SYSTEMS INTEGRATION

Substation EPC solutions
A trusted partner for delivering innovative power grid solutions
ABB has been designing and building substations for more than 100 years. In that time they have supplied thousands of substations for all voltage levels and climates, from the most congested downtown cities, to some of the most remote locations on earth. ABB engineers, build, deliver and service complete installations, with dedicated project execution capabilities, both locally and around the world.
Innovative substations by design

Connecting critical loads to the electrical grid and expanding the power systems infrastructure requires significant planning and engineering to ensure a constant, reliable supply of power. ABB provides optimized EPC substation solutions that help power plants to generate, cities to grow, industries to expand, schools to connect and homes to be powered.

ABB’s global footprint and local presence ensures complete support throughout the life of the substation. Their specialty is making projects easier for our customers, regardless of the project size or scope. From ultra-high transmission substations to industrial electrification projects, ABB is a partner that customers can rely on.

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Substation application experience

<table>
<thead>
<tr>
<th>Utilities</th>
<th>Boosting capacity, enhancing reliability and increasing availability of the transmission and distribution network through proven substation designs and innovative grid technologies</th>
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</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>Creating a reliable supply of power that supports efficient use and management of electricity, while enhancing operational performance facility wide</td>
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<tr>
<td>Renewables</td>
<td>Facilitating the integration and interconnection of cleaner energy while helping maintaining grid reliability and secure power supplies</td>
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</tbody>
</table>
EPC capabilities
From project vision through a lifetime of operational excellence

UP FRONT PLANNING AND SYSTEM STUDIES
Every project has a unique set of requirements and goals. ABB’s planning experts are able to provide an in-depth analysis of the local network and its performance characteristics. From load flow and dynamic stability analysis, to system protection and controls coordination, they uncover the true potential of the system’s critical assets, while managing risks. ABB’s goal is to provide the optimal solution that maximizes asset value and financial returns.

SUBSTATION OPTIMIZATION: DESIGN TO DELIVERY
Through up front system design and consulting, ABB’s team will take into account all functional requirements and preferences, while exploring possible alternative solutions to deliver the most optimal substation configuration. They perform complete primary and secondary engineering from design and short-circuit calculation to the engineering of the digital substation automation systems.
PROJECT MANAGEMENT AND EXECUTION

Building out the electrical grid has two recurring themes: increasing complexity and constant change. In order to be competitive, productive and profitable, experienced professionals are required to successfully execute a project. ABB’s highly qualified team of internationally certified project and site managers oversee engineering, manufacturing, site assembly and testing to ensure that the project goals and milestones are realized.

CIVIL WORKS AND COMMISSIONING

Prior to construction, ABB carefully evaluates the site to assess the requirements and the support needed to achieve a safe and cost effective on-time delivery. With their highly trained and certified site project managers, partnering with regional and local contractors, they are able to determine potential challenges along the way, and prepare for the unexpected. ABB can execute projects of any complexity, from greenfield sites in open land, to brownfield retrofits in densely populated metropolitan areas.

LOGISTICS AND PROCUREMENT

Working with ABB ensures thorough supply chain management and coordination. As an ISO-9001 certified company, their pre-qualification process for both ABB and non-ABB suppliers, along with their oversight of onsite logistics, assures ABB customers that their project is meeting all necessary requirements.

SIMPLIFIED SERVICE CONTRACTS

As an equipment and service provider, ABB can reduce O&M costs by simplifying service contracts. With a complete portfolio of services from system risk assessments, to upgrades and expansions, ABB has the product experience and project capabilities to provide warranty, post-warranty and general service contracts to keep the substation fully operational.
Value delivered
Innovative project execution combined with proven technology

WORLD CLASS SAFETY RECORD
Proactive ‘safety through design’ program that incorporates safety into the entire project life cycle, from preliminary engineering through construction and facility service life

ONE CONTRACT WITH CLEARLY DEFINED COST ESTIMATES
Single source provider for managing the design, engineering, procurement installation and commissioning with up front risk identification and management

