



Hitachi Energy Digital Substation is a core enabler to increase safety, productivity and reliability for grid operators and to reduce the overall substation cost.

HITACHI
Inspire the Next



Bridging the analog-digital gap.

Hitachi Energy Digital Substation



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“Hitachi Energy Digital Substation provides customers in the utility and industry sector with unmatched control and efficiency.

The digital substation reduces maintenance requirements and the need for miles of conventional cabling. Hitachi Energy 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
CEO, Hitachi Energy

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Hitachi Energy's Digital Substation is a core enabler to increase safety, productivity and reliability for grid operators and to reduce the overall substation cost.

Digital substations remove the last electrical connection between the high voltage equipment and the protection and control panels, creating a safer work environment, while 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 offer improved data quality and a shorter decision time in the event of an emergency.





Leading substation development for over 100 years.

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

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 first major technological step was in 1965, with the introduction of gas-insulated switchgear (GIS) that reduced substation footprints. Alongside the development of GIS technologies, Hitachi Energy has significantly improved the performance of conventional air-insulated switchgear (AIS) substations.

The latest innovation, the “combined” disconnecter circuit breaker (DCB), integrates the disconnecting function into the circuit breaker. This eliminates the need for two separate, free-standing disconnectors and reduces the substation footprint by more than 50 percent. Hitachi Energy 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. Hitachi Energy 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, 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. Hitachi Energy is constantly enhancing its solution portfolio, fulfilling the latest industry standards (e.g. IEC 61850 Edition 2.1), delivering its customers top-class products further enabling digital substations, such as the SAM600 process interface unit, released in 2023.



Constant innovation



2023

50+ digital substations commissioned and delivered worldwide

2020

Lumada for asset & work management launched
Enabling end-to-end digitalization from the field to the boardroom.

2004

First IEC 61850 multi-vendor substation automation system

1998

Sensors

Commissioning of the first digital substation with sensors for current and voltage.

1900s

Conventional

Instrument transformers and protection and control systems.

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, relevant primary components and sensors of a modern substation include high and medium-voltage switchgear, as well as substation transformers.

01 Protection and control building including automation, protection and control, and IEC 61850 station bus.

02 MPLS-TP network remote connectivity via Hitachi Energy FOX615 utility hardened multiplexer.

03 Transformer with electronic control monitoring and diagnostics.

04 Merging units & process I/O bridging the gap between analog and digital world. Compliant to IEC 61850.

05 IEC 61850 process bus connecting the switchyard to the protection and control system.

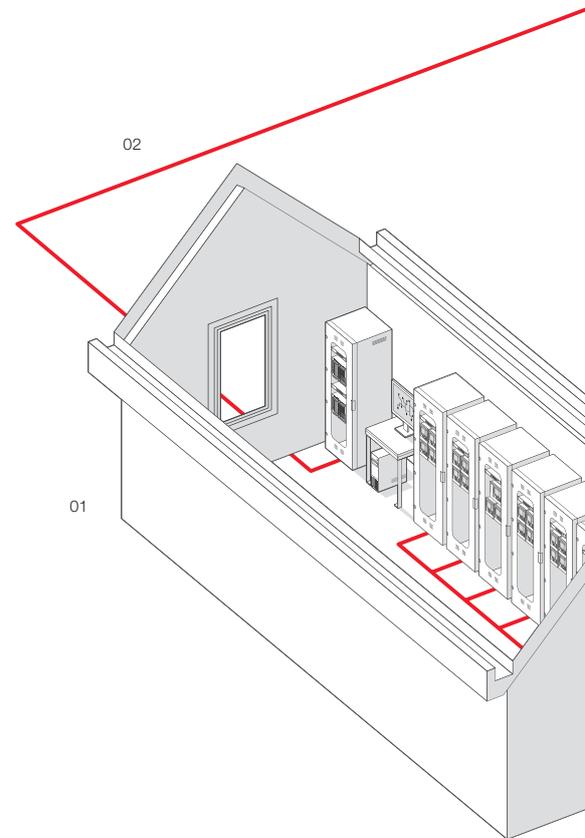
06 Hitachi Energy Network Manager control center solutions to ensure secure and efficient energy system operation.

