Digital transformation for substation automation. Leading substation development for over 110 years.

Substation Automation Systems

- Maximum safety, efficiency and reliability for local and remote control and monitoring.
- Flexible functionality and system architecture to cope with changing requirements, philosophies and technologies.
- Cyber security is an essential feature of Hitachi Energy’s products and systems.
Hitachi Energy’s modular Substation Automation Systems are designed for maximum safety, efficiency and reliability for local and remote control and monitoring of your substation. Hitachi Energy offers a smart choice for new stations, retrofit and migration projects.

Invest today in the ultimate and most efficient strategy to build substation automation systems.
Table of contents

004 - 005  Leading substation development.
006 - 007  The highlights of Hitachi Energy’s Substation Automation.
008 - 009  The offering.
010 - 011  Modular, scalable architecture for substation automation solutions.
012 - 013  IEC 61850 station bus topologies.
014 - 017  Far beyond station control.
018 - 019  A comprehensive portfolio.
020  From specification to system delivery and service.
022  Cyber security protection over system lifecycles.
023 - 024  Hitachi Energy service.
026 - 027  Hitachi Energy Digital Substation.
Leading substation development
for over 110 years.

Dependable substation performance is a key for grid reliability. Hitachi Energy has been designing and building substations since the 1900s.

In the late 1980s, Hitachi Energy innovations in substation automation replaced conventional protection and control systems with numerical ones. Hitachi Energy is also dedicated to the development of industry standards, including those used in substation automation. Hitachi Energy has been a driving force in the development and verification of the IEC 61850 substation communications standard since 1995. Since implementing the world’s very first IEC 61850 multi-vendor substation automation system in 2004, Hitachi Energy has supplied thousands of products and systems for new and retrofit projects. Hitachi Energy is the world’s leading supplier of air-insulated, gas-insulated and hybrid switchgear and substations, utility communication networks as well as IEC 61850 substation automation, protection and control solutions and systems.

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2020
Lumada for asset & work management launched
Enabling end-to-end digitalization from the process level to the control room and beyond.

2004
World’s first IEC 61850 multi-vendor substation automation.
Hitachi Energy has supplied thousands of products and systems for new and retrofit projects.

1995
Development and verification of the IEC 61850 substation communication standards.

1980s
Innovation. in substation automation replaced conventional protection and control systems with numerical ones.
Six facts about the modular substation automation systems.

1. Over 15,000 IEC 61850 Substation Automation Systems have been installed worldwide.

2. More than 30,000 Station HMI and Station Gateway/RTU have been delivered worldwide.

3. More than 35 IEC 61860-9-2 Digital Substation projects have been installed worldwide.

4. Hitachi Energy’s IEC 61850-accredited system verification center provides a 24x7 real-life system testing environment.

5. Hitachi Energy’s Grid Automation systems and Services are present in more than 40 countries.

The highlights of Hitachi Energy’s Substation Automation.

Complete solutions for efficient protection, automation, control and monitoring.

Hitachi Energy’s substation protection, control, automation and monitoring solutions are designed for maximum safety, efficiency and reliability – for all types of substations.

- **Complete portfolio** of inter-operable systems, products and tools, fully compliant with IEC 61850.
- **Flexible functionality and system architecture** to cope with changing requirements, philosophies and technologies.
- **Field-proven functionality and hardware**, as well as innovative technologies, ensure best solutions for all substation applications.
- **High availability and fast access** to revise information from anywhere in the system to shorten response times and reduce the duration of outages.
- **Cyber security** is an essential feature of Hitachi Energy’s products and systems. It is embedded from the earliest stages of the design process, through development and project execution, to ensure full functionality, without compromising reliability and interoperability.
- **Open system design** allows easy integration of additional components beyond protection and control such as transformer monitoring, metering, sub-RTUs and other third-party components.
- **Modular and scalable architecture** for easy system extension safeguards initial investment. An existing system can be extended at any time from a functional and system size perspective. For example, you can enhance a basic system by adding an advanced historian or expand from a SCADA to DMS functions.
- **Robust and highly reliable** solutions through use of substation hardened component
- **Optimal solution for migration**. Replace traditional RTU with Hitachi Energy SAS and gradually extend and migrate from the conventional to a modern IEC61850-based solution.

Hitachi Energy’s world-class protection, control and monitoring solutions ensure reliable power transmission and distribution. Our IEC 61850-compliant product portfolio provides you with open, future-proof and flexible system architecture. With Hitachi Energy’s long experience in the field, our full scope of services and global support network, we are a leader in substation automation systems.

