POWER GRIDS

We are bridging the gap.
Enabling Digital Substations.
ABB’s Digital Substation provides customers in the utility sector with unmatched control and efficiency. The digital substation reduces maintenance requirements and the need for miles of conventional cabling. ABB Ability takes these advances several steps further by combining the latest electrical gear with digital sensors and cloud computing. The result is that grid operators can make decisions based on comprehensive, up-to-the-moment information, while predictive algorithms can improve maintenance practices and asset management.

Claudio Facchin
President, Power Grids division
ABB’s Digital Substation is a core enabler to increase safety, productivity and reliability for grid operators and to reduce the overall substation cost.

Enabling a safer work environment while reducing construction and operational costs. Digital Substations remove the last electrical connection between the high voltage equipment and the protection and control panels, creating a safer work environment, whilst reducing the costs for building, land, engineering, commissioning, operation and maintenance of the system. As a key component towards smarter grids, where utilities continue to integrate increasing amounts of intermittent renewable energy sources, Digital Substations will also help improve safety thanks to improved data quality and a shorter decision time in case of an emergency.
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specifically for utilities.

ABB Ability™ Ellipse®
for connected asset lifecycle
management (CALM)

ABB Power Grids service
Your strategic partner
for a changing world.
Since then, we have supplied tens of thousands of air-insulated, gas-insulated and hybrid substations with voltage levels up to 1,200kV to a range of very different sites: from the most densely populated locations to the harshest environments on earth.

Our major technological step was in 1965 by introducing gas-insulated switchgear (GIS) that reduced the footprint of substations. Alongside the development of GIS technologies, ABB has significantly improved the performance of conventional AIS substations. The latest innovation, the "combined" disconnector circuit breaker (DCB), integrates the disconnecting function into the circuit breaker. This eliminates the need for two separate free-standing disconnectors and reduces the footprint of the substation by more than 50 percent. ABB is the first company to develop this technology for voltage levels up to 500kV.

In the late 1980s, our innovations in substation automation replaced conventional protection and control systems with numerical ones. ABB is also dedicated to the development of industry standards, including those used in substation automation. We have 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, ABB has supplied thousands of products and systems for new and retrofit projects. ABB 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.

Dependable substation performance is a key factor for grid reliability. ABB has been designing and building substations since the 1900s.
2011

New Applications.
First installation of FOCS optical CT integrated in 400kV Disconnecting Circuit Breaker.

1998

Sensors
Commissioning of the first Digital Substation with sensors for current and voltage.

1900s

Conventional
Instrument transformers.
ABB’s Digital Substation is a significant breakthrough. Innovation 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, ABB 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 and integrated sensors and substitute signaling copper wires with fiber optic communication buses. From 2008 onwards, ABB 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 pro-active management of the assets lifecycle is now possible.

The availability of increasing amount of data in the substation calls for better solutions to turn this data into actionable information, and to
ensure that data is properly and securely managed. The latest Substation Data Management and Asset Health management solutions offer means for a power utility to exploit the latest advances in this area.

ABB’s Digital Substation concept 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).
Digital Substation Benefits.

Bridging the gap between analogue and digital, enabling a safer work environment and reduced maintenance costs.

Thousands of engineering intensive and costly point-to-point copper signaling wires can be replaced by few fiber optic communication buses. The IEC 61850 standard safeguards the investment of the substation owners and enables interoperability between vendors of substation equipment.

Personnel safety is improved since less signal connections or inadvertently opened CT circuits can harm personnel during commissioning and service activities. Ultra-fast earthing switches installed in medium voltage cubicles to prevent disruptive and catastrophic damages caused by an arcing faults.

Digital Substations enable the reduction of the foot-print of a substation because less space is required for protection and control panels and functions previously executed by physically separate equipment can now be integrated in one device.

For example, in Air Insulated Switchgear (AIS) substations a Current Measurement transformer can be replaced by an optical sensor (Fiber Optic Current Sensor) and fully integrated inside a Live Tank Breaker together with disconnecting and earthing functions. In the case of an Air Insulated Switchgear substation, the footprint can be reduced by 50% compared to a conventional solution*. Higher productivity can be achieved by means of new asset management systems with monitoring and diagnostics data from substation equipment. This feature substantially improves the efficiency of service activities. Monitoring and diagnostics is a strategic feature for utilities further reducing outage time and increasing reliability.

Transient stresses can be mitigated by means of point-on-wave switching which needs data from various sensors, meaning in many cases expensive closing resistors become obsolete.

To meet the increased need for the flexibility of the transmission and distribution grids, Digital Substations provide data and information that is required for the control of grid stability and for a quick response to changing grid conditions due to the integration of intermittent resources.

Digital Substations bring unseen opportunities for modern utilities.

Cyber Security
Protecting systems from cyber abuse or vandalism from the outside world.

Increased Safety
Digital substations reduces the risk of electrical shock by substituting copper wires with fiber optic cables.

Improved Asset Management
Gain control of the substation hardware with second-by-second analysis and control.

Backwards Compatibility
Deep integration with legacy products, supporting utility communication from the past and into the future.
Future Proof
Digital Substation enables faster implementation of future technologies.

Lower CT Requirements
Digitizing data right in the field, reduces burden and lowers CT requirements.

Software Based Testing
Safe testing with software based simulation and verification.

Improved Asset Management
Gain control of the substation hardware with second by second analysis and control.

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* Based on a typical conventional 400kV double busbar AIS substation compared to a modern variant using SAM600 process bus I/O system and FOCS integrated in disconnecting circuit breakers.
** Of new secondary systems.
*** During secondary system retrofits.

Up to 80% copper cable reduction*

40% shorter installation phase**

Up to 60% less space in the relay house*

Operational cost reduction***
Key Digital Substation Technologies.

Digitalization affects all components and aspects of a substation.

To deploy their full benefits for the owner and operator, the Digital Substation features have to be planned and designed during the specification phase. This ensures that in the medium term, substantial productivity gains are achievable in operation thanks to better asset utilization and thanks to synergies between various departments such as station control, automation and protection.

1. High Voltage Primary Equipment
Primary High Voltage switchgear in Air Insulated technology (AIS), Gas-Insulated technology or Hybrid Technology (PASS) Non-Conventional Instrument Transformers enable smaller substation foot print and easier engineering. Alternatively, existing CTs & VTs can be connected to Stand Alone Merging Units, which connect the analogue measurement signals to the process bus.

2. Protection, Supervision and Control
The substation automation, protection and control system solutions ensure reliable power transmission and distribution.

To ensure interoperable and future-proof solutions, the substation automation, protection and control system has to be designed to implement the core values of the IEC 61850 standard.

3. Medium Voltage Switchgear
Air and gas insulated switchgear solutions for primary and secondary distribution that suits various applications like railway power supply and wind farm integration.

4. Communication Networks
The Communication Network inside the substation and from the substation to remote network control centers. These solutions fulfill the highest demands with respect to safety, reliability, and real time response.

Extending the Digital Grid.

