



**2009 SC B1 PROGRESS REPORT
(INSULATED CABLES)**

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1 Overview

The main highlights of 2009 are:

- SC B1 held its SC meeting in Poland for the first time ever,
- An ever growing interest in the work of the Committee with 191 experts contributing,
- The disband of two B1 Working Groups (WG) at the foreseen deadline after publishing important technical brochures " Update of Service experience on underground and submarine cables " and " Third party damages on underground and submarine cables ". Moreover, three WGs finished their work that will be published in 2010,
- Two new WG were launched during the 2009 SC meeting and 4 *ad hoc* Task Forces whose work is to discuss whether or not to install a full WG to address this topic.
- An important effort was made on the preparation of tutorials. Their quality and number are high.
- The cooperation with IEC TC20, Jicable and IEEE/ICC continued to be good

2 SC organisation

The activities of CIGRE Study Committee B1 concern all types of AC and DC insulated cable systems for land and submarine power 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 as a leading and reliable partner with competence in all engineering issues related to insulated cable systems, i.e. technical, economical, ecological and social,
- to monitor and assess current trends in cable technology,
- to promote advancements in cable technology.

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 a 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.

In 2009, the SC is composed of 24 Regular Members, 8 Observer Members, a Secretary and a Chairman, 14 coming from Manufacturers, 12 from Utilities, 3 from Consultants and 5 from Universities/Institutes.

The SC B1 has its web site at the following address: www.cigre-b1.org. The SC Secretary is also the web master.

3 Publications

Published in 2009

WG number	Name of the Publication	Publication date	Electra issue and number of TB
WG B1.10	Update of Service experience on underground and submarine cables	April 2009	Electra 243 TB 379
WG B1.21	Third party damages on underground and submarine cables	December 2009	Electra 247 TB 398

To come

WG number	Name of the Publication	Publication date	Publication type
WG B1.08	Cable systems in multipurpose or shared structures	2010	Electra 248 TB 403
WG B1.24	Test procedures for HV transition joints	2010	Electra 250 TB 415
WG B1.32	Recommendations for testing HVDC extruded cable systems for power transmission at a rated voltage up to 500 kV	2010	Electra 250
WG B1.25	Advanced design of laminated metallic coverings	2011	Electra TB

TB : Technical brochure

4 2009 main events

The 2009 SC B1 meeting was hosted for the first time by Poland. It was held in Poznan on September 22 – 24 and SC B1 offered a tutorial to polish experts.

SC B1 also contributed to two CIGRE Colloquia: "Power Frequency Electromagnetic Fields" held in Sarajevo (BA) on June 03 – 04 and "Northern European experiences and future needs of HVDC & FACTS applications" held in Bergen (NO) on June 10 – 12.

SC B1 also offered 4 tutorials during the Fall ICC meeting held in Scottsdale (AZ).

- Accessories for HV and EHV AC extruded cable systems, by Henk Geene
- Revision of qualification procedures for HV and EHV AC cables, by Wim Boone
- Statistics of AC underground cable in power networks, by Steve Swingler
- Update of service experience of underground/submarine cables, by Fredric Lesur

5 2010 main events

The Preferential Subjects that will be discussed during the 2010 CIGRE Session on August 26 are:

PS1 : Technical challenges that have been overcome in newly installed underground and submarine cable systems

- Current state-of-the-art in the design of AC and DC submarine and underground traditional cable systems.
- Current state-of-the-art in cable systems installation techniques.
- Experiences of operation of cable systems.

PS2 : Key factors in current and foreseen development of cable systems

- Environmental impact.
- Balancing capital costs (including costs for Right of Ways) vs operational costs (including costs for operation and maintenance, social costs, losses, dismantling, etc).
- Prospects of UHV cable systems.

PS3 : State-of-the-art and trends for cable system testing

- Qualification, type testing, routine, sample, after installation testing of cable systems.
- Representation of installation and operational stresses in testing of cable systems
- Diagnostic testing of cable systems.

SC B1 received 44 synopsis and 27 papers were approved.

6 Administrative report

6.1 SC Meeting

Three WGs and two preparatory TFs finished their work. Each WG kept an editorial team to finalise its documents to be published as Technical Brochure and Executive summary in Electra. The TFs will be disbanded during the SC meeting and the WGs after their report is officially sent to the central office.

