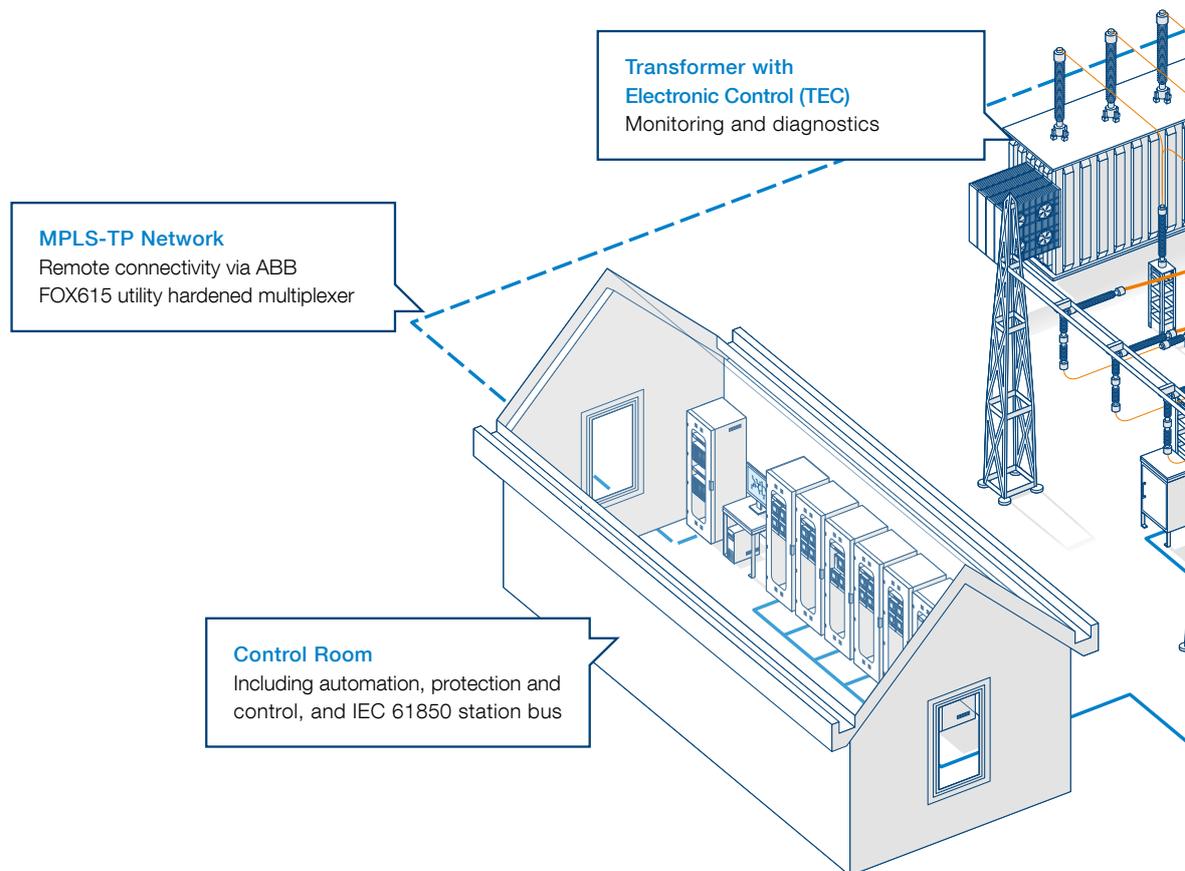


Digital substations

Enabling a stronger, smarter and greener grid

Building responsiveness, resilience and safety deeper into the grid



Our future power grids must be capable of adapting to a range of sometimes rapidly fluctuating conditions. They need to serve the needs of an ever more complex power generation, transmission and distribution landscape. One that includes a greater proportion and variety of renewable sources, along with new levels of consumer demand and grid interconnection.

Digital substations have a key role to play in helping grid operators meet these challenges through higher levels of control, responsiveness, cost management and safety. They help boost the flexibility and responsiveness of transmission and distribution grids by capturing and using accurate, real-time data to control grid stability and react quickly to changing grid conditions.

Rely on the leader in substation digitalization

Following nearly two decades of development, ABB's complete range of standardized digital substation automation, control and protection systems is ready to help power utilities digitalize substations to a deeper level than ever before – all the way out to the switchyard.