Best-in-class applications to protect and control your power system.

With our unrivaled expertise and global experience in substation automation, protection and control systems, you can be sure of getting the best solutions for your applications. We offer field-proven protection solutions for generators, busbars, lines, transformers, shunt reactors, capacitors and motors, as well as station protection systems with decentralized structure and functional integration.
The offering.

01 Substation Automation Solutions
The benefits of advanced power system management require the automation of local operations and the collection, evaluation and forwarding of data on the power system status and plant condition to higher-level systems. The Substation Automation Solutions (SAS) provide remote control and monitoring functions for all kinds of substations, starting from the distribution level up to extra-high voltage substations, and are designed for maximum safety, efficiency and reliability. Incorporated in every SAS is Hitachi Energy’s vast expertise in IEC 61850 and proven system integration capabilities. The results are future-proof systems with interoperability for optimal lifecycle management and low lifecycle cost.

The Hitachi Energy intelligent electronic devices (IEDs) for protection and control are an integral part of the SA system. The SAS and IED together lay the foundation for all the higher-level remote functions such as advanced power system management and the monitoring of the condition of the equipment while it is in service. Station level systems are easy to use and adapt to customer specific requirements. Our scalable modular systems reflect the typical needs and availability aspects for the following range of applications.

- Transmission, sub-transmission and distribution substations
- Utilities and industries
- New installations and refurbishment of existing substations
- Gas and air insulated switchgear

02 Bay Solutions Bay Control Solutions
The modular bay control solutions ensures maximum operator support and safety in the local control and supervision of AIS as well as GIS substations. Smart combinations of high-performance IEDs with conventional hardware elements are tailored to your philosophy and meet the highest demands on availability and reliability.

The inclusion of comprehensive protection function is as easy as the integration with any switchgear and IEC 61850-compliant substation automation system.

- Optimized bay control solutions for MV (medium voltage) to EHV (extra-high voltage) substations, e.g., packages for local or remote control
- Flexible realization of your control philosophy for AIS and GIS
- Scalable, modular hardware and functionality
- Proven functional designs based on global experience
- Efficient integration into IEC 61850-compliant system

Bay Protection Solutions
The modular bay protection solutions offers a clever way of safely realizing reliable protection schemes for all applications in new and retrofit substations. Hitachi Energy’s long experience and deep know-how as a global protection system supplied, field-proven functionality and hardware as well as innovative technologies are all part of the package. Short project implementation times, reduced risks and lifecycle cost as well as easy introduction of IEC 61850 into your substations are additional benefits.

- Optimized protection solutions for MV to EHV substations
- Flexible realization of your protection philosophy and schemes
- Scalable hardware and functionality
- Full use of IEC 61850 data model for efficient integration into IEC 61850-compliant systems
SUBSTATION AUTOMATION SYSTEMS

Operations center
- Lumada for asset & work management
  - APM, EAM, WFM

Network level
- Network Manager
- EMS/SCADA
- FOXMAN
- Communication networks management system
- Utility Communication Network

Communication level
- MicroSCADA Pro & RTU500 series
  - Intelligent Station HMI
  - Substation monitoring & control, data management, security management, primary equipment management, secondary equipment management, substation historian

Station level
- Relion 650/670 Series
  - Protection and control IEDs

Bay level
- IEC 61850 Station Bus
- AFS family
  - Managed switch

Process level
- CoreTec™ Transformer health monitoring
- Power Transformer
- Convensional Instrument Transformers
- UniGear Digital
  - Digital medium voltage switchgear
- SAM600
  - Process bus modules for current and voltage transformers
- SAM600
  - Process bus I/O system
- FOCUS
  - Fiber-optic current sensor

PASS switchgear
- With motor drive and digital interface

GIS switchgear
- With non-conventional current and voltage transformer, digital interface and switchgear health monitoring

CoreTec™
- Transformer health monitoring

FOX615
- Universal multiplexer

AFS family
- Managed switch

MicroSCADA Pro & RTU500 series
- Intelligent Station HMI
  - Substation monitoring & control, data management, security management, primary equipment management, secondary equipment management, substation historian

Lumada for asset & work management
- APM, EAM, WFM

Network Manager
- EMS/SCADA

FOXMAN
- Communication networks management system

Utility Communication Network

IEC 61850 Station Bus
- AFS family
  - Managed switch

IEC 61850 Process Bus

CoreTec™ Transformer health monitoring

Power Transformer

Convensional Instrument Transformers

UniGear Digital
- Digital medium voltage switchgear

SAM600
- Process bus modules for current and voltage transformers

SAM600
- Process bus I/O system

FOCUS
- Fiber-optic current sensor

PASS switchgear
- With motor drive and digital interface
Modular, scalable architecture for substation automation solutions.

