Gas-insulated Switchgear ELK-14
The modular system for GIS, 245 kV
ABB switchgear systems provide maximum reliability
Built on years of experience - ready to serve your future needs

For decades ABB’s SF₆ gas-insulated switchgear technology has earned itself an international reputation for system security, reliable performance, economical use and extremely long service life, even when operating in the toughest environmental conditions.

The latest addition to this family is the compact ELK-14 series, which has all the well established attributes of ABB’s GIS systems, but also several new innovative features. The most important among these is its size. With fewer components, the ELK-14 series is even more compact and reliable than previous models, simplifying its operation and handling, and helping cut costs during installation and service. It is ideally suited to voltages up to 253 kV (kilovolts) and has a modular design for its main circuits, and for its control and protection, which provide the flexibility needed to expand and adapt the system easily, as and when required.

**Safety**
All components are enclosed in a grounded gastight aluminum enclosure and each gas compartment is protected by a pressure relief device.

**Reliable and robust operation**
All live parts are enclosed and effectively protected from external influences by the insulation system, even when operating under severe conditions.

**Minimal down time**
ABB’s worldwide service organization, together with our well adapted maintenance schedule assures the shortest downtime for maintenance and repair.

**Extended operational time**
Top-quality materials and workmanship guarantee maximum operational time with a minimum of service and maintenance.

**Compact design**
The ELK-14 series is even more compact than previous GIS systems resulting in up to 40 percent space savings.

**Versatile modules**
The ELK-14 offers standardized solutions for GIS as well as for local control, thus combining shortest possible delivery and project lead times with maximal flexibility.

**Economy**
Use of optimized aluminum enclosures reduces the weight of the system, which cuts the cost of foundations and load-bearing components.

**Efficiency**
Prefabrication of complete bays, including the local control cubicle, together with stringent quality control at our factory, simplify installation and commissioning, and help reduce project delivery times.

**Environmental friendliness**
The compact design reduces SF₆-gas and construction materials, while the shipment of complete bays housed in containers reduces packaging.

**Accessibility and ergonomics**
All key components of ELK-14 are easily accessible, making tasks such as gas handling, the reading of gas pressure indicators, or the initiation of manual operations, easy.

**Worldwide presence**
ABB’s GIS equipment has been installed on every continent confirming ABB’s leading position as a GIS manufacturer. Our global service organization provides permanent 24/7 support for maintenance and repair.
Continuous improvements from the early stage till now
ELK-14

Since its introduction in 1966, ABB has supplied more than 20,000 bays of SF₆ GIS to more than 100 countries. Our pioneering research and development in GIS technology have contributed to this success and will continue to yield innovative improvements with every product generation. Today, ABB’s product portfolio comprises a full range of advanced GIS for voltages from 72.5 kV to 1,100 kV.

In 1969 ABB introduced one of the world’s first 245 kV transmission GIS. Subsequent generations featured horizontal puffer circuit-breakers and a low center of gravity which have reduce the impact of seismic activity. In 1993, ABB introduced the ELK-14-type GIS also rated at 245 kV, but with a novel 50 kA Auto-Puffer™ self-blast breaker and disk insulators, both contributing to the size and weight reduction of the system. In the generations that followed digital control and supervision was added along with electronic instrument transformers.

Today, the latest generation of ELK-14 GIS, introduced in 2010, features an optimized, compact layout that minimizes the volume of SF₆-gas required within for insulation. This means the latest ELK-14 has fewer building blocks resulting in a reduction in layout complexity and the space required to house it. Furthermore, operating mechanisms and terminals for instrument transformers are more conveniently located at the front of the bays, which are shipped wired and factory tested to cut the cost and time required for installation and commissioning.
Gas-insulated switchgear is built from a few versatile building blocks that enable construction of all common layouts and bus schemes. Each component – such as a switch, bus-duct, circuit breaker – is contained within a gastight enclosure filled with pressurized SF₆ insulating gas. The SF₆ gas is completely sealed within the system and is never consumed. Partition insulators divide the switchgear into individually serviceable gas compartments. Each gas compartment is equipped with a pressure relief device and material to absorb moisture and decomposition products.

