influence on overall performance of the rotating electrical machine. A replacement stator utilising today’s technology might be targeted towards providing higher efficiency, revised output power or both. The stator replacement can be combined with a rotor replacement for added benefit.

Technology improvements in stator materials include insulating systems and the use of GE patented pin vent™ cooling scheme, all of which give advantages over older designs.

New stator coils can be fitted to an existing stator but the supply of a complete stator assembly can enable machine enhancement and may minimize downtime, accelerating your return on investment.
The GE OEM advantage

Utilising OEM design data

GE designed modification, upgrade or replacement solutions may be offered as “plug-&-play” through our OEM position and detailed understanding of the original design, performance and installation criteria, interfaces and limitations. Items such as generator foundations and axis line can be correctly assessed and integrated.

Even non-GE equipment may be optimized through up to date design and technologies available from GE.

Why?

All electrical machines including generators and motors age. Highly dependent on design and operating conditions, machines may easily provide more than 20-30 years of trouble free operation. However at this point it’s about time to take stock. Inspect the machine and consider its operating parameters/desired future use. This could suggest that the best way forward is through a planned modification or upgrade.

Ageing electrical machines can become less beneficial:

- Outdated technology is often less efficient than current
- Increased chance of breakdown and long, unplanned downtime
- More frequent repairs reduce availability and increase cost
- Greater vigilance/more inspections are advisable

Time

Deploying a replacement modified or upgraded assembly can help to minimize your downtime. Your choice of when.

Operating Cost

Even small efficiency improvements can reduce operating costs - whichever rates are considered. A straightforward payback evaluation demonstrates that investment is beneficial - for example, providing a 50MW generator with 0.2% better efficiency can increase electrical power output gaining $160k per year.

Prevention

Rotating equipment ages via TEAM stress (Thermal, Electrical, Ambient and Mechanical), potentially developing more frequent failures or a greater likelihood of failure later in life.

1. A PREDICTIVE monitoring and inspection program can detect issues early and highlight the need for an in-depth inspection and repair in a planned manner.
2. A PREVENTIVE inspection (either planned or by predictive maintenance recommendation) may address issues, providing planning is far enough in advance.
3. A REACTIVE approach is usually adopted once the damage has already occurred. Repairs will likely be more costly, and additional downtime costs may exceed those of installing a complete replacement machine.

Working together we can target the provision of services to best suit your operation and your equipment.
Failure mode | Ageing mechanisms (non exclusive) | MTTR* No spare | MTTR* Spare | Potential alternatives and costs* **
--- | --- | --- | --- | ---
Stator winding insulation | Thermal degradation, mechanical wear and fatigue, voltage stress, chemical change, contamination and partial discharges | 22w | 2w | Modified/upgraded stator at c50% of machine cost
Rotor winding insulation | Thermal ageing, insulation wear, cracking, migration, conductor deformation, conductive contamination & sparking | 36w | 2w | Modified/upgraded rotor at c50% of machine cost
Bearing | Vibration, deformation, friction, misalignment, mechanical fatigue and sparking | 12w | <1w | Replacement/upgraded bearing at c10% of machine cost
Exciter insulation | Ageing of rotor and stator insulation, as above, ageing of electronic components and sparking | 14w | <1w | Replacement/upgraded exciter at c10% of machine cost
Auxiliary & control equipment | Insulation ageing, dirt, vibration, overheating, corrosion, leaks, memory deterioration and calibration deviations | 2w | 2w | Replacement/upgraded auxiliary and control equipment at c20% of machine cost
Rotor mechanical components | Spark erosion, relaxation, journal damage, mechanical deformation, corrosion and vibration | 2w | 1w | Modified/upgraded rotor at c50% of machine cost
Stator magnetic core | Thermal degradation of insulation, loss of core pressure, fatigue of components and circulating currents | 22w | 2w | Modified/upgraded stator at c50% of machine cost

* Typical values to effect a repair in weeks  ** The removed original item might both separately and offline be refurbished/repaired, preserved and held as a future emergency spare replacement or be utilised as a rolling spare to complete the upgrade of several machines.
Working together on a modification or upgrade

Begin with the simplest information...
First and foremost, what would you like to achieve from a modification or upgrade? Perhaps you’d like to start with a performance audit?