01 Basic automation solution
The compact solution for safe local control and monitoring. It features a single gateway or computer and can be upgraded at any time. The choice is yours in terms of advanced functions and/or remote control access.

Features:
• Single gateway/computer with optional HMI
• Basic monitoring and control functions

Typical applications:
• Distribution and sub-transmission

02 Enhanced automation solution
The solution for the manned substation. Single or redundant station HMI s are supplemented with an independent industrial gateway for remote control access.

Features:
• Highly reliable embedded industrial gateway for remote control access
• Single or redundant industrial station computer with HMI independent of gateway

Typical applications:
• High voltage transmission

03 Advanced automation solution
The fully redundant local and remote control solution meets even the highest availability requirements. You are assured of the continuous controllability of your substation—after all, it is of prime importance.

Features:
• Redundant, highly reliable embedded industrial gateway for remote control access
• Independent redundant industrial station computer with HMI

Typical applications:
• Extra-high voltage transmission
• Complex distribution

Options:
• Printers for event printing and hardcopy
• Engineering and operator workstations
• Single or redundant time server with integrated GPS receiver
• Network attached storage (NAS) to store data and backups
• Router and firewalls with VPN
• Proxy to connect legacy protocols and I/Os to IEC 61850
• Station alarm device
• Advanced monitoring functions
• Advanced control functions

Modular, scalable architecture for substation automation solutions.
01
Basic automation: the all-in-one solution

02
Enhanced automation: the gateway and HMI solution

03
Advanced automation: the redundant solution
IEC 61850 station bus topologies.

The communication topology for the IEC 61850 station bus can be arranged in different configurations, depending on the desired network availability, the geographical arrangement of the IEDs and on the total number of IEDs in the system.

Self-healing ring (RSTP), single attached devices RSTP: rapid spanning tree protocol

In a self-healing ring, each Ethernet switch is connected to two, and only two, neighbor Ethernet switches to form a physical loop. The ring offers full redundancy against link failures between Ethernet switches.

The redundancy protocol RSTP ensures that frames do not circulate indefinitely, and a faulty link is typically recovered within a couple of tens milliseconds. End devices are connected with a single connection to one Ethernet switch. Depending on the physical location of the connected IEDs, Ethernet switches may be placed centrally at one location, e.g., in a dedicated communication cubicle or distributed close to the IEDs inside the same protection and control cubicles.

IEC 62439-3 PRP-based topology

PRP: parallel redundancy protocol

PRP is a layer 2 redundancy protocol that provides seamless operation in case of loss of any link or Ethernet switch. PRP relies on complete duplication of the LAN. Both LANs operate in parallel and each individually can either use a star connection or a self-healing ring (RSTP) as described above. The end devices (IEDs) have to support link redundancy according PRP whereas the network is transparent. Single-port IEDs can easily be integrated with just one port connected to one LAN or, if connection to both LANs is required, using a PRP redbox.

IEC 62439-3 HSR-based topology

HSR: highly-reliable seamless ring

A ring structure between end devices saves wiring and Ethernet switches. Additionally, HSR provides seamless link redundancy, meaning there is no switch-over time in the event of a faulty link. Thus, the solution is well-suited for time-critical applications using GOOSE or sampled value communication.

Medium-voltage substations with typically one IED per bay or process bus are two typical applications for HSR based topologies. To connect a station computer, gateway or a single-port IED, an HSR redbox is required.
01
Self-healing ring (RSTP), single attached devices
RSTP: rapid spanning tree protocol

02
IEC 62439-3 HSR-based topology
HSR: highly-reliable seamless ring

03
IEC 62439-3 PRP-based topology
PRP: parallel redundancy protocol
Far beyond station control. Basic and advanced functionalities.

