Digital substations

We are bridging the gap
Enabling the ABB digital substation
Bridging the gap between analog and digital technologies creates unseen opportunities for modern utilities. Built on the international standard IEC 61850, ABB’s world-leading digital substations achieve new heights of reliability, interoperability and real-time performance. We protect existing investments while stepping up to meet the challenges of tomorrow.
Digital substations

ABB’s digital substation portfolio encompasses state-of-the-art communication solutions, station- and bay-level products, as well as process level equipment. Modern non-conventional instrument transformers (NCITs) with a digital interface increase safety and reduce footprint requirements, while stand-alone merging units open up a path to retrofits and upgrading existing substations and the ability to digitize information right at source, in the field.

Building upon the international standard for communication networks and systems for power utility automation, IEC 61850, ABB is delivering world-leading digital substations that provide the greatest potential of this technology: increased safety, interoperability, ease of configuration, maximized reliability and availability, real-time performance, smart-grid communications capabilities and reduced cost of ownership.

ABB has, from the beginning, taken a leading role in the elaboration of this standard. With the application of IEC 61850-9-2 a new era of substation automation begins and ABB is still among the leaders of this technological revolution.

IEC 61850 process bus

The exchange of sampled values, i.e., between NCIT and IED devices for protection functions and other purposes is defined in part 9-2 of the standard. The interconnection between sensors, actuators, protection and control devices, is referred to as „process bus”. Besides analog data, also status information from primary switchgear to IEDs, as well as command signals from IEDs to the primary switchgear, can be exchanged.

This finally enables the standard-compliant digitalization of the last mile in substation automation, and brings with it a whole range of benefits for utilities.
## Digital substations
### Your benefits at a glance

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Feature</th>
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<tr>
<td>Safety</td>
<td>Digitization of all data at the source reduces the risk of electrocution dramatically.</td>
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<td>The elimination of the risk of open current circuits minimizes exposure to high voltage electricity and reduces the risk of damaging equipment.</td>
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<td>Reduced installation time</td>
<td>Replacing copper cables with digital communication capability shortens installation and retrofit times and enables complete system supervision, reducing maintenance requirements.</td>
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<td>Security of investment</td>
<td>Digital technology creates a future-proof substation, thanks to efficient information management, diagnostics and data configuration for optimized operation and maintenance.</td>
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<td>Built-in cyber security</td>
<td>Enables user-friendly central management of security events and user accounts.</td>
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<td>Increased availability</td>
<td>Complete supervision of all substation automation components facilitates faster fault detection and elimination, and further minimizes the need for periodic maintenance, lowering costs as well as reducing outage times.</td>
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<tr>
<td>Increased performance</td>
<td>Merging units with minimum delay times and IEDs with the highest GOOSE performance levels supports fast data transfer and protection functionality.</td>
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## Enabling ABB product

**Level**

<table>
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<td><strong>Process level</strong></td>
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<td><strong>Bay level</strong></td>
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Since 2004, ABB has been the leading supplier of products and systems based on the IEC 61850 standard. The digitization of process data is the natural next step to take.

The ABB digital substation is bridging the gap between analog and digital, enabling a safer work environment and reduced installation and operational costs.
By providing complete solutions with IEC 61850 process integration, as part of substations with non-conventional instrument transformers (NCIT), ABB is proving its market- and technology-leading position in high-voltage substations and substation automation systems.

Having accumulated more than 15 years of in-service experience with NCITs for transmission level applications and the largest installed base of IEC 61850 substation automation systems, ABB combines the two technologies in its offerings with NCIT and process bus for sampled analog values. As defined by IEC 61850-9-2, sampled analog values are transmitted by so-called merging units (MUs). The MU time correlates and merges analog data from individual phases or measuring points in the substation before transmitting them via the Ethernet network, where the data can be accessed by protection and control devices.

Without standards, the adoption of digital messaging for intrasubstation communication was piecemeal and fragmented with mutually incompatible signaling creating an assortment of messaging within vertical silos. ABB has long championed industry adoption of IEC 61850, a standard with which the company has been intimately involved since its inception.

"Communication networks and systems for power utility automation", is a comprehensive standard broken down into components that, for example, specify how the functionality of substation devices should be described – how they should communicate with each other, what they should communicate and how fast that communication should be. All of this is critical to realizing the benefits of a truly digital substation.
Digital substations
Facts and figures

Conventional substation

Digital substation

Up to 80% copper cable reduction*

Conventional substation

Digital substation

Up to 60% less space in the relay house

Up to 50% reduction of space in the switchyard*

* Based on a typical conventional 400kV double busbar AIS substation compared to a modern variant using SAM600 process bus IO system and FOCS integrated in disconnecting circuit breakers.
30t less material transports*

40% shorter installation phase

Conventional substation

Operational cost reduction

Digital substation

50% outage time reduction
Digital substations for AIS
References and highlights

Highlight

- A fiber optic current sensor integrated into a disconnecting circuit breaker demonstrates the space saving potential of combining circuit breaker, integrated disconnector and optical current transformer as a single unit, reducing three footings to only one
- Proven capability of FOCS and process bus to provide reliable protection, operation and metering
- Relion® 670 series protection IEDs with process bus provide performance identical to conventional devices

Reference

FOCS integrated into a 420 kV air-insulated switchgear installation in Sweden. By 2010, ABB had already installed its third digital substation.