The advanced modular building block design of the ELK-14 GIS offers several unique features:

– All modules use single phase insulators. Components of all three phases are contained within a single enclosure connecting the gas compartments of all three phases without external piping.

– The shape of each enclosure is optimized to minimize the volume of SF₆ gas required to fill it. By reducing the number of flanges and sealing systems, the lightweight ELK-14 design uses fewer resources than any previous switchgear generation.

– The ELK-14’s partitioning scheme meets the highest service continuity requirements, allowing any busbar module within a double busbar system to be replaced without de-energizing adjacent feeders.

– Drives, position indicators and operating elements are conveniently located at the front panel, which simplifies operation, inspection and maintenance.

– The secondary system is flexible – besides the standard integrated control cubicle with an IEC 61850 compatible bay controller and feeder protection, ABB supplies conventional controls and separate control cubicles according to a project’s specific requirements.

Basic modules that make up the ELK-14 switchgear.

1 High-performance circuit-breaker
Full performance and low maintenance – Auto-Puffer™ high-voltage circuit-breakers.

2 Safe disconnectors and grounding switches
Easy to operate and equipped with comprehensive safety features, ELK-14 disconnectors and grounding switches contribute significantly to operational safety.

3 Reliable current and voltage transformers
ELK-14 instrument transformers serve all metering, control and protection purposes.

4 Versatile connecting elements
ELK-14 features a collection of connecting and interface elements that enable the ELK-14 series of GIS to be adapted to virtually any project’s requirements.

5 Innovative control and protection technology
ABB’s control and protection technology offers intelligent, networked, digital control and protection systems with monitoring and remote diagnostic functions.
ABB high-voltage circuit-breaker
For improved performance and lower maintenance

The circuit-breaker
ABB’s advanced circuit-breakers are used in GIS, AIS (air-insulated switchgear), hybrid PASS (plug and switch systems), as well as DTBs (dead tank breakers). Their use in several ABB applications mean we have acquired a wealth of experience and knowledge in circuit-breaker technology, which along with research and development programs designed to improve performance, keep ABB at the forefront of this field.

Feature
- Excellent electrical and mechanical endurance
- Reliable SF₆-gas insulation across the isolating distance
- Single-phase and three-phase auto-reclosing
- Suitable for controlled switching
- Full double motion Auto-Puffer™ circuit-breaker with low reaction forces, minimum drive energy and low noise level
- Reliable spring operating mechanism

Circuit-breaker
Each circuit-breaker consists of a spring operating mechanism and three single-break interrupter units attached to the support structure within a single enclosure. During overhauls, an interrupter unit can be removed easily from the enclosure and replaced by a new unit.

The circuit-breaker uses the full double motion Auto-Puffer™ operating principle. At high currents, the pressure inside the Auto-Puffer™ increasing rapidly due to rising temperatures, which closes the Auto-Puffer™ valve. The energy need now to extinguish the arc is produced by the arc itself. At low currents, the Auto-Puffer™ valve remains open and the circuit-breaker acts as a puffer breaker. Auto-Puffer™ interrupters require far less operating energy than puffer interrupters. Main- and arcing-contacts on both sides of the breaker are coupled by a gear and move in opposite directions (full double motion), which minimize mechanical reaction forces and further reduce the necessary drive energy.
**Circuit-breaker operating mechanism**

The circuit-breaker uses a spring operating mechanism for single- and three-pole operation. The mechanism combines the non-wearing properties of a hydraulic system with the robustness of mechanical spring operating mechanisms. Spring operating mechanisms are used for ABB’s entire GIS portfolio, from 72.5 kV to 1,100 kV and for various other applications in AIS, PASS and DTB. ABB has supplied more than 65,000 spring operating mechanisms of this type.