Our solutions enable utilities to optimize their operations by facilitating grid automation and the convergence of information and operational technologies (IT and OT), as part of our Internet of Things, Services and People (IoTSP) approach.

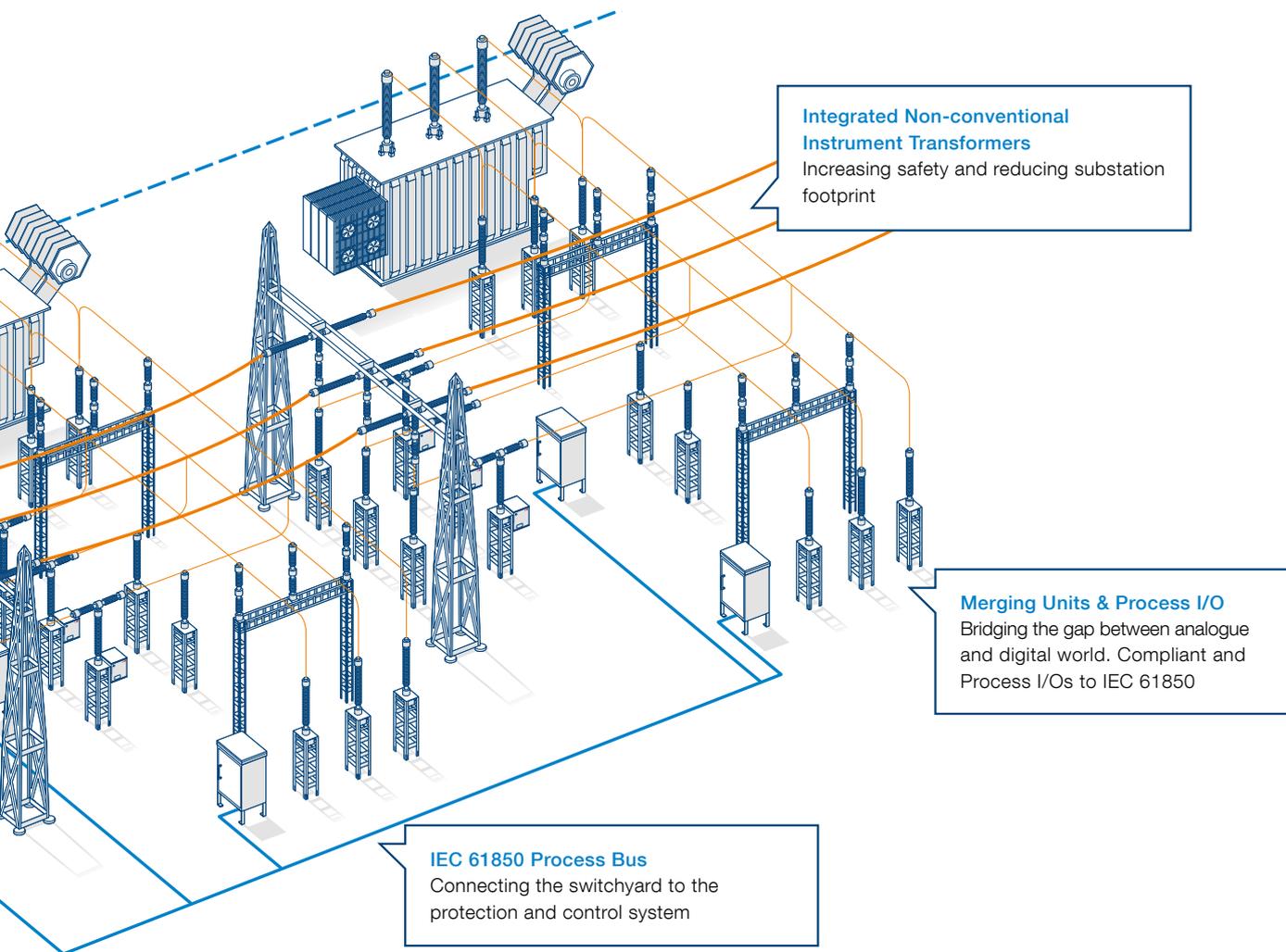
This brings together our leading primary substation equipment with the controllers and software that will allow the grid to react to rapid changes in supply and demand, as well as monitoring the condition of vital assets.