- **WG B1.22** "*Cable accessories workmanship*" to be published as a technical brochure ; an executive summary will be inserted in Electra in the second half of 2010
- **WG B1.24** "*Test procedures for HV transition joints*", to be published as a technical brochure ; an executive summary will be inserted in Electra in the first half of 2010,
- **WG B1.25** "*Advanced design of laminated metallic coverings*" to be published as a technical brochure ; an executive summary will be inserted in Electra in the second half of 2010
- **TF B1.31** "*Testing of superconducting cable systems*". The work of TF B1.31 launched last year was to consider whether a full working group was desirable on this issue,
- **JTF B1/B3.33** "*Feasibility of a common, dry type interface for GIS and Power cables of 52 kV and above*". The work of JTF B1/B3.33 launched last year was to consider whether a full joint working group was desirable on this issue,

WG B1.29 "*Guidelines for maintaining the integrity of XLPE transmission cable accessories*" was relaunched as the Convener faced some personal problems and resigned. A new Convener, Eugene Bergin, was nominated. The lifetime duration of three years was kept as no work had been done. The term of office is now 2012.

In 2009, SC B1 launched one new Working Group and one new Joint Working Group and four preparatory Task Forces:

- **WG B1.31** "*Testing of superconducting cable systems*" which term of office is 2012,
- **JWG B1/B3.33** "*Feasibility of a common, dry type interface for GIS and Power cables of 52 kV and above*" which term of office is 2012,

- **TF B1.34** "*Testing of superconducting cable systems*" which term of office is 2010,
- **TF B1.35** "*Cable rating*" which term of office is 2010,
- **TF B1.36** "*Life cycle assessment and environmental impact of underground cable systems*" which term of office is 2010,
- **TF B1.37** "*Guide operation of fluid filled cable systems*" which term of office is 2010,

SC B1 currently has three Advisory Groups, thirteen WGs, one JWG and four TFs and participates in one JTF with another organization.

6.2 TC Award

Christian Jensen (DK) were honoured with the CIGRE Technical Committee Award 2009 for his contribution to the work of the Study Committee.

6.3 Web site

The new SC B1 web site is on line since June 15, 2005 (www.cigre-b1.org). It offers an open space to the public and private pages to SC Members. Each Working body has private pages where documents can be exchanged among members.

The increasing number of visits, around 700 per month, confirms that Internet is a very important tool for internal and external communication.

7 Technical report

7.1 Advisory Groups

The TC Chairman decided to disband all the advisory groups when the SC Chairman finished his term of office to allow the incoming one to launch the advisory groups he considers useful for the SC management.

The three Advisory Groups will be disbanded during the 2010 SC meeting.

7.1.1 Strategic Advisory Group

Convener: Fredrik Rüter (Sweden)

A permanent Strategic Advisory Group (SAG) was set up in 2002, 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 is composed of a limited number of members: the Chairman, who will convene, the SC Secretary, and a few other SC Members or experts, all chosen by the Chairman.

The Conveners of the other SC B1 Advisory Groups are permanent members of the SAG.

The SAG will consider, if needed, the set up of other 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.

The SAG will meet at least once a year, but will communicate as required.

All the items discussed during the 2009 SAG meeting were covered in the 2009 SC B1 meeting agenda.

7.1.2 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 is the working body within SC B1 to co-ordinate all activities in this field. It works in close contact with the SC Chairman and the Strategic Advisory Group B1-SAG and involves 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.) in accordance with the TAG
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

This Advisory Group is a difficult one as there is not a CAG in each SC and each of them does not have the same target groups. Nevertheless, it is important to collect their needs and to feed them back with our reports. The principle for their representation is to have one representative per continent or sub-continent.

It is of evidence that a SC could not communicate directly to all the target groups and should preferentially do it through the CIGRE National Committees.

During the 2009 SAG meeting, it was decided to ask SC members to produce an annual Report regarding their country including feedback from TGs. 15 countries replied.

The main points collated are:

- There is presently a lot of cable work in the different countries and it is going to increase.
- The level of cable knowledge is decreasing due to staff retiring and industry restructuring
- SCB1 has a vital part to play in keeping HV cable knowledge alive and expanding it

7.1.3 Tutorial Advisory Group

Convener: Pierre Argaut (France)

A permanent Tutorial Advisory Group was installed in 2004 in SC B1 with the Scope to implement CIGRE TC's suggestion, that "Study Committees have to deal with education, continuous training, tutorials and publications". The B1-TAG is the working body within SC B1 to co-ordinate all activities in this field. It works in close contact with the EPEE, the SC Chairman, the Strategic Advisory Group B1-SAG and the Customer Advisory Group B1-CAG. It involves all SC B1 Members and Conveners as contacts.

