

**Year 2000**  
**Progress Report of Study Committee 13**  
**Switching Equipment**

by E. Kynast, Secretary of SC 13

**Field of activities**

Study Committee 13 is dealing with switching equipment in high voltage networks. The apparatus itself as well as its interactions with networks as complex systems and their components are considered.

The study of reliability of switchgear in service, in particular of high-voltage circuit-breakers is a basic task of the Study Committee combined with investigations concerning reduction of life-cycle costs, extension of life expectancy and increase of availability.

The future situation of energy transport and distribution will lead to an increased utilization of the equipment capabilities and therefore to higher equipment stresses. This means that a more detailed knowledge of stresses switching equipment might be exposed to in the future systems is required to propose adequate test procedures with the aim to improve equipment reliability.

New technologies and possible alternatives to presently used switching devices and their impact on transient behavior of network and other equipment are continuously observed.

Requirements for higher flexibility of system and equipment controls are given by trends in the energy market. The demand of advanced techniques for monitoring, diagnostic and application of controlled switching has been investigated. The future trends of application of digital control systems in substations as well as in switching equipment itself lead to an increased activity concerning the reliability of control systems and their possibilities of implementing advanced features.

**Activities and Cooperation with other bodies**

**Cooperation CIGRE SC 13/IEEE Switchgear Committee**

The cooperation with IEEE Switchgear Committee provides information on their recent activities. A reorganization of the Power Engineering Society (PES) was proposed to match the new Industry Structure. The proposal was made in the last IEEE High Voltage Circuit Breaker Subcommittee meeting to abandon ANSI-Standards and adopt IEC 60056 with in-country clauses. Agreement was made to consider the proposal with interested parties to make presentations at the next meeting.

A Joint Working Group CIGRE/IEEE with the subject of Seismic design of substations has been proposed by SC 23. The subject will be handled with the IEEE Substation Committee because of the amount of experience with seismic conditions in IEEE-dominated countries. A two year old standard, mainly developed by US west-coast utilities, can be base of the work.

## **Cooperation SC 13 1 IEC TC 17 and SC 17A**

The exchange of information between SC 13 and IEC TC 17/17A is practiced continuously due to some personal engagement in both committees. Beside the work in WG 13.11 the main items under discussion are:

- The draft of IEC 60056 has been distributed as Final Draft International Standard
- The revised IEC 60129 has been distributed as Committee Draft for Voting.
- The revision of IEC 60427 has been started.
- Revision of IEC 60694 will be a task for the near future.
- The cooperation between IEC and IEEE/ANSI is still going on and will lead to further harmonization concerning the high-voltage standards.

### **Activity of the Current Zero Club**

**Chairman: K. Möller (Germany)**

The Current Zero Club is a group of experts specialized on the field of current interruption. There is a continuous exchange of experience with Study Committee 13.

A meeting of the Vacuum Switch Circle took place in Ratingen, Germany May, 2000. Four groups of subjects have been discussed:

- Capacitive switching and late restrikes
- Current zero phenomena
- Current chopping and associated phenomena
- Low voltage applications

The group CFD (computational fluid dynamics) studies on SF6 circuit-breakers has been established aiming at the definition of standard interrupter geometries and standard boundary conditions based on available experimental material to be used in a benchmarking procedure for different modules of CFD tools. The co-operation of further experts in this field is welcome.

## **Activities of Working Groups**

### **Advisory Group on International Standardization**

**Convener: I. Bonfanti (Italy)**

To increase the speed of working progress it was decided to establish an Advisory Group, which will define the demand, specify the tasks and give them to small ad hoc Task Forces with adequate experts. The main object of the Advisory Group is to coordinate the activities of SC 13 required to support international switchgear standardization activities, especially IEC SC 17A in due time.

A first Task Force has already been established with the task "Determine TRV stresses applied to HVCB's during out of phase operations and develop proposals for type-testing".

### **WG 13.07: Controlled Switching**

**Convener: K. Fröhlich (Switzerland)**

The Working Group is covering the field of conditions for controlled switching for various possible applications, systems and circuit-breaker requirements as well as system and load response. The characteristics of the circuit-breakers has to be considered by these investigations.

In continuation to the document "Controlled Switching of HVAC Circuit Breakers - Guide for Application", published in Electra in 1999 the Working Group has finished the second chapter titled "Planning, Specification and Testing of controlled switching systems".

The intention of this chapter is to give guidance to users and manufacturers of controller-breaker systems how to proceed when implementing controlled switching. Also in examples guidance is given what kind of pre-studies should be carried out. These studies are the basis how to specify the controller-breaker system taking into account that controller and breaker may be from different manufacturers. Recommendations are given how to type test such a controller-breaker system. Questions of responsibility for the entire system are covered.

The future program of the Working Group will be the investigation of two subjects: Economics and enhancement of breaker performance by controlled switching and future switching cases like transformers.

