

GE
Grid Solutions

GRID AUTOMATION SERVICES & SUPPORT

Your trusted partner to enable power system
reliability, availability, efficiency and flexibility



Imagination at work

TRENDS DISRUPTING THE TRADITIONAL POWER SECTOR



DECARBONIZATION

BY 2040, RENEWABLES will represent 30% of global net electricity

IMPACT

- Generation is becoming difficult to forecast & variable
- Grid stability challenges and increasing need for system services and flexibility



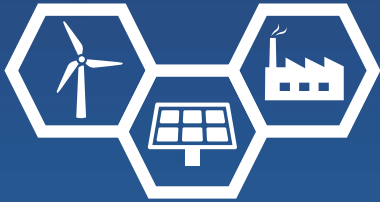
DIGITIZATION

GROWING THE NUMBER of connected devices & smart sensors, management and new software capability

IMPACT

- Need for reliable cybersecurity
- Must orchestrate generation, grid and flexibility with grid software
- Demand for data management and analytics





DECENTRALIZATION

GROWING PENETRATION of distributed resources (renewables, storage)

IMPACT

- End user becomes an active actor of the power system ('prosumer')
- Growing complexity of distribution grids
- Edge devices management



ELECTRIFICATION

INCREASE of electric transportation and electrical heating

IMPACT

- Growth of electricity demand
- Need for energy systems integration
- New distributed resources adding more grid flexibility

An aerial photograph of an industrial facility, likely a refinery or chemical plant, featuring numerous large white storage tanks in the foreground, a complex of buildings and piping in the middle ground, and several wind turbines scattered across the landscape. The background shows a wide body of water under a clear sky.

As our industry and the power system evolves, Grid Automation Services is designed to support customers through their planning, design, system operations and maintenance transformations

GE SOLUTIONS AND SERVICES

GE provides a full range of services & support tailored to meet a broad range of power system needs across utility and industrial applications. With deep domain knowledge and industry experts located globally, GE's technical specialists and subject matter experts can help you plan, design, operate, maintain, and modernize your protection, control, monitoring, and automation systems.

Offering innovative and high quality services that optimize the customer's electrical infrastructure, GE is focused on customer specific outcomes to drive return-on-investment through maximized asset performance and asset life extension.

Local technical experts provide tailored services that meet the unique needs of each customer and application including:

- Power network consulting, planning, and operational implementation
- Asset lifecycle management strategies including product upgrades and retrofit solutions for protection, control, monitoring, and substation automation solutions
- Multi-year service agreements
- Field services
- Consulting & value added services
- Communications network design and deployment

With a global team that provides regionalized support and services, GE's Grid Automation Services team is the right partner to navigate the challenges of a contemporary electrical system.

SERVING GLOBAL CUSTOMERS WITH LOCAL EXPERTISE



DEEP DOMAIN EXPERTISE

More than 1,000 years of cumulative experience with a dedicated team of electrical systems experts and technicians



LOCALIZED TEAMS

250 Service Application Engineers and Customer Site Engineers across the globe



GLOBAL REACH

Provide reliable on site service, consulting, and technical support to more than 6,000 utility and industrial customers globally



GE's Grid Automation business unit has a long history of providing reliable and innovative solutions for our customers. We understand that our customers need a trusted partner that will provide reliable service when abnormal events occur, expert advice, regular maintenance and predictive diagnostics to increase uptime as well as advanced application expertise and technology to deliver business outcomes.

GE's Grid Automation Services team is committed to providing comprehensive technical services and support. Our team of support engineers available 24/7, locally available Field Service Engineers who can be on site within hours, and Application Engineers who provide consulting for some of the most advanced protection, control, and automation schemes work to solve our customers' toughest electrical system challenges.

GA GLOBAL ENGINEERING SERVICES PORTFOLIO



LIFE CYCLE MANAGEMENT

- Latest Computing & Communications Technologies
- Cyber Security NERC-CIP, IEC62443 Compliant Solutions
- Plug-and-Play Retrofit Kits



ENGINEERING & CONSULTING

- Transmission Systems Services
- Distribution Systems and DERs Integration Services
- Advanced Technologies and Microgrids



CYBER SECURITY SERVICES

- Cyber Security Assessment
- Training
- Advanced Cyber Security Services



VALUE-ADDED SERVICES

- Electrical Signature Analysis Advanced Diagnostics
- Remote Monitoring & Diagnostics
- Electrical Control System Management



TECHNICAL TRAINING

- Power System Fundamentals
- IEC61850 Digital Substation
- Future of Protection Seminars



LIFE CYCLE MANAGEMENT

Across industries and market segments, power system operators and managers face growing pressures to drive greater output, efficiency and reliability from their systems, while lowering life cycle and operational costs.

The Grid Automation Services team supports customers in achieving these goals by providing comprehensive technical support and continuous improvement services on demand or as part of tailored Master Service Agreements.

