

Product brochure

# Gas-insulated Switchgear ELK-14

## The modular system for GIS, 245 kV

# ABB switchgear systems offer maximum flexibility than we draw on experience to meet the needs of tomorrow

ABB's SF<sub>6</sub> gas-insulated switchgear technology has been proving its worth, day in, day out, for years. In applications all over the world. It owes its leading international position to a string of significant advantages. And the fact that it's economical and has 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. Which simplifies operations and cuts costs from the moment you start using it. 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 when you need to. Simply and efficiently. We call it systematised flexibility.

Ideally suited for voltages up to 253 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 disconnect/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.

## **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.

## **Longevity**

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

## **Economy**

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

## **Efficiency**

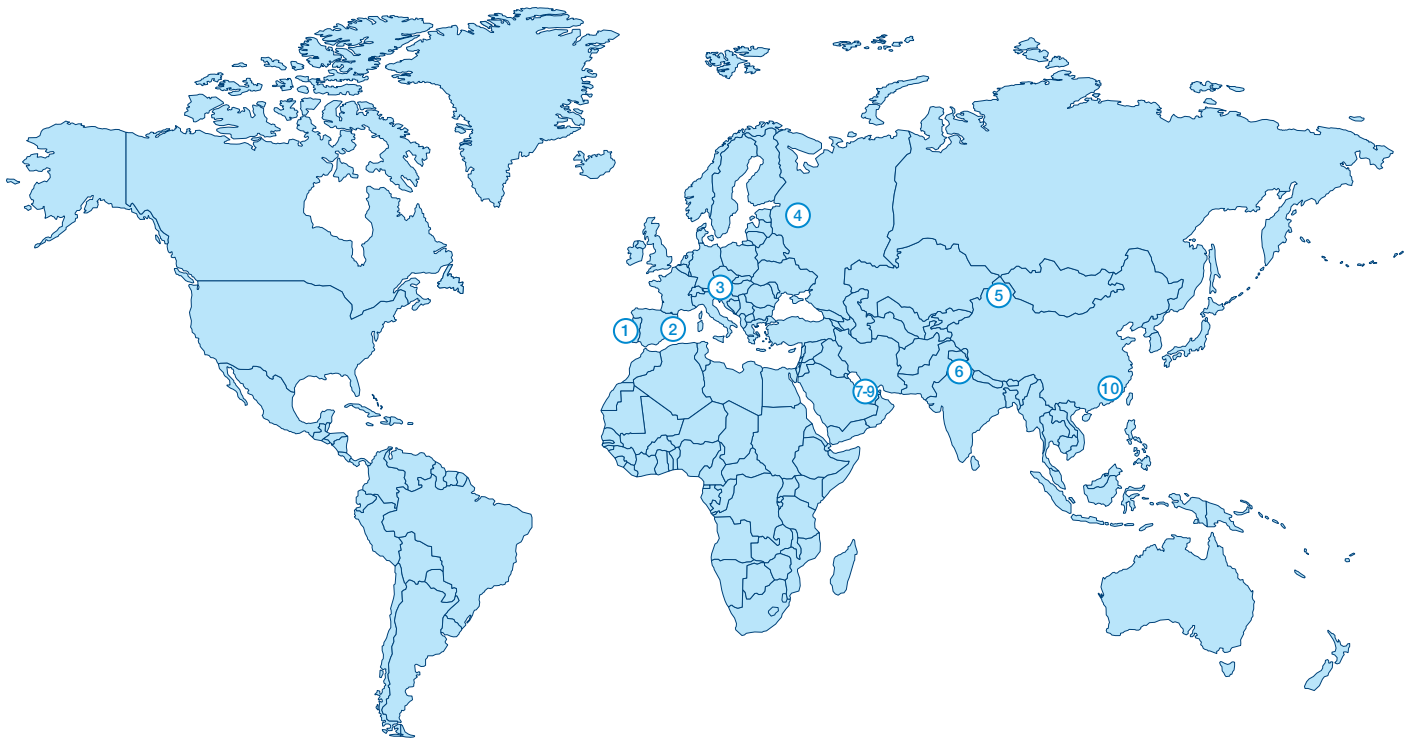
Prefabrication of subassemblies and stringent quality control at our own factory simplify final installation and commissioning.

## **Environmentally friendly**

Significant reduction in number of flanges and seals, as well as a small compact design.