Monitoring & Diagnostics
Through remote access, the asset owner can evaluate the status of the equipment without dispatching an engineer to the site, saving both valuable time and resources. Since monitoring detects condition changes in real-time – versus periodically with traditional diagnostic methods – the asset owner has time to plan and act before faults occur.

Historian and System Data Management
Historian effortlessly collects, archives and enables you to visualize and analyze the primary process data. System Data Management software provides a solution for the automatic management of service and cyber security relevant data across your substations.

Digital Operations
An unparalleled range of solutions for asset performance management, operations and workforce management, and network control to help customers reach new levels of efficiency, reliability, safety and sustainability. With the capabilities to integrate information technologies (IT) and operational technologies (OT) to provide complete solutions to our customers’ business challenges.
The Substation Evolution.

Transition from conventional schemes to the Digital Substation.

Traditional substations have always relied on copper cables connecting together primary equipment like circuit breakers, conventional current and voltage transformers and protection relays. But digital technologies, communications and standards are driving the evolution of something new – Digital Substations.
Helping to defend the digital grid.  
Three steps to cyber security vigilance.

Every grid automation system is potentially out of date and constantly needs maintaining and updating. By not updating your system you leave yourselves exposed to attack, the threat exponentially increases the longer the system is not maintained and updated.  
ABB Power Grids service offers a three step approach to cyber security to help defend your systems:

**Assess**
To begin the process ABB carries out a cyber security assessment to help you understand how to improve security throughout your system. A detailed cyber security assessment report is then produced and provided to you along with a set of recommended actions for improved cyber security.

**Implement**
ABB provides recommended actions for you to implement based on the cyber security assessment and our experts domain expertise. Upon agreement ABB implements the recommendations to your system, ensuring your system is more secure.

**Sustain**
By appointing ABB as your cyber security partner; you enter a care agreement which ensures you benefits not only from ABB’s huge domain expertise across the globe but also your system will be regularly assessed by the cyber security care team for any potential cyber security infringements. This ensures a long term approach is taken to ensure sustained cyber security vigilance.
Six layers of protection.
Delivering better cyber security via defense in depth.

Unique security assessment solutions.
Assessment and monitoring services for system software, system hardware and communication networks are fundamental in order to keep a system constantly secure. Overseeing the cyber security status of your system, ABB’s collects system data for comparison against industry best practices and standards to detect weaknesses within your system’s defense. This pinpoints areas that require action to help protect your system by ensuring it has multiple layers of security.

Preserving the past for a rapid response to tomorrow’s challenges
If the worst does happen, and cyber-attack or natural disaster strikes, then the security of an off-site back-up will make recovery that much easier. ABB’s back-up solutions can ensure the integrity, and availability, of critical data, no matter what happens to the original.

Effortlessly updating and improving your system
Modern operating systems and embedded software often need to be patched to defend against emerging threats. Efficient patch management is an essential part of any security policy, but one that is often neglected. Products can be made significantly more robust by closing ports and services that are not in use. Our products have been systematically hardened to ensure that the products are robust against attacks and perform their main function.

Evolving protection against sophisticated threats
Our substation automation systems can be equipped with industry-standard malware and intrusion protection solutions, like anti-virus protection and application whitelisting.

Constantly vigilant for attacks and breaches
Firewalls can protect the perimeter of a network and a well-designed security policy will separate the network into distinct, controlled zones, protected by internal firewalls to ensure that a compromised server doesn’t mean compromising the entire network.

Security updates & hardening

Backup & recovery

Procedures & policies

Malware Protection

Perimeter protection

Educating and supporting system users
Cyber Security will always be a challenge on a global scale; no single solution can keep increasingly interconnected systems secure, so ABB works with customers to understand your processes and procedures, group security policies and computer settings to create a defense-in-depth approach where multiple security layers detect and deter threats – if, where and when they may arise.
Innovative High Voltage Air-insulated Switchgear (AIS) With Fiber Optic Current Sensor (FOCS)

ABB’s Fiber Optic Current Sensor, FOCS integrates into IEC 61850-9-2 process bus system supplying protection and control IEDs as well as revenue meters with accurate current measurements.

- An AIS solution for Digital Substations with integrated FOCS is available for both ordinary LTB (Live Tank Breakers) and Disconnecting Circuit Breaker (DCB). The DCB provides the functions of a circuit breaker and a disconnector combined in a single unit, thus giving 3 functions in one device: measurement, interruption and isolation.

Integrating the FOCS into Live Tank Circuit Breaker solutions provides the following advantages:

- Faster installation times; plug and play. One FOCS replaces many CT cores, simplifying design and engineering substations.
- Lower environmental impact.
- More intelligent protection and control due to smart process bus interface.
- Compact solution. Lower environmental impact.
- More intelligent protection and control due to smart process bus interface.
- Compact solution.

DCB with integrated FOCS

Conventional AIS bay

DCB with FOCS
Free-standing Fiber Optic Current Sensor (FOCS-FS)

FOCS-FS is the free-standing version of ABB’s FOCS technology. It is a non-conventional instrument transformer enabling digital HV substations and smart grids with an optical IEC 61850-9-2LE Ethernet output.

Beside inductive current transformers, oil or SF6 insulated, ABB has developed since 1990s optical current sensors, based on the Faraday effect principle, whereby light is used to deduce the precise magnitude of current that is creating the magnetic field. As a result, the design is inherently free of magnetic saturation, therefore suitable for capturing fast transient currents, short circuit currents, and alternating current (AC) with DC-offset.

- FOCS-FS is a 3-phase sensor system consisting of:
  - Three hollow insulators filled with nitrogen at ambient pressure and supporting the sensor heads
  - One outdoor kiosk, installed on the steel structure of the central phase and connected via optical fiber to the three HV columns and to the relay house via a duplex ethernet optical cable (IEC61850-9-2LE protocol).
  - An opto-electronic module located in the kiosk:
    - Sends polarized light to the sensor
    - Receives the reflecting polarized light from the sensor
    - Compares in close-loop control the phase displacement in the polarized light in proportion to the magnetic field and the primary current.
    - Converts the result into an optical IEC 61850 Ethernet output.

The level of redundancy that can be specified is given by the number of opto-electronics units integrated in the system.

All solutions can be equipped on request with merging units, which digitalize analog signals coming from voltage transformers, synchronize those signals with the digital signal coming from FOCS-FS and consolidate both signals into a digital output stream complying with IEC61850-9-2 LE protocol.
Innovative High Voltage Hybrid Switchgear
PASS (Plug And Switch System).

The PASS for Digital Substations is a compact hybrid switchgear fully assembled and high-voltage tested in factory, for rapid installation and energization. PASS can leverage Digital Substation features such as the Motor Drive™ and an intelligent local control cabinet fully enabled with IEC 61850 communication protocol.

Motor Drive™
Motor Drive™ 1.4 is a digitally controlled servomotor that drives the contacts of a high-voltage circuit-breaker contacts with the highest precision, while the energy necessary to enable the operations is stored in capacitors. The input/output (I/O) and interlocking of the PASS module are managed by electronic boards, which can be easily configured at any stage of the project. The switchgear is equipped with an electronic local control cabinet which enables the high voltage switching bay to be operated digitally with a Human Machine Interface.
Innovative High Voltage Switchgear
Motor Drive™ operating mechanism.