On-Demand Support & Services:

Technical Services

- Technical support
- Event and root cause analysis
- Installation & commissioning
- Field service
- Technical training
- Maintenance & repairs
- Remote monitoring & support

Life Cycle Management

- Site inspections and audits
- Expert product application audits
- Product upgrades
- Systems upgrades and migrations



CUSTOMER SERVICE AGREEMENTS

A customer service agreement is one of the best ways to capitalize on your substation automation, intelligent controls, and networking investments. Our application and technical service engineers understand the fundamental design of your devices and can help you maximize the use of these technologies in your unique environments and applications. By partnering with GE, you can focus on your operation to ensure maximized electrical system uptime and availability.

We have created a tiered approach to ensure you have the right level of engagement and service from our teams.

	Basic	Standard	Care-free
Remote Support			
Customized notifications on product news	✓	✓	✓
Office hours support with SLA commitments	✓	✓	✓
24x7x365 support with SLA commitments	-	✓	✓
Quarterly reports	-	✓	✓
Troubleshooting via secure datalink	-	-	✓
On-Site Support			
Preventive scheduled maintenance visits	✓	✓	✓
Annual review of contract performance	✓	✓	✓
On-call support with SLA commitment	-	✓	✓
Expert visits (audit/consulting/enhancements)	-	-	✓
Periodic training	-	-	✓
Repairs			
Repairs with SLA commitments	✓	✓	✓
Advance replacement prior to repair	-	✓	✓
On-site repair with SLA commitment	-	-	✓



PRODUCT AND SYSTEM UPGRADES

Why upgrade? Because the industry is going through a major change driven by renewables adoption and technological advancements, such as computing power at the edge, digitalization, storage, electrification, and end user empowerment. These trends are creating new challenges and opportunities for power system operators in ways we have not seen before.

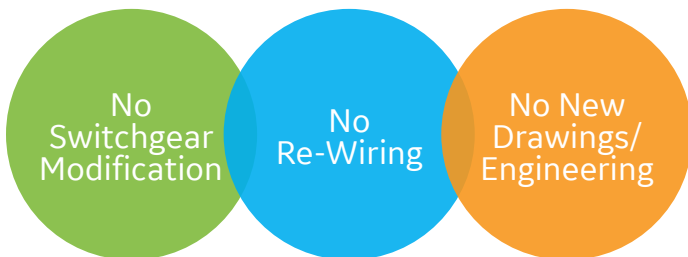
Always at the forefront, GE continues to deliver new, innovative technologies and solutions designed to enable power system flexibility, renewables integration, demand response, distributed generation, and energy efficiency.

With simplicity and 'future-proof' design concepts in mind, we continue to deliver products that can be easily upgraded or replaced, allowing you to take advantage of the latest features and functions with minimized outage time and costs.

With many of our retrofit and upgrade solutions, customers gain the benefits of:

- No/minimum rewiring required. Our retrofit kits provide a plug-and-play upgrading experience enabling quick turn around
- Software upgrades that can be performed remotely. Our products have a setting files translation feature to help customers reduce the downtime required for the upgrade
- Connecting to the higher level control system. Our upgrade kits come with a flexible option that allows customers to upgrade the product without having to change the DCS

Our Field Service Engineers have the required experience to perform product and system upgrades in a matter of hours. Visit our website to learn more about our upgrade and retrofit kits. Use our interactive SR to 8 Series Retrofit explorer to see the simplified three step upgrade process.





FIELD SERVICES

Our Field Service Engineers are available to provide technical expertise on site. With over 1,000 years of cumulative experience in protection and control, substation automation, monitoring and diagnostics, and industrial communications, we work with our customers to understand their needs and requirements and work relentlessly until the business objectives are met. Whether it is as simple as installing and commissioning one device or as complex as installing and commissioning full substation control systems, industrial power management solutions, or a communications network for a mining operation, our Field Service Engineers are committed to providing a stellar customer experience.

Our Field Engineering Services include:

Technical Services

- Supervision of installation
- Commissioning of protection systems
- Upgrade services
 - H/W and F/W upgrades
 - Setting file upgrades
- Site audits / surveys
- Scheduled maintenance services
- Site trouble shooting and repair
- Repair depot for factory repairs
- Product user training
- Testing/Commissioning of relay systems
 - Testing (all manufacturers' devices)
 - Doble/Omicron – auto scripts, etc
 - All applications and protocols



ENGINEERING & CONSULTING

GE's technical consulting services team provides a wide range of capabilities to assist customers with their power system protection, substation automation, technology integration, and monitoring and diagnostics challenges.

Our dedicated team of experienced consulting engineers can provide end-to-end solutions and/or specific support to meet your project needs. From new systems to understanding the best way to upgrade an existing system, GE's consulting team has been trusted to analyze, design, and implement traditional and advanced solutions for power system applications including:



STEP 1 ANALYZE

- Calculation of settings
- Load flow & short circuit analysis
- Coordination studies
- Harmonic analysis
- Arc flash
- Motor starting & reacceleration study
- Dynamic stability analysis
- Transient system studies
- Relay performance
- Instrument transformer suitability study
- Modification requests analysis

STEP 2 DESIGN

- Retrofitting & refurbishment solutions
- Control system modification
- Upgrade and migration solution
- IEC61850 process bus applications
- IED configuration
- Protection schemes
- Automatic transfer schemes
- System integrity protection schemes (SIPS)
- DER integration studies, dynamic line rating (DLR), distribution automation, fast load shedding (FLS)
- Communications configuration
- Test procedures



STEP 3 IMPLEMENT

- Factory acceptance test
- Integration factory acceptance tests
- Hardware in the loop testing using RTDS
- Site acceptance test
- Commissioning
- Training
- On site training
- Protection & control optimization

Real Time Digital Simulation Testing Labs

Located in four strategic centers around the world, GE offers advanced testing services for protection, control and substation automation systems. Utilizing real time digital simulators (RTDS), these laboratories enable robust testing of protection, control, and communication systems under realistic conditions.

