

2003 SC B1 PROGRESS REPORT

(INSULATED CABLES)

by Y.MAUGAIN, Secretary of the Study Committee

1 Overview

The main highlights of 2003 are:

- The first year within the new CIGRE organisation and as so the first year for SC B1,
- The first time ever that the SC B1 annual meeting was held on the African continent,
- The first time that a tutorial was organised,
- The SC launched a Strategic Advisory Group (SAG) to assist the Chairman in the definition of strategic directions that should be followed by the SC.
- The SC launched a Customer Advisory Group (CAG) to ensure that the needs of the SC B1 Target Groups are fulfilled,
- The SC disbanded three Working Groups (WGs) and one Task Force (TF) at the foreseen deadlines, the relative publications are or will be published soon,
- The SC launched four TFs, two of them having to prepare the terms of reference of potential WGs.

2 SC organisation

The activities of CIGRE Study Committee B1 concern all types of AC and DC insulated cable systems for land and submarine connections and are focused mainly on high voltage applications. Whenever appropriate, however, lower voltage applications are also considered.

Within this field, the scope of work of the Study Committee covers theory, design, applications, manufacture, installation, testing, operation, maintenance and diagnostic techniques.

The main goals of the SC B1 are the following:

- to contribute effectively to the progress in insulated cable systems technology,
- to facilitate the integration of insulated cable systems in electric power networks and in the environment, covering the complete life cycle of cables,
- to maintain its leading position in the field of power cables by providing unbiased and neutral information on all essential cable aspects,
- to be recognised by the Electric Power Industry and others as a leading and reliable partner with competence in all engineering issues related to insulated cable systems, i.e. technical, economical, ecological and social.

The basic operating structures of the SC are its Working Groups. Their effective performances are based on a clear definition of their terms of reference and on work plans with specific time limits (typically three years).

In order to achieve this, it is the normal practice of SC B1 to set up an **ad hoc** Task Force (TF) to define the terms of reference of a new WG prior to its establishment. The duration of this type of TF must not exceed one year.

SC TFs may also be set up to study and/or update specific topics that do not justify the establishment of a full WG.

The SC is composed by 24 Regular Members, 8 Observer Members, a Secretary and a Chairman, 11 coming from Utilities, 15 from Manufacturers and 8 from Universities/Institutes.

The SC B1 has its web site at the following address: www.cigre-sc21.org. The SC Secretary is also the web master.

3 Publications

Published in 2003

WG/TF number	Name of the Publication	Publication in Electra	Publication date and number of the technical brochure
WG 21-01	Testing DC Extruded Cable Systems for Power Transmission up to 250 kV	Electra 206	Technical Brochure 219 February 2003
JWG 23/21/33.15	Gas Insulated Lines	Electra 206	Technical Brochure 218 February 2003
WG 21-20	HTS cable systems	Electra 208	Technical Brochure 229 June 2003
AORC B1 Panel	Report on the recent AORC Panel Regional Workshop in Malaysia	Electra 210	October 2003
Tutorial	Tutorial on thermal environment and monitoring based dynamic current rating of underground cables	Electra 211	December 2003

To come

WG/TF number	Name of the Publication	Publication type	Publication date
TF B1-10	Thermal rating of HV accessories	Electra No 212 + TB	February 2004
WG B1-02	Thermal monitoring of underground HV cable systems	Electra No 213 + TB	April 2004
WG B1-19	Technical and environmental issues regarding integration of underground systems in the network	Electra No 215 + TB	August 2004
WG B1-18	Special Bonding of HV cables	Electra + TB	mid 2005

TB : Technical brochure

4 2004 main event

The CIGRE Session dedicated to Insulated Cables will be held In Paris – Palais des Congrès on Friday, September 3rd 2004, all day.

The Preferential Subjects are:

PS 1: High voltage AC and DC underground cable systems and new transmission media

- *state of the art and improvements of cables and accessories,*
- *testing,*
- *installation,*
- *monitoring and diagnostics,*
- *maintenance.*

PS 2: High voltage AC and DC submarine cable systems

- *state of the art and improvements of cables and accessories,*
- *testing,*
- *installation and protection,*
- *monitoring and diagnostics,*
- *maintenance.*

PS 3: Underground and submarine cable systems in the changing operating environment

- *impacts of deregulation,*
- *environmental restrictions,*
- *economical constraints,*
- *social awareness,*
- *operational requirements,*
- *impact of dispersed generation,*
- *relevant issues of distribution systems,*
- *optimal utilisation of existing assets.*

5 Administrative report

5.1 Tutorial

The 2003 meeting of SCB1 was held in Mabula (South Africa) on August 27th, 28th and 29th, 2003 with an attendance of 40 members and experts.