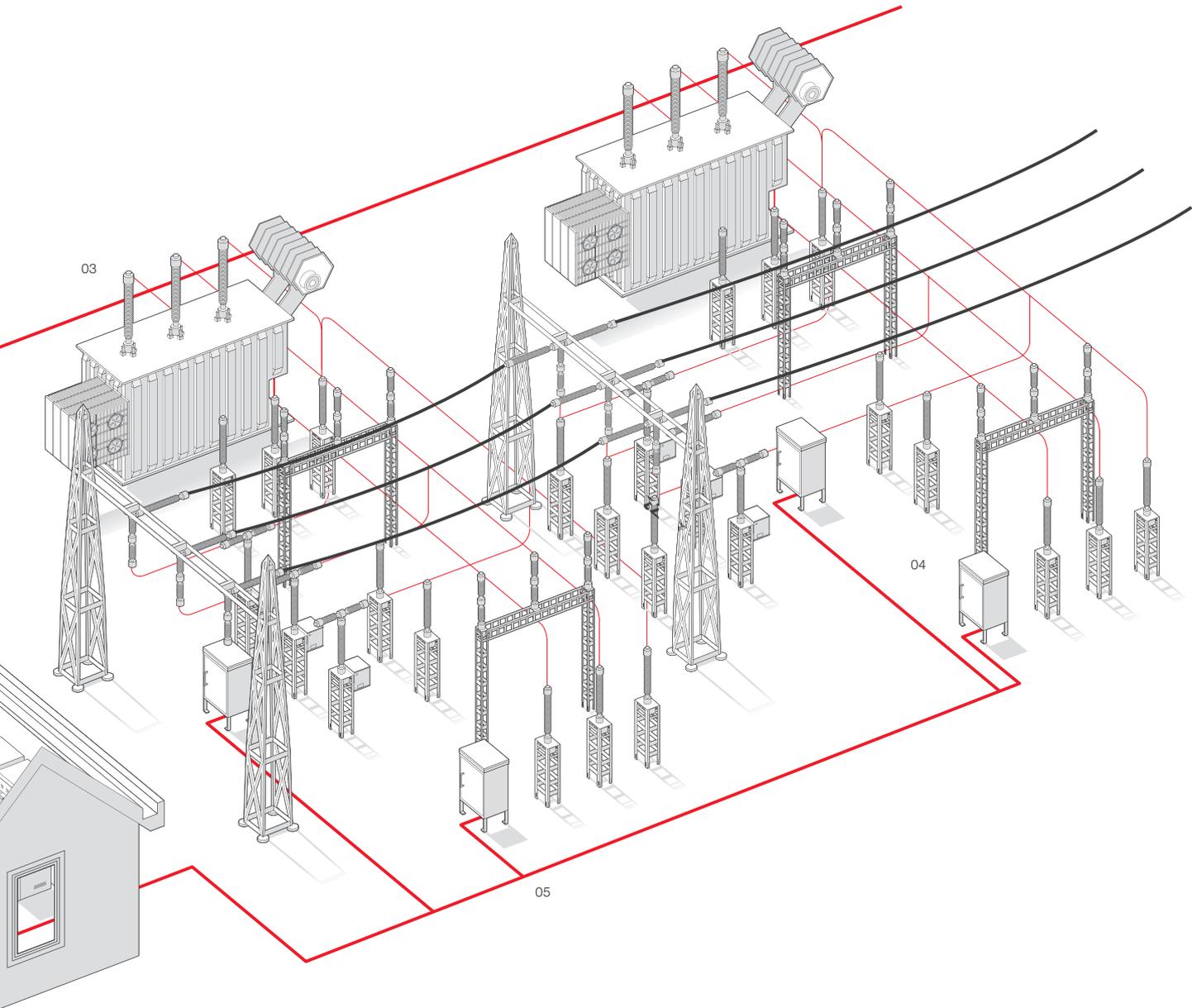
The defining feature of a digital substation is the implementation of a process bus. The IEC 61850 process bus enables the substitution of point-to-point copper connections between IEDs, other devices (e.g., instrument transformers, gas monitoring, MotorDrive™, etc.) and switchgear by means of a safe, 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 1990s, 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, bulky current and voltage transformers 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 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.