Configured to model each users' specific power system configuration, customers are able to perform simulations and validate procedures including test plans, relay settings validation, thousands of different fault scenarios, and relay application qualification testing.

CYBERSENTRY™ CYBER SECURITY SERVICES

Digital connectivity brings many advantages to the OT operations, but it can create a higher level of cyber security risk. The unique and critical nature of OT environments requires approaches that safeguard and secure data and networks. As we work to modernize the grid and standards and regulations evolve to meet changing market needs, customers rely on us to provide domain expertise and guidance as they navigate their digital journey.

With a broad portfolio and deep domain expertise, GE delivers standards-based and comprehensive cyber security solutions. Coupled with highly skilled consultants, technology partnerships, and security-focused research and development centers, we take a holistic approach to cyber security that cuts across our products, systems, technical services and training.

Our CyberSentry™ Cyber Security Services include a comprehensive portfolio of methods and tools to quickly improve cyber security without the need to change your process.

Based on major security frameworks such as NIST, NERC CIP, DoE, and IEC62443, our solutions lie on top of the industry standard security approach of: Identify, Protect, Detect, Respond and Recover.



CYBERSENTRY™ CYBER SECURITY SERVICES



Security Assessment



Security Awareness Training



Advanced Security Services



Steam



Gas



Nuclear



Wind



Hydro



Solar



Transmission



Distribution



Substation



Prosumer

IDENTIFY

Health check
Compliance check
(NERC CIP,
IEC 62443 etc)
Risk assessment

PROTECT

Boundary protection
Malware protection
Patch management
System hardening
Password management
User and access management

DETECT

Security incident and event management
Intrusion detection

RESPOND

Incident response

RECOVER

Backup & recovery

Cyber Security Assessment

GE's security assessment services help our customers understand their security posture and the security threats specific to their systems. The combination of GE's deep expertise in their products and control systems ensures that the assessment results are accurate and targeted. A portfolio of assessments are proposed to assess cyber security risks, and prioritized remediation actions are provided as a result of the assessment. Assessments include:

- **Health check** on-site 1 day non-disruptive assessment using CyberSentry Security Control (CSC) framework, that is specifically designed to evaluate ICS cyber security
- **Compliance check** on-site 3-5 days non-disruptive compliance assessment on selected regional or international security standard (ISO, NIST, NERC-CIP)
- **Risk assessment** Non-disruptive comprehensive assessment with threat model & risk dashboard based on NIST Cyber Security Framework

Advanced Security Services

Our advanced security services offer defense-in-depth solutions that allow you to identify, protect, detect, respond and recover from cyber threats. Our services cover security roadmap guidance, security consulting solutions, deployment and integration, site testing and commissioning, training and long-term support. These services enable our customers to improve their system's security posture without compromising its operational performance. Key areas of security enhancement includes:

- Malware prevention
- Password management
- Security monitoring
- Boundary protection
- Network security
- Network intrusion detection
- System hardening
- Incident response plan
- User account management & access control
- Backup/restore solution

Security Awareness Training

A comprehensive portfolio of security training courses for critical infrastructure and industrial control systems to increase staff knowledge and improve their identify, detect, and respond detect, respond and recover to cyber attacks. Training content is developed and delivered by GE's security experts, who regularly analyze and implement real-world OT security solutions.

GE's in-person security training courses are specifically designed to promote ICS cyber security mindset.

- **Executive Awareness (4 Hrs):** Learning how to become cyber resilient and the impact of cyber threats on business
- **General Awareness (1 Day):** Basic understanding of the cyber security fundamentals, attacks, threats and best practices
- **Risk & Vulnerability (2 Days):** Understanding of risk management and how to protect the control system from cyber threats
- **Security controls hands-on (3 Days):** Learning cyber security technical skills with hands-on experience



VALUE-ADDED SERVICES

BUSINESS OUTCOMES ENABLED BY GA SERVICES

As we have the privilege of partnering with many customers' around the globe, we have a deep understanding of our customers challenges and needs and are able to provide tailored services and solutions to address them. New technologies can bring great benefits but can be challenging to adopt. We are here to support our customers through the entire process.

Improve System Reliability & Uptime

Our utility customers' business growth is dependent on their ability to provide uninterrupted power for industries, commercial, and residential users. Any failure of their power network translates into major losses for them and their customers. Grid Automation is continuously integrating new technologies into its products to ensure system reliability and uptime improvements, and offers a comprehensive upgrade package for customers to take advantage of these technologies. The GA Services team can support in assessing the current installed base and proposing an upgrade plan optimized between investment and benefits. Our experts are also available to install and commission the equipment with minimum interruption of system operations.