LOWEST PROJECT RISK
Technical reliability coupled with professional project management for risk mitigation, scope control and schedule assurance

MEETS ALL RELIABILITY AND SAFETY STANDARDS
Easily meet federal and local standards, avoiding substantial fines from regulators and securing the safe operations of a system’s critical assets

INNOVATIVE AND FLEXIBLE SUBSTATION DESIGNS
GIS, AIS, hybrid and modular design options allow for flexible substation layouts to accommodate any environment

INTEGRATING CUTTING-EDGE GRID TECHNOLOGY
Leverage existing and emerging technologies to ensure grid reliability and maximize operational performance

FAST TRACK COMPLETION OF PROJECT
Ability to fast track substation projects and offer modular packages held to the latest performance, reliability and safety standards

SAVE ON OPERATION & MAINTENANCE COSTS
With direct access to substation equipment experts, ABB provides robust system designs that are managed under one service contract to ensure performance

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Substation components

| Power transformers for stepping the voltage up and down |
| Instrument transformers for measuring the current or voltage |
| Switchgear and circuit breakers for interrupting rated and short-circuit current |
| Ground switches for connecting parts of the substation to ground |
| Surge arrestors for protecting the switchgear from high overvoltages caused by lightning |
| Substation automation, control and protection systems for the electrical equipment in the substation |
| Power Distribution Centers (PDCs) and e-houses, housing the medium voltage switchgear and/or electrical control and protection systems |
A TRUSTED PARTNER FOR DELIVERING INNOVATIVE POWER GRID SOLUTIONS

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**Portfolio of technologies**
Greenfield, hybrid, expansion or retrofit...

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**GIS SUBSTATIONS**
Compact and resilient substations

ABB substations with gas-insulated switchgear (GIS) are unmatched when it comes to compactness, reliability, efficiency and safety, ensuring maximum power availability. The robust, low maintenance GIS design minimizes the substation footprint allowing it to be installed indoors, in urban areas and in harsh environments. With significantly reduced space requirements and enclosed substations sheltered from the elements, the GIS substation enables customers to save on operation and maintenance costs throughout the life cycle of the substation. ABB pioneered the development of GIS technology, delivering the world’s first GIS substation in 1967. Since then, they have delivered over 10,000 high-voltage GIS bays.

**AIS AND HYBRID SUBSTATIONS**
Cost-efficient, proven and reliable

Air insulated switchgear (AIS) is the most commonly used type of equipment for substations. It offers flexibility in terms of equipment configuration, as well as comparatively low installation costs. For nearly 100 years, ABB has been offering customers a variety of substation designs and configurations to meet their unique project needs and requirements.

ABB also offers hybrid substation solutions that combine gas and air insulated switchgear technologies to make installation more compact, minimize maintenance requirements and maximize availability and reliability.

**DIGITAL SUBSTATIONS**
Bridging the gap between analogue and digital technologies

ABB’s Digital substation is a core enabler to increase safety, productivity and reliability for grid operators and to reduce the overall substation cost. To ensure inter-operable and future-proof solutions, the substation automation, protection and control system is designed to implement the core values of the IEC 61850 standard. The digital substation can also significantly reduce the size of the substation by including more compact non-conventional instrument transformers and by using protection and control IEDs resulting in smaller control rooms. The copper signaling wires can be replaced by a few fiber optic communication buses, further simplifying the substation design. Additionally, the digitalization of substations can enable secure communications from the substation to any remote network control center. Through remote access, the asset owner can evaluate the status of the equipment without dispatching an engineer to the site, saving both time and resources. These solutions fulfill the highest demands with respect to safety, reliability and real time response.
SUBSTATION EPC SOLUTIONS

MODULAR AND SKID-MOUNTED SUBSTATIONS
Standard design, quick delivery and minimal site works

ABB’s modular and skid-mounted substations are designed to save time and money by minimizing upfront engineering hours and reducing civil works, electrical installation, testing and commissioning at the customer’s location. The modular substations are designed so that each of the major sub-systems of a substation can be assembled and tested in a factory environment and then transported to the project location for on-site erection with minimal assembly. For substations up to 420kV, ABB can provide skid-mounted substations where the entire substation is factory-assembled on a single platform, tested and easily transported to the site.