**Primary equipment supervision**
- Continuous monitoring of switching objects
- Display of measurements
- Access to control dialogues

**Measurements**
- Direct from VTs IEC, PTs ANSI and CTs
- mA- and V-Signals
- Time-tagged at bay level
- Statistics

**Control**
- Dialogues for switching objects and tap-changer operation
- Single and double commands
- Analogue set values

**Dynamic busbar coloring**
- Dynamic coloring of the different switchgear parts
- One color per power source
- Enhanced overview for complex substations

**Safety checks**
- Select-before-operate
- Interlocking (bay and station-wide)
- Synchroncheck
- Double-command blocking

**Automatic sequences**
- Execution of pre-defined switching sequences
- Safety checks (same as for switching of individual objects)
- Freely configurable sequences
**System supervision**
- All bay and station level IEDs
- Auxiliary and devices (printer, etc.)
- Communication network/links

**IED parameterization**
- Configuration/parameter upload from IED
- Change of individual parameters or parameter sets
- Access to all IED parameters

**Disturbance record analysis**
- Waveform visualizations, signal vectors
- Fault location, advanced calculation
- Frequency deviation, apparent and reactive power calculation
- Automatic analysis

**Disturbance record upload**
- Manual upload
- Automatic cyclic upload

*Not available in basic*
Far beyond station control. Basic and advanced functionalities.

Sequence of events
- Event list
- Historical events
- Filtering function
- Export facilities

Blocking list*
- Summary display of current blocking situation in the process database
- Blocking of alarms, events, updates, control, printing and reprocessing

Calendar*
- Start time-related activities
- Execution of activities during a certain time period, once or repetitively
- Flexible configuration, individual and independent configuration per day

Alarms
- Alarm list (persistent/fleeting alarms)
- Alarm acknowledgment
- User-defined alarm classes
- Control of acoustic alarm

External alarming
- Fax, voice message
- SMS, pager system
- E-Mail
Trends
• Short-term observation and analysis
• Assignment of any process values
• Graphical or tabular representation
• Calculation formula

Measurement reports
• Statistical measurement reports stored in report database
• Hourly/daily/weekly/monthly/yearly report
• Tabular or graphical representation
• Report data in ASCII or CSV format
• Sum, mean, average, min. max.

Historian and analytics
• An view of the primary process enables facts-based decision making
• Collect and store various types of data in a database designed to thousands of values over longer time periods in an accurate and reliable way
• Assessment for fault analysis such as as routine/filter, fault analysis, report, data correlation

Service guidance such as trip counter table
• Maintenance information for CBs
• Numbers of opening operations
• Accumulated magnitude of the trip currents

Load shedding
• Control at bay level, configuration and supervision at station level
• Static load shedding
• Adaptive load shedding

High-speed busbar transfer
• Change-over of motor-feeding busbar from normal to backup supply and vice versa
• Control at bay level, configuration and supervision at station level

* Not available in basic
A comprehensive portfolio.

Robust and proven solutions.

From the control center to primary equipment, Hitachi Energy delivers a comprehensive portfolio of products, systems and services for substation automation. Our offering is future-proof, equipped with the latest cyber security features, compliant with international standards and robust enough to perform well in the harshest environments. Hitachi Energy is the trusted partner for a complete substation automation portfolio and more.
07 Wired Communication Networks
Hitachi Energy's wired and wireless communications technology serves customers in numerous areas including power generation, power transmission and distribution as well as customers in mining, oil and gas, transportation and public infrastructure.

08 Protection and Control relays
Designed for remote control and monitoring protection, fault indication, power quality analysis and automation. Protection and control relays represent the control center of a switchgear panel.

09 Wireless Communication Networks
Hitachi Energy offers robust and cost effective solutions for building communications links to physically disparate locations, industrial Internet of Things (IIoT) end points and mobile devices across geographies that spans a few miles or thousands of miles. With a wide range of robust wireless communication products and services, Hitachi Energy can meet the challenges of any environment.

Tools
Hitachi Energy’s comprehensive suites of tools for engineering, integration and testing supports you throughout the complete lifecycle of protection and control IEDs and IEC 61850-based substation automation systems. With many advanced features, the tools allow you to manage your installation efficiently from engineering and commissioning to operation and maintenance.

Integrated Engineering Tool IET 600
Designed for configuring IEC61850-based fully digital substation automation systems and applications.

Integrated Testing Tool ITT600
SA Explorer is designed for easy diagnosis and troubleshooting of IEC 61850-based substation automation systems and applications.

PCM600
interacts with IEDs over the fast and reliable TCP/IP protocol via a corporate LAN or WAN, or directly through the communication port at the IED. It is able to read and write all configuration and setting data of an IED with a single command.
Complete solutions
from specification to system delivery and service.