Realize new revenue streams and business opportunities

Our customers are constantly being challenged to increase their top line, and need solutions to help them achieve this with limited investments. For example, when a new wind or solar farm is added to the power network, there will be situations when the green power will have to be curtailed due to network constraints.

With our expertise in the industry and our advanced technology, we can provide innovative non-wires alternative solutions to maximize the utilization of current infrastructure to avoid curtailment of renewable energy and increase revenues. Our services include consulting, system design, installation and commissioning, and long-term maintenance agreements to ensure the revenues predicted are achieved.





Maximize Asset Performance and Extend Life

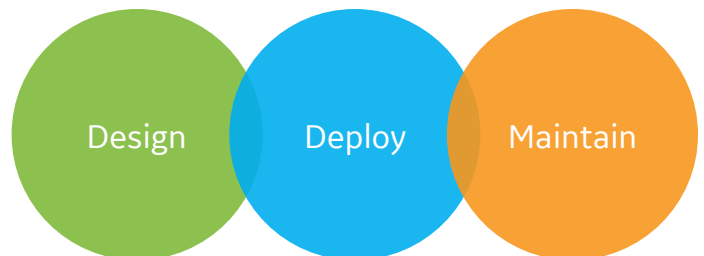
Increasing the return on invested capital is top of mind for all our customers. Whether they are operating a power network or an industrial plant, maximizing asset performance is key to their success. Our service team has the expertise to take the fundamental physics of an asset, combine it with external inputs like offline data, weather information, or electricity pricing, and design a system that optimizes operations while pushing the limits of asset performance. Our services team partners with utility or industrial customers to determine the right asset parameters to be monitored and external data points to be collected, design the system architecture to maximize the asset performance, as well as install and commission it as per customer needs.

Reduce Operational Costs and Extend Maintenance Intervals

In operation globally, our products collect critical information about the assets they are monitoring and protecting. With integrated diagnostics and analytical capabilities, our devices predict issues and identify root causes, providing operations teams with actionable intelligence. This allows our customers to move from schedule based maintenance to condition-based maintenance which has been proven to bring significant reductions in O&M costs. Our Services team can offer assessments, system design, I&C and master service agreements, to help customers achieve their operational goals.

Enhance Safety and Security

Digitalization is poised to provide phenomenal benefits to electric utilities and industrial operations and, as such, it is adopted everywhere in the world. As customers digitize their systems and connect a multitude of devices, there could be an increased risk of cyber attacks that can disrupt systems and operations, as well as cause damage to equipment. Our Cyber Security Services consultants are on a mission to help customers lower risks and protect against potential attacks through a focused approach centered around detection, response, and recovery if an attack happens.



OUTCOME-BASED SERVICES

In today's environment our customers including power generation, industries (such as metals, oil and gas, and mining) transmission and distribution utilities, and renewable generation owners and operators are challenged to deliver more flexibility and improved profitability. Grid Automation understands their needs and is prepared to partner with our customers to deliver outcome-based solutions and services. Our framework consists of an assessment stage to define the goals, followed by system design and validation, site installation, testing, and commissioning. A long term service agreement can be put in place to ensure sustainable benefits.



GENERATION INDUSTRY

INDUSTRY SEGMENT



OUTCOMES

- | | |
|-----------------------|---------------------|
| Supply security | Production uptime |
| Decreased energy cost | Energy independence |
| Additional revenue | Energy efficiency |
| Reduced O&M cost | Lower O&M cost |

SERVICES

- | | |
|--|---|
| Generator protection /
Transmission protection
Panels retrofit | Installed base upgrades
Electrical control system |
| Electrical control system* | Remote monitoring |
| Remote monitoring* | Automatic transfer scheme |
| Automatic transfer schemes* | Fast load shedding* |
| Fast load shedding | Reactive power support |
| Asset health management | Asset health management |
| Grid interconnection | Device management |
| | Automatic transfer scheme |
| | Radio and optical
communication system design
and engineering |
| | Cyber security services |

* See following pages for detailed case study examples

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TRANSMISSION

DISTRIBUTION

RENEWABLES

MICROGRID & ENERGY STORAGE



INDUSTRY SEGMENT

Stability, reliability, resiliency
lower O&M cost
Increased network capacity
Transmission infrastructure investment deferral

DERs reliable integration
Renewables targets
Lower cost, increased capacity

Levelized cost of electricity
Increased power evacuation
Less curtailment reduction
Improved transport capacity

Greater energy cost savings
Investment deferral
Advanced DER integration
Reduced T&D losses

OUTCOMES

Remedial action schemes*
System integrity protection schemes
Wide area monitoring, protection, control
Renewables interconnection studies
IEC61850 substation design
Substation IEDs upgrades
Substation IEDs O&M
HVDC control w/PMU HVAC
Cyber security services

DER integration studies
Dynamic line rating*
Distribution substation design*
Active & reactive power control
Device management
DG aggregation
EV integration

MV/LV system design
Power network analysis
Asset health management*
Grid interconnection
IEC61850 substation design
Substation IEDs upgrades
Substation IEDs O&M