**WG 13.08: Life management of circuit breakers**  
**Convener: A.L.J. Janssen (Netherlands)**

The WG completed its work by mid 2000. The results are presented in the CIGRE Technical Brochure No. 165 "Life management of circuit-breakers. A summary of the studies was presented in CIGRE Report 13-104 during the Session 2000 and in ELECTRA No. 191 (August 2000).

The Working Group has collected service experience and especially experience with life management techniques. The studies show that the number of short circuit faults is larger but the amplitudes of short circuit currents are smaller than expected. The environmental stresses are usually within the limits of the standardized "normal conditions", only some circuit breakers are subjected to heavier pollution or humidity conditions. Concerning the maintenance most utilities use the TBM (time based maintenance) with the trend going to CBM or RCM (condition based-, reliability centered- maintenance). Although the knowledge about aging and wear and the parameters to be observed is still incomplete and the criteria to be applied for diagnostics and monitoring are still limited the trend is going to increase the overhaul intervals. It must be resumed that there is no general answer how to handle life management of circuit breakers.

**WG 13.09: Monitoring and diagnostic techniques for switching equipment**  
**Convener: C. Jones (United Kingdom)**

The WG completed its work on monitoring and diagnostic techniques for switching equipment. The results as final report are presented in the CIGRE Technical Brochure No. 167 "User guide for the application of monitoring and diagnostic techniques for switching equipment for rated voltages of 72,5 kV and above". A summary of the studies has been published in ELECTRA No. 191 (August 2000).

Condition monitoring and diagnostic techniques are playing an increasingly important role in the design, life cycle cost evaluation, commissioning, operation, maintenance and end of life determination of substation equipment. Users need guidance on the applicability and implications of the various techniques and how their benefits can be evaluated. This report gives guidelines for the application of monitoring and diagnostic techniques to switching equipment based on the work of CIGRE WG 13.09 during the period 1996 to 1999. The report covers all switching technologies (oil, air blast and SF6) and also includes disconnectors and earthing switches as well as circuit breakers. The report covers equipment rated at 72.5 kV and above.

**WG 13.10: Specifications for short current limiters**  
**Convener: A. Greenwood (USA) / H. Schmitt (Germany)**

The upgrading of the load carrying capacity of medium and high voltage distribution systems leads to considerations to use short circuit current limiters. The Working Group is determining the degree of current limiting needed and the operational conditions for current limiters use.

The first report of the Working Group "Functional specifications for short circuit current limiters" has been finished for publication on the CIGRE web-sides. The summary for publication in ELECTRA has been prepared.

The report points out the critical features that must be addressed for special designs. To give a specific list of requirements is not possible at this time. A great variety of techniques are applied at present which are described in 26 applications, most of them industrial. The results of an inquiry among potential users of fault current limiters out of industry as well as utilities are incorporated.

The future program of work for WG 13.10 will be the exploration of the topics "State of the art", "Testing" and "System demands" related to fault current limiters.

**WG 13.11: Application Guide for IEC 60056 and 60694**  
**Convener: H.H. Schramm (Germany)**

To support users and to provide them with background information a guide will be worked out upon the requirements of the Standards IEC 60056 "High-voltage alternating-current circuit-breakers" and IEC 60694 "Common specifications for high-voltage switchgear and controlgear standards".

The Working Group has reviewed the topics to be included in the application guide and got a long list of detailed tasks in this field. The first chapters has been finished and distributed within SC 13 for comments. The draft contains the following chapters:

- Introduction
- Classification of circuit-breakers
- Short-line fault
- Terminal fault
- Short-circuit current and arcing time TRV

For the chapter "Classification of circuit breakers" the real-stress data collected from WG 13.08 has been considered as background information.

The next step of the Working Group will be the drafting of the chapters:

- Insulation coordination
- Capacitive current switching
- Rated (operating) frequency 50/60 Hz
- Continuous current and overload

The final guide has been suggested for publication as a double-logo brochure of CIGRE and IEC.

**WG 13.12: Circuit-breaker controls**

**Convener: P. Högg (Switzerland)**

The new Working Group 13.12, has been approved by the Technical Committee, and is under the convenership of P. Högg, Switzerland. The task of WG 13.12 is to investigate the recent developments in circuit-breaker control technology, as change from conventional to electronic control. The integration into substation control in respect on the requirements of circuit-breakers and systems and the future trends in this area will be lined out.

Background of the work for WG 13.12 is that circuit breaker controls have a major impact on the reliability of circuit breakers. In the 2nd International Enquiry on high voltage circuit breaker failures and defects in service control systems were identified as the cause of 24 % of all major failures. Circuit breaker controls have typically become more complicated in recent years and have many special requirements for each utility customer. Also in recent years circuit breaker control system functions have been expanding to include controlled switching, monitoring and diagnostics. The Working Group has been started meanwhile with the aim to present a final report in 2003.

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