ABB started replacing conventional protection and control systems with numerical types as far back as the 1980s. ABB is also dedicated to the development of industry standards, including the development and verification of the IEC 61850* substation communications standard which began in the mid-1990s.

Since implementing the world's very first IEC 61850 multi-vendor substation automation system in 2004, ABB has supplied hundreds of systems and thousands of products for new and retrofit projects.

ABB is now implementing fully digital substation automation, control and protection solutions around the world that deliver the full potential of the technology – achieving new heights of reliability, interoperability and real-time performance, while protecting investments and preparing for future challenges.

*IEC 61850 is the standard that defines substation communication protocols and the need for interoperability between systems from different vendors.



Enhancing technical and financial performance

Substation automation systems have largely replaced conventional equipment at the station level in modern substations. However, there is still a significant quantity of conventional equipment and copper wiring at the bay and process levels, between the primary and secondary equipment.

By replacing or complementing analog equipment with digital signaling deeper into the substation – right down to the instrument transformers – we can help power utilities achieve significant cost savings, performance enhancements and safety improvements. In short, digital substations are simpler, more compact, safer and more efficient than conventional substations.

Our experience has shown that digitalizing a substation can reduce the quantity of copper in air-insulated switchgear (AIS) substations by as much as 80 per cent, through the use of fiber-optics. This not only represents a significant cost and space saving, it also enhances safety or operating personnel.

Easier to build, maintain and expand

ABB's digital process interface devices are easy to fit and can be safely located out in the switchyard, as they are at least as robust and reliable as the equipment they interface to.

With complete galvanic isolation of the protection and control equipment from the grid, installation and maintenance become much safer, easier and quicker, with far less downtime. Digital equipment enables permanent system supervision, reducing the need for manual intervention.

Furthermore, with complete supervision of all substation automation components, utilities benefit from earlier detection and preventive elimination of malfunctions, and reduced periodic maintenance needs. With merging units and high-performance IEDs, protection functionality is also enhanced.



Advanced technologies that smooth the path to digital

ABB's market-leading digital substation solutions are built around two key areas of technology, in which we have nearly two decades of in-service experience. These are digital sensors for transmission-level applications, and IEC 61850-compliant substation automation systems, in which we have the largest installed base.

In the vast majority of substations in operation today, control and protection signaling is predominantly analog at the process level, limiting flexibility and compromising reliability and safety. Conventional primary equipment, such as current and voltage transformers, is connected to intelligent electronic devices (IEDs) using parallel copper wires carrying analog current and voltage signals. The IEDs receiving that data perform first-level analysis and often provide the gateway into the digital world.

Powerful combination

By bringing together our sensor and process bus expertise, ABB can help utilities bring their substations fully into the world of smarter grids by converting to digital signaling as soon as data is gathered.

ABB's comprehensive digital substation solutions seamlessly integrate state-of-the-art standards-based control and protection IEDs with all the relevant primary components and sensors needed in a modern substation. The primary components include high and medium voltage switchgear, as well as transformers and other key equipment.

In digital substations the functionality of control and protection moves closer together, and can run on the same IEDs. Functionality is allocated to devices during the engineering process, according to the required processing power, user specifications and economic considerations. For example, the entire control and protection functionality of a gas-insulated switchgear (GIS) bay can be integrated in a local control cubicle in the bay – removing the need for a separate control room.

The many benefits of the digital process bus

At the core of ABB's digital substation solution – almost its defining feature – is the IEC 61850 digital process bus*. This provides the control and communication connectivity between all substation equipment.

Conventional substations contain many individual point-to-point copper connections between IEDs and the primary equipment. In digital substations, one single fiber-optic line called the digital process bus replaces these copper connections. It carries digital data such as current and voltage measurements and commands between high-voltage equipment and the protection and control equipment that acts as the brains of the substation.

The process bus has several advantages, the first of which is the elimination of the complex copper wiring schemes. Not only is such copper wiring costly to purchase but also to design, install, test and commission – so by replacing it with a fiber-optic line offers significant savings. In addition, removing conductive copper cabling from substations improves safety for operating personnel.