Feasibility and planning studies
Cost-benefit analysis
System detailed design and engineering
Protection schemes
Load and generation forecast
Fast load shedding
Energy dispatch and Volt-VAR optimization
Emergency demand response
Black start
On site installation and commissioning
Maintenance service agreement

SERVICES

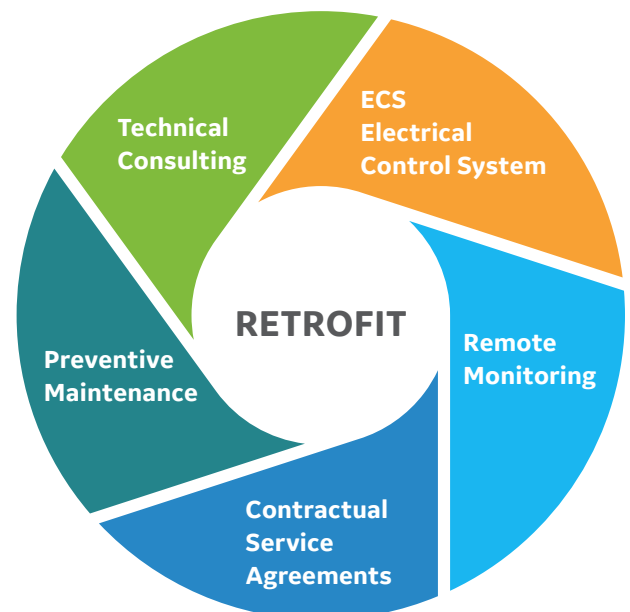
POWER GENERATION RETROFIT

Generator Protection Panel & Transformer Protection Panel Retrofit Solutions



Multiple solutions for different needs:

- Complete cabinet retrofit
- Door replacement with prewired terminals
- Device replacement
- Device modules replacement



GENERATION AND INDUSTRIAL SERVICES

ECS

Electrical Control System

Customer Challenge / Need

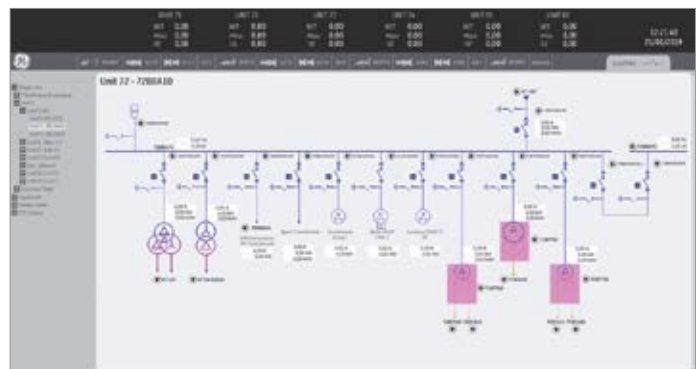
Large installations with multivendor devices lack the required visibility for operators to make decisions real-time to keep the process running and to optimize its performance.

Outcome

- Highly flexible application to adapt to existing installations requirements
- Minimizes hardwiring impact
- More than 10x more data when compared to traditional hardwiring monitoring providing a centralized electrical sequence of events
- Automatic oscillography retrieval for fast local or remote fault analysis after an electrical incident
- Event and alarm time stamping at source (1ms resolution)
- Direct remote access to the IEDs data
- Remote monitoring and support platform
- Cybersecurity features:
 - Radius & LDAP
 - Encryption
 - Hardening
 - Whitelisting
 - Achilles L1 tested
 - OpenVas tested
 - Threat modeling analysis



ECS HMI device screen detail



ECS HMI single line diagram detail

eRMT

Electrical Remote Monitoring Tool Remote Support Enabler

Customer Challenge / Need

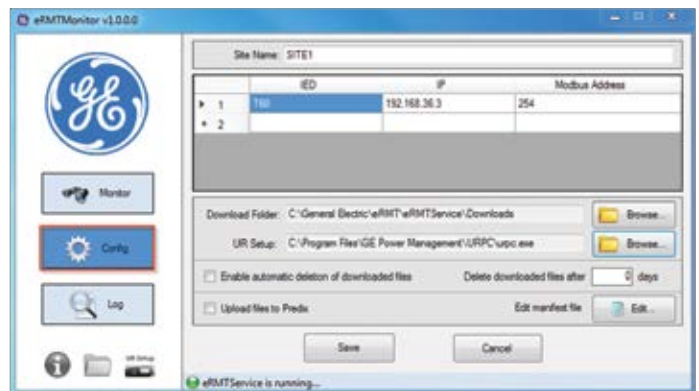
Simple centralized event logging / disturbance recording aligned with remote monitoring strategies. Ensure SLA response times for events out of Ensure SLA response times for complex events → Electrical Assets events

Service Offering

Licensed software running as a Windows service centralizing events, oscillographies and settings modifications running in customer OSM (On Site Monitoring HW).

Outcome

With data available at their fingertips, Grid Automation Services experts can provide 24x7 support with ultra-fast response.



eRMT configuration interface

AUTOMATIC TRANSFER SCHEMES

Customer Challenge / Need

Power continuity after an electrical incident. Busbar isolation for maintenance without disturbing the rest of the electrical network.