State-of-the-art specifications are based on the computer specification (the system specification description or SSD file), which contains the single-line diagram and the allocated functionality. Our scalable solutions are based on IED capability, which are defined by ICD files. Hitachi Energy engineers the optimal system solutions at the bay and station level. Our systems are thoroughly tested in our System Verification Center. These solutions are adapted according to the user requirements, including the integration of third party equipment.

The delivered system is documented in a substation configuration description (SCD) file, which contains the substation topology (single-line diagram), the communication between functions at the bay and station level, as well as the logical nodes representative of the required functions. This procedure also ensures full data entry and an exact copy in the event of identical bay types. Based on this SCD file, the different tests (including FAT & SAT) can be easily performed and the user facilities for easy adaption or extensions later on. The result is an optional system delivery, with high-quality documentation and excellent performance.

Engineering
The client requirements are integrated and processed into the basic/detail design by experienced specialists, applying and utilizing the experience of the Hitachi Energy automated engineering tools. This automation will minimize the risk of errors and will improve the quality of the supplied system and reduce the commissioning and testing time.

Project management
Hitachi Energy’s world-class project management, system integration know-how and intimate knowledge of the complete power process are just as important as our sophisticated solutions – they are the key to ensuring the successful, timely and competent realization of your project. Hitachi Energy has an unrivaled wealth of global experience, and our ongoing interaction with customer engineers means we continue to deliver added value for our customers.

Manufacturing & testing
Hitachi Energy manufactures according to the highest standards, with streamlined and flexible processes to ensure that quality is consistently maintained. Our testing area is equipped with state-of-the-art facilities developed in-house, and we ensure smooth installation and commissioning.

Commissioning
Hitachi Energy employs specialized testing and commissioning engineers, and we are available to supervise commissioning and testing on site upon request. Hitachi Energy is also able to recruit commissioning engineers from our local units around the globe.

Training center
We train an average of 800 participants per year in automation, protection, SCADA (supervisory control and data acquisition) applications and power system management, on location at Hitachi Energy University (Baden, Switzerland) or directly at the customers’ premises. We are also in charge of empowering our engineering centers in IEC 61850 SA system integration.

Developing business with EPCs
Hitachi Energy’s global engineering center is the point of contact for engineering, procurement and construction (EPC) contractors, guaranteeing fast and easy cooperation. Loose-engineered systems turn into cost-effective, turnkey solutions with standardized processes, implementing the latest technology and full compliance to specifications, while keeping risk low for the EPCs.

Customer support and service
We are concerned for, and take care of our customers’ requirements even after realization including the support of older installations irrespective of which OEM, main or EPC contractor has integrated our products and systems into the plant.
Cyber security protection over system lifecycles.

End-to-end cybersecurity solution.

Cybersecurity measures help to monitor, manage and protect systems and products, ensuring they comply with industrial standards and follow the defense in depth approach. All grid automation systems from Hitachi Energy are designed and configured according to best practices and provide a broad range of cyber security measures, which are grouped into three main categories:

1 Monitor
Monitoring features provide real-time security and monitor the health and activity of assets across grid automation systems, including networks and applications.

2 Manage
Managing features help users monitor and manage critical activity, including configurations, changes and patches across grid automation systems.

3 Protect
Protecting features defend grid automation systems against unauthorized access, attacks, exploits and malware that compromise system availability, performance, security and compliance.

L3–Communication level:
- Secure communication
- (Encryption, real-time)

L2–Station level:
- Zoning & perimeter protection
- Malware protection
- Patch management
- Backup & recovery
- Account management
- Security logging & monitoring
- System hardening

L1–Bay level:
- Zoning & perimeter protection
- Secure communication
- Account management
- Security logging & monitoring
- Product hardening

Remote access
SCADA
Firewall
IDS
HMI/gateway
Ethernet switch
Protection and control IEDs
Electronic security perimeter
Physical security perimeter
Hitachi Energy Service.
Your strategic partner for a changing world.

**Spare parts**
We offer spare part services for hundreds of parts, delivered quickly to any destination.

**Rapid response**
We guarantee fast and flexible response to maximize your equipment uptime.

**Training**
Your strategic partner for a changing world.

**Preventative maintenance**
We employ powerful tools and knowledge to optimize and extend your equipment life.

**Cybersecurity**
We enable smarter system protection to make your utilities more efficient, more productive, and more economic.