Prior to this SC meeting, a tutorial was held, which subject was proposed by the South African National Committee of CIGRE to provide for local delegates a forum to interact with international experts and to discuss issues of local concern. It was composed of three individual presentations:

- Thermal Environment of Underground Links
- Thermal Monitoring of Underground Cables
- Dynamic Cable Rating of Underground Cables

The other objectives of this event were to take advantage of the overseas meeting to disseminate work of SC B1 in the hosting country and to align the activities of the SC with the needs of resident customers and target groups.

In addition, tutorial delegates were invited to share the first part of the SC meeting dedicated to the most significant events in the Electric Power Industry relative to cable systems.

5.2 SC Meeting

Three WGs and one TF finished their work and were disbanded. The WGs kept an editorial team to finalise the documents to be published as Technical Brochures and Electra papers.

- **WG B1-18** "*Special Bonding of HV cables*". The work was finished on the *power frequency conditions*. To complete the work on this difficult subject, it was decided to launch a one year TF (**TF B1-13**) to deal with the *transient conditions*. Both items will be published in the same technical brochure by mid 2005.
- **WG B1-19** "*Technical and environmental issues regarding the integration of underground cable systems in the network*", (to be published as a technical brochure, a summary paper being published in ELECTRA No 215, August 2004)

- **WG B1-02** "*Thermal monitoring of underground HV cable systems*" (to be published as a technical brochure, a summary paper being published in ELECTRA No. 213, April. 2004)

In 2003, SC B1 launched one new Working Group, four Task Forces and a Customer Advisory Group:

- **WG B1-07** "*Statistics on underground cable in transmission networks*" which term of office is 2006,
- **TF B1-13** "*Special Bonding of HV cables - transitory aspects*" which term of office is 2004,
- **TF B1-14** "*Cables systems in multipurpose or shared structures*" which term of office is 2004,
- **TF B1-15** "*Remaining life of existing HV AC underground lines*" which term of office is 2004,
- **TF B1-16** "*Review of Recommendations for tests of power transmission DC cables for a rated voltage up to 800 kV*" which term of office is 2004,
- **CAG (Customer Advisory Group)**, permanent, to ensure that the needs of the SC B1 Target Groups are fulfilled.

SC B1 currently has two Advisory Groups, five WGs and four TFs. Moreover, SC B1 is involved in one Joint TF with other CIGRE SCs.

The Study Committee proposed its Strategic Plan 2002-2012 and its Action Plan 2003-2005 to the CIGRE Technical Committee and were approved.

5.3 Web site

The web site will be updated according to the new design chosen for the main CIGRE web site.

5.4 TC Award

Fredrik Rüter was honoured with the CIGRE Technical Committee Award 2003 for his contribution to the work of the Study Committee.

6 Technical report

6.1 Strategic Advisory Group

Convener: Reinhard Schroth (Germany)

A permanent Strategic Advisory Group (SAG) was set up, which terms of reference are to assist the Chairman in the definition of the strategic directions that should be followed by SC B1.

The SAG will consider, if needed, the set up of other more specialized Advisory Groups and will decide about the use of their outcomes.

The SAG will initiate, whenever appropriate, the set up of new TFs or WGs, will care about educational issues, such as Tutorials, Symposia, presentations, etc...

6.2 Customer Advisory Group

Convener: Eugene Bergin (Ireland)

A permanent Customer Advisory Group was installed in SC B1 with the Scope to implement CIGRE TC's suggestion, that "Study Committees have to ensure that the needs of their Target Groups are fulfilled." The B1-CAG will be the working body within SC B1 to co-ordinate all activities in this field. It will work in close contact with the SC Chairman and the Strategic Advisory Group B1-SAG and will involve all SC B1 members as contacts and interfaces to their national or local customers.

