Gas-insulated Switchgear ELK-14
The modular system for GIS, 300 kV
ABB switchgear systems offer maximum flexibility
Than we draw on experience to meet the needs of tomorrow

ABB’s SF₆ gas-insulated switchgear technology has been proving its worth, day in and day out, for years. In applications all over the world. It owes its leading international position to a string of significant advantages: system security, reliable performance, economical use and an extremely long service life, even under the toughest conditions.

Apart from its many classical qualities, the ELK-14 series boasts several very advanced features. With compact architecture and fewer components, for example, it requires far less space than previous systems. Its use simplifies operations and cuts costs from the moment you start using it. And goes on doing so. ABB’s GIS systems are designed for future upgrading because both main circuits and control & protection are totally modular. Which means you can expand and adapt them when you need to. Simply and efficiently. We call it systematized flexibility.

Ideally suited for voltages up to 300 kV, the modular ELK-14 range combines innovation with tried-and-tested qualities: the features that have given ABB GIS systems their international reputation.

**Safety**
The combined disconnector/earthing switch guarantees maximum operational safety.

**Reliability**
All live parts are enclosed and effectively protect the insulation system against negative external influences. The amount of moving parts and number of drives are reduced to a minimum.

**Availability**
World-wide service organization, together with a well adapted 3-level spare part concept, assures shortest downtime for maintenance and repair.

**Long-life cycle periods**
Top-quality materials and workmanship guarantee maximum life with a minimum of service and maintenance.

**Compactness**
The ELK-14 range is so well designed that it requires up to 40% less space than previous GIS systems.

**Flexibility**
The system’s modular architecture permits individual solutions that can be adapted to changing needs at any time.

**Economy**
Use of aluminium enclosures reduces the weight of the system, cutting the cost of foundations, load-bearing components and reduction of variants.

**Efficiency**
Prefabrication of subassemblies and stringent quality control at our own factory simplify final installation and commissioning.

**Environmentally friendly**
Significant reduction in number of flanges and seals, as well as a small compact design.
## World-wide success

GIS ELK-14

<table>
<thead>
<tr>
<th>Country</th>
<th>Substations</th>
<th>Bays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>8</td>
<td>69</td>
</tr>
<tr>
<td>Australia</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Bahrain</td>
<td>16</td>
<td>105</td>
</tr>
<tr>
<td>Brazil</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Canada</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>China</td>
<td>11</td>
<td>51</td>
</tr>
<tr>
<td>Egypt</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>France</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>India</td>
<td>5</td>
<td>35</td>
</tr>
<tr>
<td>Ireland</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Italy</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>Kuwait</td>
<td>5</td>
<td>71</td>
</tr>
<tr>
<td>Liban</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Lybia</td>
<td>5</td>
<td>72</td>
</tr>
<tr>
<td>Malaysia</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Mexico</td>
<td>6</td>
<td>64</td>
</tr>
<tr>
<td>Morocco</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Norway</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Poland</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>Portugal</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Qatar</td>
<td>7</td>
<td>138</td>
</tr>
<tr>
<td>Russia</td>
<td>23</td>
<td>260</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>7</td>
<td>40</td>
</tr>
<tr>
<td>Singapore</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>South Africa</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Spain</td>
<td>17</td>
<td>128</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Sweden</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Switzerland</td>
<td>12</td>
<td>90</td>
</tr>
<tr>
<td>Syria</td>
<td>3</td>
<td>56</td>
</tr>
<tr>
<td>Thailand</td>
<td>4</td>
<td>26</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>7</td>
<td>56</td>
</tr>
<tr>
<td>USA</td>
<td>6</td>
<td>32</td>
</tr>
</tbody>
</table>
In the early stage of transmission GIS, ABB introduced one of the world’s first 245 kV transmission GIS ELK-1 in 1969. The low centre of gravity using a horizontal single-break puffer circuit-breaker, optimal characteristics in seismic areas could be achieved. Meanwhile the circuit-breaker is implemented in different applications up to 1100 kV and 80 kA by using different number of breaks. Over the years, ABB was continuously faced with changing market demands and further steps in technology. Together with continuous requests in more compact products due to increasing costs for land in megacities. Thus, ABB introduced a successor product for ELK-1 called ELK-14 in 1993, applying latest perceptions in GIS technology and service experiences, together with adaptations of the product to the increasing demands of latest IEC standards, the most compact GIS with horizontal arrangement of the circuit-breaker could be created for voltage range up to 300 kV and short-circuit ratings up to 63 kA. Changing standards and further market development towards higher competitiveness result in a standardisation process to minimize complex installation variants. Any different switching variants can be simply and transparently realised from tried and tested standard modules.