# World-wide success

## ELK-14



### ① Sacavem

220 kV GIS  
5 + 2 bays

### ② Cas Tresorer

220 kV GIS  
12 bays

### ③ Kops II

220 kV GIS  
6 bays

### ④ Moscow

220 kV GIS  
15 projects  
100 bays

### ⑤ Urumchi

245 kV GIS  
5 bays

### ⑥ Maharani Bagh

220 kV GIS  
13 bays

### ⑦ Sitra

220 kV GIS  
7 bays

### ⑧ Financial Harbour

220 kV GIS  
7 bays

### ⑨ Buquwwah

220 kV GIS  
7 bays

### ⑩ Fujian

245 kV GIS  
7 bays

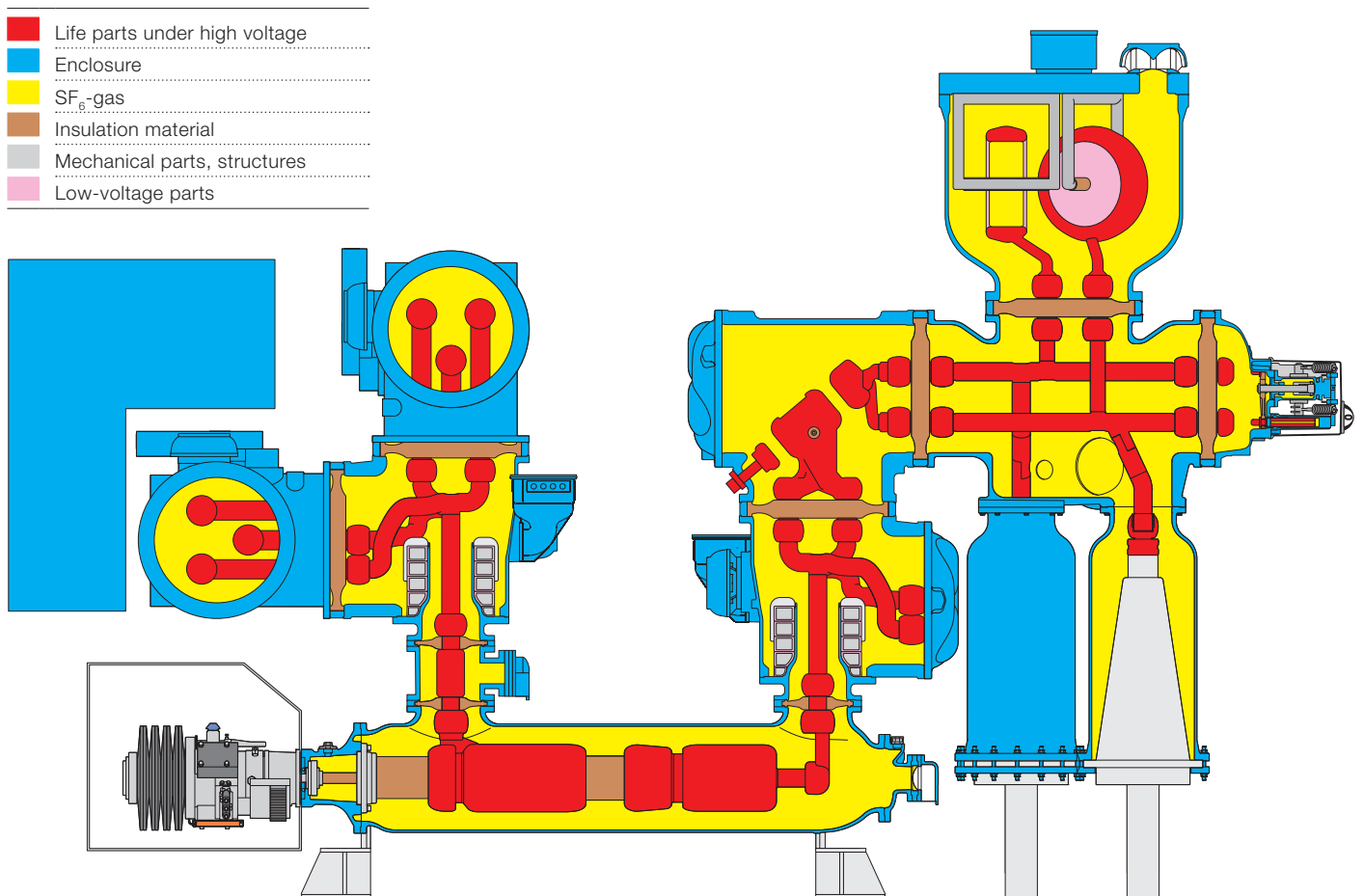
# Continuous improvements from the early stage till now

## ELK-14

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 800 kV and 80 kA by using different number of breaks. By 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 newest perceptions in GIS technology and service experiences. Together adaptations of the product to the increasing demands of latest IEC standards, the most compact GIS with horizontal arrangement of the well-proven puffer circuit-breaker could be created for voltage range up to 245 kV and short-circuit ratings up to 50 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 further improvement with regard to compactness was realized with the ELK-14 for 245 kV. This product combines very compact functionality from 3-phase technology with established 1-phase technology (especially the circuit-breaker as core of the GIS). This mixture of 1-phase and 3-phase technology enables the ELK-14 to guarantee highest reliability together with highest compactness. An additional advantage is the fact, that the bay is completely factory tested and shipped per bay. The customer benefits from risk minimization during erection.





ELK-14 double busbar switchgear



# The ELK-14 switchgear system from ABB

## clear-cut advantages and outstanding qualities

### The concept

Improved performance with fast erection in less space. For main circuits and control & protection. That's what makes ABB's ELK-14 technology so revolutionary. And because it needs up to 40% less space and 60% less installation time. These drastically cuts your construction costs, your project load time and saves you operating costs at the same time. Reduced flange connections and the total numbers of flanges in combination with the reduction of total gas volume is a further improvement towards environmental friendliness.

### The approach

Fewer components. Complete bay assembly in the factory. Greater efficiency. Plus another major benefit of the new 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's modular, it can be extended or adapted at any time to meet your present and future requirements.

### 1 High-performance circuit-breakers

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

### 2 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.

### 3 Reliable current and voltage transformers

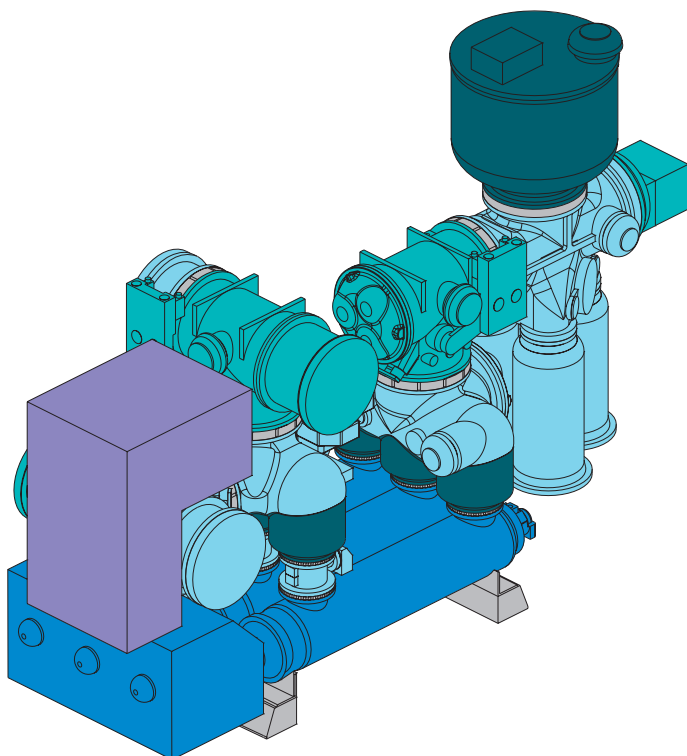
ABB's GIS range also includes current and voltage transformers which are as efficient as they are economical, and leave nothing to be desired in terms of service life.