The Terms of Reference (ToR) of the B1-CAG are as follows:

1. Identification of Target Group
 - systematically identify SC B1's Target Groups in different countries
 - listing of respective organizations, persons, social groups, etc.
 - analyzing of organizational levels and hierarchies
 - identifying of most important and influential addressees
2. Communication means with TGs
 - develop systematic and effective concepts for active contacts and communication

- consider how to implement sustainable communication links to organizations and persons
 - consider how to disseminate most effectively B1's activities and outcomes to TGs
 - propose appropriate presentations (Paris Session, Tutorials, Symposia, etc.)
3. Collection and mapping of TG's needs
- identify problems and map systematically needs of TGs
 - propose review/revision of current SC B1 activities with regard to needs of TGs
4. Collection and evaluation of feed-back from TGs
- collect and map the degree of TG's satisfaction
 - evaluate the findings and derive, if necessary, measures for improvements and new actions
 - identify opportunities to increase TG's satisfaction
 - coordinate activities at national level where appropriate

6.3 WG B1-18 "Special bonding of HV cables"

Convener: Ray Awad (Canada)

WG B1-18 was set up in 1998 and, after a change of convenership, re-launched in 2000.

The terms of reference were:

- to make a recommendation on the design of the special bonding equipment to be used on HV and EHV cable systems.

The different stages of the work were the following:

- Background from previous papers in ELECTRA (28, 47, 128).
- Experience with existing systems
- Identification and analysis of system electrical transient
- Insulation Co-ordination Criteria
- Additional important considerations on system design and application (multiple circuits, influence of special bonding on adjacent installations etc.)

The WG presented its final report on "*power frequency conditions*" in 2003, which was approved. WG B1-18 was disbanded and the work will continue as one-year TF B1-13 with the analysis of the "*transient conditions*".

The work of both working bodies will be published in one comprehensive document in 2005.

6.4 WG B1-19 "Technical and environmental issues regarding the integration of HV underground cable systems in the network"

Convener: Pierre Argaut (France)

WG B1-19 was set up in 1999 with Pierre Argaut (FR) as Convener and presented its final report in 2003, which was approved.

The terms of reference were the following:

- To establish the appropriate terminology,
- To identify and review existing transmission systems and reasons for choosing these solutions in the voltage range 45 kV-500 kV,
- To review emerging problems caused by changing environmental and economical pressure (including market, deregulation),
- To identify technical and environmental issues of integration of cable systems in HV transmission networks throughout the life-time of the cable.

This WG presented a paper during the 2002 Session.

Their production will be published after editorial comments by mid 2004.

6.5 WG B1-02 "Thermal monitoring of underground HV cable systems"

Convener: Robert Rosevear (United Kingdom)

WG B1-02 was set up in 2000 and presented its final report in 2003, which was approved.

The terms of reference were the following:

- To review the existing and emerging technologies and applications of underground cable monitoring systems in order to provide a better understanding of the capabilities of the equipment and associated software to enable users to make a more informed selection,
- To make recommendations regarding the utilisation of thermal monitoring and dynamic rating capability,
- To make recommendations concerning any areas of uncertainty or risk (hardware, interfacing, accuracy, etc. in order to facilitate the continued utilisation,
- The scope of the WG should cover both MV and HV applications. Both thermal monitoring aspects and dynamic rating capability should be considered.

The WG had also close contacts with IEE ICC Group.

The Final Report (Technical Brochure) will be published in early 2004 (Electra No. 213, April 2004).

6.6 WG B1-03 "Large conductors and composite screens"

Convener: Eric Dorison (France)

WG B1-03 was set up in 2001 and is due to present its final report in 2004.

The terms of reference are the following:

To elaborate some recommendations for HV and EHV extruded power cables calculation and measurement on:

- AC resistance of large conductor cross section cables,
- Short circuit performance and losses assessment of composite screens.

The progress is satisfactory in spite of the high technical level required to discuss this topic.

The draft of the final document is awaited for June 2004.

6.7 WG B1-04 "Maintenance of HVAC underground cables and accessories"

Convener: William Boone (The Netherlands)

WG B1-04 was set up in 2001 and is due to present its final report in 2004.