The components of the operating mechanism
- Charging system
- Energy storage with disk spring stack
- Three independent actuator pistons and control valves
- Auxiliary switches and position indicators

A hydraulic energy control system is integrated within a compact, sealed block that does not require any external piping. All components are easily accessible for maintenance and repair, and in emergencies, trip and close circuits can be operated manually at the drive.

**Charging**

A pump moves oil from the low-pressure oil reservoir to the high-pressure side of the energy storage piston and compresses the disk spring stack. A micro switch stops the pump when the disk spring stack is fully charged.

**Close operation**

A magnetically operated change-over valve initiates the close operation and connects the high pressure side of the energy-storage piston to the actuator piston(s). Both sides of the actuator piston(s) are connected to the high-pressure reservoir. Due to the different areas of both surfaces of the actuator piston(s), the circuit-breaker closes and is retained in a closed position.

**Open operation**

The trip coil operates the change over valve and connects the actuator piston to the low pressure reservoir. The circuit-breaker opens and is retained in an open position by the pressure difference.
Disconnector and earthing switches
Safe and reliable

The disconnecter
Disconnectors provide a safe insulating gap to isolate sections with different potential, e.g., busbar disconnectors, which isolate a feeder. The ELK-14 contains two variants – one busbar disconnector and one general purpose disconnector.

The operating mechanism is mounted in the central drive cabinet at the front of the bay. Hand-crank access for emergency operation, position indicator and mechanical interlocking are mechanisms conveniently located at the front panel and are accessible from the operator’s corridor.

Feature
- Reliable SF₆-gas insulation across the isolation distance
- Reliable switching of bus-transfer and bus charging currents
- High capacity for carrying rated and short-circuit currents
- Single-phase insulated partition insulator
- Conveniently located emergency hand-crank access
- Reliable 3-pole operating mechanism
- Separate, mechanically coupled position indicator, accessible via the front panel
- Viewing port for checking position and condition of contacts

The earthing switch
Earthing switches connect isolated sections of the switchgear to the ground so that personnel are protected during maintenance and assembly work.

Feeder terminals are often equipped with fast-acting (or make-proof) earthing switches. These devices are able to earth induced currents on overhead lines, discharge larger capacitances such as cables, and provide safety when the opposite end of a line is not properly de-energized. The fast-acting earthing switch includes a spring operated mechanism, which is either charged by a motor or in emergencies by a hand crank.

Similar to disconnectors, the operating mechanism is located in the central drive cabinet at the front of the bay. Hand-crank access for emergency operation, position indicator, and mechanical interlocking, are mechanisms conveniently located in the front panel of the drive and are accessible from the operator’s corridor.

Feature
- Reliable grounding of main circuit
- High short-circuit current carrying capacity in closed position
- Fast earthing switches capable of short-circuit current making and switching induced currents
- Conveniently located emergency hand-crank access
- Location of drive unit outside the SF₆-gas compartment
- Position indicator mechanically coupled to the moving contact at the front panel
- Viewing ports for checking position and condition of contacts
- Safety elements such as padlocks available
Disconnector/earthing switch
Fast-acting earthing switch
Disconnector in busbar module
Disconnector
Fast-acting earthing switch
Maintenance earthing switch
ABB voltage and current transformers
Providing maximum safety, longevity, and reliability

The voltage transformer
The inductive voltage transformer units are connected to the switchgear with a connecting flange and three partition insulators. Single phase insulated, with components of all three phases contained within a single enclosure to avoid external gas pipe connections.

Feature
- SF₆ impregnated film insulation between the transformer windings
- High secondary output power and accuracy
- Ratio and number of secondary windings dependent on project specific requirements
- Effective damping of very fast transients transmitted to the secondary side
- Rectangular-type core of low loss magnetic sheets
- Separate gas volume with density monitoring
- Over-pressure relief device provided
- Secondary fuses on request
- Maintenance-free

The current transformer
The inductive current transformers are attached to the enclosure and are located outside the gas compartment so that no gastight feed through to the secondary terminals is required. Each current transformer may contain multiple cores for metering and protection within a single cast resin case. Current transformer parameters such as burden, ratio, accuracy class and transient performance are set to meet the specific project’s requirements. Multi-ratio transformers provide different ratios selectable by taps.

