

GE
Grid Solutions

SERVICES

Optimizing Asset Reliability,
Up-Time and Performance



imagination at work

Electrical asset reliability and performance are key requirements for attaining customer business objectives and return-on-investment.

Part of achieving these objectives is ensuring that throughout their lifetime, electrical assets are operating optimally. More importantly, if critical challenges do arise where those assets are not performing as planned, it's imperative that customers have reliable and responsive technical subject matter experts with comprehensive and high quality services that provide on-demand support to address these challenges quickly.





A Complete Range of Solutions

Turn asset management challenges into eco-efficient solutions

GE provides a full suite of services tailored to meet a broad range of application requirements and are managed by industry experts located throughout several regions around the world.

GE's technical specialists can operate on networks, transformers, protection, information and control equipment, power electronics equipment and the entire air-insulated or gas-insulated substations. They will also ensure that all quality and safety regulations for the associated equipment are respected and met.

Offering complete, innovative and high quality services that optimize the customer's electrical infrastructure, GE improves return-on-investment by extending the lifetime of assets. Local technical experts provide comprehensive solutions to maximize asset lifecycle with a wide range of services:

- From network consulting, planning to operational implementation
- From asset diagnostics to condition-based maintenance
- From emergency support to full operations and maintenance
- From technical training to customized competence development programs

Make equipment smarter and more sustainable with field-proven expertise

GE's mission is to ensure its customer's electrical assets are reliable, efficient and environmentally-friendly, by leveraging the technical know-how of GE's product design and manufacturing engineers into customized service solutions.

GE provides innovative technology solutions to keep its customers high voltage substations and equipment up-to-date, safe, reliable and efficient. The asset performance management solutions optimize infrastructure performance while keeping operating costs under control.

Local service sites around the world are managed by strict quality management systems including GE's own systems and processes, and fulfill the requirements of ISO® 9001, environmental standards ISO 14001 and OHSAS® 18001.



Service Experts Throughout The Product Lifecycle

Transmission assets constitute an important capital investment and are critical to the successful operation of an electrical power system. Dedicated attention given to each equipment components is essential in keeping assets safe and reliable. Based on manufacturing and field experience, GE can maximize equipment life by providing efficient and customized solutions to meet customer's unique application requirements.

Maximize assets throughout each stage of their lifecycle

Asset performance management

- Site inspection and diagnostics
- Oil analysis in lab for transformers
- HV equipment retrofit with continuous online monitoring systems
- Analytics for asset health management

Operations and maintenance

- Corrective maintenance for minor and major failures
- Condition and time-based maintenance
- Emergency support, diagnosis and repair
- Spare parts supply and strategic inventory management
- 24/7 support and a dedicated team with response time commitment
- Full operation of the substation