### 4 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.

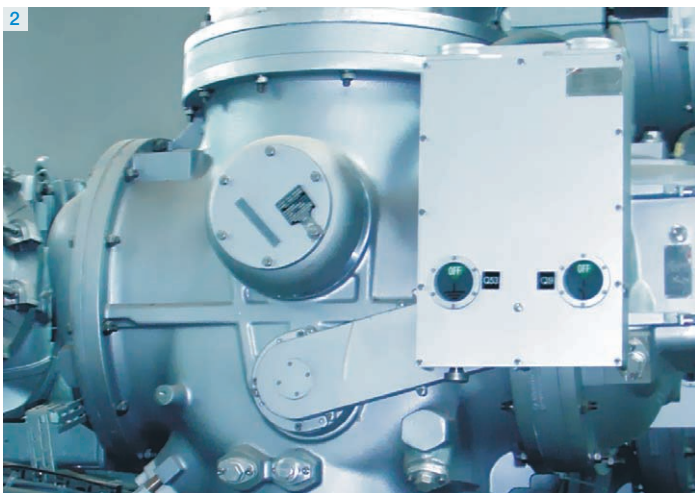
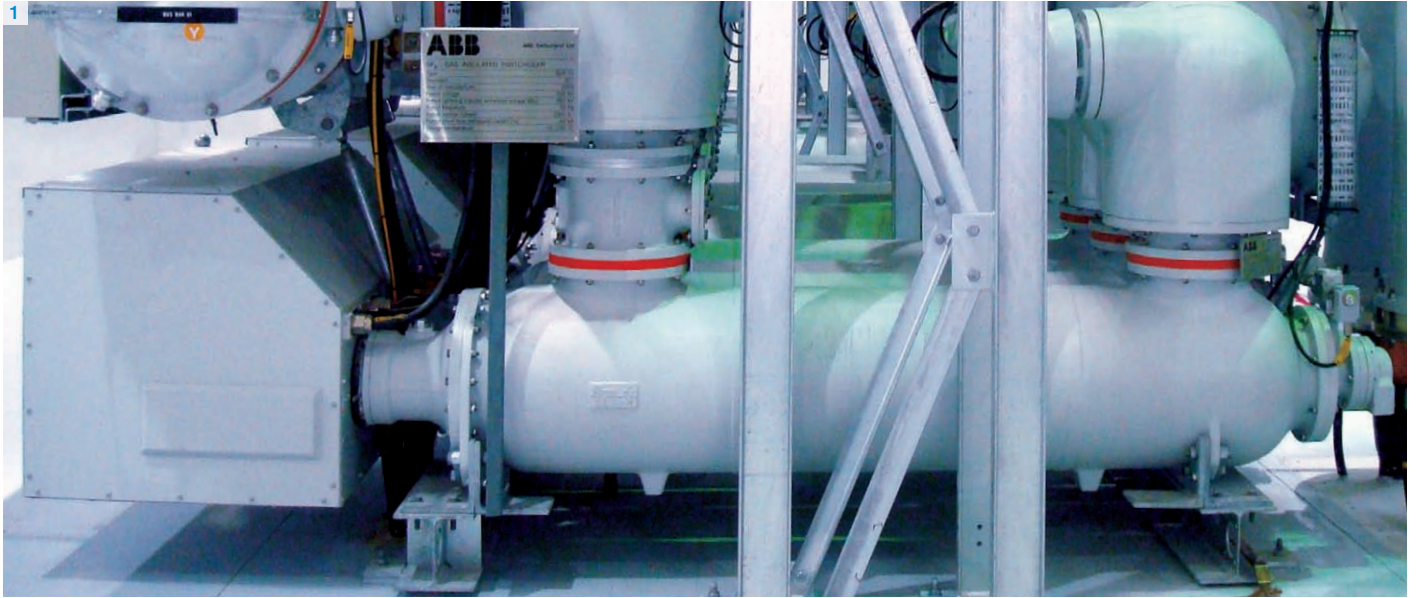
### 5 Innovative control & protection technology

Finally, ABB's forward-looking control & protection technology is fully integrated and completely open. Which makes it more adaptable and simplifies operation.



#### Modules

	Circuit-breakers
	Disconnectors and earthing switches
	Voltage and current transformers
	Connecting elements
	Control & protection



# ABB high-voltage circuit-breaker for solid, improved performance and less maintenance

## The circuit-breaker

Over the years, the circuit-breaker using SF<sub>6</sub>-gas for insulation and 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.

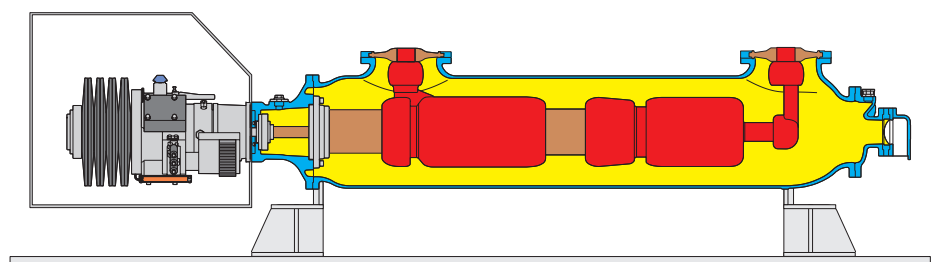
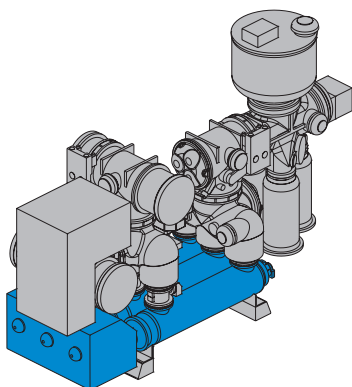
## Feature

- 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 hydraulic spring operating mechanism
- Continuous self-supervision of hydraulic system
- No external hydraulic piping
- 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 well proven puffer principle. During an interruption, a compression piston in the chamber generates the SF<sub>6</sub>-gas pressure required to extinguish the arc between the contacts.



Circuit-breaker with operating mechanism





Circuit-breaker with operating mechanism

### Circuit-breaker operating mechanism

Each pole of the circuit-breaker is equipped with the hydraulic spring operating mechanism. The compact, modular design of the circuit-breaker operating mechanism, consisting of

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

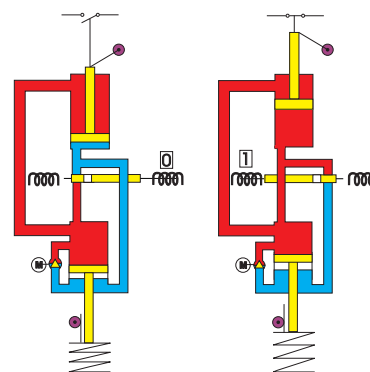
It guarantees easy access to all components inside the drive for overhaul and repair. Sealing of the pressure operated hydraulic circuit against the atmosphere is achieved entirely by highly reliable static seals.

### 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 moves then 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 it's closed position due to the differential pressure principle.



Schematic diagram (working principle)

- High pressure
- Low pressure

# 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 is based on 3-phase technology and combines two functions – a disconnector and a maintenance earthing switch – in one common 3-phase enclosure, sharing one common operating mechanism. Due to the modular design of the disconnector/earthing switch, every kind of variant can be realized in a compact design.

The disconnector/earthing switch is part of the busbar module. This busbar module is usually equipped with an expansion element, which guarantees flexible and elastic coupling of every kind of bay type.

The operating mechanism is of modular design, which enables highest service friendliness and rapid replacement of complete drive modules. In addition, the complete busbar module can be replaced in one step ensuring minimized time for repair.