Feature
- Simple ring-core type windings
- Ratio, number of cores, accuracy, and transient performance determined in accordance with a specific project’s requirements
- Efficient damping of very fast transients transmitted to the secondary side
- Maintenance-free
Terminals and connecting elements
ELK-14 – a system with unique adaptability

The connecting elements
Switch gear systems need to be flexible so they can be tailored to meet the technical requirements of each project. This is why ABB supplies a variety of connecting elements in several shapes and sizes including elbows joints, T-elements and straight sections.

The ELK-14 provides a universal expansion joint to absorb heat expansion, and vibrations during operation and civil engineering works. During site installation, the expansion element ensures that neighboring bays can be coupled easily and flexibly.

Surge arresters
Surge arresters limit switching and lightning over voltages. If required, ELK-14 is equipped with gas-insulated metal-oxide surge arresters. Surge arresters are fully metal enclosed components. Ratings and discharge classes are set by the project specific requirements.

Terminal connections
ABB’s GIS range includes connecting elements for peripherals, such as, SF₆-air bushings, enclosures for cable terminations and direct transformer connections.

Transformer connections
Standardized transformer connection enclosures link power transformers directly to the switchgear via SF₆ insulated bus ducts. Vibrations, thermal expansion of the transformer and switchgear, as well as movements resulting from the settling of foundations, are compensated by bellows and expansion joints. A removable high-voltage conductor link isolates the transformer for testing.

Feature
- Effective compensation of vibrations
- Connections between the SF₆ switchgear and the transformer
- Isolation of the SF₆ switchgear from the transformer for testing possible
- Interface according IEC 61639
- Maintenance-free
Cable terminations
ELK-14 provides cable connection enclosures for fluid-filled, dry-type or plug-in cable terminations, which are part of the accessory manufacturer’s scope of supply.

Feature
- Interface in accordance with IEC 62271-209 for fluid-filled or dry-type cable terminations
- Space saving, compact variant for dry-type or plug-in terminations
- A removable link disconnects and isolates the GIS from the cable during high-voltage tests
- Maintenance-free

SF₆-air bushing
The SF₆/air bushings are available in two variants: with classical porcelain insulators or in the standard version, with composite insulators and silicon sheds. Creepage distance, length, and shape depend on the project specific environmental requirements.

Feature
- High-creepage distances
- Self-cleaning silicon sheds
- Single-pressure SF₆-gas insulation
- Explosion and vandalism-proof
- Resistance against sandstorms
- Universal fitting positions possible
- Lightweight
- Maintenance-free
ABB’s proven local control concept
Operational benefits based on long experience

The local control cubicle (LCC) includes all required functions for control and supervision of the GIS bay. The LCC is usually integrated and located on top of the operating mechanism cabinet. As an integral part of the ELK-14 GIS, the LCC is wired, factory tested and shipped together with the bay as one transport unit. This reduces installation and commissioning time to a minimum and eliminates errors during site installation. Only connections from the LCC’s prepared terminal blocks to dedicated protection cubicles, control systems, power supply, and inter-bay wiring, are installed onsite.

Usually, the LCC contains control devices and feeder protection. ABB’s advanced Relion® family of protection and control-IEDs, as well as the state-of-the-art bay control mimic, with well-proven two-hand operation for conventional control, ensure the safe and economic operation of the switchgear.