Renovation, modernization and extension

- Substation optimization and lifetime extension with complete refurbishment

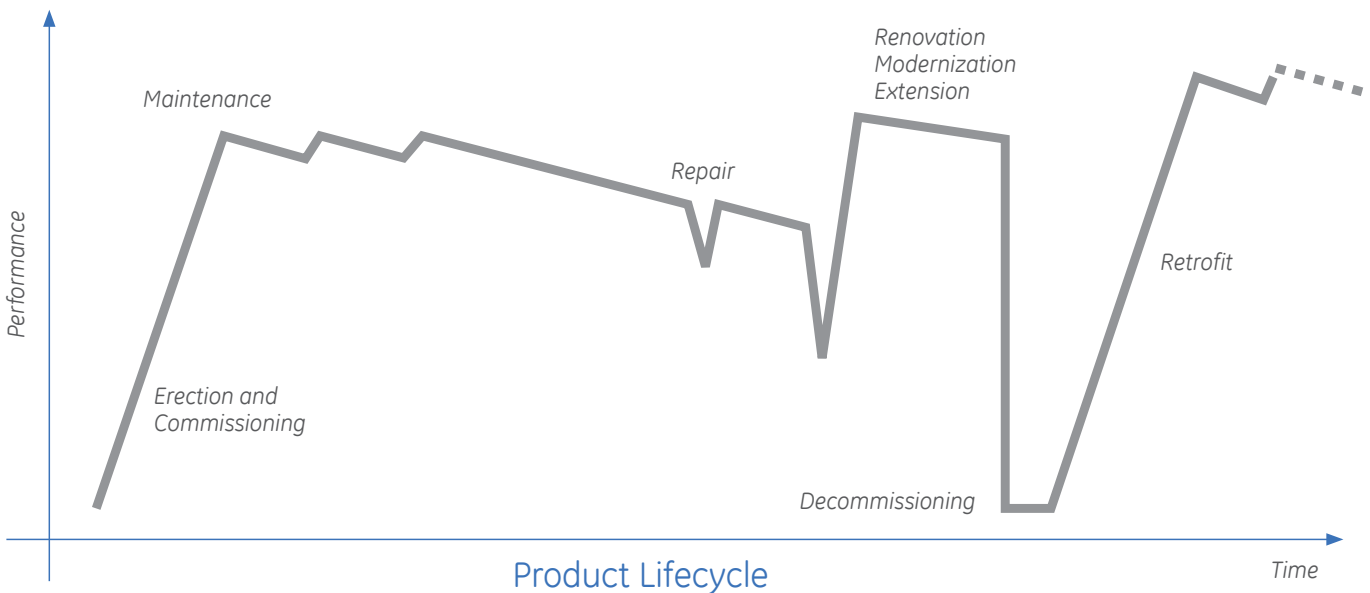
- Obsolescence management solutions with asset retrofit and upgrades
- Substation extension and electrical ratings increase

Network consulting

- Power systems analysis and engineering
- Infrastructure audit and optimization
- Network expansion, reinforcement and integration studies
- Stability and security analysis (post incident, reliability, availability and maintainability)

Technical training

- e-learning
- Modular training
- Software training
- Competence development programs
- Education partnership



GLOBAL EXPERTISE DELIVERED LOCALLY

We deliver field operational support through our network of experts that are focused on service quality.



As close to customers as any local company with the expertise and long-term sustainability of a global company.

GE aims to deliver continuous field operational excellence through its broad service expert's network. Providing high quality of services as well as the competence development of the technicians and supervisors is GE's top priority. GE's subject matter experts' competencies, qualification levels and certifications are checked regularly in compliance with local regulations and strict internal GE standards. As a result, wherever our customers are located, GE provides the best field experts to ensure complete satisfaction.

Product Lifecycle Management

Guarantee the reliability and availability of grid assets with custom services

Erection and commissioning

GE's local teams ensure that assets are erected, tested and commissioned according to stringent, state-of-the-art processes. A certification process, which is based on "on-the-job coaching" of customers teams, guarantees the same high levels of quality for all assets installed regardless of the location.

Strategic spare parts management

Although some parts primarily play a supporting role, they are vital for optimal operations. GE offers strategic spare parts management to avoid risks on main and critical components. This is an effective solution to cope with urgent corrective maintenance as well as controlling replacement lead times and costs. Several options are proposed including stocking at a GE facility, stocking within your facility or utilizing a shared stock approach.