## Feature

- Reliable SF<sub>6</sub>-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 SF<sub>6</sub>-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

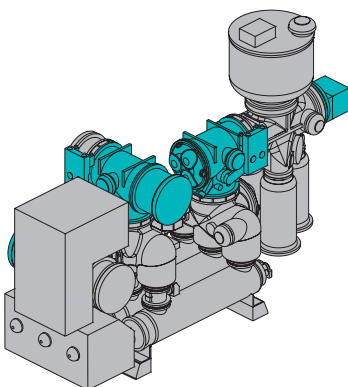
The fast-acting earthing switch is used to earth insulated sections of the installation to protect personnel during overhaul and assembly work. But it is also employed for earthing capacitance (cables, transmission lines, etc.). The earthing switch can be mounted at any position and to any module by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

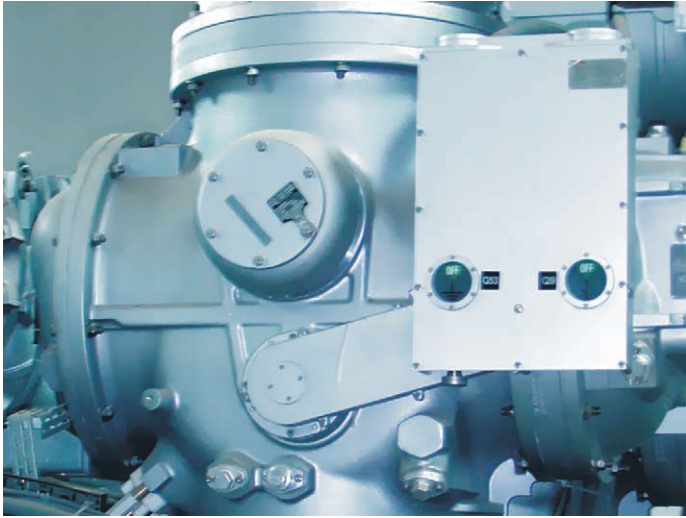
The controlled “Open”-operation results from a slow linear contact motion directly driven by an electric motor. The fast-acting earthing switch is based on 3-phase technology in one common enclosure, sharing one common operating mechanism. The operating mechanism is from compact design, which enables high service friendliness and rapid replacement of the drive unit without opening the gas compartment.

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

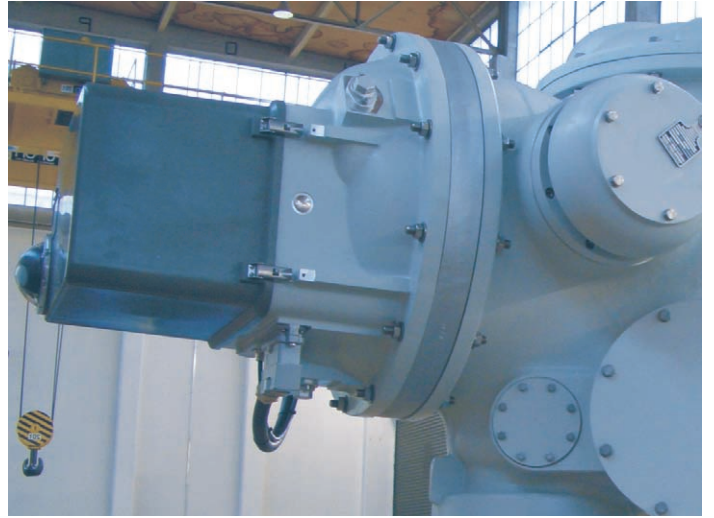
## Feature

- 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 SF<sub>6</sub>-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

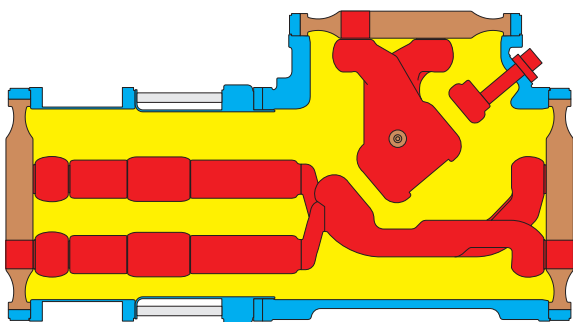




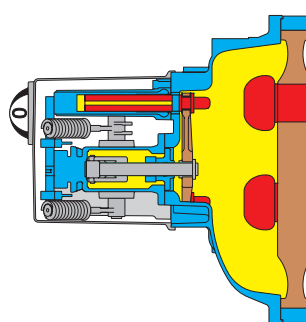
Disconnector/earthing switch



Fast-acting earthing switch



Disconnector/earthing switch



Fast-acting earthing switch

# ABB voltage and current transformers offer maximum safety, longevity, practicality and total reliability

## The voltage transformer

Used for system protection or revenue metering, ABB's powerful transformers give 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 3-pole inductive voltage transformers are connected to the switchgear with a standardised connecting flange and a barrier insulator. The primary winding is wound on top of the core. The secondary windings are connected to the terminals in the external terminal box through a gas-tight multiple bushing.

### Feature

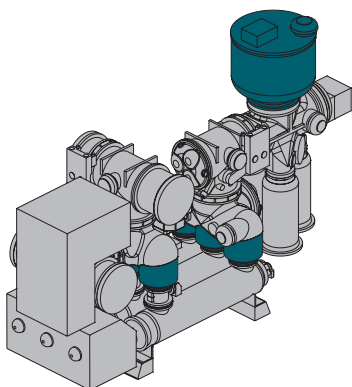
- Utilisation of SF<sub>6</sub>-gas as insulating medium, together with plastic foil in the windings
- High secondary output and accuracy
- Ratio and number of secondary windings according to actual GIS plant requirements
- Effective damping of very fast transients, transmitted to the secondary side
- Rectangular type core of low loss magnetic sheets
- No ferroresonance possible in absence of circuit-breaker grading capacitors
- 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 current transformer are placed in a common enclosure, which represents the interface module between 1-phase and 3-phase design.