Then to get underway, just let us know the:
• Manufacturer and serial number of your machine (ideally with a photo of your machine’s rating plate)
• Electrical parameters: V line, Hz, kW, kVA & pf, etc.
• Required industry standards and 3rd party approvals

We can then start to develop a solution together.

Availability

We appreciate that many rotating machines are planned to run continuously, 24 hours a day, 7 days a week. GE is there when and where you need us with:
• OEM expertise
• A local presence globally
• Installation and commissioning services
• Field engineering services
• Performance auditing
• Spare parts/exchange units/life-cycle services

Flexing GE’s knowledge and experience

Rest assured every aspect of your equipment runs smoothly when you put your trust in GE. From proposals onwards we can manage your project through to completion.

As a generator and motor OEM, GE is able to provide:
• In-depth product knowledge – We’ve been there at every step of the process from design to manufacturing to installation, commissioning and continued maintenance. No one has a better understanding of our products, not only as an individual component, but as part of a coordinated system.
• OEM data – We have unique access to invaluable information that includes: engineering drawings, operational performance data and a vast repairs database.
• Field and factory engineering resources working together to create proactive solutions to maintain, optimize, and extend key infrastructure assets.
• Genuine GE parts and repair services with factory approved testing—unlike non-GE providers

Local presence backed by a global organization

Our world-class Global Customer Service and Support Center is available 24/7, 365 days a year. We have strategic distribution centres and authorized distributors that carry inventory. We support your genuine replacement part needs any time or any place.

With a comprehensive global network of service engineers and technicians, GE is uniquely positioned to provide you with the knowledge, experience, and skills for the full range of your industrial service needs.

From system design to maintenance and outage support, GE has the resources and capabilities to assure that you are maximizing your equipment’s performance and reliability.

Single-source provider for start-up and commissioning of your GE equipment

Proper start-up and commissioning of rotating equipment is vital to the long-term health of an electrical system. Our Start-up and Commissioning Services provide the people and knowledge to complete the job right and on schedule. With GE Power Conversion Start-up and Commissioning Services, you can be assured that your equipment has been installed properly and meets the standards for operation.

Field engineering services

We offer a complete line of engineering services for:
• Planned and on-demand engineering
• Modifications and upgrades
• Appraisals and studies (see Auditing below)
• Project engineering
• GE onsite remote diagnostics
Performance auditing
Understanding the health of your equipment lets you plan maintenance, equipment upgrades and modifications to meet productivity objectives. A GE Equipment Performance Audit is a comprehensive review of the system and its ability to maintain performance levels.

Benefits include:
- Improving system operation and reliability
- Maximizing equipment capacity
- Prolonging equipment life
- Identifying opportunities to optimize equipment performance and spare parts inventory

Parts repair/replacement
Our flexible program lets you choose the solution that best fits your schedule and budget:
- Test and Certification – Affordable verification of inventory
- Repair/return – Cost effective if lead-time is not critical
- Exchange - Fastest method to receive reconditioned parts
- Remanufactured - Lower cost alternative to new parts
- New - Genuine OEM parts
- Life-cycle Solutions - Extend your GE equipment life with:
  - Scheduled GE Part/Service Reviews
  - Proactive Refurbishment Programs
  - Whole system services

Involved in the manufacture of high voltage electrical equipment and rotating machines since 1912
GEC, AEI, Alsthom, Cegelec, Alstom, Vickers Machines, English Electric, British Thompson Houston, Converteam

For more information, contact your local GE office:
- France +33 177312323
- Germany +49 69 66125588
- India +91 44 469 80008
- UAE +971 2 6994931
- UK +44 1788 563800
- USA +1 844 4374474
- China +86 400 021 5605
- ANZ +61 1300 193 189
Imagination at work