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

1. Identification of the potential groups interested in education, continuous training, tutorials or technical presentations
 - identify SC B1's Tutorial Target Groups in different countries,
 - listing of respective organisations: students, young or older engineers, universities, etc...,
 - identification of the respective expected topics to be taught and training levels,
 - identification of other learned societies, IEE, IEEE,....
2. Identification of the means to disseminate the SC B1 knowledge
 - prepare the structure of appropriate presentations (Paris Session, Tutorials, Symposia, events organised by other learned societies, etc.) in accordance with the CAG
3. Collection of SC presentations
 - establish an education and training procedure
 - preparation of a standard presentation,
 - each SC working body will prepare a full presentation (up to 30 slides),

- the TAG will prepare a synthetic presentation (up to 4 slides)
4. Coordination of activities with EPEE and with other SCs

To compensate the lack of expertise, one solution is to propose technical education and training through tutorials that could be addressed from basic to advanced experts, from students and teachers to managers and public.

The TAG proposed a common tutorial structure that could be easily managed according to the depth needed by the public.

Each current and new WG will have in its terms of reference the production of a tutorial. For the past WGs, some SC B1 experts are preparing the relevant tutorials.

By the end of 2009, the list of validated tutorials is:

- Thermal Environment of Underground Links
- Thermal Monitoring of Underground Cables
- Dynamic Rating of Underground Cables
- Environmental Impact Assessment
- Technical and Environmental Issues regarding the integration of a new cable system in the Network
- Special Bonding of High Voltage Power Cables
- Large Cross-sections design
- Composite Screens design
- Maintenance for HV Cables and Accessories
- Accessories for HV / EHV Extruded Cables
- Earth Potential Rises
- Lightning Impulse Transients on Long Cables
- Up-Dating of Service Experience of HV Underground and Submarine Cable Systems
- Remaining Life Management and Replacement Program for HV Cables

Tutorials can be offered by SC B1 Members or experts on demand.

The next targets are:

- DC Cables, under preparation, to be updated after B1.32 work completion
- Submarine cables, to be started after B1.27 work completion
- History of the cable industry

7.2 Working Groups

7.2.1 WG B1.08 Cables systems in multipurpose or shared structures

Convener: Ray Awad (Canada)

WG B1.08 was set up in 2004 and presented its final report in 2008.

The final report and the executive summary were duly approved by the Chairman and sent to the central office. The publication is expected in February 2010. After publication, the WG will be officially disbanded.

The terms of reference were the following:

- To establish the appropriate terminology,
- To collect comprehensive information and experience on the use of multipurpose or shared structures for the installation of cable systems. It is anticipated that a comprehensive questionnaire developed by the WG will be necessary. The survey should not be limited to technical aspects such as type of cables, structure design, construction, installation, other infrastructure installed, mutual impacts, maintenance and operational constraints. It should also consider economical aspects, occupational health and safety aspects, administrative aspects, legal aspects and decision-making aspects,
- To collate, summarise and review the information,

- To identify the issues that need to be considered when installing underground cable systems in multipurpose or shared structures,
- To recommend guidelines for the practical application of for the installation of cables.

The scope of work should cover:

- MV, HV, and EHV cables,
- Solid, fluid and gas insulated cables,
- Multi-purpose tunnels and structures shared with pipe services (water including hot or cooled, oil, gas and sewage) and other utilities (other electricity services and telecommunications), Transport services (Roads, Railways and Subways).

7.2.2 WG B1.10 Update of Service Experience of HV cable systems

Convener: Robert Rosevear (United Kingdom)

WG B1.10 was set up in 2004 and the final report was presented in 2008.

The WG published a Technical brochure in April 2009 and was disbanded.

The SAG identified service experience as a topic which was not addressed since long, as the last figures published by CIGRE regarding underground cables dealt with the experience gained between 1982 and 1986, those regarding accessories for HV cables with extruded insulation dealing with the experience gained up to 1992 and the last figures regarding submarine cables being published in 1986.

The terms of reference were:

To update up to 2003 existing service experience and previously published information studying at least:

- Technology,
- Laying zone (urban, rural, submarine,...),
- Type of current (AC, DC),
- Internal or external faults,
- Type of cable burial, (protection or not)
- Number of faults per year per mileage,
- Fault duration,
- Repair duration.

