ABB Service High Voltage Products

Gas-insulated switchgear (GIS) type EBK-0, ELK-01/-02
Retrofit circuit breaker with operating mechanism

A new level of performance retrofit means upgrading an existing system with modern components, in order to optimize technical, safety relevant, economic, and ecological factors. The ABB retrofit solution covers exchange of the components which have been subject to the most wear during the many years in operation. One of the core switchgear components is the circuit breaker.

**Customer benefit**
Consequently, a retrofit circuit breaker solution is a cost efficient method to upgrade and extend the life of switchgear. The result is a major improvement in reliability, safety, maintenance reduction, and performance - an outstanding way to optimize the return on investment.

- Reliability
  - Significant life time extension
  - Lower maintenance requirements
  - Long term availability of spare parts
  - Short lead time of spare parts

- Safety
  - Fault risk reduction
  - Additional embedded safety features
  - Improved operator protection

- Technology
  - Latest circuit-breaker generation
  - Upgrading of technical ratings
  - Type-tested according to latest IEC & ANSI standards

- Project execution
  - Short implementation time for replacement
  - Minimum outage time
  - Smooth site activity

- Investment
  - Fixed capital investment
  - Minimization of further maintenance costs
  - Warranty for retrofit components

**Main product features**
- The possibility to equip the circuit breaker gas compartments with bursting discs and dry filters
- The formerly used „separate gas supply“ is dropped (compressor, interconnected gas tubes, pressure witch)
- The pressure built up for the arc extinguishing is remarkably reduced
- The gas pressure supervision is simplified
- The permissible number of operations without maintenance could be increased clearly
- Reliable and immediate spare parts supply
- Increase of the mechanical strength from
  - 2,000 to 5,000 CO-operations

**Design and performance**
The performance of the circuit breaker will be remarkably increased by interchanging of the existing complete circuit breaker with one component of the latest GIS circuit breaker design. The combination of a hydraulic operating mechanism with new circuit breaker will increase the value of the switchgear and lead to today’s state-of-the-art technology.
The development, engineering and production of the new circuit breaker retrofit are based on the long experience of ABB in the field of gas insulated switchgears (GIS). The SF₆ breaker is completely pre-assembled as well as finally tested and ready for ex works shipment.

Advantages
The SF₆ technology and the combination of auto-puffer breakers with hydraulic operating mechanisms offer many technical and commercial advantages which altogether lead to a remarkable reduction of the life cycle costs of the switchgear plant:

Distinctive advantages are
• Short assembly times
• Maintenance free
• Low weight
• High operational safety
• High reliability
• Compressor loose gas system
• Existing infrastructure remains unchanged

Technical description
Circuit breaker
The metal encapsulated circuit breaker retrofit complies with all currently accepted IEC regulations and is correspondingly type-tested. It is equipped with a preassembled hydraulic spring operating mechanism (HMB-1), which renounces of an external hydraulic system.

The circuit breaker requires less maintenance actions and operates on the single pressure type with auto puffer principle. The interrupting chamber used in this breaker originates from the conventional outdoor type, which was tested under extremely severe conditions. It features consistent separation between the continuous-current contacts for extinguishing the arc. A blowing piston connected to the contact nozzle generates the SF₆ gas flow necessary for the arc extinguishing during the interruption at nominal currents.

In contrast to conventional blast-piston breakers, the auto-puffer breaker is equipped with a two-stage blast volume. The partial volumes are separated by a freely moving non-return valve from each other. Because of this, the required operating mechanism energy for the breaker can be drastically reduced. Furthermore, a „soft“ switching procedure is achieved, i.e. the arc will not be abruptly extinguished so that it is torn off. Due to this, new ignitions will be effectively suppressed.

The majority of breaking operations are operational ones, i.e. most switching operations are performed with the lower stress from compression volume. The reaction forces and wear-and-tear are correspondingly slight. Because of this, the reliability and availability of the circuit breaker is increased. The breaking time from energizing of the opening release until the final arc extinguishing is less than 50 ms at nominal voltage for a 50 Hz network.

Operating Mechanism
The new circuit breaker is equipped with the hydraulic operating mechanism HMB-1, which reconciles the advantages of the hydraulic operating mechanisms with those of mechanical spring energy storage:
- The formerly usual N₂ storage is replaced by a maintenance free spring energy storage
- Hydraulic oil instead of worn out mechanic
- Wear free recession of the switching movement in the hydraulic system
- No leakages and corrosion due to sealed hydraulic systems, i.e. no external connection tubes are required

Gas system
- Sealing System
The sealing system at circuit breaker retrofit is equivalent to the approved sealing system for the individual flange joints at ABB GIS series ELK-04. It is designed to reduce the leakage rate at normal services to an absolute minimum (pressure, temperature, load and fault). ABB guarantees an annual leakage rate of less than 1 % based on the high quality of our sealing system for each gas compartment.
Purity
The new circuit breaker is for use of SF₆ gas in accordance with IEC376 (new gas).

At rebuilding works and opening of gas compartments at the switchgear, the new required SF₆ gas is obtained from gas bottles. No more second-hand gas is used anymore.

Supervision
The gas density, which has to be supervised in the gas compartment, is continuously compared with the gas density of an identical gas reference volume. Since the gas in both volumes has the same temperature, the densities can be compared by a pressure comparison. The measured gas density is also indicated visually. The indicator has a simple color coding: Green = ok, Red = Gas density too low

If the gas density drops below a predefined value, the gas density relay generates alarm signals:
- Circuit breaker SF₆ pressure level 1: The normal operation is not yet restricted (refill with SF₆ gas).
- Circuit breaker OFF blocking SF₆ pressure stage 2: The circuit breaker cannot be operated anymore in order to avoid damages at the circuit breaker. Manually switch off in emergency mode.
- Note: Protection trips are no longer operational.

Gas treatment
Under normal operating conditions, the SF₆ gas filling of the switchgear does not have to be particularly reconditioned. We have nevertheless foreseen vacuum couplings for each gas compartment so that a refilling during service is also ensured.

Decompression
Every gas compartment is equipped with a nickel-plated bursting disc which shows better long time tightness compared to the old graphite discs. The bursting discs have a defined bursting pressure at 10 bar to prevent the aluminum housing by an excessive pressure rise in case of short current. A metal cover is appropriated above the bursting discs, which conducts the hot pressure and decomposition products from present persons in case of short current. The following advantages result from this design:
- higher safety for the operating personnel
- no uncontrolled ejection of gasses and decomposition products

Technical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>145 kV</td>
</tr>
<tr>
<td>Rated lightning impulse voltage 1.2/50</td>
<td>650 kV</td>
</tr>
<tr>
<td>Rated power frequency withstand voltage</td>
<td>275 kV</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Rated current</td>
<td>3150 ares</td>
</tr>
<tr>
<td>Rated breaking current</td>
<td>40 kA</td>
</tr>
<tr>
<td>Rated operating sequence</td>
<td>O 0.3 min - CO 3 min - CO</td>
</tr>
<tr>
<td>SF₆ filling pressure at 20° C</td>
<td>700 kPa</td>
</tr>
</tbody>
</table>