During the latest improvements of ABB’s ELK-14, a great deal of emphasis was placed on excellent accessibility of all items of equipment requiring operator attention in spite of the compact design and space-saving arrangement. The installation can therefore be readily accommodated in smaller buildings.

A Product Certificate for the entire product ELK-14 signed by independent authority assures: Conformity of all type-tests with standards, conformity with the design and construction, conformity of routine testing and conformity of all internal manufacturing processes according the certified quality management system.
ELK-14 switchgear in 1½-breaker arrangement
The ELK-14 switchgear system from ABB
Clear-cut advantages and outstanding qualities

The concept
Improved performance in less space. For main circuits and control & protection. That’s what ABB ELK-14 technology so revolutionary in making. And because it needs up to 40% less space, it drastically cuts your construction costs and saves your operating costs at the same time.

The approach
Fewer components. Greater efficiency. Plus another major benefit of the improved GIS generation from ABB: the state-of-the-art control & protection technology is open and completely integrated. Which increases the range of possible applications and makes it easier to operate.

The outlook
Maximum system security with a minimum of maintenance. Another quality feature of the environment-friendly ELK-14 system. And because it is modular, it can be extended or adapted at any time to meet your present and future requirements.

High-performance circuit-breakers
Enhanced performance and lower maintenance – that is the simple principle behind ABB’s high-voltage circuit-breakers. Designed for maximum efficiency with quality in mind.

Save disconnectors and earthing switches
Like all ABB technology, the disconnectors and earthing switches are designed to meet present and future needs. In terms of construction and design as well as system safety.

Reliable current and voltage transformers
ABB’s GIS range also includes current and voltage transformers, which are as efficient as they are economical, and leave nothing to be desired in terms of service life.

Versatile connecting elements
ABB’s product range also features a collection of connecting elements in various shapes and sizes which enable our substations to be adapted to virtually any customers requirement.

Innovative control & protection technology
ABB’s forward-looking control & protection technology is fully integrated and completely open, which makes it more adaptable and simplifies operation.

Modules

| Circuits-breakers | Disconnectors and earthing switches | Voltage and current transformers | Connecting elements | Control & protection |
1 Circuit-breaker | 2 Disconnectors/earthing switches | 3 Voltage transformer and fast-acting earthing switch | 4 Connecting elements | 5 Control & protection
The circuit-breaker
Over the years, the circuit-breaker, using SF₆ gas for insulation and arc-quenching purposes, has been continuously developed and improved. Extensive operating experiences as well as continuous research and development activities are the basis when anticipating future market requirements.

Feature
– Reliable making and breaking capacity for heavy load and short-circuit currents
– Easy access to active parts for inspection and overhaul
– Low noise level
– Separate contact system for continuous current and current interruption
– High dielectric withstand in open and closed position
– Single-phase auto-reclosing
– Compact hydromechanical spring operating mechanism
– Continuous self-supervision of hydraulic system
– Type tested according latest IEC and ANSI standards
– Maintenance-free design

Breaker Design
Each circuit-breaker in the ELK-14 GIS comprises three single-phase metal-enclosed breaker poles. Each pole consists of the operating mechanism, the interrupter column with one interrupting chamber and the enclosure with the basic support structure. In case of an overhaul, the interrupter column can easily be removed from the enclosure.