The Hitachi Energy Digital Substation has also paved the way for well-known innovative switchgear solutions such as PASS (plug and switch system).



Digital Substation benefits.

Bridging the gap between analog and digital. Enabling a safer work environment, reduced maintenance costs and end-to-end digitalization from the process level to the control room and beyond.

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.

Safety is improved because less signal connections or inadvertently-opened CT circuits can harm personnel during commissioning and service activities. Digital substations enable the reduction of the footprint of a substation because less space is required for protection and control panels and functions previously executed by physically separate equipment can be integrated in one device.

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, 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.



Cybersecurity

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



Increased safety

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



Improved asset management

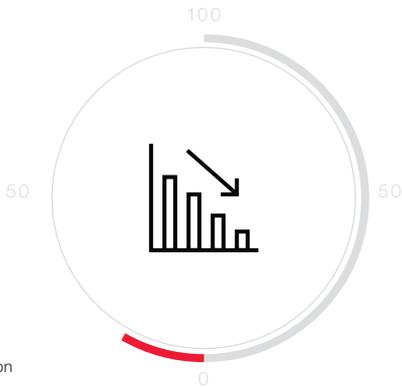
Gain control of substation hardware with second-by-second analysis and control.



Backwards compatibility

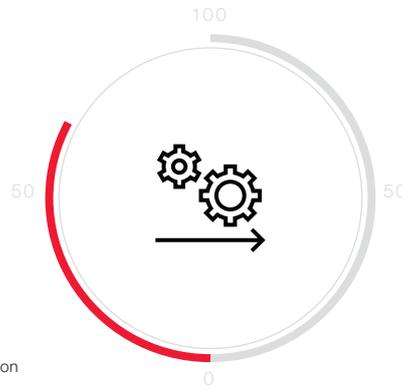
Deep integration with legacy products, supporting utility communication from the past and into the future.

Up to 80% copper cable reduction*



■ Digital Substation
■ Conventional Substation

40% shorter installation phase**

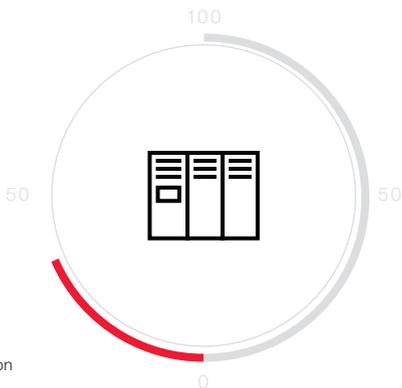


■ Digital Substation
■ Conventional Substation

* Based on a typical conventional 400kV double busbar AIS substation compared to a modern variant using SAM600 process bus I/O system.

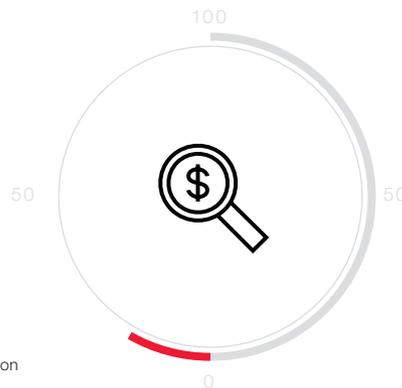
** Of new secondary systems.

Up to 60% less space in the relay house*



■ Digital Substation
■ Conventional Substation

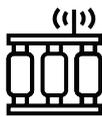
Operational cost reduction



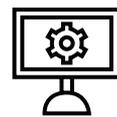
■ Digital Substation
■ Conventional Substation



Future-proof
Digital substations enable 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.

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