**Basic functions**
- Safe local control of all motorized equipment
- Key switch selectable operation mode (local/remote/emergency and normal/interlock/bypass)
- Interface to remote control and protection, either hardwired or through station bus
- Feeder and station interlocking, depending on the position of all high-voltage apparatus as well as various blocking conditions
- Local command inhibition (eg, crank-handle insertion)
- Circuit-breaker supervision, including gas density, position indication, operation counters, pole discrepancy and operating mechanisms monitoring
- Gas density supervision of the entire switchgear
- Measurement visualization and alarm indication

**Advanced functions of modern local control cubicles**
- Remote communication to substation automation system, eg, through IEC 61850
- Horizontal communication between control- and/or protection-IEDs applying IEC 61850 GOOSE messages
- Synchro-check performed by the bay control-IED
- Auto-reclose as well as back-up or main protection functions can be integrated in the IED
- Optional integration of dedicated protection or monitoring devices inside the LCC

Depending on the project’s requirements, ABB also delivers stand-alone LCCs with all customary control and protection devices according to customer specifications.
Substation protection and control
Innovative and reliable solutions for optimal power flow

ABB's world-class protection and control solutions ensure reliable power transmission and distribution. Our IEC 61850-enabled product portfolio provides you with open, future-proof and flexible system architectures with state-of-the-art performance. With our long experience in the field, our full scope of services and global support network, ABB has become a global leader in substation automation and protection.

Complete solutions for efficient protection, automation, control and monitoring
ABB’s substation protection and automation solutions are designed for maximum safety, efficiency and reliability, for all types of substations:

- Fully IEC 61850 compliant solution portfolio of interoperable systems, products and tools
- Flexible system architecture to cope with changing requirements, philosophies and technologies
- Field-proven functionality and hardware, as well as innovative technologies, ensure best solutions for all applications
- High availability and fast access to precise information from anywhere in the system, speeding up responses and reducing outage time
- Cyber security embedded as an integral part of the product and system lifecycle, without compromising reliability and interoperability
Total quality control
From manufacturing to maintenance

All ABB GIS comply with or exceed the latest international standards (IEC/ANSI) and have been type tested in independent laboratories. Our certified design and manufacturing processes guarantees the highest quality of our products.

ELK-14 bays are fully assembled and tested in the factory with standardized, automated and reliable procedures. After routine testing, shipping units are packed in accordance with the freight carrier’s requirements, the duration of transportation, the dispatch route and site storage requirements. Its compact size allows complete bays to be shipped in standard containers, which may also be used for temporary storage at the installation site.

Pretested, wired and SF₆ prefilled bays reduce the installation work significantly. Bays are coupled using standard tools and gas handling is minimized. Site testing according to IEC/ANSI standards and ABB quality assurance procedures include leakage checks on flanges, instrument transformer tests, control and monitoring functions, resistance measurements and a high-voltage test. Site installation can be carried out by ABB, but also by personnel from your own company under the guidance of a certified ABB supervisor. ABB’s University offers training courses for every aspect of GIS installation, operation and maintenance.

ABB’s metal enclosed gas insulated switchgear requires minimal maintenance in service. In normal operational conditions, more than 25 years fault-free operation is assured with periodic visual checks, after which time a first full inspection is recommended. ABB Service provides competent 24/7 worldwide support in case of failures.
Single busbar bay with SF₆-air bushings

Section of a 1½-breaker arrangement
Main technical data
ELK-14

ELK-14 double busbar bay
- Circuit-breakers
- Disconnecter and earthing switches
- Voltage and current transformers
- Connecting elements
- Control & protection
### Main data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>up to 253 kV</td>
</tr>
<tr>
<td>Power-frequency withstand voltage, 1 min.</td>
<td>460 kV</td>
</tr>
<tr>
<td>Power-frequency withstand voltage, 1 min. across open contacts</td>
<td>530 kV</td>
</tr>
<tr>
<td>Lightning impulse withstand voltage across open contacts</td>
<td>1200 kV</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Rated continuous current</td>
<td>3150 A</td>
</tr>
<tr>
<td>Rated short-time withstand current</td>
<td>50 kA</td>
</tr>
<tr>
<td>Rated withstand impulse current</td>
<td>135 kA</td>
</tr>
</tbody>
</table>

