



CIGRE STUDY COMMITTEE A3 “HIGH VOLTAGE EQUIPMENT”

Year 2003

Progress Report of Study Committee A3

by E. Kynast, Secretary of SC A3

Field of activities

Study Committee A3 is responsible for the theory, design, construction, and application of high voltage equipment components, equipment, and equipment systems for both AC and DC systems.

This equipment includes all devices for switching, interrupting, or limiting currents (circuit breakers, load switches, disconnect switches, earthing switches, fault current limiters, etc.) independent of technology according to the scope of the former SC 13.

Furthermore it includes surge arresters, capacitors, busbars and equipment insulators, instrument transformers, bushings, and all other high voltage equipment not specifically covered under another study committee's scope. Air and gas-insulated equipment, solid insulation used in high voltage equipment and equipment using other insulation systems and interrupting media will be covered. Emphasis is on function and interaction of high voltage equipment.

Since the reorganization of CIGRÉ in August 2002 this Committee is named Study Committee A3 “High Voltage Equipment”. The scope of the former Study Committee 13 “Switching Equipment” has been carried over and expanded to include all high voltage equipment.

The transition from SC 13 into A3 with the wider scope was successfully performed in the years 2002/2003. A broad expertise is available among the SC Members covering all the equipment which is within the responsibility of A3.

CIGRE SC A3 Colloquium and Tutorial – Sarajevo 2003

Following an invitation from CIGRE National Committee for Bosnia and Herzegovina the International Colloquium “Asset Management of Switching Equipment and New Trends in Switching Technologies” in Sarajevo has been organized by CIGRE Study Committee A3 in cooperation with CIGRE National Committee for Bosnia and Herzegovina on September 15 and 16, 2003.

Three Preferential Subjects have been chosen for the Colloquium. Twenty one papers have been submitted by authors from Australia, Brazil, France, Germany, Iran, Japan, The Netherlands, Pakistan, Switzerland, USA and Bosnia and Herzegovina. The Colloquium was very well attended by 83 participants and invited guests from 15 countries. The Preferential Subjects and the related papers are as follows: - Asset Management of switching equipment; - New trends in Switching Technologies; - Increased fault currents and Fault Current Limiters (FLC). For a general report see ELECTRA No. 211 – Dec. 2003.

Just after the Colloquium, during the following two days, CIGRE SC A3 has held its annual meeting. Using the opportunity to have so many scientists and professors in one place, CIGRE SC A3 in cooperation with Faculty of Electrical Engineering of the University of Sarajevo organised a parallel running Tutorial. It was an intensive two-day course which covered high voltage circuit breakers technology and switching techniques through carefully chosen lectures. Thirty two attendants have successfully completed the Tutorial. The Dean of the Faculty of Electrical Engineering Sarajevo, Prof. Dr Melita Ahic-Djokic awarded Certificates.

Structure and groups of SC A3

Study Committee A3 is representing 35 countries by regular and observer members.

In order to cope with the diversity of different topics SC A3 has to cover, Advisory Groups were installed. Advisory Group A3.01 “Strategic Planning” defines the goals, directions and strategy of the Study Committee in detail, figures out necessary fields of activity and supports establishing of new working groups.

AG A3.02 and AG A3.03 are responsible for coordination of the activities of SC A3 and the relevant IEC Technical Committees respectively IEEE standardization bodies.

Advisory Group A3.04 “Tutorials” will develop, manage and deliver tutorials within the scope of SC A3. This AG will also handle links with universities and the promotion of research topics to the universities. Tutorials can be held in conjunction with CIGRE events: Regional Meetings, National Committee Meetings, Colloquiums and Symposiums.

Concerning the technical work four working groups (WG A3.07, 10, 11 and 12) are focussed on switchgear only in continuation of SC 13.

Two working groups (WG A3.06 and 13) are dedicated to reliability and changing network conditions. Their scope has been adapted to the broader task of SC A3, so beside switchgear, other high voltage equipment will be considered.

Four new working groups, covering surge arrestors, non conventional instrument transformers, current limiters and grading capacitors were established in 2003. Kick-off meetings took place and working plans has been discussed in the WGs and the SC.

Activities of Working Groups

WG A3.06 : Reliability of HV equipment

Convener: C.E. Sölver (Sweden)

Background of the reliability study was the former studies published in 1981 and 1994 focussed on circuit breakers. The scope of new work was originally circuit-breakers and disconnectors. It has been expanded to include also instrument transformers. Consequently the title of the WG has been changed to "Reliability of HV equipment".

A questionnaire was worked out to cover all relevant data concerning the reliability of the different kinds of equipment. In the beginning of 2004 the questionnaire will be distributed to the utilities.

WG A3.07: Controlled switching

Convener: M. Waldron (United Kingdom)

A summary of the document "Controlled switching of HVAC circuit-breakers – Planning Specification & Testing" was published in Electra No. 197, August 2001.