### Feature

- Simple ring-core type windings integrated in the main current path
- SF<sub>6</sub>-gas as main insulation according to ABB's well-proved-GIS technique
- Secondary windings on split ring-cores, located inside of the SF<sub>6</sub>-gas compartment and mechanically protected
- The ring cores are integral parts of the split-up module
- Efficient damping of the very fast transients transmitted to the secondary side
- Any accuracy class defined by international standards is possible
- Maintenance-free



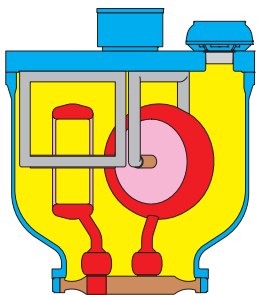




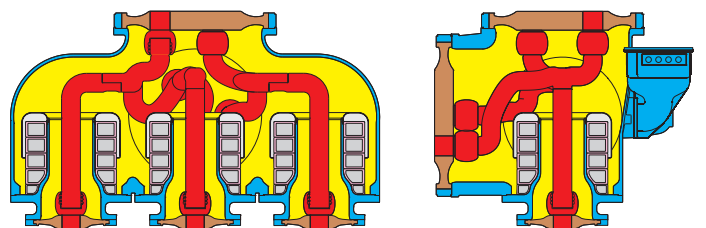
Voltage transformer



Current transformer in split-up module



Voltage transformer



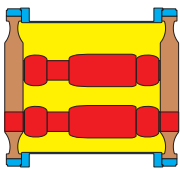
Current transformer in split-up module

# ABB ELK-14 a system with unique adaptability that goes for the connecting elements, too

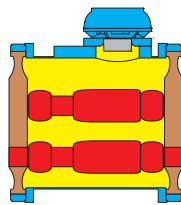
## The connecting elements

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

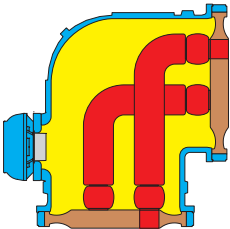
The ELK-14 provides an universal expansion element, which allows heat expansion, vibrations during operation and prevents from being sensitive against tolerances in the length of different connections. Especially during erection, the expansion element ensures an easy and flexible coupling of two neighboured bays. The expansion element can be applied to nearly all modules and provides proper dismantling of modules.



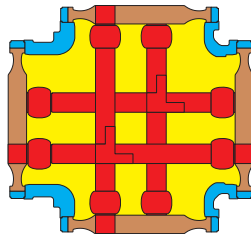
straight



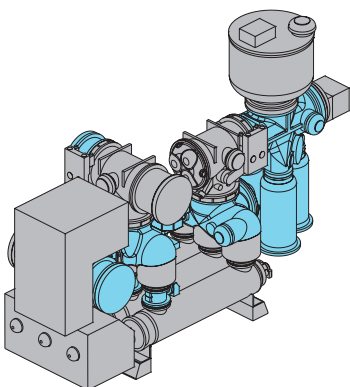
straight with flange



L-element



cross-shaped



## The terminal connections

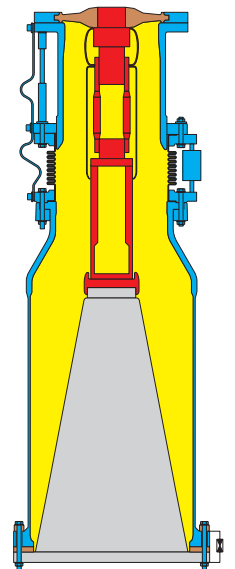
As might be expected, ABB's GIS range includes the connecting elements for peripherals such as the SF<sub>6</sub>-air bushings, the enclosures for the cable terminations and the enclosures for the transformer terminals.

## 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 SF<sub>6</sub> switchgear and the transformer
- Isolation of the SF<sub>6</sub> switchgear from the transformer for testing possible
- Interface according IEC 61639
- Maintenance-free



Transformer connection



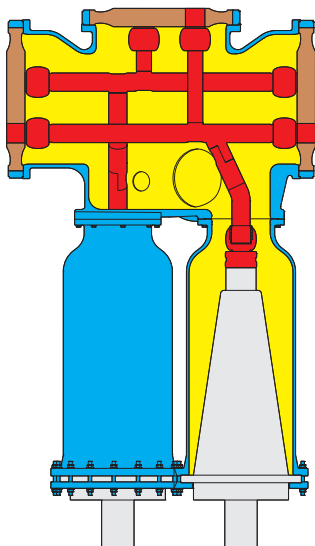
Cable connection

### The cable termination

Cable connections are available for fluid-filled or dry type cone insulators, which are part of the cable manufacturer's scope of supply.

### Feature

- Interface according IEC 62271-209 for fluid-filled or dry type cable-terminations
- Compact, simple design
- All fitting positions possible
- The GIS and the high-voltage cable can be galvanically separated and the high-voltage tests be carried out independently
- Relatively small size of the sealing ends, the advantages of XLPE cable can be fully exploited
- Maintenance-free



Cable connection



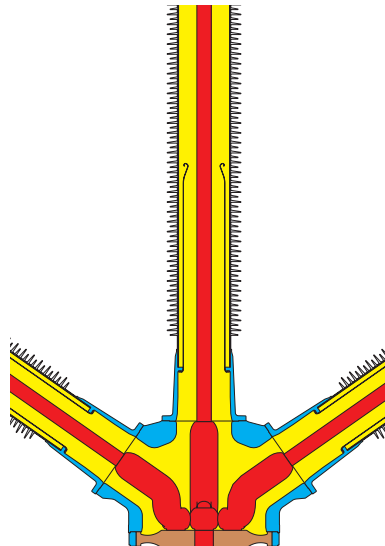
SF<sub>6</sub>-air bushing

### The SF<sub>6</sub>-air bushing

The SF<sub>6</sub>-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 SF<sub>6</sub>-gas insulation
- Explosion and vandal-proof
- Resistivity against sandstorms
- All fitting positions possible
- Low weight
- Maintenance-free



SF<sub>6</sub>-air bushing

# 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

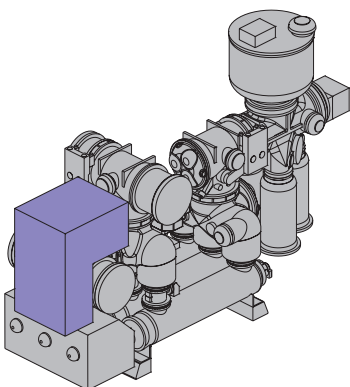
- Feeder and station interlocking, depending on the position of all high-voltage apparatuses with their blocking functionality
- Blocking of commands when crank handle of disconnectors or earthing switches is introduced.
- Extensive circuit-breaker supervision through "Anti-pumping", pump and hydraulic system supervision, operation counter for circuit-breaker and pumps.
- 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