It was possible to collect information up to the end of 2005.

Scope of work :

- The voltage range will be above 50 kV limited to transmission levels according to the countries.
- AC and DC cables,
- Land and submarine cables.

7.2.3 WG B1.11 Upgrading and Uprating of Underground Cable Systems

Convener: Frederic Lesur (France)

WG B1.11 was set up in 2004 and was due to present its final report in 2007.

In 2007, the Convener presented the final report which was considered of good value.

Some concerns were raised as upgrade may lead to legal problems. A great warning is awaited at the beginning of the report.

At that time, some items were missing. Most of them are completed, but the report was not fully finalized at the time of the 2008 meeting. It was asked to speed up to publish the report in 2009.

Due to personal problems, the Convener was not able to dedicate enough time to deliver the final report at the expected delivery time. He will do his best to finalize the report quickly.

The difficulties to obtain planning permission for new sites favour the life extension of existing facilities, with the goal of transmitting more power with higher reliability.

The terms of reference are:

- To review the literature on similar subjects (IEC, CIGRE, IEEE publication),
- To establish the appropriate terminology,
- To inventory the possible technical solutions for increasing the transmitted power in an existing cable system, or extending the life duration of the cable system
- To gather available utility experience in such cases,
- To list the technical and environmental issues to be addressed in such cases,
- To propose a step by step approach.

Scope of work :

- AC and DC cables
- Extruded and lapped cables
- Land and submarine cables
- Cooling systems.

The study will be limited to whole cable systems, not considering the components themselves.

7.2.4 WG B1.21 Third party damages on underground and submarine cables

Convener: Christian Jensen (Denmark)

WG B1.21 was set up in 2005 and presented its final report on schedule in 2008.

The final report and the executive summary were duly approved by the Chairman, sent to the central office and published in December 2009. After publication, the WG was officially disbanded.

Utilities are already suffering for a long time from third party damages, the damages caused to cables from so-called external origins: usually digging activities but also indirect aggression such as overheating, corrosion or change of backfill due to other utilities. Compared with the efforts to solve "internal" damage, issues are usually treated in an off-hand or unmanaged way, although in terms of money it is a very serious problem.

The terms of reference were:

To give guidance to all relevant parties involved (cable owners, utilities dealing with electricity, contractors, authorities, other utilities) as follows:

- To define the right terminology.
- To collect information worldwide about third party damage failure statistics. To collect information about main "damagers", the most sensitive areas and the most "dangerous" civil works techniques.
- To collect information about existing practices to control/solve the problem in different countries around the world.
- To propose improvements to present methods, after examination and comparison of present methods/practices.
- To propose guidelines on how to effectively control/reduce third party damages of cables.

Scope of work :

- AC and DC cables.
- Land and submarine cables.
- MV (whenever appropriate), HV and EHV.
- Mechanical, thermal damages and, more generally, all damages caused by human activities.

7.2.5 WG B1.22 Cable accessories workmanship

Convener: Kieron Leeburn (South Africa)

WG B1.22 was set up in 2005 and was due to present its final report in 2008. The Convener said that the WG was not able to present the final report as initially requested in the Terms of Reference and asked for a one year extension. Even if the Chairman was not happy with the WG progress, he agreed on the one year extension and strongly required the final report being ready by end of June 2009.

The final report was presented during the 2009 SC meeting and was well received. An editorial team took into account the final comments. After the Chairman's approval, the report will be sent to the central office for publication.

One of the trends in the cable technology is the reduction of the cable insulation thickness and therefore the growing of electrical stress based on a better knowledge of the insulating material and the extrusion process. As the cables are made under well-defined factory conditions, their quality and reliability are usually assured. Accessories, however, are mounted on site, and even if this job is done by skilled and trained jointers, it is realized in more delicate and undefined conditions than in the factory.

In view of safeguarding the cable system's reliability which utilities rely on, it is important to study the electrical stress limits in the different types of joints, to learn about the safety margins between theoretical and practical strength levels, to examine the necessary skills of jointers and relative Quality Assurance and to study the recent service experience of high stressed cables.