Exposed to outdoor temperatures that range from -20°C to +30°C, the completely redundant FOCS system has been working failure free since April, 2010.

Benefits

- Reduced need for copper cabling resulting in material savings, shorter installation times
- Substation retrofits can be performed more quickly and safely, with minimal outage times
- Reduced space requirements with smart combinations of modern measuring technology and switching apparatus, such as disconnecting circuit breakers
- Increased safety with digitized field data, minimizing the number of voltage-carrying wires needed in protection and control panels
- Lower maintenance requirements due to a larger supervised area
Digital substations for GIS

References and highlights

Benefits

- Replacing conventional current and voltage transformers with non-conventional instrument transformers (NCITs) eliminates all current and voltage circuits, increasing operational safety
- Compact NCITs reduce the required volume of SF6, an environmental benefit
- NCIT technology for GIS has proven to be extremely reliable, increasing availability, reducing life cycle costs
- Overall, this leads to maximized availability and stability for the power grid

Highlights

- Refurbishment of secondary system (protection, control, substation automation, etc.) to IEC 61850 and IEC 61850-9-2 process bus-based system
- Proven sensors were kept in place and extended with IEC 61850-9-2 merging units
- Commissioning was done stepwise, with minimal outage times

Reference

Non-conventional instrument transformers and IEC 61850-9-2 process bus for gas-insulated switchgear substations.

The first commercial process bus installation, the so-called digital substation, was successfully put into operation in Australia in 2011. It was the first of a series of six outdoor substations with process bus and NCIT technology installed.
Enabling products

Digital substations

**SAM600 process bus I/O system**

The SAM600 process bus I/O system makes your substation safer and easier to upgrade, operate and maintain during its complete lifecycle. It brings the advantages of the digital substation to new and existing installations, integrating conventional instrument transformers. Built to withstand the harshest environments, the SAM600 system fits alongside primary equipment, collecting information close to the source in the field, and converting it into IEC 61850 digital format.

**ELK-CP GIS NCIT for current and voltage measurement**

The ELK-CP NCIT uses two redundant Rogowski coils to measure the current value. The primary voltage is measured by a capacitive voltage divider. The measured values are digitally processed by the “secondary converters” and sent to the merging unit, which provides the analog values according IEC 61850-9-2LE to protection, control and revenue metering equipment. The CP-MU merging unit was the world’s first to be conformance certified.

**FOCS Fiber Optic Current Sensor**

FOCS (available as a free standing version, or integrated in a disconnecting circuit breaker) offers significant improvements over conventional CTs and facilitates direct introduction of digital process bus in HV substations. This new design exceeds magnetic CT technology with respect to safety of operation, current measurement and frequency response, footprint/weight savings and environmental friendliness. The fast response of FOCS and precise measurement of both ac and transient dc current results in improved substation protection and monitoring functions. The digital interface of FOCS is compliant with IEC 61850-9-2LE communication for integration into digital substation automation systems.

**Relion 670® series and REB500 protection and control IEDs**

REB500 busbar protection system and 670 series protection and control IEDs provide versatile functionality, as well as maximum flexibility and performance to meet the highest requirements of generation, transmission and subtransmission protection and control systems. Thanks to IEC 61850-9-2LE compatibility ABB’s protection and control IEDs are the perfect fit for all digital substation applications.
MicroSCADA Pro
MicroSCADA Pro is designed for complete functionality, providing real-time monitoring and control of primary and secondary equipment in transmission and distribution substations. It enables safe and easy interaction with protection and control IEDs, as well as with the process via the operator’s workplace, effectively supporting correct actions and maximizing the availability of your power system.

SDM600
SDM600 is a comprehensive software solution for automatic management of service- and security-relevant data across your substations. With support for IEC 61850 protection relays and the capacity to talk to legacy equipment through the File Transfer Protocol, it interrogates relays around the network.

RTU500 series
The open architecture of the RTU500 series enables adaptations to a variety of electrical and process automation applications. RTUs are equipped with a flexible and modular design. Innovative technologies ensure that RTUs include modern functionalities to continuously meet your requirements. In addition, you do not only get reliable and efficient products, but easy handling and efficient services as well.

FOX615
FOX615 provides the perfect combination of traditional TDM (PDH/SDH) technology and sophisticated Ethernet/IP features. It allows easy integration into existing infrastructure and extension projects, enabling step-wise migration, while protecting investments.

NSD570
To protect the electric power system against failure and damage, the teleprotection system has to selectively disconnect the faulty part by transferring command signals within the shortest possible time. NSD570 is designed for the transmission of protection commands over all kind of communication media, such as copper wires, optical fibers, analog and digital channels of optical networks and microwave radio links, as well as Ethernet/IP based telecommunication networks.
Digital substations
ABB is bridging the gap between analog and digital

More than 100 years of experience in protection and control solutions for power systems stands behind ABB’s knowledge and expertise in substation automation. Using high-quality ABB products, our technology experts build robust, secure and future-proof systems for substations.

Bridging the gap between:
- technology, innovation and modern power infrastructure
- what is happening in the network and the information available to operators
- all components, for better and more efficient information flows
- humans and power systems
- equipment at the process bus and station levels
"Bridging the gap to connect technologies, data and people."