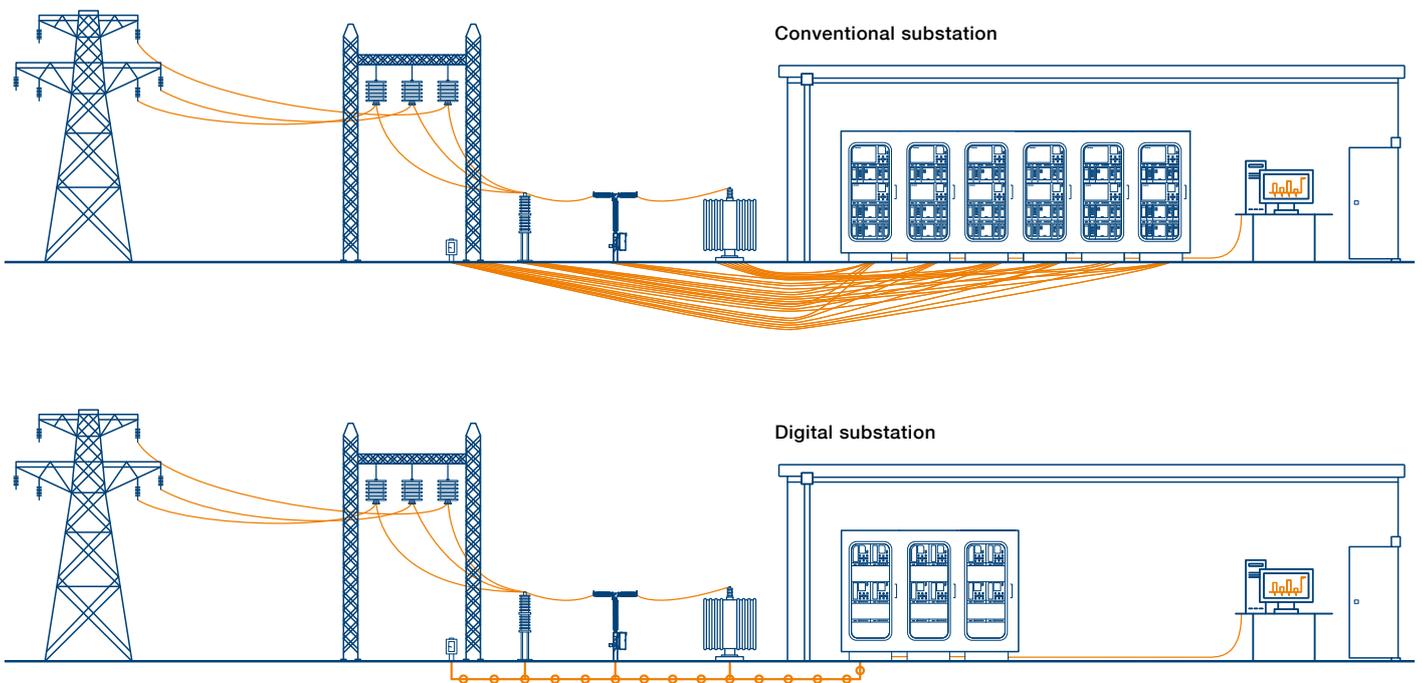
Another aspect of traditional substations is the equipment used to measure current and voltage. Not only is this large and bulky standalone equipment but it also requires regular maintenance for testing and calibration. Digital substations offer savings in comparison as they make use of digital current and voltage sensors that reduce footprint as they can be integrated into primary equipment and do not require regular maintenance or calibration.

For the reason, our digital substation solutions help enhance the productivity, functionality and reliability of assets, while reducing footprint and, crucially, improving safety.

Digital technology can also monitor and diagnose the mission-critical functions of power transformers and switchgear on-line continuously, allowing for proactive management of the asset's lifecycle.

Software systems are the final element of digital substations, with examples being ABB's substation data management and asset health solutions. They turn digital substation data into actionable information safely and securely.

Digital substations replace many point-to-point copper cables with a single fiber-optic process bus.



*The digital process bus is managed by the IEC 61850-2 subsection of the standard for digital substation communication. It underpins the true digital substation and requires a new approach to substation architecture, design and construction.

Protecting the future with global standards

Communication networks and systems for power utility automation – a standard we have been intimately involved with since its inception.

This is critical to realizing the full benefits of digital substations, as it enables utilities to digitalize substations using a variety of systems in a compatible, coordinated, scalable and, above all, future-proof way. Investments are protected over many years.

IEC 61850 standardizes the description of substation functions and how and what they should communicate and how fast that communication should be.