The terms of reference are:

- To review the literature on the subject
- To complete the terminology not covered by TB 177 "Accessories for HV cables with extruded insulation"
- To prepare an easy to understand guide that could be useful for non-technical customers aligned to IEC voltage ranges
- To prepare guidelines for jointers training. The objective is to have this document referenced in call for tenders

Scope :

- HV Extruded AC >30kV cable systems only (MV and HTS cables are excluded)
- Land and Submarine cable systems
- Special considerations may be needed for large conductors
- Types of joints and terminations
- Interface preparation (Different methods)

It was considered that the experts' skills were not sufficient to cover the submarine cables. It was agreed to delete these types of cable systems from the ToR and validated by the TC Chairman.

7.2.6 WG B1.23 Impact of EMF on current ratings and cable systems

Convener: Harry Orton (Canada)

WG B1.23 was set up in 2006 and was due to present its final report in 2009.

The Convener informed that due to late start (delay in the Convener's nomination), the WG was unable to deliver the final report on time and asked for a one year extension. This was agreed by the Chairman who required a final report ready for May 2010.

Regarding magnetic values, the Convener said the WG won't recommend levels but will just propose mitigation techniques, most of them being already used by some utilities.

Regarding costs, the Chairman said that there should be a quality discussion only.

Numerous methods have been devised by electric utilities and various research organizations to manage power frequency magnetic field levels in the vicinity of underground cable systems. Although information will be available (ongoing work TF C4.2.04) concerning considerations for implementing the various methods, their impact on construction, their cost effectiveness, and their impact on cable ratings needs to be evaluated. In particular, there are differing opinions about the derating effects of transmission cables placed in ferromagnetic shielding structures such as pipes and casings. Past work at CIGRE and elsewhere addressed magnetic field calculation procedures (with and without

ferromagnetic components), however, they do not address the derating impact of the magnetic field management methods or their practical application to electric utility systems.

Terms of Reference:

- To define the correct terminology for field management techniques.
- To review practical magnetic field management methods that are currently used for underground transmission cable systems.
- To quantify the shielding effectiveness of practical methods.
- To review practical design and construction considerations relating to engineering, standardization of components, scalability, constructability, environmental suitability of component materials, impact by third party damage, reduction of rating due to air inclusions, corrosion, theft of materials, logistics, and worker skill level.
- To review the cost effectiveness of different field management methods.
- To quantify the cable ampacity de-rating aspects of the various field management methods

This working group will neither cover any environmental or biological effects of EMF, nor discuss any specific levels of EMF.

Scope of work :

The work shall focus on single conductor, high voltage, AC land cable systems, excluding pipe type cables with :

- Extruded dielectric insulation
- Laminar dielectric insulation

Health affects will only be covered very briefly as this is not within the Working Group Scope.

Since there is no electrical field external to an underground transmission cable, the Working Group will focus on magnetic field mitigation techniques, their effects on cable ratings and their related costs.

De-rating of cables due to magnetic field mitigation must be based upon existing standards and regulations. Reference will not be given to magnetic field absolute values, but only to the shielding factors required to mitigate the field.

Investigation of commercially available software to determine magnetic field levels for specific mitigation designs will be included in the study.

It was confirmed that the pipe type cables will be excluded from the scope of work as the EMF level is low for this cable technique.

7.2.7 WG B1.24 Test procedures for HV transition joints

Convener: Marco Marelli (Italy)

WG B1.24 was set up in 2006 and was due to present its final report in 2009.

The final report was presented during the SC meeting and was well received. An editorial team will take into account the final comments. After the Chairman's approval the report will be sent to the central office for publication. The publication is expected in 2010.

The main challenge has been to compromise between scientific rigor and practical aspects. Several factors related to industry and market evolutions affected the possibility to apply old practices; meanwhile any restriction on testing was potentially impeding product evolution, transition joints still being a niche product. As a consequence, recommended test procedures are often presented as guidelines, so that their application must be subject to agreement between purchaser and manufacturer.

Extruded cable is increasingly being used for transmission and distribution circuits in preference to cables with lapped insulation. It is becoming more common for a length of extruded cable to be introduced into a lapped cable circuit, when the latter is repaired or diverted. International cable specifications are generally written to cover a specific insulation technology e.g. IEC 60840 applies to cables with extruded insulation and their accessories. Applications that involve cables with more than one insulation system are not usually considered. The test regimes differ between lapped paper and extruded polymeric insulation ; for example an AC after laying test might be used with extruded cable and a DC test with paper cable.

Terms of Reference:

- To review the range of transition joints currently available
- To review the existing international standards and the extent to which they cover the testing of transition joints
- Align voltage levels to those specified in IEC Standards for extruded cable systems
- To propose test regimes for transition joints and their associated cables. Type, routine, sample and after-laying tests should be considered.