All aspects around the controlled switching of circuit breakers has been investigated by this working group. The group has finished all interim reports and is now in the latter stage of producing a final document which covers:

Guide for application (Electra 183 and 185, 1999)

Planning, Specification and Testing (Electra 197, 2001)

Guide for new applications (09.2003); Benefits of controlled switching (09.2003)

WG A3.10: Specifications for short current limiters

Convener: H. Schmitt (Germany)

The up-rating of the load carrying capacity of medium and high voltage distribution systems leads to considerations to use short circuit current limiters. The first report of the Working Group "Functional specifications for short circuit current limiters" has been published. 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.

Three further parts of work – Testing; State of the Art; System Demands - were finished and published in the Technical Brochure No. 239 in 2003. A summary was published in ELEKTRA No. 211, Dec. 2003.

WG A3.11: Application Guide for IEC 62271-100 and IEC 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 62271-100 "High-voltage alternating-current circuit-breakers" and IEC 60694 (future IEC 62271-001) "Common specifications for high-voltage switchgear and controlgear standards".

The Application Guide will cover a very wide range of topics concerning the field of high voltage equipment. Some last questions were discussed in 2003 and it has been decided that the Applications Guide to will be published as a complete brochure brochure in 2004.

WG A3.12: Circuit-breaker controls
Convener: H. Wilson (USA)

The task of WG A3.12 is to investigate the recent developments in circuit-breaker control technology, and also the 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 as well as service experience with the control techniques.

Background of the work for WG A3.12 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.

A questionnaire has been worked out in order to get more detailed information on failures on control circuits of high voltage circuit breakers. Based on the questionnaire the WG Members made quite a number of interviews. In total 25 utilities has been involved. After evaluation of the questionnaire an overview of the main results and some hints of trends will be presented in a first publication in 2004.

WG A3.13: Changing network conditions and system requirements
Convener: A. Janssen (Netherlands)

The impact of recent developments, such as dispersed generation, long distance transmission of power, reactive power compensation and voltage control, power quality issues and power electronics, has to be investigated both in terms of the degree of penetration and the severeness of their influence. From the point of view of HV- equipment the necessity for future adaptations of standards will be studied. The Working Group held the kick-off meeting in 2003 and gathered topics and discussed the structure of work to be done in the future.

WG A3.15: Non conventional instrument transformers
Convener: P. Tantin (France)

The technological progress in the last decade in Information Technology and Electronics has led to important changes in substation layout:

- substations are tending to become increasingly compact
- data transmission is becoming digital.

Non conventional current and voltage transformers with compact dimensions and digital outputs are naturally finding a place in these new substation architectures.

The Working Group should study three different aspects with respect to NCITs: Primary sensors, testing and calibration and communication will be the main topics to be dealt with.

WG A3.16: Fault current limiters – Impact on existing and new protective schemes
Convener: H. Schmitt (Germany)

The use of fault-current limiters in medium voltage (MV) systems has an impact on the protection schemes and functions in electrical systems. Depending on the current limiting

technique used, protection concepts of electrical networks have to be adapted or revised to ensure proper protection selectivity.

The working group focuses on the impact and interaction of different limiting technologies such as super conducting fault current limiters, power electronic limiters (e.g. solid state breakers) or pyrotechnical limiters (Is-limiters) on existing protection concepts in MV or HV systems.

WG A3.17: Evaluation of stresses of Surge Arresters and appropriate test procedures

Convener: B. Richter (Switzerland)

Surge Arresters are widely applied in HV and MV AC and DC systems. They provide over-voltage protection from the generator in the power plant up to the end-user, including protection of substations, overhead-lines, and cables. They are installed in fixed installations and on traction vehicles, e.g. trains, metros, trolleys. During service they are subjected to a wide variety of electrical, mechanical and environmental conditions. In the Surge Arrester community an ongoing discussion can be observed addressing mechanical tests, climatic tests, short circuit tests, impulse current tests, d.c. tests, and long duration tests.

The proposed WG will review and report on the following main topics : - DC application, - surge arresters as integral part of equipment, - energy stresses, - testing and - monitoring of surge arresters.

WG A3.18: Operating Environment of Voltage Grading Capacitors applied to HV circuit-breakers

Convener: M. Runde (Norway)

Voltage grading capacitors are widely applied to multi-gap HV circuit-breakers. During service they are subject to a wide variety of electrical, mechanical and environmental conditions however there is little common consensus within the switchgear community regarding the true nature of the stresses to which these capacitors are subjected. Grading capacitor failures have been reported in the following categories: - leakage; -ingress of surrounding medium; - electrical and mechanical degradation.

The WG will review and report on all aspects of the operating environment of grading capacitors. This will be correlated with state of the art of testing procedures and failure history. Recommendations will be made regarding improved, commonly applicable test procedures for grading capacitors both as an integral sub-component of a circuit-breaker and as a separate sub-component.

Website of SC A3

Currently the website got a new face which is in line with the new Scope of SC A3. The website contains all relevant information to obtain a general idea of the structure and technical work of the committee. The new structure was finished in May 2003 and is implemented into the CIGRE website below the former designation SC 13. Keywords of the content are: mission and scope of SC A3, scopes of all working groups and overview of the other working bodies, members list, publications and protected members area containing SC-internal news and working documents.