Intelligent Local Control Cabinet (I-LCC)
The I-LCC embeds the configurable logic needed to integrate typical local control cabinet components (e.g. interlocking) and to control auxiliary devices. It also guarantees smooth integration into substation automation systems using IEC 61850, bringing the technology to continuously monitor the functions of the switchyard, whilst performing real-time simulation and diagnostics, allowing pro-active management of the life-cycle of the asset and remote service intervention.

Operating features include:
- Low operation forces
- Simple installation without adjustment
- Advanced self-monitoring system
- Only one (1) moving part in the drive
- Low stable power consumption
- Extremely low noise level

Diagnostics
Motor Drive™ collects and stores a wide array of data that can be downloaded and analyzed. Stored events of the circuit breaker’s activities and detailed information about the latest operations are available. Supervisor and diagnostic module of Motor Drive™ verifies that the system is working correctly; it continuously monitors:
- The function of all boards and Internal supplies
- The integrity of interlocking
- The functionality of motor control chain

The auto-monitoring functionality, together with the dramatic reduction of mechanically moving parts, gives outstanding reliability, and has been tested for 30000 close/open operations.
Innovative High Voltage
Gas-insulated switchgear
With combined current and voltage sensors (CP series).

ABB’s digital GIS comes integrated with Non-Conventional Instrument Transformers (NCIT), that increase operational safety, simplify switchgear design and reduce switchgear footprint. The IEC 61850 process bus replaces conventional copper cabling between local control cubicle and protection cubicle.

The measurement signals are provided by two redundant Rogowski coils for the current and 2 redundant capacitive ring sensors for the voltage. The low power analog signals from these sensors are converted to a digital signal in redundant electronic modules mounted directly at the sensor. The sensors are sealed for life and repair or replacement during the life cycle of the primary equipment is not needed. The electronics mounted on the sensor enclosure however is pluggable and can be changed easily.

The NCITs for metal enclosed switchgear have been in service in substations since 1998 and have proven to be reliable in service and stable under extreme climatic conditions (high temperatures, outdoor applications). Electronic components have been MEOST (Multiple Environmental Overstress Test) tested and optimized In fact more than 300 systems have been in continuous operation for more than 10 years.

The control IEDs are mounted in the control cubicle at the GIS bay where all the binary signals to and from switches for a bay are connected and from there the signals are broadcast by means of a process bus. Alternatively, the protection IEDs can be integrated in the local control cubicle as well. The ABB metal enclosed circuit breakers NCIT merging unit was the world’s first to be conformance certified by UCA International Users Group.

With multiple Ethernet ports and connections to NCITs, it offers high flexibility to system design or any switchgear layout and provides largely fail safe communication networks between NCITs and control/protection IEDs. This arrangement eliminates most of the point-to-point signaling wires between the bay cubicle, the protection and to the station level.
Non-Conventional Instrument Transformers (NCITs)
For metal-enclosed switchgear.

ABB offers the NCIT CP sensor based on the Rogowski coil principle and on voltage capacitive dividers for metering, protection and control accuracy in a single device. The CP sensor can be physically integrated into metal enclosed switchgear like GIS, DTB (Dead Tank Circuit Breakers), Hybrid Switchgear and MFM (Multi Functional Modules).

Conventional CTs saturate at high currents, therefore various different sizes of CTs are needed for coping with protection, measurement and metering purposes. The dynamic range and accuracy of NCITs covers the entire functional range with one sensor.

A redundant set of Rogowski coils and the capacitive voltage sensors are integrated in a concentric HV switchgear conductor segment, the sensors are redundant by installing two separate systems. The analogue signals are converted to digital and processed directly at the sensor.

The CP-MU merging unit combines and synchronizes the current and voltage measurements from the sensors on the individual phases to IEC 61850-9-2 process bus information.

- World’s first UCA-certified IEC 61850-9-2LE compliant merging unit.
- Interfaces with sensors of up to three three-phase measuring points.
- Reducing the number of components in 1 1/2 breaker and double busbar arrangements.
- Multiple Ethernet ports bring high flexibility to system design.
- Reducing the need for Ethernet switches in protection circuits.

Conventional CTs and VTs will gradually be replaced by Electronic CT and VT (ECT/EVT) CP-MU merging unit for protection and control.
SAM600 Process Bus I/O System

SAM600 integrates conventional instrument transformers into modern, IEC 61850-9-2 process bus substation automation, protection and control systems.

The modular design of SAM600 enables safe, efficient, and stepwise retrofit of any substation in AIS or GIS technology. In order to maximize the benefits of IEC 61850 process bus, SAM600 modules are placed in marshalling kiosks across the switchyard close to the primary apparatus.

SAM600 bridges the gap between analog and digital worlds and enables the upgrading of existing conventional substations to Digital Substations with IEC 61850 process bus as it interfaces any conventional instrument transformers.

SAM600 also supports different communication redundancy architectures according to IEC 62439-3 (HSR/PRP)

Distributing current and voltage information digitally through optical fibers reduces the risk of wrong handling of current and voltage circuits, increases personnel safety and reduces the risk of equipment failure. The current and voltage signals, once digitized, can be made available wherever needed inside the substation and elsewhere.

The modular process bus systems can be tested in the factory, from station automation system down to the process interface units. This minimizes the installation, cabling and commissioning time when deploying the pretested system on site.

Constant supervision of all electronic components and digital communication in the substation minimizes the need for periodic maintenance and allows for faster remedial action in case of failure.

SAM600 CT
Connects conventional instrument transformer for current measurements to the IEC 61850-9-2 process bus.

SAM600 VT
Connects conventional instrument transformers for voltage measurements to the IEC 61850-9-2 process bus.

SAM600 TS
Communication redundancy (IEC 62439-3 HSR/PRP) and time synchronization via 1PPS or IEC 61850-9-3.
Upgrading
Existing conventional substations can be upgraded to Digital Substation by introducing a process bus connection to conventional.

More efficient project delivery and installation
Reduction of field cabling not only reduces the use of expensive copper, but minimizes engineering efforts, installation and on-site testing.

Unrivalled flexibility
SAM600 is designed around one hardware module per primary object - SAM600-CT and SAM600-VT for interfacing any conventional current or voltage instrument transformers, and optionally SAM600-TS for time synchronization, either standalone or in combination with a GPS clock. The modules can be chained into a system to optimally adapt to different application types – “the sum is more than the whole of its parts”.

Multiple communication ports allow for simple and highly flexible process bus architectures, minimizing the need for Ethernet switches.

SAM600 process bus I/O system can combine current measurements acquired from next-generation sensors, such as ABB’s FOCS, with voltage measurements from conventional VTs.

Efficient design and operation
Strict adherence to the IEC 61850 standard results in futureproof installations that take advantage of enhanced tool suites for engineering and testing, such as ABB’s IET600 system configuration tool and ITT600 SA Explorer for simple and efficient testing.