Service Offering

To maximize power availability and IED capabilities, an automatic transfer scheme (ATS) is programmed into the protection relays with a minimum installation impact.

The use of IEC61850 GOOSE messages is a fast and reliable way of exchanging data with no hardwiring requirement other than an Ethernet network. Nevertheless, conventional hardwiring is also an option.

Fast transfers in make-before-break or break-before-make, slow or time delayed transfers can be performed and customized for any application.

Outcome

- No process disruption after an automatic reconfiguration of the electrical distribution to continue providing power to downstream loads.
- Faulty busbar is isolated from the rest of the process loads or electrical network.

INDUSTRIAL FAST LOAD SHEDDING (FLS)

Customer Challenge / Need

Avoid complete system collapse due to load - generation unbalance caused by the loss of one or more local generators or incomers from the grid.

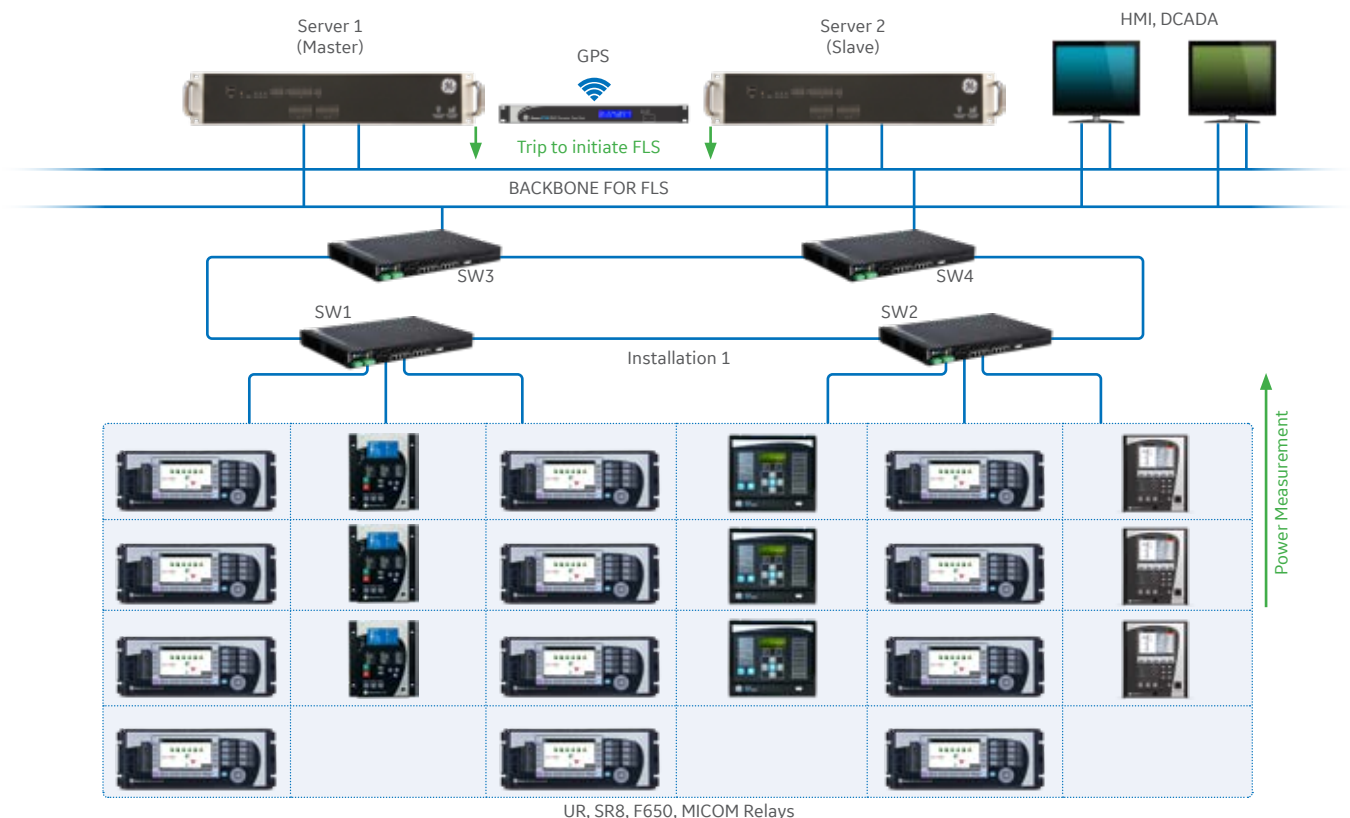
Unlike undervoltage, underfrequency or frequency rate of change load shedding schemes, fast load shedding schemes can initiate load shedding before the system frequency or system voltage declines, which in many cases is essential to maintaining system stability.

