ABB is the world’s leading supplier of generator circuit breakers. A complete range of powerful, reliable and cost-saving maintenance services are offered on generator circuit breakers for all types of power plants. ABB High Current Systems Services continuously improves its assessment methods used to evaluate the condition of the circuit breaker. Dynamic Resistance Measurement (DRM) is an innovative part of the analysis inspection service, which allows checking of the breaker in a closed state, as outlined below.

ABB offers you an exciting measurement method to evaluate the condition of SF6 generator circuit breakers in order to save time and money. As an owner of an ABB generator circuit breaker, you already know that periodic maintenance and overhaul of the generator circuit breaker are essential to ensure the continuing safe operation of your circuit breaker and the assets that it protects. We now offer our customers Dynamic Resistance Measurement (DRM) as part of the analysis inspection service, which enables us to measure critical circuit breaker parameters without disassembling the interrupting chamber.

Background
Today’s SF6 circuit breakers are designed with an interrupting chamber that contains a nominal contact system and an arcing contact system. The nominal contact system carries the current when the generator circuit breaker is in its closed position (see figure 1). During an opening operation, the nominal contacts separate first. The current then commutates onto the arcing contacts, which separate a few milliseconds later (see figure 2). The arc, which is formed after the separation of the arcing contacts, is cleared at the next current zero-crossing. During each opening operation, depending on the rms-value of the switched current, a fraction of the arcing contact material burns away. This leads to a shorter time difference – between the separation of the nominal contacts and the separation of the arcing contacts – during the next switching operation. This time difference is called the contact overlap time. The circuit breaker requires overhaul when the contact overlap time has fallen below a defined minimum value. Any further operation may cause the interrupting chamber to explode.

Measuring principle
During an opening operation, abrupt resistance changes coincide with the separation of the nominal contacts and the separation of the arcing contacts. According to Ohm’s law, at a constant DC test current, these resistance changes result in sudden changes of the voltage drop measured across the interrupting chamber. The corresponding time difference (see figure 3) is measured as the contact overlap time.
Main benefits
- The remaining electrical lifetime of a generator circuit breaker can be measured with the Dynamic Resistance Measuring (DRM) method in an excellent way.
- DRM can be performed on a fully assembled interrupting chamber.
- It is a fast and cost-effective method to inspect the condition of the equipment.
- Periodic inspection enables a better scheduling of overhauls what leads to shorter downtimes and therefore lower breakdown costs.

Electrical lifetime calculations
Based on physical and theoretical models as well as experimental data, it is possible to calculate the effects of ablation on the arcing contact if all switching operations and their respective currents are known. The numbers vary from circuit breaker type to circuit breaker type; specific details can be found in the operation & maintenance manual of the circuit breaker, or the two-page ablation coefficient summary.

Analysis inspection service
The analysis inspection service includes the DRM, the analysis of the customer’s electrical lifetime calculation, and the inspection of the mechanical wear and contamination of the SF₆ generator circuit breaker. The DRM and the electrical lifetime calculation both give information about the electrical lifetime of the circuit breaker.
The analysis inspection service as maintenance concept helps to save on the cost of an extended downtime that is caused by the complete disassembly of the circuit breaker to visually assess the state of the arcing contact. As a result of the analysis inspection service, the customer knows the condition of the circuit breaker, as well as when to completely overhaul the SF₆ generator circuit breaker.

Summary
- Breaker operations cause ablation of arcing contact material.
- DRM determines the contact overlap.
- To ensure safe operation, the contact overlap time must not fall below a minimum value.
- DRM is part of the analysis inspection service.

Figure 3: Typical DRM graph