Benefits of a digital substation

- Cyber security
- Increased safety
- Backwards compatibility
- Eco efficiency
- Reduced cabling
- Improved asset management
- IEC61850 standard
- Higher reliability
- Reduced footprint (AIS)
- Reduced installation time
- Reduced maintenance
- Software based testing
- Lower CT requirements
- Future proof

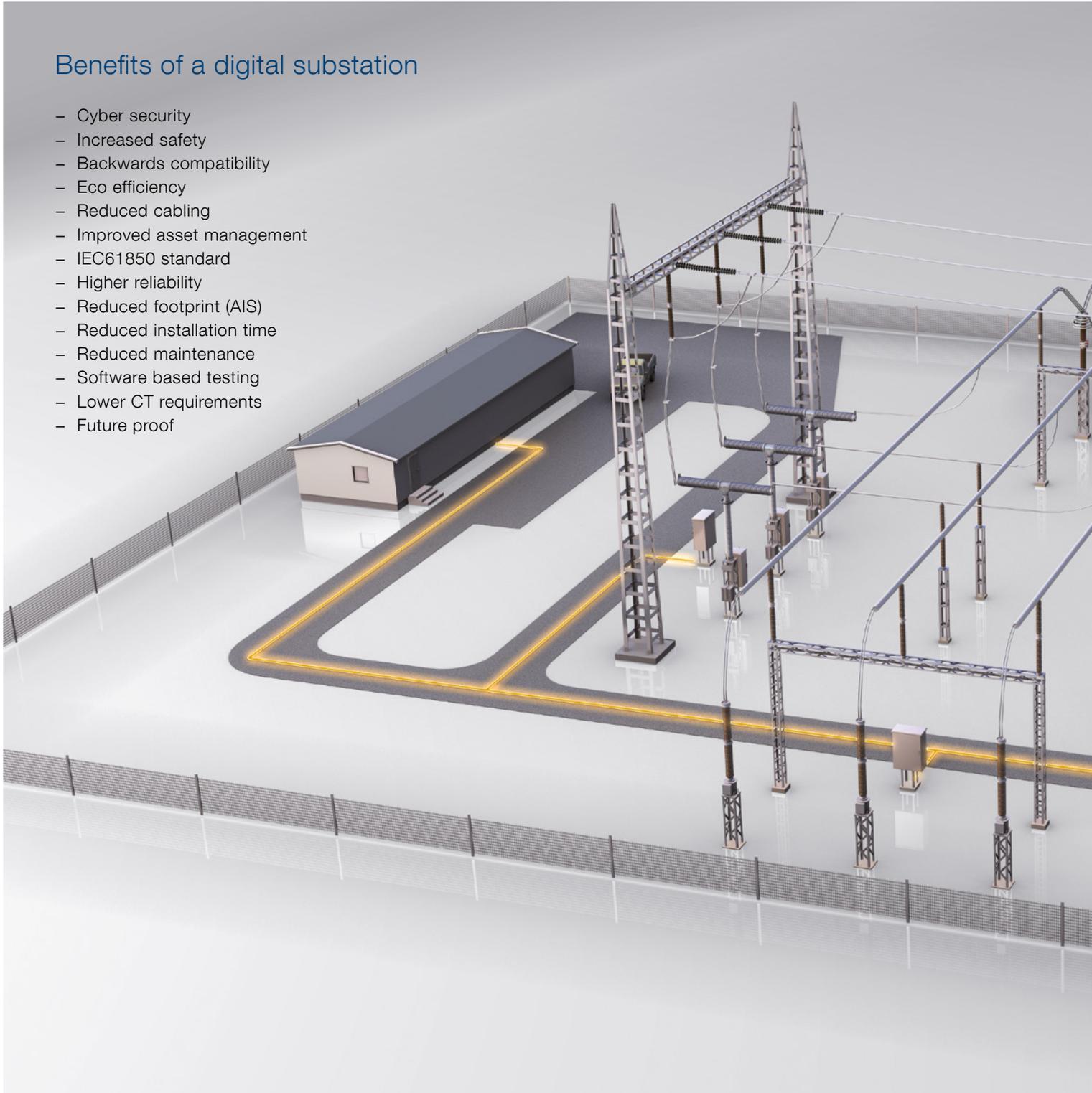
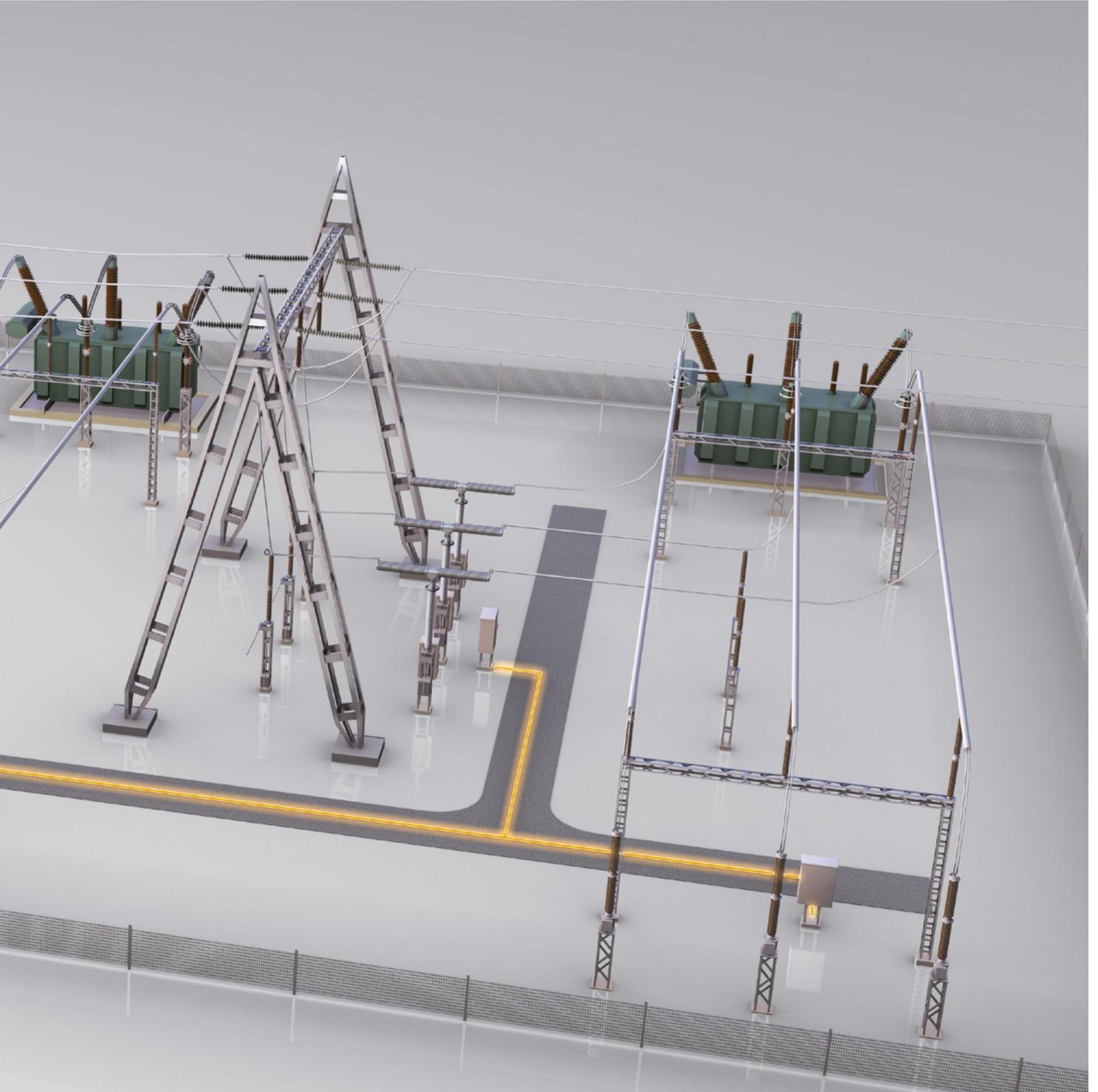


ABB is well positioned with a complete digital substation portfolio

Digital substations are a key component in shaping the evolving grid and ABB's technology will enable customers to optimize their operations.

Thanks to our heritage and experience in power and automation technology, ABB is ideally placed to support customers in meeting complex challenges and delivering a more flexible and intelligent grid. Digital substations are central to an increasingly automated grid.

ABB communication and automation technologies put us at the forefront of the power transformation, shaping the Internet of Things, Services and People to enable a stronger, smarter and greener grid.



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