Service Offering

- Study, design, install, integrate, and commission
- Maintain and support solution after installation

Outcome

- Shed unimportant loads to save critical processes. Cost saving on lost manufacturing and plant restart
- FLS system that can respond within 32 ms which is 3 to 30 times faster than conventional load shedding solutions
- Supports IEC61850 GOOSE and PMUs, among other protocols



Example of Fast Load Shedding Architecture

TRANSMISSION SERVICES – REMEDIAL ACTION SCHEMES

Special Protection & Control Systems – Remedial Action Schemes

Customer Challenge / Need

System reliability challenges due to the high penetration of utility-scale distributed energy resources (DERs) that are interconnected with the bulk power system (BPS):

- System protection
- Low system inertia (frequency instability)
- Intermittent generation
- Disturbance ride-through requirements
- Voltage regulation and reactive power control (Volt-Var support)
- Power quality and stability challenges (harmonics, sub-synchronous resonance, etc.)
- Active power control optimization

At the same time, the grid is facing ever-increasing demand for:

- Optimized/increased energy transfer capacity
- The need to enhance System integrity protection scheme (SIPS) maintainability, expandability, and adaptivity
- Validation of emerging technologies/solutions via special studies & advanced testing
- Optimized application of HVDC systems and hybrid AC/DC systems

Service Offering

- System impact assessment (SIA) studies to interconnect variable DERs to BPS: (i) steady-state studies, (ii) dynamic studies, and (iii) transient studies
- Interconnection design and studies for BPS-connected DERs
- Hardware in-the-loop (HIL) testing of protection and control relays/schemes
- Design and implementation of System Integrity Protection Schemes (SIPS)
- Work with customer to define requirements
- System stability studies to identify remedial actions
- Develop technical solution and communication system architecture
- Solution validation, including acceptance testing via advanced testing and result analysis
- Automatic data collection and results analysis
- System integration
- Commissioning

Outcome

- Maintain grid integrity during major disturbances
- Enable increased power transfer during critical operating periods





DISTRIBUTION SERVICES – DYNAMIC LINE RATING

Dynamic Line Rating Solutions

Customer Challenge / Need

Utilities are facilitating renewable energy usage, and the distributed nature of this generation introduces operational challenges and capacity constraints for distribution networks. In addition, regulators are demanding network performance improvements with limited maintenance and CAPEX budgets. Utilizing the network capacity to its maximum permitted limits based on prevailing conditions is a critical need for utilities.

Service Offering

GE offers value-added services based on its innovative Intelligent Line Monitoring System. The advanced analytics built into the solution computes dynamic line ratings (DLR) based on real-time operating conditions. This enables distribution utilities to better manage their feeders, avoid conductor degradation, increase usage of sustainable energy generation and set increased circuit ratings based on a greater understanding of prevailing conditions.

The DLR computation is based on CIGRE and IEEE models. In addition to DLR values, the solution also provides

- Local sag/clearances
- Weather data monitoring
- Site specific ice load warnings
- Monitored network data

Outcome

- Line capacity uplift up to 50% of the line static rating, based on prevailing conditions
- Evacuation of more power from windfarms by leveraging dynamic line rating of the feeders
- Creation of headroom in distribution circuits, deferring further network investment
- Identification of critical line spans





DISTRIBUTION SUBSTATION – DESIGN SERVICES

Distribution Substation Design

- Substation layout: electrical equipment sizing and specification
- Protection and control
- Power system studies (short circuit, coordination, arc flash, etc.)
- Utility interconnection analysis
- Ground grid analysis and design
- Power quality improvements
- Monitoring and diagnostics
- Substation expansion
- Life cycle management
- Remote monitoring/physical security
- Battery system monitoring

Differentiation

- Pretested, drop in package
- Asset health management
- Wireless and/or power line carrier communications inside
- Integrated cyber security solution
- Seamless integration of substation design with automation
- IEC61850 optical-digital substation

Advanced Applications Enabled

- Dynamic line & transformer rating
- Volt/VAR optimization
- Fast load shedding
- Automatic capacitor bank control
- Fault location isolation and system reconfiguration/restoration
- Capacity as a service

Grid Automation Services Benefits

- Reduce cost and increase reliability
- Increase capacity and stability
- Network visibility with a cyber secure solution

MICROGRID SERVICES

Customer Challenge / Need

As natural disasters have increased in number and impact over the years and electricity prices have increased (particularly due to network operation costs), more and more consumers are thinking about solutions to become grid independent. Military and university campuses, commercial and industrial consumers, and small or remote communities are turning to solutions like microgrids to achieve this goal.

Service Offering

A microgrid is a group of interconnected loads and DERs with clearly defined electrical boundaries which can be operated as a single standalone controllable entity, either in grid-connected or in grid-isolated (islanded) mode. Each electrical system that operates as a microgrid has to be designed with a specific outcome in mind and taking into consideration all aspects of the system including the protection, control, and automation scheme.

Our Grid Automation Services team has been involved in design and deployment of microgrid systems for more than 10 years covering all these aspects. We can provide: feasibility and planning studies, routine and special studies (transient, dynamic, and steady-state), system detailed design and engineering; protection scheme design and relays setting files, factory acceptance testing (FAT) and integration; on-site installation, integration, commissioning (SAT) and maintenance & support.