Built in supervision functionality, via IEC 61850, minimizes the need for periodic maintenance.

Optimal placement of modules
SAM600 comes in a compact form factor and is DIN-rail mountable for fast installation and replacement. It can be installed in existing protection and control panels, or placed close to primary apparatus in a marshalling kiosk or VT terminal box in the switchyard.

Safe and simple testing and maintenance
Customizable terminals allow the use of standard cables, tools and work procedures. This reduces training needs for installation, testing and maintenance. One module terminates all signals of a primary apparatus, including both main and auxiliary signals such as test switch or fuse failure supervision. This substantially reduces cross wiring and allows an engineer to work on one object without influencing others.
Relion®
The power of one solution for protection and control.

The Relion® series offers a standardized library of functionality on a high performance, common hardware architecture, and provides the flexibility and configurability to suit any application area.

With its proven reliability, high accuracy and high performance operation, the Relion® series of protection devices can be used for the most demanding applications for your power system network.

The Relion® 670 and 650 series protection and control IEDs (Intelligent Electronic Device) provide versatile functionality as well as maximum flexibility and performance to meet the highest requirements of any application in generation, transmission and sub-transmission protection systems.

Relion® 670 series
IEDs for protection and control.

Relion 670 series of protection IEDs support IEC 61850-9-2 sampled analog values. All devices can process multiple sample values streams and also operate in mixed configurations with sampled values and conventional wired current and/or voltage signals.

The line protection is performed by the REL670 for distance protection and RED670 for line differential protection. Line differential protection supports multi-ended transmission lines with conventional and/or digital current measuring at the remote end substation(s). If permitted by the line differential communication method, the line differential protection can operate without GPS clocks, mirroring conventional setups where the “echo mode” of RED670 is used.

All IEDs are IEC 61850-9-2 enabled, as for example RET670 transformer differential protection can either work with all digital currents, measured by NCITs or conventional CTs and digitized by stand alone merging units like SAM600, or it can work in mixed configuration with some currents provided as sampled values and other wired conventionally from traditional CTs.

The phasor measurement unit RES670 is fully compliant with standard for Synchronized Phasor Measurements for Power Systems, IEEE 1344-1995 and IEEE Std C37.118-2005 (Both measurements and data communication), IEEE Std C37.118.1-2011 and IEEE Std C37.118.1a-2014 (Measurements), IEEE Std C37.118.2-2011 (Data communication) communication capabilities enable easy integration of RES670 in substation automation systems. Several protection and control functions of the Relion 670 series IEDs are available in RES670.

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Relion®
The power of one solution for protection and control.

Safeguarding your investment
Continuous monitoring and protection of the primary equipment.

Utility grade protection
Electromagnetic compatibility compliant with IEC 60255 and IEEE/ANSI C37.90.

Critical application reassurance
Redundant communication for 100% availability.
The Relion 650 series of protection and control IEDs (intelligent electronic devices) provide ready-to-use solutions configured with complete protection functionality and default parameters to meet the needs of a wide range of applications. Key functionality includes:

- Complete and ready-made application solutions
- An HMI with on-screen keyboard, user configurable push buttons and three-color LED indications with programmable LED text-based alarm descriptions, making it easy and fast to work with the IED
- Minimized parameter setting based on default values and ABB’s global base value concept. Only parameters related to the application need to be set, such as the line data
- Centralized Account Management (CAM), which enables deployment of users, access rights and certificates in the substation automation system in a structured and standardized way
- Flexible Product Naming (FPN), which allows the mapping of the standard logical device names, logical node names and attributes to a customer oriented and IED-vendor independent IEC 61850 model

In the 650 series IEDs, most basic parameters are set before delivery from the factory. You only need to set the parameters specific to your application. This allows you to quickly take your IEDs into operation. The application manual includes setting examples to support your protection engineers.

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### Relion® REB500

**Distributed busbar protection.**

For busbar protection and breaker failure protection, ABB provides a REB500 distributed busbar protection system. The REB500 bay units interface to the IEC 61850-9-2 sampled values. The REB500 busbar and breaker failure protection system is designed to work without station wide synchronization of analog sampling to provide highest availability of the protection.

The distributed busbar protection system can operate with process bus as well as conventional current and voltage values. This enables for example seamless extensions of existing installations.

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IET600
Integrated Engineering Tool for IEC 61850 Digital Substation.

Integrated Engineering Tool for IEC 61850 fully Digital Substation
Integrated Engineering Tool IET600 is designed for configuring IEC 61850-based fully Digital Substation automation systems and applications. IET600 allows system engineers and integrators to define and configure the complete substation automation system according to IEC 61850. It features powerful graphical interfaces to design the substation topology, manage the communication between all IEC 61850 compliant IEDs in the substation and generate a complete description of the substation in an SCD file. IET600 is the world’s first system engineering tool to be IEC 61850 Edition 2 conformance certified.

ITT600
Integrated Testing Tool for IEC 61850 Digital Substation.

Integrated Testing Tool, ITT600 SA Explorer, is designed for easy diagnosis and troubleshooting of IEC 61850-based substation automation systems and applications. It features convenient navigation, comprehensive presentation of application data, and support for system consistency check both on-line and off-line. This allows anybody to use the same tool to analyze and debug substation automation applications regardless of their level of knowledge of IEC 61850 communication.

The ITT600 SA Explorer tool offers facilities for exploring and analyzing the communication configuration of the protection and control IEDs (Intelligent Electronic Devices) and IEC 61850 communication in substation automation systems, including GOOSE messages. Its versatile functionality eliminates the need for multiple testing tools for different purposes, such as MMS browsers, and protocol and Ethernet analyzers.

The powerful features of ITT600 SA Explorer provide test engineers with access to any IEC 61850-compliant IED. The tool’s various functions allow efficient testing of the IED application and isolate the root cause of system communication problems. This significantly reduces testing and commissioning time in a fully Digital Substation.

ITT600 SA Explorer is easy to use, and does not require the skills of a data communication specialist. By translating the complex terminology of communication protocols into the standardized IEC 61850 language, it makes the essential information available to all users.
PCM600 provides versatile functionalities for the entire life cycle of Relion® protection and control IED applications. This easy-to-handle tool helps you manage your protection and control equipment all the way from application and communication configuration to IED maintenance and service.

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

PCM600’s unique graphical application configuration concept enables configuration and monitoring of the complete IED application from input to output. The online monitoring allows an easy and fast testing of all protection and control functions.

The IEC 61850 standard-compliant PCM600 allows a seamless integration of Relion IEDs into any IEC 61850 system. PCM600 and Relion IED series are the perfect solution for any protection and control application.
Right and reliable information is the basis for correct and safe operations. MicroSCADA Pro maximizes information availability by supporting redundant system servers and communication at any substation in every situation.

MicroSCADA Pro SYS600 is a modular and scalable software for real-time monitoring and control of primary and secondary equipment in substations.