POWER QUALITY SOLUTIONS
Reactive power needs

From SVCs to STATCOMs and synchronous condensers, ABB provides reactive power solutions that ensure power quality and whole system efficiency. By instantly absorbing or injecting reactive power in AC electrical grids, these solutions are able to provide voltage support and regulation, power factor correction, harmonics mitigation, and improve transit stability of the grid. These technologies integrate power generation, from transmission through distribution and delivery, ensuring the grid stays up and the lights stay on.

ENERGY STORAGE
The power to control energy

With over a decade of expertise in energy storage, ABB is a pioneer and leader in the field of distributed energy storage systems. ABB’s EssPro PCS and EssPro Grid solutions provide customers with the ability to solve power quality, stability, and availability issues. Strategically placed energy storage systems can increase operational performance and grid reliability, better integrate alternative energy sources, balance supply and demand, and ensure that energy is readily available when primary power sources are interrupted. The benefits of energy storage can span power generation, through transmission and distribution, and all the way to users.

...a solution for every project need
As a leading provider of equipment for generation, transmission, and distribution of electrical power, ABB has a comprehensive substation service offering that can help customers optimize their resources and reduce operational costs without compromising quality, efficiency, and reliability.

From up front engineering and design services to brownfield substation assessment and optimization support, ABB has services to improve operational efficiency throughout the utility network.

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### Substation technical services
Maintaining and extending the performance of critical assets

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### Service system services

<table>
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<tr>
<th>Service offering</th>
<th>Application</th>
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</thead>
<tbody>
<tr>
<td>Engineering and design</td>
<td>Full range of substation engineering services including substation design and optimization, protection &amp; control, design support for integrating new technology and power systems studies</td>
</tr>
<tr>
<td>Substation improvement projects</td>
<td>From substation upgrades, retrofits and expansions, ABB offers a full range of project services to modify transmission and distribution networks to help ABB customers improve reliability and boost system capacity</td>
</tr>
<tr>
<td>Substation care</td>
<td>From the time-based maintenance contracts to more advanced and robust reliability centered maintenance (RCM) contracts, ABB is here to offer expertise to customers who need to prolong the longevity of their substations</td>
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<tr>
<td>Risk assessments</td>
<td>In order to gain a comprehensive overview of the substation’s risk profile, ABB has proprietary software to evaluate the condition and current state of performance of the substation</td>
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<tr>
<td>Substation LifeStretch</td>
<td>LifeStretch is an innovative approach to assess the current condition of the substation and identify a variety of alternative solutions to increase performance and overall life span of the substation based on the customer’s financial and technical requirements</td>
</tr>
<tr>
<td>Security and resiliency</td>
<td>Protecting the electrical grid from damage caused by natural event or human interference has never been more critical. ABB offers a multi-discipline to help focus on critical assets and ensure regulatory compliance while mitigating risks caused from external events</td>
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</table>
Substation experience
Complex projects engineered and constructed across many industries and environments

IMPROVED RELIABILITY AT SITE WITH LIMITED FOOTPRINT
ABB installed a GIS substation for a large investor owned utility in California, the utility’s first operational GIS. The existing 60kV air-insulated switchgear (AIS) and bus infrastructure on site was razed and replaced with 12 breaker 60kV GIS and building. The 60kV reliability was improved with a converted bus configuration from double bus single breaker (DBSB) AIS to breaker and a half (BAAH) GIS, replacement of existing dead ends, and upgraded with a Modular Protection Automation & Control (MPAC) building. In spite of an extremely tight site surrounded by wetlands, an existing natural gas power plant, and an on-going nuclear plant decommissioning effort, the project was completed early.