Maintenance and repair

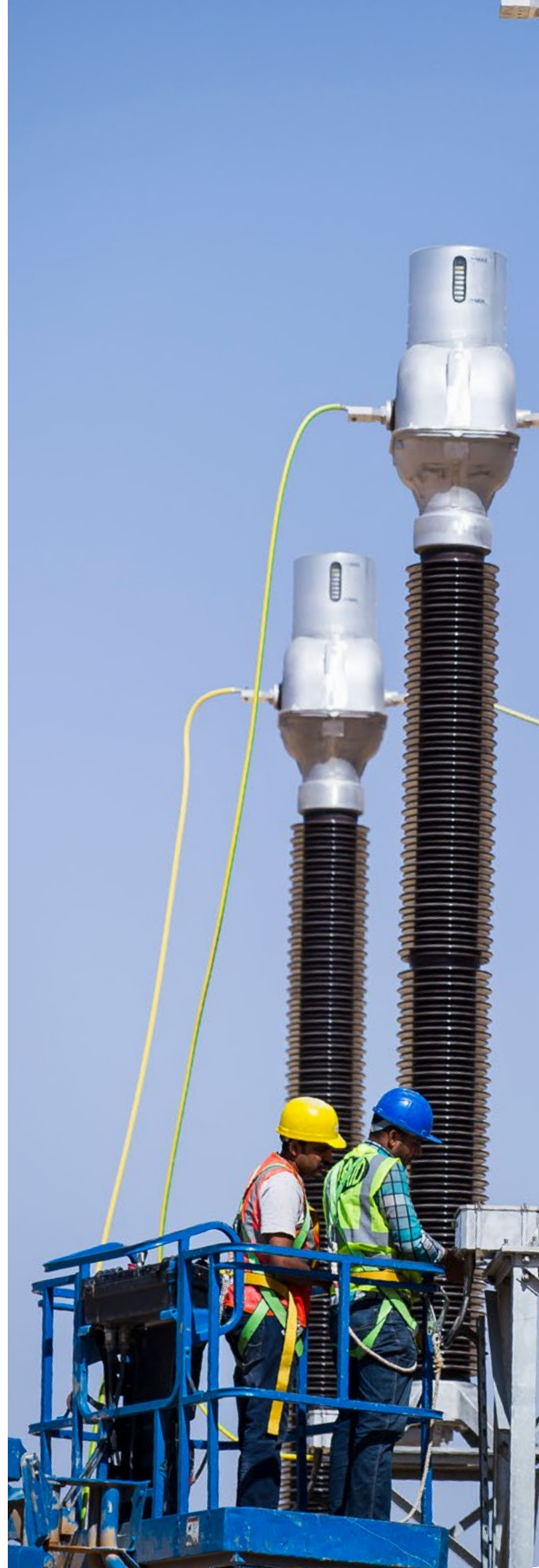
GE recommends regular maintenance on equipment to ensure optimal operation and to reduce the risk of failure. Maintenance plans must be carried out by a qualified field services supervisor with the prerequisite technical levels. During warranty period, maintenance levels three (3) to five (5) must be conducted by the manufacturer. GE's local teams can support its customers with emergency repairs, time-based, predictive and corrective maintenance.

Oil analysis

With more than 25 years of experience, GE's laboratories can perform reliable fluid tests and will provide expert assessments and overall condition reports on the transformers. Based on analysis and diagnostics, customers can anticipate dysfunctions and limit losses. Necessary maintenance and repairs can be conducted while avoiding outages or induced production downtimes. A dedicated GE team can ensure diagnosis within eight (8) days and emergency requests within eight (8) hours.

Decommissioning

During decommissioning, GE is committed to handling equipment correctly and responsibly, with recyclers and collectors governed by regulations and directives with a special focus on preserving the environment. GE objectives are to reuse a maximum number of parts, thus using fewer raw materials and meeting other customers' needs for obsolete equipment still in service.





Operations and Maintenance

Optimize asset performance over the long term

Whether for a specific critical product range within an electrical infrastructure or over the entire network, GE can provide lifetime support for new and legacy products or third-party equipment, including full lifetime operations and maintenance management.

GE's team of technical experts provide complete and comprehensive services to ensure substation stability, security, reliability and performance such as asset performance management, preventive maintenance, strategic spare parts and technical training.

The combination of GE's services to complement customer's existing resources and competencies include:

- Responsibility for controlling and operating electrical networks on any Original Manufacturer's Equipment (OEM)
- Asset performance management including usage planning, operations, condition-based maintenance, repair and replacement
- Dedicated experts with prompt response times and 24/7 emergency support capability on all fault rectification related issues
- Condition assessment with periodic on-site visits
- Strategic spare parts management
- Technical training and competence development

Asset Upgrades

Give the substation a second life

When facing performance improvement or obsolescence issues, GE experts perform an assessment of the equipment in order to make the best decision based on site diagnostics. The solutions offer lower implementation costs, higher return-on-investment and shorter lead-times than replacement.