It is designed for complete functionality for real-time monitoring and control of primary and secondary equipment in transmission and distribution substations. It allows easy and safe interaction with protection and control IEDs, as well as with the process via the operator’s workplace. This way, it effectively promotes taking the right actions and achieving the maximized availability of a Digital Substation.

The system allows the definition of automatic alarms to optimize the timing of maintenance through monitoring the number of breaker operations, fault and disturbance statistics and motor start-ups.

MicroSCADA Pro prevents simultaneous operation of primary equipment. It reserves the device and verifies whether the selected object can be operated before executing commands. Additionally, station wide interlocking schemes, which are complementary to the bay level interlocking, prevent dangerous operations that might otherwise damage primary equipment.

Optimized Maintenance

Apparatus Safety
**Personnel Safety.**
MicroSCADA Pro increases personal safety in many ways.

The breakers and disconnectors are operated from a separate control room in the substation. Minimizing the risk for personnel injuries by further prohibiting operation of objects, for instance, in maintenance situations, thus ensuring personnel safety. Notification of the on-going maintenance work can be attached to the process views and a control dialog to inform operators accordingly. MicroSCADA Pro also permits the definition of authorization levels for different user categories to prevent unauthorized actions. Intuitive and consistent icons with selectable and pre-defined color schemes enhance the visual comfort for the operator. This makes it easy to master the overall harmony of the various information displays in your interface, and get familiar with the system quickly.

**RTU500 series**
Intelligence distributed across your power grid.

Your benefits:
- Secure investment thanks to agile migration concepts as well as functional and software extensions
- Maximum flexibility and adaptability to meet the requirements of today and tomorrow
- Cost-efficient monitoring and control solutions thanks to intuitive and efficient configuration tool
- Eco-efficient solutions for reduced environmental impact, allowing for the integration of renewables into the power grid
- Future-proof RTUs thanks to technological innovativeness and interoperability
- ABB is your long-term partner with more than 40 years’ experience in electrical and industrial automation applications
- RTUs incorporate strong and resilient cyber security features for secure
Medium Voltage Switchgear.
Medium Voltage Switchgear for Digital Substations.

Digital Switchgear
Digital Switchgear is a new solution implemented to the traditional Metal-Clad ANSI switchgear. It is accomplished by using well-proven components such as current and voltage sensors, Relion® protection relays and IEC 61850 digital communication.

The current sensors used are of highly compact design, optimized for the use in traditional Metal-Clad ANSI switchgear. Each panel can accommodate two sets of current sensors.

The voltage sensors are very compact as well. They are integrated as part of support insulators housed in the cable compartment or built directly in the busbar compartment.

The current and voltage sensors are of very high accuracy (accuracy class 0.5), however revenue metering might require yet higher accuracy classes or the installation of instrument current and voltage transformers for the specific purpose. The transformers can optionally be added to sensor-equipped panels.

Digital Switchgear benefits
• Smart grid flexibility
• Minimizes lifetime costs
• Quick delivery
• Flexibility during switchgear operation
• Reliability and safety
• Space saving solution
• Green solution
• Customization and changes

Digital Switchgear features
• Covers the entire ANSI medium-voltage, metal-clad product portfolio
• Available for applications up to 27kV, 4000A and 50kA
• Current and voltage sensors with accuracy class 0.5
• Relion protection and control relays with IEC61850-9-2LE
Current sensors for Digital Switchgear

Electronic Instrument Transformers (Sensors) offer an alternative way of making the current measurements needed for the protection and monitoring of medium voltage power systems. Sensors based on alternative principles have been introduced as successors to conventional instrument transformers in order to significantly reduce size, increase safety, and to provide greater rating standardization and a wider functionality range. These well-known principles can only be fully utilized in combination with versatile electronic relays.

Construction of ABB’s current sensors is done without the use of a ferromagnetic core. This fact results in several important benefits for the user and the application. The main benefit is that the behavior of the sensor is not influenced by non-linearity and width of hysteresis curve, which results in a highly accurate and linear response over a wide dynamic range of measured quantities.

A linear and highly accurate sensor characteristic in the full operating range enables the combination of metering and protection classes in one winding. With KECA 80 Cxxx sensors measuring class 0.5 is reached for continuous current measurement in the extended accuracy range from 5% of the rated primary current (Ipr) not only up to 120% of Ipr (as being common for conventional current transformers), but even up to the rated continuous thermal current. For dynamic current measurement (protection purposes) the ABB sensors KECA 80 Cxxx fulfill requirements of protection class 5P up to an impressive value reaching the rated short-time thermal current Ith. That provides the possibility to designate the corresponding accuracy class as 5P630, proving excellent linearity and accuracy measurements.

Current measurement in KECA 80 Cxxx sensors are based on the Rogowski coil principle. A Rogowski coil is a toroidal coil, without an iron core, placed around the primary conductor in the same way as the secondary winding in a current transformer. However, the output signal from a Rogowski coil is not a current, but a voltage.

**Current sensors for MV panels features**
- Linear characteristic
- No magnetic core
- Combined accuracy class of 0.5 for metering and 5P630 for protection purposes
- Wide dynamic range reaching values up to rated short-time thermal current
- Very compact mechanical design to better fit into MV switchgear
- Safe secondary outputs
Electronic Instrument Transformers (Sensors) offer an alternative way of making the voltage measurement needed for the protection and monitoring of medium voltage power systems. Sensors based on alternative principles have been introduced as successors to conventional instrument transformers in order to significantly reduce size, increase safety, and to provide greater rating standardization and a wider functionality range. These well-known principles can only be fully utilized in combination with versatile electronic relays.

Construction of ABB’s voltage sensors is done without the use of a ferromagnetic core. This fact results in several important benefits for the user and the application. The main benefit is that the behavior of the sensor is not influenced by non-linearity and width of hysteresis curve, which results in a highly accurate and linear response over a wide dynamic range of measured quantities. A linear and highly accurate sensor characteristic in the full operating range enables the combination of metering and protection classes in one device. Voltage measurement range for metering accuracy class 0.5 and protection accuracy class 3P.

Voltage measurement in KEVA B sensors is based on the resistive divider principle. The output voltage is directly proportional to the input voltage.

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**Voltage sensor for MV panels features**
- Compact mechanical design to better fit into MV switchgear
- No ferroresonance phenomena
- Safe secondary outputs
- Only 2 types covering the voltage range up to 27kV
- No primary fuses required, decreasing maintenance requirements
Innovative arc flash mitigation in less than 4 ms: the highest possible level of arc flash protection for personnel and equipment, maintenance of a secure power supply and the reduction of production stoppages.

The occurrence of an arc fault, the most serious fault within a switchgear system, is mostly associated with extremely high thermal and mechanical stresses in the area concerned. A new, active arc fault protection system is based on the knowledge gained from decades of experience with the ABB vacuum interrupter and Is-limiter technology. This latest arc fault mitigation technology now effectively helps to avoid these negative effects if a fault should occur.