The circuit-breaker is of the single-pressure type and works on the latest arc-quenching technology. During an interruption, a compression piston in the chamber generates the SF₆ gas pressure required to extinguish the arc between the contacts.
Circuit-breaker with operating mechanism

Circuit-breaker operating mechanism
Each pole of the circuit-breaker is equipped with a hydromechanical spring operating mechanism. The compact, modular design of the circuit-breaker operating mechanism, consists of:

- Housing
- Position indicator
- Power-pack for energy storage without any kind of external hydraulic pipe
- Monitoring module for control purpose

It combines the advantages of the hydraulic operating mechanism with those of the spring energy storage type, which furthermore enjoys due to its working principle the following advantages.

- Interrupting security despite broken disc spring
- Working principle guarantees additional safety margins for circuit-breaker performance in service

The operating mechanism guarantees easy access to all components inside the drive for overhaul and repair. Sealing of the pressure operated hydraulic circuit against the atmosphere is achieved entirely by highly reliable static seals.

Working principle
A hydraulic pump moves oil from the low-pressure reservoir to the high-pressure side of the energy storage piston, connected to the disc springs. The output piston, which is connected to the operating rod of the circuit-breaker column, is controlled by a change-over valve.

For opening, it switches hydraulically to the open position after the trip coil is actuated for opening the breaker and connects the bottom side of the output piston with the low-pressure reservoir. The circuit-breaker then moves to open position where it will be retained due to the hydraulic pressure.

For closing the circuit-breaker, the change-over valve connects the bottom side of the output piston to the high-pressure reservoir after actuation of the closing coil. Now, both sides of the output piston are connected to the high pressure and the circuit-breaker is moving to its closed position due to the differential pressure principle.

Schematic diagram (working principle)
There are many good reasons for trusting ABB’s know-how
And that applies to disconnectors and earthing switches too

The disconnector/earthing switch
The disconnector/earthing switch combines two functions
– a disconnector and a maintenance earthing switch – in one common enclosure, sharing one common operating mechanism.

The disconnector/earthing switch is based on a modular design. It has identical active parts for all variants and incorporates an insulating gap for the disconnector and one for the earthing switch. Variable arrangement of the active parts allows up to eight different configurations. This ensures the highest degree of flexibility with the lowest number of different parts.

The operating mechanism is of modular design. The modular design enables rapid replacement of complete modules, thus ensuring greater service friendliness and excellent access for maintenance and repair.

Feature
– Reliable SF₆-gas insulation across the isolation distance
– Reliable switching capacity for small capacitive currents and bus-transfer currents
– High capacity for carrying rated and short-circuit currents
– Space-saving combination of disconnector and earthing switch
– Mechanical interlocking between disconnector and earthing switch
– Insulated earth connection allows measurements without opening gas compartment
– Manual operation by hand crank possible
– Reliable 3-pole operating mechanism
– One drive only for both functions
– Location of drive unit outside SF₆-gas compartment
– Separated mechanically coupled position indicator for each function
– Viewing port for checking position and condition of contacts
– Fully type-tested for conformity to latest IEC and ANSI standards

The fast-acting earthing switch
The fast-acting earthing switch is used to earth insulated sections of the installation to protect personnel during overhaul and assembly work. But it is also employed for earthing capacitance (cables, transmission lines, etc.). The earthing switch can be mounted at any position by using a linear connection element, thus ensuring the greatest flexibility in switchgear layout.

The controlled “Open”-operation results from a slow linear contact motion directly driven by an electric motor, which is located in one of the outer phases and connects the other phases by rotating shafts. This enables optimal switching movement during contact opening.

The fast “Close”-operation is spring-actuated. After a closing command, the electric motor and the rotating shafts will compress the spring of a phase. After reaching the required state of charge, they are automatically released until the next closing command is activated.

Feature
– Reliable earthing of main circuit
– High short-circuit current carrying capacity in closed position
– High short-circuit current making capability
– Insulated operating mechanism
– Capable of switching induced capacitive and inductive currents
– Fast linear contact motion by spring-loaded drive for “Close”-operation
– Manual operation by hand crank possible
– Location of drive unit outside the SF₆-gas
– Position indicator mechanically coupled to the moving contact
– Viewing ports for checking position and condition of contacts
– Safety elements such as padlocks can be provided
– Fully type-tested for conformity to latest IEC and ANSI standards
ABB voltage and current transformers offer
Maximum safety, practicality and high reliability

The voltage transformer
Used for system protection or revenue metering, ABB’s powerful transformers offer years of trouble-free service. Even for heavy-duty applications. They are based on the electromagnetic transformer principle, where primary and secondary windings are galvanically separated from one another. The single-pole inductive voltage transformers are connected to the switchgear with a standardised connecting flange and a partition insulator. The primary winding is wound on top of the core and the secondary windings. The latter are connected to the terminals in the external terminal box through a gas-tight multiple bushing.