Renovation

- Expand the life of ageing equipment, replace worn circuit-breaker, switches, control and protection equipment and process transformer oil
- Conduct power transformer life extension, circuit-breaker mid-life overhaul and substation refurbishment to ensure equipment safety, reliability and performance

Modernization

- Adapt new designs and technology to equipment in operation to avoid obsolescence
- Conduct substation modernization by adding condition monitoring systems or disconnectors motorization
- Retrofit or upgrade certain key components such as cooling systems or breakers and add condition monitoring devices

Extension

- To face evolving power demand, increase electrical ratings such as nominal current, short-circuit current and others
- Install additional bays/poles to an existing substation (GE or other OEM) to answer network evolution needs

Asset Performance Management

Make efficient and proactive decisions on assets

GE offers a comprehensive business solution for its customers that maximizes the value of their assets by optimizing maintenance and asset replacement strategies. These recommended solutions take into consideration budget constraints, the condition of existing assets, and the criticality of each piece of equipment.

To optimize infrastructure, GE offers integrated solutions to manage assets efficiently. Based on site inspections and asset condition assessments, GE's experts analyze data to define the 'Asset Health Index' of equipment and provide recommendations on asset usage planning, operations, repair and replacement in order to maximize existing infrastructure. GE's asset management solutions include:

- Site inspection and diagnostics
- Continuous online condition-monitoring systems
- Communications and integration solutions
- Analytics for Health Index management
- Utility business process integration

Whether its transmission, generation, distribution or industry and infrastructure electrical assets, GE provides the models and tools to enable customers to meet their company objectives in terms of:

- **Reliability** by reducing outages, assessing and mitigating operational risks
- **Cost efficiency** by maximizing asset life while optimizing maintenance costs and hedging risk costs, with particular care taken for ageing infrastructures
- **Strategy** by providing the information needed to establish corporate asset investment plans and performance objectives with regulators and shareholders
- **Organization** by capitalizing on electrical know-how in the context of an ageing workforce and aligning departments with consistent goals for increased efficiency

With early detection of incipient failures, the failure rates can be reduced by up to 70%, while reducing maintenance costs by up to 30%. The following devices are usable on any manufacturer's equipment, and third party condition-monitoring devices can also be integrated to meet specific objectives.



Power transformers

GE offers options ranging from data collection by dissolved gas analysis (DGA) sensors to the comprehensive monitoring of all transformer components including active parts, bushings, onload tap changers, cooling system and conservators.

Gas-Insulated Switchgear

GE has developed innovative digital gas sensors and advanced processing techniques. These devices can monitor and forecast gas density, localize internal arcs, monitor circuit-breaker conditions and analyze UHF partial discharge events.

Circuit-Breakers

GE devices can monitor active parts, mechanisms and auxiliaries, and provide advanced analysis such as electrical wear calculation, arcing time, travel curve analysis, SF6 gas monitoring of density and leakage detection.

Network Consulting

Anticipate tomorrow's challenges for sustainable network reliability

GE offers a range of power system analysis and engineering solutions to maximize asset performance either for new installations or to improve the efficiency and performance of existing infrastructures. Network consulting experts will support projects throughout each phase including:

- Upstream: feasibility, design and planning
- Midstream: performance testing and upgrade, component optimization, transient stability analysis, dynamic interaction assessments and reliability studies
- Downstream: extension and evolution definition and post incident analysis

Reliability analysis tools offer electrical system managers effective ways to monitor performance and ensure supply quality for complex power systems. Beyond the standard power flow or short circuit calculations, these studies provide the information required to improve network reliability in a cost-effective and sustainable manner.

GE's range of tested, tailor-made solutions for upgrading, expanding or even reducing a network ensures that systems will operate reliably and safely.