The Ultra-Fast Earthing Switch of type UFES™ is a combination of devices consisting of an electronic unit and the corresponding primary switching elements which initiate a 3-phase short-circuit to ground in the event of an internal arc fault. The extremely short switching time of the primary switching element in conjunction with the rapid and reliable detection of the fault, ensures that an arc fault is extinguished almost immediately after it arises (Extinguishing time < 4 ms after detection).

The UFES electronics are available in two designs. In this portfolio, the electronic detection and tripping unit (DTU) type QRU1 provides an expandable complete solution with internal light and current detection, which is able to monitor small protection areas without any additional devices.

On the other hand, the electronic tripping unit (TU) type QRU100 uses only external detection units for monitoring of the protected area. In this context, the TU suits ideally for the connection to the ABB arc protection system type REA. Compatible and accordingly tested interfaces are available for this purpose.

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**Arc fault protection features**

- Highest possible level of arc flash protection for personnel and equipment
- Secure power supply
- Ultra-Fast Earthing Switch of type UFES™
- Rapid and reliable detection of faults
- Available in two designs
Relion® 615/620 series IEDs for protection and control.

Protection and control relays represent the control center of a switchgear panel. UniGear Digital uses 615 and 620 series types of protection and control relays from ABB’s Relion family.

Relion® 615 series IEDs for protection and control
The Relion 615 series protection relays can be defined as a compact and versatile solution for power distribution in utility and industrial applications. The 615 series provides standard configurations, which allows you to easily adapt and set-up your applications, still allowing you to adapt the configuration according to application-specific needs. The 615 series combines compactness and powerful features in one smart package. Out of 615 series we have three dedicated product types available for UniGear Digital – REF615, REM615 and RED615.

Feeder protection and control REF615
REF615 is a dedicated feeder protection relay perfectly aligned for the protection, control, measurement and supervision of utility and industrial power distribution systems including radial, looped and meshed networks, also involving possible distributed power generation.

Motor protection and control REM615
REM615 is a dedicated motor protection relay perfectly aligned for the protection, control, measurement and supervision of asynchronous motors in manufacturing and process industry. REM615 offers all the functionality needed to manage motor starts and normal operation also including protection and fault clearance in drive and network disturbance situations.

Line differential protection and control RED615
RED615 is a phase-segregated, two-end, line differential protection and control relay. With in-zone transformer support and voltage protection, it is perfectly harmonized for utility and industrial power distribution networks. The RED615 relays communicate between substations over a fiber-optic link or a galvanic pilot wire connection. Protection of ring-type and meshed distribution networks generally requires unit protection solutions, also applied in radial networks containing distributed power generation. With relation to UniGear Digital solution this protection relay will be used for more dedicated applications only.
Relion® 620 series
IEDs for protection and control.

The Relion 620 series protection relays increase flexibility in demanding utility and industrial applications for power distribution.

They are delivered with example configurations to ease adaptation into your specific applications. The series offers customization possibilities, which supports higher levels of standardization in the applications. The 620 series extends the hardware possibilities further compared to the 615 series. From within the 620 series we have two dedicated product types available for UniGear Digital – REF620 and REM620.

Feeder protection and control REF620
REF620 is a dedicated feeder IED perfectly aligned for the protection, control, measurement and supervision of utility and industrial power distribution systems, including radial, looped and meshed distribution networks.

Remote I/O unit
RIO600

The remote inputs/outputs unit RIO600 is designed to expand the digital and analog inputs/outputs of ABB’s Relion® protection relays and to provide inputs/outputs for the station automation device COM600 using the IEC 61850 communication.
**FOX615**
Enabling seamless migration and extension of existing communication infrastructures.

An outstanding multiservice platform for real-time utility communication.

ABB’s FOX615 is a hybrid solution supporting traditional TDM (PDH / SDH) and Multi-Protocol Label Switching - Transport Profile (MPLS-TP) – the latest standard designed to address the new applications using packet switched technology natively. The majority of existing communication networks of power utilities are based on Time Division Multiplexing, TDM, which allocates dedicated circuits to specific communications and thus guaranteeing the required communication performance parameters such as bandwidth, latency and symmetry. New standards today are based on packet switched technologies (e.g. IEC 60870-5-104 or IEC 61850) and therefore integrate natively into a packet switched MPLS backbone network. Well known features of SDH networks were left behind when MPLS was originally created for dynamic public telecommunication networks and implemented as IP/MPLS.
That’s why an enhancement of the standard was required, leading to MPLS-TP bringing back those missing features from SDH to the MPLS world such as bidirectional and static channel routing or end to end channel supervision using Operational Administration Maintenance (OAM). FOX615 provides native MPLS-TP and SDH functionality as part of the hybrid approach implemented.

The combination of state of the art SDH technology and future MPLS-TP technology provides an easy and flexible way to migrate technology in a utility network. All FOX615’s which are deployed in the field today can easily be upgraded to MPLS-TP. It also allows the parallel implementation of SDH and MPLS-TP in one node, separating traffic according to their performance requirements. One further option is to just implement a pure MPLS-TP node. FOX615 today offers much more to a utility than any other multiservice platform for real-time utility communications.

FOX615 is designed to be deployed in harsh environment ranging from extreme temperatures to magnetic and electrical fields, which can be particularly severe during short-circuit events. Furthermore it includes integrated teleprotection interfaces for distance as well as for differential protection. These interfaces are designed to work in TDM as well as in MPLS-TP networks. Especially the implementation of differential protection over PSN networks imposes huge challenges, as the PSN inherent jitter has to be compensated to guarantee a reliable functionality. FOX615 can guarantee the communication channel performance required of those critical application. Additionally FOX615 provides the possibility to distribute exact Time of Day information, pass it on to end devices and can help to become more independent of any 3rd party clock source e.g. GPS.
In a Digital Substation, data becomes easily available for various purposes. In particular, data can be analyzed from an operations perspective but also for maintenance purposes. Ultimately, this allows straightforward implementation of data-driven maintenance strategies like reliability centered maintenance. For the precise automatic assessment of HV equipment, condition monitoring systems provide additional, key parameter for the asset management system. Examples of such parameters are continuous SF6 density in a GIS or ablation factor for a GCB.

ABB’s monitoring systems are applicable for new substations and for retrofitting of existing installations. They map all available data and warning / alarm information via IEC 61850 to the station bus. Additionally, an embedded web server allows access to the data via an Ethernet port. The port can be connected to a wireless LAN interface which enables access to the data on handheld devices including tablets or smartphones inside the substation building.
Modular Switchgear Monitoring (MSM)

The Modular Switchgear Monitoring (MSM) is an add-on system to continuously supervise SF6 density in enclosures of high-voltage gas-insulated switchgears. The system is suitable for all kinds of switchgear layouts and operates independently of control and protection devices. MSM is applicable for retrofit of existing substations and for new installations.

Early warnings reduce SF6 emissions and enable the operator to plan maintenance/repair work. MSM uses SF6 density sensors based on quartz crystals to directly measure gas density.

The sensors have an excellent long-term stability performance, identifying leakages long before becoming critical.