### Circuit-breaker

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>First pole-to-clear factor</td>
<td>1.3</td>
</tr>
<tr>
<td>Rated breaking current, 50/60 Hz</td>
<td>40/50 kA</td>
</tr>
<tr>
<td>Rated making current, peak value</td>
<td>130 kA</td>
</tr>
<tr>
<td>Drive type</td>
<td>spring</td>
</tr>
<tr>
<td>Rated opening time</td>
<td>≤ 30 ms</td>
</tr>
<tr>
<td>Rated breaking time</td>
<td>≤ 50 ms</td>
</tr>
<tr>
<td>Rated closing time</td>
<td>≤ 100 ms</td>
</tr>
<tr>
<td>Reclosing time</td>
<td>≤ 300 ms</td>
</tr>
<tr>
<td>Rated operating sequence</td>
<td>O - 0.3s - CO - 1min or CO - 15s - CO</td>
</tr>
<tr>
<td>High-speed auto-reclosing</td>
<td>single- and three-phase</td>
</tr>
<tr>
<td>Mechanical endurance</td>
<td>class M2</td>
</tr>
<tr>
<td>Capacitive switching</td>
<td>class C2</td>
</tr>
</tbody>
</table>

### Disconnector & earthing switch

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitive current switching capability mA</td>
<td>250 mA</td>
</tr>
<tr>
<td>Bus transfer current switching capability A/V</td>
<td>1600/20</td>
</tr>
<tr>
<td>Opening/closing time</td>
<td>≤ 2.5 s</td>
</tr>
<tr>
<td>Mechanical endurance</td>
<td>class M2</td>
</tr>
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</table>

### Fast-acting earthing switch

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching performance</td>
<td></td>
</tr>
<tr>
<td>Making capacity</td>
<td></td>
</tr>
<tr>
<td>- Current</td>
<td>50 kA</td>
</tr>
<tr>
<td>Inductive currents</td>
<td></td>
</tr>
<tr>
<td>- Voltage</td>
<td>2 kV</td>
</tr>
<tr>
<td>- Current</td>
<td>80 A</td>
</tr>
<tr>
<td>Capacitive currents</td>
<td></td>
</tr>
<tr>
<td>- Voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>- Current</td>
<td>3 A</td>
</tr>
<tr>
<td>Motor running time</td>
<td>≤ 2 s</td>
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</table>

### Voltage transformer

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated output (total)</td>
<td>100 VA</td>
</tr>
<tr>
<td>Rated accuracy class</td>
<td>0.2%</td>
</tr>
<tr>
<td>Rated thermal power (total)</td>
<td>1000 VA</td>
</tr>
<tr>
<td>Rated voltage factor</td>
<td>1.9/8 h</td>
</tr>
<tr>
<td>Number of secondary windings</td>
<td>1 or 2</td>
</tr>
</tbody>
</table>

### Current transformer

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cores for metering</td>
<td></td>
</tr>
<tr>
<td>Cores for protection (transient performance optional)</td>
<td></td>
</tr>
</tbody>
</table>

### SF₆-air bushing

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous bending load</td>
<td>2500 N</td>
</tr>
<tr>
<td>Test bending load</td>
<td>5000 N</td>
</tr>
<tr>
<td>Creepage distance</td>
<td>20, 25, 31 mm/kV</td>
</tr>
</tbody>
</table>
Several aspects of the product described in this brochure are subject to intellectual property protection. In February 2011, the publicly accessible intellectual property portfolio relating to the ELK-14 was as follows:

**Granted intellectual property rights:**
- EP0522303B2
- EP0676842B1
- EP0678952B1
- EP0730160B1
- EP1351267B1
- EP1569256B1
- EP156911B1
- EP1675142B1
- RCD001804139A1

**Pending applications:**
- EP1863052A1

For further information such as to the status, country coverage and any new publications relating to the intellectual property portfolio particularities visit our website http://www.abb.com.