As a leading industry system integrator, GE has the global experience and expertise to analyze, specify and design network systems to meet a broad range of application requirements.

Technical Training

Enhance team's know-how and productivity

GE's Grid Solutions Technical Institutes offer a full range of training in electrical grid safety, operations and maintenance, protection, control and network management solutions in a variety of locations around the world. These value-adding courses encompass all aspects of electricity from fundamentals to in-depth equipment knowledge. Trainees benefit from trainers' field experience and expertise in modern techniques.

When considering operational performance, theoretical study is necessary, but not sufficient, to increase or optimize site personnel competence. What makes a real difference is the experience gained through practice.

At GE's Technical Institutes, training combines theory with practical hands-on experience on real equipment or in 'sand boxes' for software courses. Customers can select from a full range of training methods that best suits their needs including e-learning, classroom courses, hands-on, set curriculums and competence development programs.

GE's Grid Solutions Technical Institutes continuously improve existing training modules and develop new courses according to local regulations and new technologies, products and solutions.





Comprehensive Service Increase Asset Reliability

Air-Insulated Substations

GE offers complete services for all current and legacy products, from circuit-breakers ranging from 66 kV up to 1200 kV, to disconnectors and instrument transformers including:

- Strategic spare parts: hydraulic rams, interrupting chambers, supporting columns and spring mechanisms
- Monitoring: stress assessment analysis for SF₆ circuit-breakers with spring mechanisms, synchronization relays, SF₆ monitoring and online monitoring
- SF₆ management: leak detection and repair, gas quality and pressure checks
- Renovation, modernization, extension: turnkey generator circuit-breaker (GCB) retrofit, GCB mid-life overhaul, complete component overhaul after 20 years of operation, disconnector motorization and additional bays and poles



Gas-Insulated Substations

GE supports managing gas-insulated substation (GIS) and extending their lifetimes, especially those installed in complex environments such as populated areas, mountains, small areas, etc. A full range of services are provided for GIS from 72.5 kV up to 800 kV and include:

- Strategic spare parts: gaskets, arcing contacts, closing and tripping springs, valves and compressors
- SF₆ management: leak detection and repair, gas quality and pressure checks
- Monitoring: SF₆ monitoring, partial discharge, UHF electromagnetic waves, continuous online and condition solution
- Renovation, modernization, extension: overhauling after 25 years of operation, switchgear retrofits, minor or major modernization and additional bay installation on all asset brands



HVDC and FACTS

To ensure the performance of power electronics equipment such as HVDC, FACTS, high current rectifiers and reactors or capacitor installations, GE provides comprehensive service solutions, which include services for remote areas. The HVDC and FACTS offering includes:

- Strategic spare parts: DC and AC plants, management of obsolescence and emergency return to service
- Preventive and corrective maintenance in support of reliability, availability and maintainability (RAM) requirements
- Asset management with continuous online condition- monitoring and 24/7 support
- Renovation, modernization, extension: overhaul after 20 years of operation, valve retrofits, upgrade from analog to digital control and electrical equipment modernization with the latest technologies



Power Transformers

Power transformers are critical for ensuring a sustainable supply of power to prevent outages. With the loss of insulation being irrecoverable, transformer failure risk can be minimized only if oil quality is maintained, moisture is controlled, temperatures are managed, incipient faults are detected and corrected, and an overhaul is conducted at midlife. GE's power transformer services include:

- Strategic spare parts such as bushings, tapchanger, fan motor and pumps
- Condition assessment with oil analysis and continuous online monitoring system
- Renovation, modernization, extension: mid-life overhaul after 20 years in operation, oil processing and preservation upgrade, cooling upgrade for lifetime or power increase, ratio and voltage regulation adjustments to new needs, thermal upgrade with Nomex winding insulation and retrofit of GE and third-party equipment



A Worldwide Manufacturer with More Than 100 Years of Experience

GE Delivers Continuous Field Operations Excellence

Infrastructure | Traction Transformer Renovation

For a European transport company, GE conducted the complete half-life refurbishment services for 20 traction transformers operating more than 20 years.