Applications
- SF6 density monitoring in Gas Insulated Switchgear and Metal enclosed Breakers
- Optimize maintenance by using trend calculation
- Provides data for remote condition monitoring and advanced maintenance strategies

Generator circuit-breaker monitoring system GMS600
State-of-the-art monitoring.

ABB’s next generation monitoring system GMS600 further enhances generator circuit-breaker (GCB) monitoring. It’s built on the already established GMS600 technology, which monitors the contact ablation factor. The updated version offers additionally, unique features such as SF6 gas monitoring and trending (GMS600-G), temperature monitoring of primary conductors (GMS600-GT) and enhanced operating drive supervision.

Based on ABB’s well-proven Relion Series 650, GMS600-G and GMS600-GT provide an accurate indication of time remaining before the GCB needs servicing, an efficient data logging system and an intuitive network interface via web client application. They are applicable for retrofit of existing substations and for new installations. GMS600 supports the overall increase of power plant safety and reliability whilst enabling cost-effective lifetime management by the innovative Value Base Customer Care (VBCC) concept of ABB. This concept combines sophisticated, prognostic algorithms for data analysis of GMS600 data with ABB experts experience in order to give asset specific service recommendations.
CoreTec™ continuously monitors mission-critical functions of the transformer and traces the history. It simulates various possible operating conditions and forecasts the impact on the transformer’s lifecycle.

The system is modular and scalable to cope with present and future requirements. It offers higher functionality than comparable systems. CoreTec is guaranteed to be maintenance free for 15 years.

The device is compact and easy to install for new and retrofit installations. Only a few sensors are required, cabling is minimized. No specific additional hard- or software is needed. The unit displays important operating parameters in a user-friendly web interface.

CoreTec is an intelligent, safe and reliable solution for predictive transformer service management. It fits to most transformers and can be used for retrofit.

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**Transformers**

ABB transformers for Digital Substations.

ABB transformers for Digital Substations are equipped with CoreTec™, with unique features for transformer protection, control, monitoring and diagnostics. CoreTec™ connects to the station by means of a standard IEC 61850 bus.

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**Key CoreTec™ features**

- Early detection of malfunctions
- Overload assistance
- Condition assessment
- Improved maintenance planning
- Real time data
- Remote access
- Long term data storage
- Intelligent status prediction
- Advanced cooling control
CoreSense™
CoreSense continuously monitors hydrogen levels in transformer oil to provide an early warning for most incipient malfunctions. CoreSense™ also continuously monitors moisture. Moisture has an impact on the insulation system and potentially accelerates aging. The hydrogen and moisture reading of CoreSense combined with ABB’s unique experience best enables to recommend effective corrective actions.

Intelligence can be provided to individual transformers, however the highest benefits are achieved from a whole fleet of transformers, when the transformer status reports are automatically collected by a central dashboard providing a fleet health assessment.

CoreSense has no moving parts, it is based on an innovative thermal pump technology. It can be connected to the transformer at any location including the drain valve. The thermal pump induces the necessary oil flow by convection instead of conventional mechanical pumps, eliminating a source of failures.

ABB offers reliable online monitoring solutions across multiple industries worldwide and has an extensive installed base of sensors and analyzers. With over 100 years of experience as the leading transformer supplier, ABB has intimate knowledge of how transformers behave. Where other market players provide sensors, ABB provides Transformer Intelligence.

Key CoreSense™ features
- Online monitoring of hydrogen in transformer oil based on a novel solid-state hydrogen and moisture sensor (no membrane)
- Easy to download data in csv. format for offline analysis
- Two user-configurable alarm levels WARNING and ALARM for both hydrogen and moisture
- Large number of communication protocols and options
- 4-20 mA inputs allow connection from external sensors (i.e. load, ambient temperature or oil temperature)
- Sensor configuration and administration streamlined and intuitive web interface
Embedded sensors and intelligent devices provide grid operators with rivers of data, which ABB MicroSCADA Pro Historian’s data logging and reporting functionality now refines into valuable reports and analyses. This advanced capability effortlessly collects, archives and enables the observer to visualize and analyze the primary process data. ABB MicroSCADA Pro Historian is the tool that enables you to benefit from critical, accurate grid information. It is the way to understand what has happened, and what is happening in a power grid.

**MicroSCADA Pro Historian**
Critical and accurate grid information software.

The modern electricity grid is a complex, intelligent mechanism that is indispensable to modern life.

**An accurate view of the primary process enables fact-based decision making**
MicroSCADA Pro Historian collects and stores various types of data in a database designed to archive hundreds of thousands of values over long time periods in an accurate and reliable way.

**Intuitive, easy operation ensures full utilization of the capabilities**
The flexibility of the user interface provides enterprise wide ease of use. Various needs from high level business summary to advanced equipment performance and detailed analysis of the electro-technical behavior are supported.

**Quickly and easily installs into existing MicroSCADA Pro systems without service interruptions**
Extend your current MicroSCADA Pro system with the Historian to start gathering your data and immediately benefit from the advanced analysis possibilities. The Historian can safely be connected to a running MicroSCADA Pro system without interruption to the operation.

**MicroSCADA Pro Historian makes measurements and trends visible and understandable**
The advanced visualizations allows information to be presented in a clear way. Any user can easily compose new reports and layouts to adapt to every situation that emerges.
Protection relays do the vital work of monitoring the delivery network, but ensuring they’re all updated and properly configured has become increasingly burdensome, at least until the SDM600 takes on the job of tracking versions. Using IEC 61850 interfaces the SDM600 software keeps a watchful eye on protection relays so the user can ensure they’re all running the latest software, and to the greatest effect. SDM600 also talks to relays when collecting, and collating, fault records data. The gathered comtrade files are recorded into short reports for later analysis, while the SDM600 dashboard presents historical reports so we can see what happened and when with unprecedented ease. Authenticating users is another task which has ballooned as management networks grow in complexity, and one which SDM600 takes in its stride. Cyber security is a vital component in modern networks, but fragmented directory policies risk exposing critical vulnerabilities which SDM600 can avoid.

With centralized security logging and central account management SDM600 becomes the gatekeeper to the automation network.
Mastering the control room of the future takes ability. ABB Ability™
### ABB Ability™ Network Manager™

Control center solutions to ensure secure and efficient energy system operation.

**ABB Ability™ Network Manager SCADA**

ABB Ability™ Network Manager SCADA is the real-time processing platform for successful management of all remote control operations of generation, transmission and distribution systems. The platform addresses the needs of electrical power networks for railways and airports to ensure safe and reliable power supplies. It is also used for multi-utility applications including gas and water networks.

The platform has high availability and performance, supporting multiple redundancies across hardware and software. With an extensive toolbox for adapting to safety procedures and work processes to ensure compliance with transportation safety regulations. Possibility to include emergency control center and backup facilities with highest available cyber security. Ensuring secure and efficient energy system operations through advanced operator support, standardized data management and high volume processing of real-time and historical data.

ABB Ability™ Network Manager SCADA supports all sizes of electrical network, with large numbers of client workplaces both mobile and stationary. Full flexibility to equip each workplace to the appropriate size and number of monitors, alarm actuators and other devices.