The terms of reference are the following:

- To define different types of maintenance, in co-ordination with similar work already done within other CIGRE study committees,
- To list technical problems (maintenance issues) in different types of cable and accessories, to specify related detection/repair methods, to compare different approaches and if possible to develop common criteria for decisions (condition assessment tools)
- To collect case studies about how maintenance has been accomplished in practice,
- To indicate how certain maintenance actions can be improved from a technical and from an economical point of view,
- To recommend guidelines for structured maintenance, tailored to the different type of cable/accessory and adjusted to system requirements and to customer needs.

Two new efficient members joined the group.

The survey of the different maintenance methods is under work with the failure mode analysis and the relative maintenance tools.

The draft of the final document is awaited for June 2004.

6.8 WG B1-05 "Transients affecting long cables"

Convener: Georg Balog (Norway)

WG B1-05 was set up in 2001 and is due to present its final report in 2004.

The terms of reference are the following:

- To review the literature on the subjects: transients on long cables, experience with long cables, modelling of end terminations. JWG 21/33 has published a paper "Overvoltages in HV AC underground cable systems". This paper should be used in the studies.
- To gather as much utility experience on long cables as possible.
- To define and limit the term "long cable".
- To make recommendations regarding the transient voltage withstand levels for long cables.
- To make recommendations on testing of the system. Some parts may also have to be tested with higher stresses than others.

The Working Group is helped in his task by the Norwegian research council. The Convener considered that the WG was successful in determining the different formulae, but they are not in full agreement with what was thought before.

A 10 km cable cannot be considered as a long one, the maximum voltage being at the end.

The draft of the final document is awaited for June 2004.

6.9 WG B1-06 "Revision of qualification procedures for underground HV cable systems"

Convener: Jean Becker (Belgium)

WG B1-06 was set up in 2002 and is due to present its final report in 2005.

The terms of reference are :

For the range of AC extruded underground cable systems for voltages above 30 kV up to 500 kV, review and complete the qualification procedures for the different HV voltage ranges with the goal to come quickly and economically to the market with innovative solutions but without jeopardising the reliability of the installed system:

- propose tests where there are lacks: e.g. short circuit tests, climatic tests on terminations etc.,
 - evaluate whether in high voltage systems up to 150 kV a long term test has to be recommended above given dielectric service stresses or where the innovation is not built on earlier experience,
 - define what "earlier experience" means,
 - in case of major innovations in EHV cable systems evaluate whether long term tests can be replaced by shorter ones, which should be defined by the WG,
- in order to build up a guide of qualification procedures depending on earlier qualification(s) at the same and/or different voltage levels and on field experience.

The WG set up 3 TFs. Their scope could be summarised by what should be done, what has been done and what could be done about the revision of the qualification procedures. The first results of the 3 TFs are awaited at the end of 2003.

The SC welcomed this very effective group. The WG is due to present its final report in 2005.

6.10 WG B1-07 "Statistics on underground cable in transmission networks"

Convener: Steve Swingler (United Kingdom)

WG B1-07 was set up in 2003 and is due to present its final report in 2006.

The terms of reference are the following:

- To collect statistics for the lengths of underground and overhead circuits at a range of transmission voltages. Only existing lines and projects planned for implementation by 2006 should be included,
- To describe significant underground cable projects realised in the period 1996-2006 giving the reasons why undergrounding was selected,

- To describe the factors which must be considered when evaluating the cost of overhead or underground connections,
- To describe the other factors which must be taken into account in order to make a balanced choice between overhead and underground technology.

It was agreed to exclude submarine cables and DC ones as they are usually submarine, but it will be necessary to explain the main DC land projects.

The voltage range will be above 50 kV limited to transmission levels according to the countries.

6.11 TF B1-10 "Thermal rating of HV accessories"

Convener: Henk Geene (The Netherlands)

TF B1-10 was set up in 2001 on request of IEC TC 20 and presented its final report in 2003, which was approved.

The terms of reference were the following:

- To clearly specify the terms "thermal and thermo-mechanical ratings" of accessories
- To review existing test specifications with regard to appropriate verification of thermal and thermo-mechanical performance of accessories
- To consider, if applicable, improved or new test procedures for thermal verification of accessories
- To prepare recommendations to IEC, whether and how specific thermal and thermo-mechanical tests should be combined with and/or integrated into the existing test specifications for extruded HV and EHV cables (IEC 60840 and IEC 62067).
- To prepare guidelines how to relate the findings of basic laboratory tests to the multitude of practical configurations.