Feature
– Utilisation of SF₆-gas as insulating medium, together with plastic foil in the windings
– High secondary output and accuracy
– Ratio and number of secondary windings according to actual GIS plant requirements
– Effective damping of very fast transients, transmitted to the secondary side
– Rectangular type core of low loss magnetic sheets
– No ferroresonance possible in absence of circuit-breaker grading capacitors
– Horizontal or vertical mounting possible
– Separate gas volume with density monitoring
– Over-pressure relief device provided
– Secondary fuses on request
– Maintenance-free

The current transformer
The ring core current transformers concentrically enclose the primary conductor. The core support is provided by the pressure-proof enclosure, which is insulated from the basic flange to prevent the return current from passing through the cores.

Feature
– Simple ring-core type windings integrated in the main current path
– SF₆-gas as main insulation according to ABB’s well-proved-GIS technique
– Secondary windings on ring-cores, located outside of the SF₆-gas compartment and mechanically protected
– Efficient damping of the very fast transients transmitted to the secondary side
– Any accuracy class defined by international standards is possible
– Maintenance-free
ABB ELK-14 a system with unique adaptability
That goes for the connecting elements too

The connecting elements
Switching systems need to be as varied as the purposes for which they are intended. That is why ABB supplies connecting elements in all shapes and sizes: cross-shaped and T-elements, as well as simple straight sections, are the links that join up individual GIS components.

Compensators of various types allow for heat expansion, vibrations during operation and tolerances in the lengths of specific components. Moreover, lateral dismantling units guarantee hassle-free assembly and dismantling.

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

The transformer termination
The transformer connection enables transformers to be connected directly to the switchgear using bellows.

Feature
– Effective compensation of vibrations
– Connection between the SF₆ switchgear and the transformer
– Isolation of the SF₆ switchgear from the transformer for testing possible
– Interface according IEC 61639
– Maintenance-free
The cable termination
Cable connections, which are part of the cable manufacturer’s scope of supply, consist typically of an epoxy resin barrier insulator and can be either of dry type or of fluid-filled type.

Feature
– Interface according IEC 62271-209
– The GIS and the high-voltage cable can be galvanically separated and the high-voltage tests be carried out independently
– Removable link easily accessible
– Flange available to attach a test bushing
– Easy mounting of the cable at any rotation angle
– Maintenance-free

The SF₆-air bushing
The SF₆-air bushings are available in two different versions: with classical porcelain insulators or in the standard version, with fibre-reinforced resin insulators with silicon sheds.

Feature
– High creepage current resistivity
– Self-cleaning silicon sheds
– Single pressure SF₆-gas insulation
– Explosion and vandal-proof
– Resistivity against sandstorms
– All fitting positions possible
– Low weight
– Maintenance-free
ABB’s standardised local control concept
A comprehensive scalable solution

The local control cubicle
The local control cubicle is based on the Bay Control Solution concept BCS as a comprehensive scalable solution for control cubicles. The BCS is suitable for all types of switchgear used in transmission and subtransmission systems and every possible busbar configuration. The BCS includes all required functions for control and supervision of a complete GIS as well as the marshalling of all connections to and from the GIS bays.

Safe station operation is ensured through following base functions.

Functions
- Feeder and station interlocking, depending on the position of all high-voltage apparatuses with their blocking functionality
- Blocking of commands when crank handle of disconnectors or earthing switches is introduced.
- Extensive supervision through “Anti-pumping”, operation counter for circuit-breaker including pump-motor supervision
- Gas density and position supervision of circuit-breaker.
- Supervision of pole discrepancy for circuit-breaker.