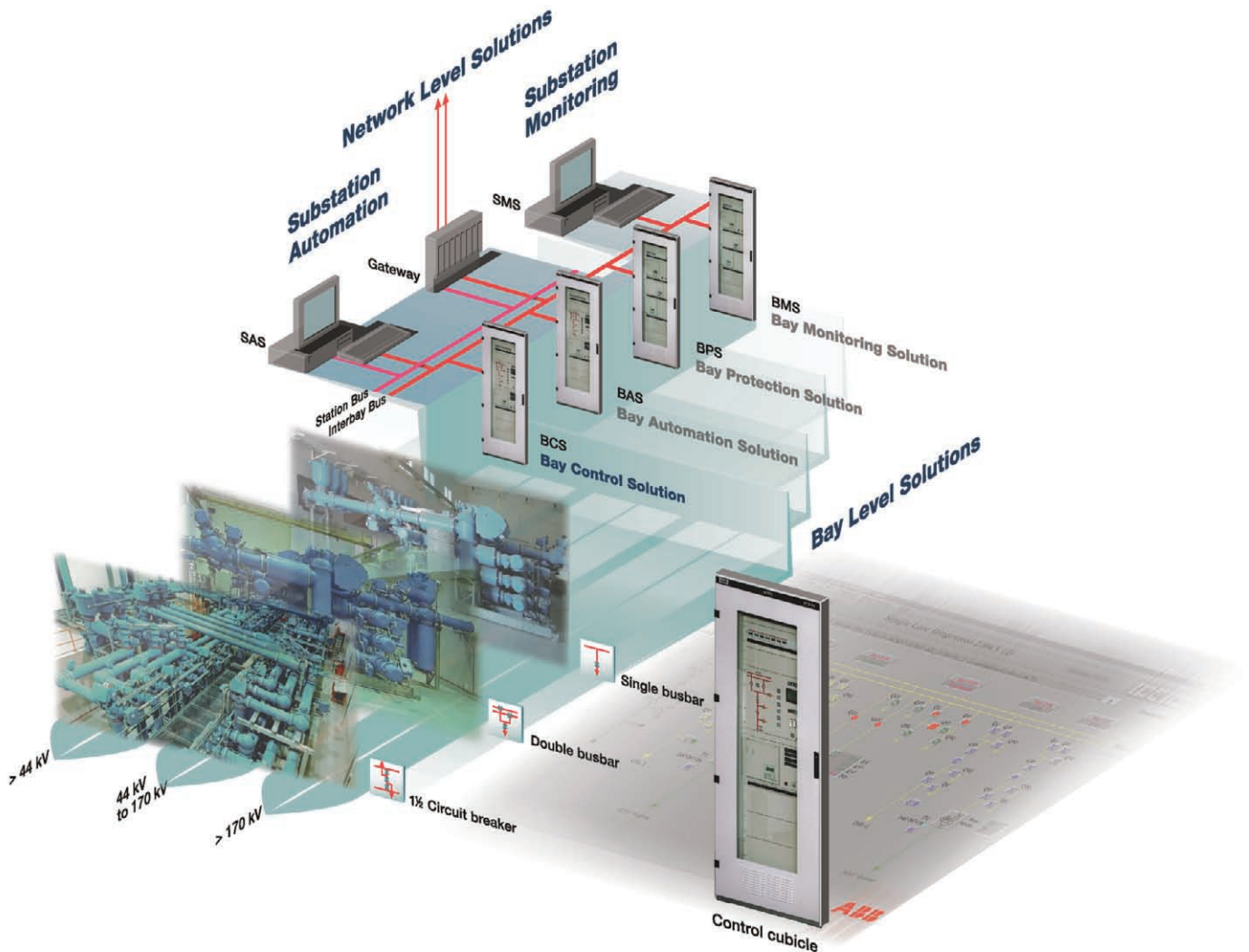
- Representation of the single-line diagram/gas schematic diagram including position indication of all primary apparatuses such as circuit-breaker, disconnectors and earthing switches with reliable LED's
- Up to 8 high-voltage switching devices can be monitored and controlled with an easy-to-use two 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