The Final Report will be published in early 2004 (Electra No. 212, Febr. 2004) and officially sent to IEC TC 20.

6.12 TF B1-13 "Special bonding of HV cables (Transient conditions)"

Convener: Ray Awad (Canada)

In order to complete the work done by WG B1-18 on the power frequency conditions, it was decided to set up a Task Force on the transient conditions, which Terms of Reference are:

- Identification and analysis of system electrical transients
- Insulation Coordination Criteria
- Additional Key System design/Application Considerations (multiple circuits, influence of special bonding on adjacent installations etc.)

The TF is due to present its final report in 2004.

6.13 TF B1-14 "Cables systems in multipurpose or shared structures"

Convener: Susumu Sakuma (Japan)

In many congested areas, where it becomes more and more difficult to find new cable routes, construction costs for individual cable installations could be very high. It seems obvious to use existing or incoming structures with other utilities whenever possible. Benefits, options, restrictions, mutual impacts, etc. of such installations shall be analysed.

The TF is due to present in 2004 the Terms of Reference for a potential full WG on the above subject.

6.14 TF B1-15 "Remaining life of existing HV AC underground lines"

Convener: William Boone (The Netherlands)

For network owners "Remaining Life" is a very desirable issue, not to say the most desirable one. Based on the expertise available in WG B1-04, an attempt shall be made to investigate this topic by a systematic approach.

The TF is due to present in 2004 the Terms of Reference for a potential full WG on the above subject.

6.15 TF B1-16 "Review of "Recommendations for tests of power transmission DC cables for a rated voltage up to 800 kV""

Convener: Gunnar Evenset (Norway)

A document "Recommendations for tests of power transmission DC cables for a rated voltage up to 800 kV" was published by WG 21-02 in Electra No. 189 in April 2000. The experience with testing according to these recommendations was that some problems occurred due to different interpretation by manufacturers and buyers. In the future it will be even more important to be precise in the wording of our test recommendations, as some users may not have any expertise of their own in the field of high voltage DC cables.

To comply with one of CIGRE's primary objectives, i.e. to meet and satisfy the demands of our different target groups, a task force was therefore established to review the wording in the recommendations published in Electra No. 189.

The task will be limited to the reviewing and further clarifying the recommendations. No additional technical considerations will be made.

A reviewed version of the "Recommendations for test of power transmission DC cables for a rated voltage up to 800 kV" will be presented at the SC B1 meeting in 2004. The decision on a possible publication will be made by the SC dependent on the outcome of this investigation.

6.16 JTF SCB1/ICC "Interactions between CIGRE SCB1 and IEEE/PES Insulated Conductors Committee"

Convener: William Boone (The Netherlands)

This JTF was set up in 1999 as a permanent institution with the tasks:

- Exchange of information, representation at meetings by respective Chairmen or their delegates,
- Presentation of ICC and SC B1 activities at respective meetings
- Consideration of possible joint activities.

6.17 JTF C3/B1/B2/B3 "Electromagnetic fields and the impact of proposed exposure limits"

Convener: Jarmo Elovaara (Finland)

This JTF was set up in 2001 and is due to present its final report in 2004.

Scope:

To study the economic, technical, operational and other implications of the proposed exposure limits (mainly ICNIRP/EU) and to suggest a process for developing exposure limits to be adopted in future transmission systems. The study shall be conducted in co-operation with relevant external bodies (e.g. ICNIRP, WHO, EU, EURELECTRIC) and include:

- examination of typical magnitudes of electromagnetic fields, for both general public and occupational exposures in or close to substations, overhead lines and power cable systems (mainly collection of data). Typical magnitudes arising in office, factory and domestic environments will also be included for reference.
- summary of means available to reduce field levels
- possible implications for system design (occupational exposure limits may influence the operational security of the system)
- consideration of broad frequency spectrum fields (effects of harmonics)

- survey of cost implications of the recommended exposure limits considering general public as well as occupational exposure; both in the case of existing power transmission systems and in case of future transmission systems
- to elaborate the process of defining exposure limits considering all relevant aspects, such as technical, economical and risk management

Due to a number of reasons, the progress of this JTF is not as far as scheduled. At present there are discussions with the leading SC and the other participating SCs how to improve this situation.