**Software & firmware lifecycle**
We optimize connectivity, reliability and efficiency of your assets to increase speed and yield.

Grid Automation Service
Hitachi Energy Service.

Your strategic partner for a changing world.

We may not make the world go round, but Hitachi Energy’s global Customer Care team does its part to keep it running. Through our four key pillars of focus, we provide ongoing technical and functional support to help you meet your objectives.

Rapid response
When something goes wrong, you need it fixed fast! Whether it’s spare parts, replacement equipment or repairs, our care agreements are tailored to your needs. Our remote services and 24x7 call center also provides quick troubleshooting and root cause analysis services so you can identify the most effective course of action and address problems before they grow.

Preventative maintenance
We employ powerful tools and knowledge to optimize and extend your equipment life. Hitting key performance targets can be tough to do when you’re trying to keep costs under control. Our team can devise solutions that help you hit your targets as well as provide software applications that deliver actionable insights for future performance improvements.

Software & firmware lifecycle
We optimize connectivity, reliability and efficiency of your assets to increase speed and yield. We can help you extend the life of your assets with extensions, upgrades, and retrofits. When it’s time to retire an asset, we offer end-of-life services that help you do so cost-effectively and responsibly.

Spare parts
We enable smarter system protection to make your utilities more efficient, more productive, and more economic. From cradle to grave, Grid Automation Service is there to help you take care of your assets by providing installation and commissioning services, maintenance, replacements, spare parts and consumables, and training. We can also help you extend the life of your assets with extensions, upgrades, and retrofits. When it’s time to retire an asset, we offer end-of-life services that help you do so cost-effectively and responsibly.

Training
1:
Your strategic partner for a changing world. We offer training at Hitachi Energy’s facilities at Hitachi Energy University training center and customized training programs and tailored courses at your site, as well as online training.

We are with you around the world
Hitachi Energy Service has more than 150 Customer Care Centers strategically located around the globe. These one-stop shops are staffed by 6,000 professionals with extensive industry and service experience on a wide array of power equipment and systems. Our team of power experts and analysts can help you address today’s toughest power challenged and prepare you to meet the challenges of the future.
Hitachi Energy Digital Substation

A significant breakthrough in substation technology.

Based on the seamless integration of state-of-the-art IEC 61850-based control and protection IEDs, with all relevant primary components and sensors of a modern substation. The primary components include high and medium-voltage switchgear, as well as substation transformers.

The defining feature of a Digital Substation is the implementation of a process bus. The IEC 61850 process bus enables the substitution of point-to-point copper connections between IEDs, other devices (e.g., instruments transformers, gas monitoring, MotorDrive™, etc.) and switchgear by means of a safe, standardized optical communication bus. Thanks to the process bus, real-time measurement signals and status information can be broadcast throughout a substation without complex wiring schemes.

In the late nineties, Hitachi Energy commissioned the world’s first Digital Substation in Australia for Powerlink, a transmission service provider in Queensland. Even though the concept has evolved since then, the basic principles remain the same: substituting heavy and bulky current and voltage sensors with small, integrated sensors and substitute signaling copper wires with fiber optic communication buses.

From 2008 onwards, Hitachi Energy introduced the IEC61850-9-2 process bus between non-conventional instrument transformers and protection and control equipment. Digital Substations enable electric power utilities to increase productivity, reduce footprint, increase functionality, improve the reliability of assets and, crucially, improve safety for service personnel. Digital Substations exploit the benefits of digital protection, control and communication technologies, mirroring the trend towards digitalization seen in many other industries.

This trend towards digitalization also applies to other areas of the substation. Within medium-voltage switchgear panels, the horizontal exchange of IEC 61850-8-1 GOOSE and sampled analog values reduces wiring and accelerates the testing and commissioning. Digitalized technology can now continuously monitor mission-critical functions of high and medium voltage switchgear as well as substation transformers, while performing real-time simulation and diagnostics, ensuring that the proactive management of the assets lifecycle is now possible.
The availability of increasing amounts of data in the substation calls for better solutions to turn this data into actionable information, and to ensure that the data is properly and securely managed. The latest substation data management and asset health management solutions offer the means for a power utility to exploit the latest advances in this area.

The Hitachi Energy Digital Substation has also paved the way for well-known innovative switchgear solutions such as PASS (plug and switch system) and, most recently, the disconnecting circuit breakers with integrated fiber optic current sensors (DCB with FOCS).