We can also design and deploy advanced features for microgrids such as:

- Planned islanding
- Fast load shedding (for unplanned islanding)
- Fault location, isolation, system reconfiguration
- Black-start, synchronization, and reconnection
- Volt-VAR control
- Load and generation forecast
- Capacity reserve management
- Advanced energy management

Outcome

Grid Automation Engineering Services experts design and deploy microgrid systems with customer benefits in mind such as system reliability and resiliency, reduced cost of electricity, reduced O&M costs, increased renewable energy usage.



ENABLING INCREASED POWER EVACUATION FROM WIND AND SOLAR FARMS

Customer Challenge / Need

Wind and solar farm owners and operators are forced to curtail excess energy when they cannot push it through an existing network due to network constraints.

Service Offering

Using predefined triggers, the system can be allowed to evacuate excess power from wind or solar farms without affecting network stability. Grid Automation Engineering Services experts can assist with:

- System simulation and analysis with RTDS
- Coordination studies
- Inrush current simulations
- Power flow studies
- Special protection and control schemes
- Asset health index calculation
- Data collection and protection scheme testing
- Installation and commissioning
- Benefits vs asset health tradeoff advice using continuous remote monitoring and diagnostics
- Dynamic line rating (DLR) system design and deployment

Outcome

These solutions enable wind and solar farm operators to avoid curtailment and increase revenues. The benefit for the interconnected utility will be avoiding the investment in new transmission lines needed to increase wind or solar energy usage.





ENERGY STORAGE SYSTEMS

Customer Challenge / Need

An energy storage system enables the microgrid to efficiently and effectively manage its power delivery needs. It gives operational flexibility by reducing system loads during critical peak conditions. Energy storage makes electricity grid a highly reliable source for continuous power generation. Grid Automation Services provides solutions for energy market services, ancillary services, grid support applications, renewable integration applications and end-user applications.

Service Offering

Grid Automation experts can provide the following engineering services:

- Interconnection design and engineering (protection, grounding, auxiliary power, black start, etc.)
- Energy storage studies (steady-state and transient, including optimization studies)
- Develop operational guidelines
- Integration and development of application-level controls
- FAT and SAT (including advanced real-time closed-loop testing)
- Services agreement

Outcome

These services enable wind and solar farm operators to increase electric supply capacity, power quality, and power network reliability. Customers will also be able to perform peak shaving, demand charge management, renewable capacity firming, and optimization of wind & solar generation integration with the grid.

TRAINING & DEVELOPMENT

Gain operational advantages by getting the most out of your GE intelligent controls, automation, monitoring & diagnostics, and communications solutions

GE's Grid Automation training institute offers comprehensive technical training for power system protection, control, automation, cyber security, monitoring & diagnostics, and industrial communications needs.

Training sessions are offered in-person at one of our training facilities, at your own facility, or virtually through tele-presence. Attendance at one of our learning centers provides an exceptional learning experience as students learn via live testing labs and interactive demonstrations with a hands-on approach. Our state-of-the-art facilities offer regularly scheduled events.

Customer Experience Centers*

Learn about our history and today's state-of-art products, services and solutions.

Manufacturing Facility*

See how it all comes together. We invite you to tour our facility and meet our team of experts responsible for the assembling, quality assurance and testing of all our products.

Industry Experts

Our team of experts provides training from different perspectives

Practical Workshops

Our courses provide you with the best of both worlds as participants gain a combination of theoretical and hands-on learning when attending our product training sessions, through our lab tools.

* The availability of offerings is subject to location. Please connect with a member of our team at training.multilin@ge.com for further details.



TRAINING OFFERING

GE's Global Training Centers

GE has training centers around the world offering on-demand, standard or customized courses. Courses taught in GE's training centers feature state-of-the-art technology and learning material, providing students with a rich learning experience using smart boards, hands-on workshop equipment, telepresence and digital device technologies.



Training - Beyond the Classroom

Interactive Learning Website Courses

GE's Grid Automation Services is proud to offer, the largest selection of computer-based trainings in the industry. Our interactive learning website covers concepts from the basics of power systems theory to configuring advanced applications.

These interactive multimedia presentations make complex concepts easy to understand while the student can learn at their own pace and review the course material as often as desired. Grid Automation Services also offers completely customized protection related website-based on the specific applications used at your facilities.



Website

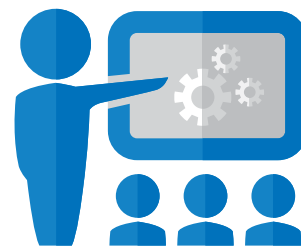
www.gegridsolutions.com

Provides information on the latest news, events and developments here at GE Grid Solutions.

Training Level Certification

Certification is based on three levels:

1. **FUNDAMENTAL:** Recommended for those at entry-level or professionals with less experience
2. **IN-DEPTH:** Targeted to experienced professionals involved in site services or related jobs
3. **ADVANCED:** Recommended for professionals involved in Advanced protection, control and monitoring applications



Advanced Training

www.gegridsolutions.com/multilin/support/training

Offers the most-up-to-date details regarding scheduled course offerings.



GEGridSolutions.com

GE reserves the right to make changes to specifications of products described at any time without notice and without obligation to notify any person of such changes.

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Imagination at work