Utility | Offshore Operations and Maintenance

A utility entrusted GE to conduct operations and maintenance on its offshore 400 kV DC substation. The contract was more than three years and included training.

Power generation | PTR Fleet Management

An American power generation company awarded GE a long-term contract to operate and maintain its entire transformer fleet, comprising of more than 650 transformers from different brands.

Industry | Voltage Source Converter Upgrade

An American carbon and steel producer improved the reliability of its substation by having GE experts replacing control and valves plus adding a continuous online monitoring system.

Power generation | Post Incident Analysis

Following a substation incident, GE investigated and proposed a curative and preventive solution which avoided a country-wide blackout.

Industry | AIS Spare Parts Management

A Brazilian mining company bought strategic spare parts stocks (245-300 kV circuit-breakers, instrument transformers, disconnectors), for its AIS substations to avoid disruption risks and as a result, lowered the organization's overall costs.

Utility | GIS Renovation and Monitoring Retrofit

GE overhauled a Brazilian substation after 20 years of operations and modernized it by installing a Bwatch continuous online condition-monitoring system.

Industry | Transformer Refurbishment

A European aluminum company selected GE for the refurbishment of two transformers built in the 1970's. One was a GE legacy product and the other was from another OEM.

Oil & Gas | AIS Competence Development

Following the renovation of an AIS substation, GE trained 100 technicians to ensure the efficient and safe operations of a substation.

Oil & Gas | Transformer Renovation

In the Middle East, a petrochemical company entrusted GE with its transformer renovation and modernization project. This included the refurbishment of six rectifier transformers with Nomex insulation.

Utility | AIS and GIS Long-Term Maintenance

A partnership was established with a Middle Eastern utility. GE was awarded a five-year maintenance program on 51 substations.

Power Generation | AIS Spare Parts

A power generation company in China set up strategic spare parts stocks and an emergency support contract with GE to limit disruption risks.

Infrastructure | GIS Operations and Maintenance

GE supports two Indian airports in operating and maintaining their 110 kV substations. The contract includes emergency support, service level agreements (SLA) and training for five years.

Utility | GIS Extension

An Asian utility, with the support of GE, conducted several extensions on GE and third party 245 kV and 300 kV GIS substations.

Utility | HVDC Operations and Maintenance

GE conducted a three-year operations and maintenance contract on a 400 kV interconnection and 1800 MW HVDC back-to-back installation in the Middle East.

Utility | Asset Management

GE conducted the full condition assessment of 10,000+ distribution substations for a Middle Eastern utility. This included inspection data integration and analytics utilizing GE's eterraassetcare software.

Oil & Gas | AIS Competence Development

Following the renovation of an AIS substation, GE trained 100 technicians to ensure the efficient and safe operations of a substation.

Power generation | GCB Retrofit and PTR Overhaul

A leading Australian power generator awarded GE with the contract for a generator circuit breaker (GCB) retrofit on third-party equipment and the overhaul of 112 transformers over 3 years.

Achieve Business Objectives with a Trusted Services Provider

Power Generation

As a power generation company, a top objective is improving operational performance including grid availability, flexibility, reliability and profitability. GE assists its customers in achieving these objectives by providing the following services:

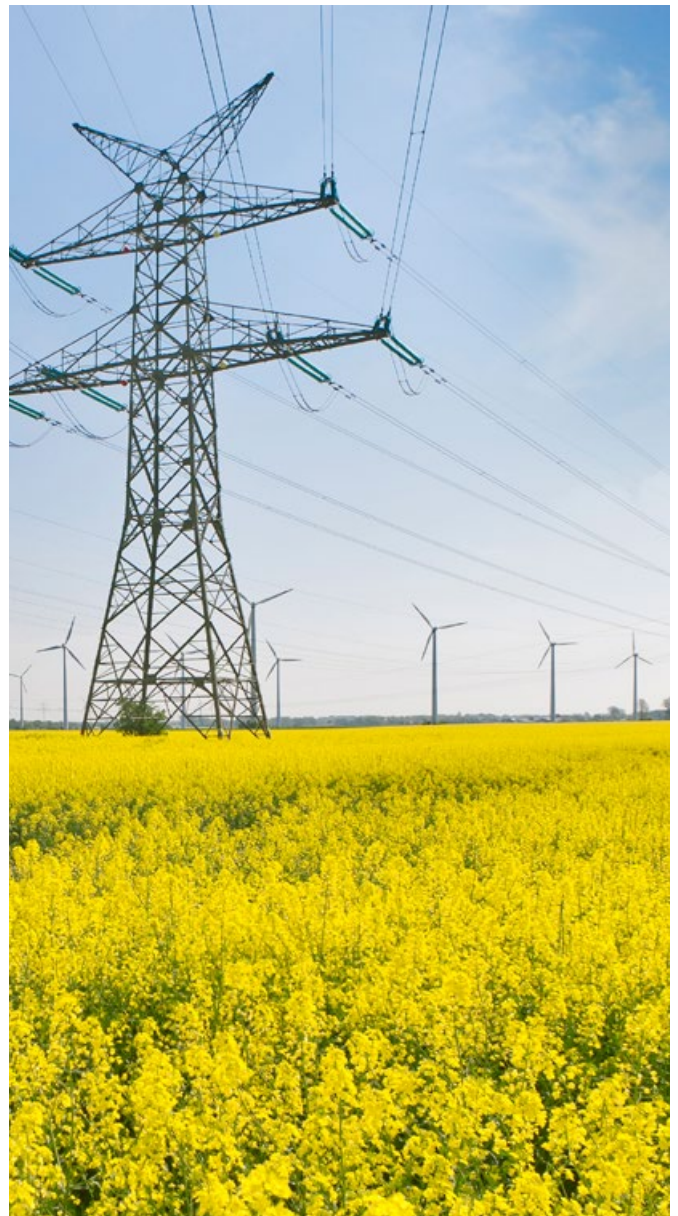
- Defining and conducting maintenance strategies according to criticality including corrective, time-based, condition-based, reliability centered or risk-based maintenance
- Optimizing installation performance including generator circuit-breaker (GCB) operations and maintenance to reduce failure risk by up to 50%, GCB retrofit, oil quality management of transformers, transformer condition assessment and overhaul and a continuous online monitoring add-on to increase equipment availability



Power Utility

As a power utility, asset availability and operational performance objectives are to cost-effectively deliver reliable power to end-users. GE assists its customers in achieving these objectives by providing the following services:

- Conducting maintenance and overhauling equipment
- Optimizing installation and network performance through improvement recommendations, renovation and modernization of substations and equipment
- Improving technical team knowledge through technical training, EHS certification, competence development on new assets and online monitoring



Industry and Infrastructure

As an industrial company, focusing on the core business, while at the same time being guaranteed the reliable energy from substations, are critical objectives. Loss by disruption must be controlled and minimized. GE assists its customers in achieving these objectives by providing the following services:

- Limiting risks of disruption by conducting recommended maintenance and providing strategic spare part stocks to avoid delivery lead time issues
- Making efficient decisions on asset management through real-time condition assessments, expert recommendations, full operations and maintenance services



Oil and Gas

As an oil and gas company, it's essential to prevent equipment failures that can lead to unplanned downtime. Ensuring electrical infrastructure is reliable and efficient, especially in remote areas, is critical. GE assists its customers in achieving these objectives by providing the following services:

- Managing assets proactively through continuous online monitoring and making fact-based decisions based on GE's experts' recommendations
- Maximizing productivity and return-on-investment with maintenance plans, flexible solutions and network performance analysis and improvement planning that fits with the needs of each customer's application requirements while at the same time monitoring evolving regulations



Grid Solutions

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imagination at work