Benefits of ABB Ability™ Network Manager SCADA include:
- Scalable for easy expansion of data and functionality, as well as multiple redundancies
- Stable platform with high throughput even during disturbance situations
- Extensive reporting and archiving possibilities
- Cyber security built into all functions and sub-systems
- Support for multiple RTU protocols, including: IEC 60870-5-101/-104, DNP 3.0, and RP570
Transmission Management Solutions
Network Manager EMS manages transmission networks ranging from sub-transmission and regional dispatch centers to large nationwide control centers. The EMS module comprises a comprehensive set of powerful applications for analysis of network security and operation economy. By using advanced operator support, standardized data management and large data volume processing. Executing in real-time and study environments.

The system provides a complete set of advanced power system application functions. These are setup to find the optimum solution for transmission network operations in deregulated markets and for combined network and power generation operations in traditional markets.

Network data are both telemetered and calculated, building a complete network model used by the EMS network applications including forecasting, training simulation, security analysis, and playback mode.

Benefits of Network Manager EMS include:
• Secure and efficient network operation, in regulated and deregulated markets.
• Improved quality of supply.
• Optimal utilization of the transmission network.
• ENTSO-E CGMES and CIM compliant.
• Advanced visualization and situational awareness for operators, leading to enhanced grid operation.
• Continuous monitoring of the network stability, minimizing the risk of widespread blackout.
• High-fidelity Training Simulator for advanced operator training, under steady-state and dynamic power system conditions providing information about equipment maintenance and outages.
ABB Ability™ Ellipse® APM
Analytics software designed specifically for utilities.

Asset performance management (APM) is not a new concept; as a label, it merely describes the discipline of overseeing the lifecycle of the electrical equipment required for utilities to operate. But as a business strategy, APM describes a specific combination of technologies, analytics and work processes that has only recently become commercially viable to bring an unparalleled level of order, automation and comprehensiveness to this function.

The first job of an APM system is to gather information from the widest range of sources, such as test and inspection reports, maintenance status reports and data from operational technology systems. This disparate data must be consolidated so that it can be analyzed and converted into actionable knowledge.

Secondly, APM should add asset operational and performance intelligence – an embedded understanding of the equipment itself in order to track information about the current condition and performance of each asset. This information is key to supporting repair and replacement decisions. The third function of asset health is to deliver this information in an appropriate format to whoever needs it. Whether it’s for the executive suite as a dashboard of key performance indicators (KPIs) or for the service technician in the field about to perform maintenance on an asset, analytics and dashboards enable information to be readily and contextually understood.

Finally, the most effective APM takes full advantage of the integration to existing work management systems to generate work orders and facilitate execution of these decisions. The complex interconnectivity of these work processes demands an enterprise-wide approach to managing asset health.

Ellipse APM, formerly known as Asset Health Center, is a robust solution that offers:
- Asset knowledge and expertise
- Data integration, archiving and storage
- Equipment performance models and algorithms
- Analytics and dashboards
- Integration to systems for asset management, supply chain management, and work management and execution.

Combined with ABB Ability sensors, monitors and communication gateways, Ellipse APM is the foundation for a comprehensive, end-to-end asset health strategy.
Preventive maintenance

An ARC Consulting Group survey of utilities estimates that corrective maintenance can cost 10x as much as predictive maintenance. In addition, they found that approximately 65% of the time, traditional preventive maintenance often results in no action.

Predictive analytics

AEP, one of the largest electric utilities in the United States, has avoided failures using Ellipse APM’s predictive analytics. In one specific example, they saved $4 million when a transformer began to show rapid gassing (H2 and acetylene), was taken offline, and the loose leads that would have caused failure were repaired.

Operational technology

Gartner states that “Enterprises need to develop new IT management capabilities to leverage the convergence of real-time information generated by the increasing number of smart IT-enabled assets (commonly referred to as “operational technology”) with traditional business IT.”

Reliability centered maintenance (RCM)

Reliability centered maintenance (RCM) programs often take a very long time to show benefits in the electricity transmission environment, partly because failures are not as frequent. ABB has already completed the FMEA and root cause analysis for EHV and HV equipment and embedded this knowledge into Ellipse APM. By starting with Ellipse APM, organizations can quickly gain the benefits of RCM without the delay of waiting for failures to happen in their own organization.
The most basic mission of any industrial organization is to keep operations efficient, assets optimized, work scheduled, and performance maximized. Imagine if you could easily accomplish all of this with a single, graphical dashboard view for orchestrating operations, people and maintenance scheduling. You could always have the right resources, doing the right work, on the right asset, at the right time. Now add in analytical modeling and the ability to predict potential system failure, and you have ABB Ability™ Ellipse® for connected asset lifecycle management™.

ABB Ability Ellipse is ABB’s comprehensive solution for enterprise-wide management of assets, people and processes. ABB Ability Ellipse connects the capabilities of three cornerstone industry functions including enterprise asset management (EAM), workforce management (WFM), and asset performance management (APM) to optimize operations and maintenance planning based on asset criticality and risk of failure. The result is fewer unplanned equipment failures and system outages, as well as increased asset availability, reliability, and performance.

CALM is a comprehensive solution for:

- Asset & work management
- People management
- Financial management
- Performance management
- Reporting and analytics
- Workforce dispatch
- Job site productivity
- Inventory management
- Supply chain management

ABB Ability Ellipse for connected asset lifecycle management (CALM)
The right work, on the right asset, at the right time, using the right resources.
Key features

- Combines ABB’s world-class, industry-specific solutions for EAM, WFM, and APM systems and processes into a single source of truth
- Consolidates access, reporting and dashboards for asset management, asset performance analytics, and work scheduling capabilities
- Provides detailed equipment, project, and work order models for both short and long-term planning
- Aggregates data organization-wide to increase visibility and improve decision making

Key benefits

- Improves asset and resource utilization, increases workforce safety and helps mitigate risk
- Improves responsiveness by delivering critical maintenance information to field technicians such as reports, images, instructions and video
- Easily relays input of field activity and asset information from the job site to the EAM system
- Reduces maintenance and operating costs, improving services to your customers
- Combines the strengths of monitoring data, industry expertise and machine learning technology for continual operations improvement
- Proactively predicts, prescribes and prioritizes maintenance activity based on potential risk of asset failure and operational criticality
- Enables compliance with regulatory requirements and industry recommendations
### ABB Power Grids service.

Your strategic partner for a changing world.

We may not make the world go round, but ABB’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 24/7 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.

#### Operational efficiency

Need to modernize or address a sticky issue? Our consultants can help you assess the challenge and design cost-effective, fit-for-future solutions. In addition, we offer a wide range of commercial and proprietary enterprise-level applications to help you improve operational efficiency.

#### Performance improvement

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.

#### Life cycle management

Cradle to grave, Power Grids 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.

#### We are with you around the world

ABB Power Grids 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 challenges and prepare you to meet the challenges of future.
'We are protection for your investments'