The local control cubicle is fitted with pre-wired interface terminal blocks for the connection to feeder and station protection. This interface includes all needed measuring values of the feeder as well as protection trip 1, trip 2 and signals from the auto-reclose system. Additional pre-wired terminal groups are provided for the connection to remote control systems and remote alarm systems. On customer’s request additional functions (optional) can be provided. Standardised plug connections instead of terminal connections are available.

The Bay Control Mimic BCM is the main component of the control cubicle.

Features
- Representation of the single-line diagram/gas schematic diagram including position indication of all primary apparatuses such as circuit-breaker, disconnectors and earthing switches with reliable LED’s
- Up to 8 high-voltage switching devices can be monitored and controlled with an easy-to-use two hand push-button system based on the “select before operate” principle
- Optional light guided operation to support the operator
- Digital display of measuring values as current, voltage, active and reactive power
- Integrated local/remote key switch
- Alarm unit for 16 feeder alarms e.g. gas alarm, DC and AC supervision
Local control cubicles
The GIS from ABB
Uniquely variable, invariably unique

Innovative technology, intelligence and flexibility, combined with the very highest quality: these are the outstanding features of the successful ELK-14 range. It meets all the latest international standards and will more than satisfy your expectations. Constructive and creative, economical and ecologically safe. As it is well thought-out as it is mature, it can be used for virtually any application.
Double busbar bay with cable connections

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

GIS ELK-14 double busbar bay

- Circuit-breakers
- Disconnector 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 300</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</td>
<td>1050 kV</td>
</tr>
<tr>
<td>Lightning impulse withstand voltage across open contacts</td>
<td>1050 + 245 kV</td>
</tr>
<tr>
<td>Switching impulse withstand voltage</td>
<td>850 kV</td>
</tr>
<tr>
<td>Switching impulse withstand voltage across open contacts</td>
<td>850 + 245 kV</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Rated continuous current</td>
<td>4000 A</td>
</tr>
<tr>
<td>Rated short-time withstand current</td>
<td>50/63 kA</td>
</tr>
<tr>
<td>Rated withstand impulse current</td>
<td>125/170 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>1.3/1.5</td>
</tr>
<tr>
<td>Rated breaking current, 50/60 Hz</td>
<td>50/63 kA</td>
</tr>
<tr>
<td>Rated making current, peak value</td>
<td>135/170 kA</td>
</tr>
<tr>
<td>Drive type</td>
<td>Hydromechanical spring</td>
</tr>
<tr>
<td>Rated opening time</td>
<td>&lt; 20 ms</td>
</tr>
<tr>
<td>Rated breaking time</td>
<td>&lt; 40 ms</td>
</tr>
<tr>
<td>Rated closing time</td>
<td>&lt; 55 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>
</tbody>
</table>

### Disconnector & earthing switch

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitive current switching capability</td>
<td>250 mA</td>
</tr>
<tr>
<td>Bus transfer current switching capability</td>
<td>1600/20 A/V</td>
</tr>
<tr>
<td>Opening/closing time</td>
<td>&lt; 3 s</td>
</tr>
</tbody>
</table>

### Fast-acting earthing switch

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making capacity</td>
<td>50/63 kA</td>
</tr>
<tr>
<td>Inductive currents</td>
<td>15 kV</td>
</tr>
<tr>
<td>- Current</td>
<td>160 A</td>
</tr>
<tr>
<td>Capacitive currents</td>
<td>15 kV</td>
</tr>
<tr>
<td>- Voltage</td>
<td>10 A</td>
</tr>
<tr>
<td>Motor running time</td>
<td>&lt; 6 s</td>
</tr>
</tbody>
</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>
ABB’s ELK solutions offer
Improved performance, more practically - at a fraction of cost

Switching systems require an exceptionally high degree of safety

Indoor switching systems are designed to minimize space to claim

Protected installations especially when exposed to particular dirty, polluted or corrosive environments (e.g. coastline locations, deserts or industrial zones)

Extension of conventional outdoor substations with limited space
In underground switching systems for hydro-electric and pump-storage power stations

Upgrading the voltage level of existing conventional substations without the need for more space

Hybrid solutions combining dead tank and live tank components to reduce dimensions