WIND FARM COLLECTOR SUBSTATION IN OKLAHOMA
ABB was the substation EPC provider of a collector substation in central Oklahoma, utilizing its 34.5 kV MV GIS switchgear technology. This project included a generator step up transformer complete with high voltage breakers, switches, instrument transformers, capacitor banks and the switchgear featured in a Power Distribution Center (PDC). In addition to the collector substation, ABB’s scope of supply included a 6 MVar STATCOM used for reactive power compensation to help regulate voltage and power factor to enable a reliable connection to the utility network.

A CARIBBEAN GRID BENEFITS FROM GIS TECHNOLOGY
As a smaller island, Puerto Rico’s electrical grid is more vulnerable to power disruption and outages than larger interconnected grids. The most proven and reliable technology is required to ensure grid stability and reliability. As a result, the local utility partnered with ABB to build a GIS substation with a full scope of ancillary equipment provided the engineering, procurement, construction and commissioning of the three substations ranging from 115 kV to 38 kV, to finally 13.2 kV with a combined total of 122 bays. The project has demonstrated superior reliability, enhanced system stability, and lowered operating and maintenance costs.

UPGRADES AND EXPANSION FOR A STEEL COMPANY
A steel company in Alabama was experiencing operational and reliability issues with existing electrical infrastructure. To help solve these growing concerns, ABB designed and provided power transformers for the planned upgrade of their 500kV substation. Additionally, ABB upgraded the cold mill substation by splitting the existing 46kV line into two taps, circuit breakers at each line tap, 15kV switchgear lineup, protection and control panels, duct banks and manholes to support cable modifications, a power transformer, and the installation of distribution cables. ABB also provided electrical facilities to help power their new galvanizing line building, installing a new switchgear lineup, new protection and control panels, a lengthy duct bank and power cables. Upon the completion of both projects, ABB was able to solve several operational issues, increase reliability, and enable company expansion and growth.
In order to improve service reliability, an investor owned utility needed to upgrade a 115 kV transmission substation located in a densely populated area with significant soil issues due to its location near San Francisco Bay. To address these site concerns, ABB converted the 115 kV air-insulated double-bus-single-breaker (DBSB) switchyard into a new gas-insulated breaker-and-a-half (BAAH) design. ABB provided full EPC scope of supply including engineering, equipment and construction labor to design, build, test and commission the switchyard. The switchyard includes new 115kV dead end structures, underground high voltage cable, gas insulated switchgear (GIS), enclosed in a weather proof enclosure and the latest in modular protection, control and automation technology, adhering to IEC 61850.

In Prudhoe Bay, located on the northern coast of Alaska, resides the world’s largest pipeline system, the Trans-Alaska Pipeline. This 800 mile system transports oil from the Arctic Ocean south, consisting of feeder pipelines and 12 pump stations, each 75 miles apart. These pump stations are located deep in the arctic tundra, and are susceptible to soil upheaval, shrinkages, snow accumulation and exposure to wildlife. To ensure the reliability of the power connection and preserve the delicate surrounding environment, ABB engineered, delivered and installed an elevated, skid mounted 138 kV to 13.8 kV, 20 MVA Substation. This modular substation safely provides power to the pumping station, while avoiding becoming a nesting place for the local wildlife population.

A North Carolina utility, responsible for providing power to a major college campus, required a new substation to support a steam generation plant and emergency black start equipment. The university preferred a solution that aesthetically blended in with the campus community and chose to house part of the substation in an architecturally designed building. ABB engineered the GIS ring bus and medium voltage switchgear to fit within the dimensions of the building, and leveraged the structure to semi-shield two transformers from outside view. The end result was a highly reliable, efficient, site-optimized GIS substation for smoother campus operations, with no degradation of the aesthetics of the campus environment.

ABB has performed several EPC Substation projects in Burbank, California, serving the power needs of multiple movie and television industry facilities nearby. With real estate at an absolute premium in this area, ABB’s GIS technology has minimized site footprint and maximized operational reliability in 35kV and 69kV projects. These substations have supported electrical reliability for the dramatic increase in local generation that sustains a high population density region, along with the motion picture industry’s unique energy demands.