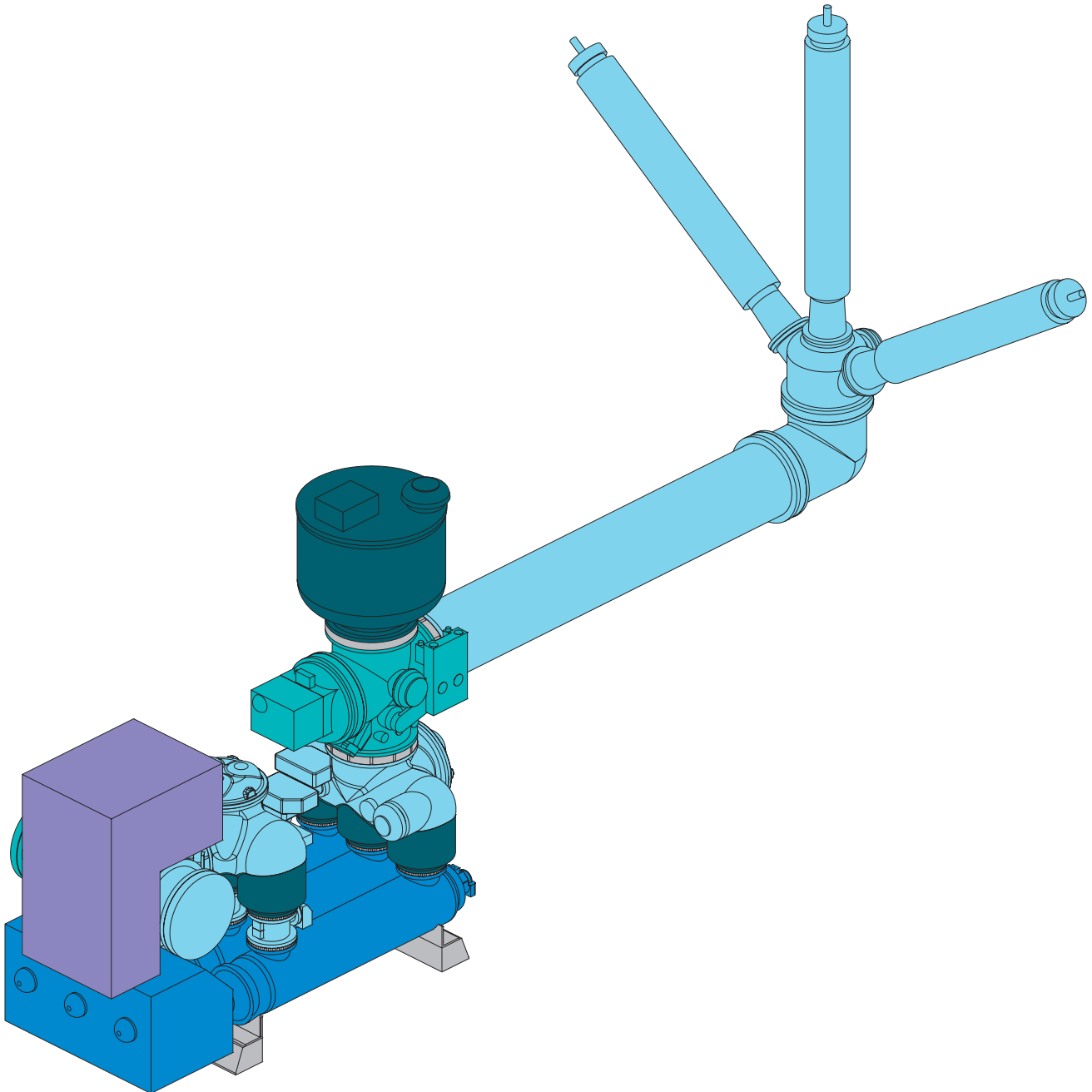
Local control cubicle



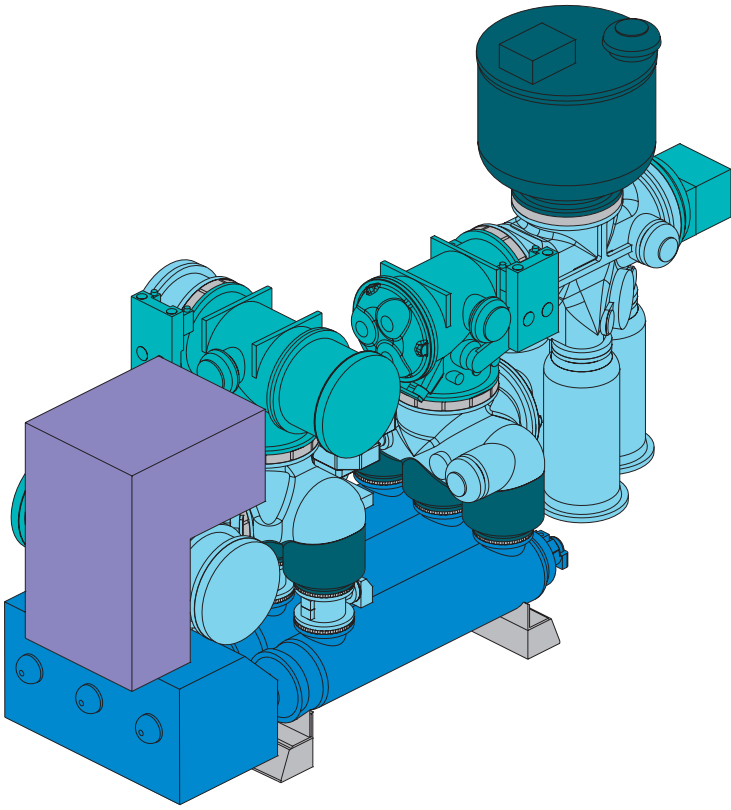
# The GIS from ABB

uniquely variable, invariably unique

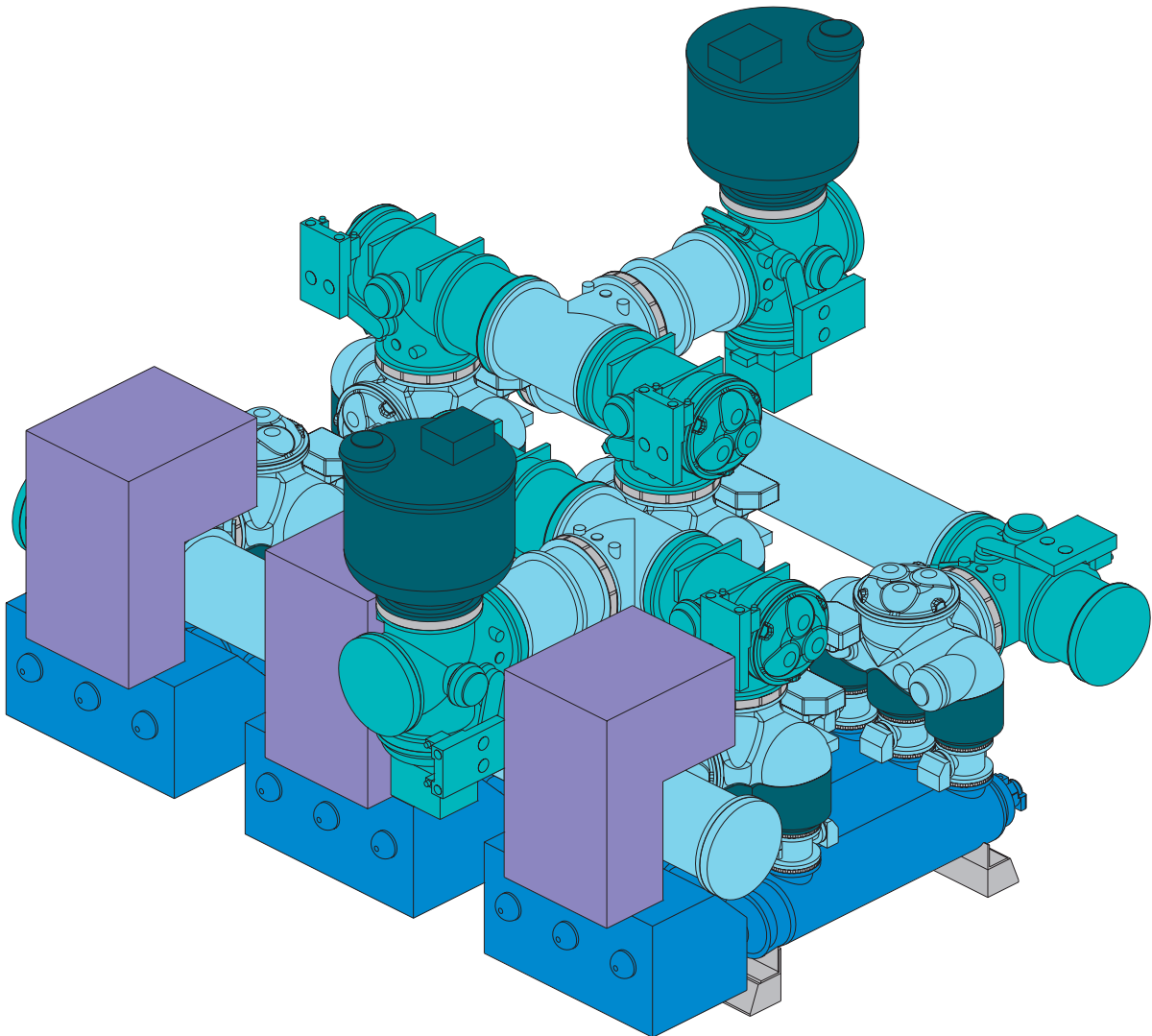
Innovative technology, intelligence and flexibility, combined with the very highest quality: these are the outstanding features of the successful ELK-14 range. It satisfies all the latest international standards and will more than satisfy your expectations. Constructive and creative, economical and ecologically sound. Because it's as well thought-out as it's mature. And can be used for virtually any application.



Single busbar bay with SF<sub>6</sub>-air bushings



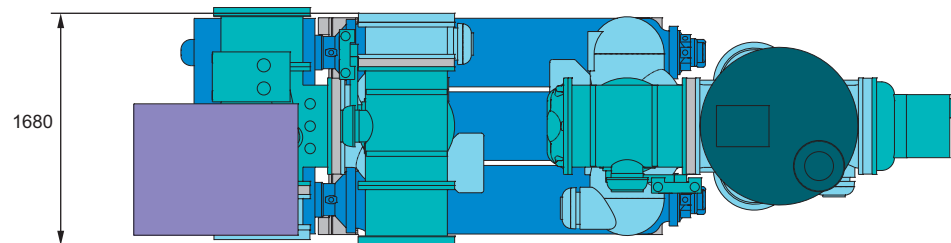
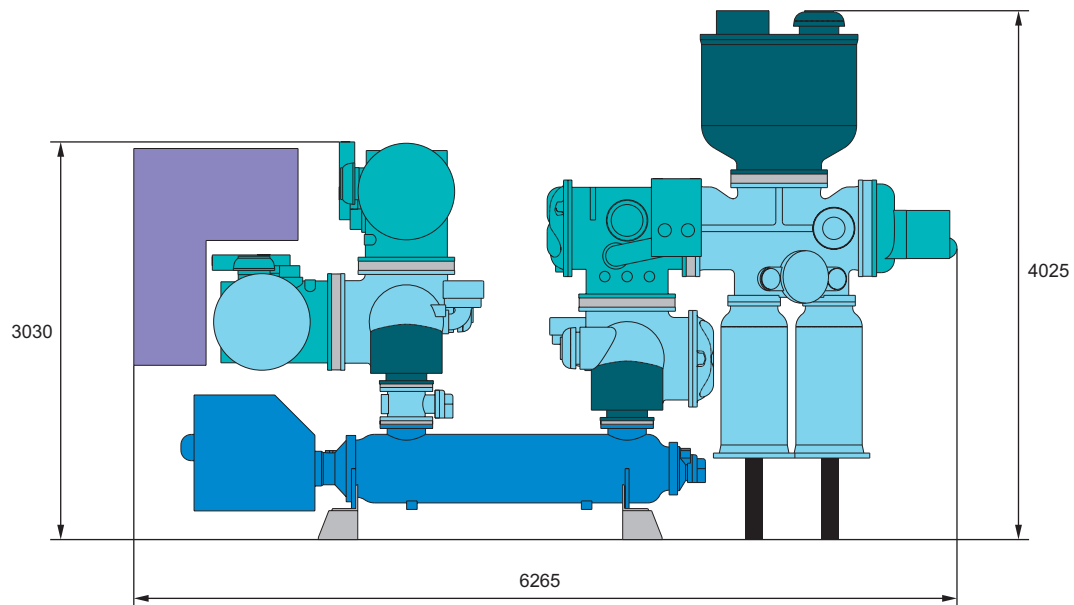
Double busbar bay with cable connections








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

Rated voltage	kV	up to 253
Power-frequency withstand voltage, 1 min.	kV	460
Power-frequency withstand voltage, 1 min. across open contacts	kV	530
Lightning impulse withstand voltage	kV	1050
Lightning impulse withstand voltage across open contacts	kV	1200
Rated frequency	Hz	50/60
Rated continuous current	A	3150
Rated short-time withstand current	kA	50
Rated withstand impulse current	kA	135

### Circuit-breaker

First pole-to-clear factor		1.3/1.5
Rated breaking current, 50/60 Hz	kA	50
Rated making current, peak value	kA	135
Drive type		hydraulic spring
Rated opening time	ms	19 (+0/-5)
Rated breaking time	ms	39
Rated closing time	ms	60 (+0/-10)
Reclosing time	ms	≤ 300
Rated operating sequence		O - 0.3s - CO - 1min or CO - 15s - CO
High-speed auto-reclosing		single- and three- phase

### Disconnecter & earthing switch

Capacitive current switching capability	mA	250
Bus transfer current switching capability	A/V	1600/20
Opening/closing time	s	2±0.5

### Fast-acting earthing switch

Switching performance		
Making capacity		
- Current	kA	50
Inductive currents		
- Voltage	kV	2
- Current	A	80
Capacitive currents		
- Voltage	kV	12
- Current	A	3
Motor running time	s	< 2

### Voltage transformer

Rated output (total)	VA	100
Rated accuracy class	%	0.2
Rated thermal power (total)	VA	1000
Rated voltage factor		1.9/8 h
Number of secondary windings		1 or 2

### Current transformer

Cores for metering		
Cores for protection (transient performance optional)		

### SF<sub>6</sub>-air bushing

Continuous bending load	N	2500
Test bending load	N	5000
Creepage distance	mm/kV	20, 25, 31

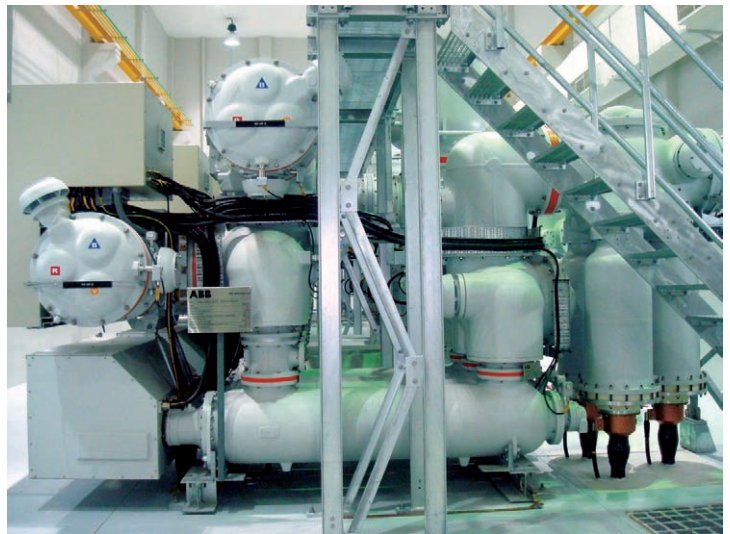
# ABB's ELK solutions offer improved performance, more practically - at a fraction of cost

Switching systems requiring an exceptionally high degree of safety

Indoor switching systems designed to take up a minimum of space

Protected installations 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



# Contact us

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