Scope of work :

The WG should take into account AC cables and accessories for rated voltages above 30 kV up to 500 kV. Transition joints in submarine or DC cable systems are not considered. Priority should be given to jointing paper cables with extruded cables, in particular SCFF cables with XLPE cables. All forms of testing should be considered. Priority shall be given to after-laying and type tests.

7.2.8 WG B1.25 Advanced design of laminated metallic coverings

Convener: Pierre Mirebeau (France)

WG B1.25 was set up in 2006 and was due to present its final report in 2009.

The Convener gave a presentation of the final report and said that the proposed recommendation has been updated taking into account:

- The cable designs as pointed out by the world survey
- The tests of ELECTRA 141 that are considered as relevant to evaluate the quality of the system by the cable manufacturers.
- The questions raised by the operation feed back got in the questionnaire. An answer was given to each question.

An editorial team will take into account the final comments. After the Chairman's approval, the report will be sent to the central office for publication. The publication is expected in 2010.

WG 21.14 published in 1992 "Guidelines for tests on high voltage cables with extruded insulation and laminated protective coverings". Numerous improvements appeared on laminated coverings since then in parallel with field experience. We now have a feed back relative to their use as a function of the length to be laid, the installation method (ducts, directly buried...), the environment, the design of the metallic screen (aluminium, copper wire screen + aluminium, copper...), the connection and grounding of the screen (single point, cross bonding, double point)...

In parallel, new processes and new installation methods have appeared.

Terms of Reference:

- To review and update the tests on cables with extruded insulation and laminated protective coverings taking into account the system view, i.e. the installation of accessories. Tests on cable, on accessories and on the system itself should be addressed, including the short circuit one
- To issue a Guide to Use for non experts explaining what could be the different cable designs

Scope of work :

- Extruded cable systems only
- AC cable systems only with a focus above 36 kV
- Land cables

7.2.9 WG B1.27 Test recommendations on XLPE AC submarine cables from 170 kV to 500 kV

Convener: Anders Gustafsson (Sweden)

WG B1.27 was set up in 2007 and is due to present its final report in 2010.

The Convener expressed in his presentation the good contribution of the experts involved. Work is ongoing with no major issues encountered so far. It was confirmed that land to sea transition joints will be included.

The Chairman was happy with the WG progress and wished them good luck for the future. The final report is expected by end of May, early June 2010.

For a long time the prevailing highest voltage for XLPE submarine AC cables was 170 kV. A recent submarine installation of single-core XLPE AC cables at 420 kV has moved the technology forward significantly. The existing Recommendations on AC submarine cables are presently limited to 170 kV.

It is considered necessary to prepare test recommendations on XLPE AC submarine cables from 170 kV to 500 kV.

Terms of Reference:

- Examination of relevant IEC standards / CIGRE recommendations and documentation.
- The work should adopt a system approach. Particular attention should be paid to repair joints as part of the sub-marine cable system and the Working Group should consider tests with external water pressure, heat cycling and mechanical handling (during installation of a repair joint).
- The work should propose development and prequalification tests for the EHV submarine cable system and re-qualification in case of minor or major changes and define the range of prequalification and type approval for EHV submarine cable systems.
- The work should propose tests for long submarine cable lengths - both in the factory and after installation and explain clearly the basis for the recommended tests and the range of application.
- The work should include a review of the currently available technologies for sub-marine cable and joint design and consider possible implications for testing
- A Technical Brochure should be prepared for publication

A recommendation should be prepared to Cigré B1 on the revision of "Recommendations for testing of long AC submarine cables with extruded insulation for system voltage above 30 (36) to 150 (170) kV". This review should be performed based on the new edition of IEC 60840.

7.2.10 WG B1.28 On-site Partial Discharge Assessment of HV and EHV cable systems

Convener: Nigel Hampton (USA)

WG B1.28 was set up in 2008 and is due to present its final report in 2011.

Due to strong time and finance pressures, the WG preferred to undertake the work with as much activity as possible being conducted by correspondence. A presentation was done by the Convener during the last spring ICC meeting. The WG was considered on good tracks.

Cable Systems undergo various steps in testing, specifically tests after installation. To provide additional information after installation, on-site pd measurements may be undertaken. Such measurements under field conditions may be complicated to perform, and complex to analyse, but can provide valuable data on the quality of the cable installation. There is a significant interest from the owners of using these techniques both for verifying the sound installation, but also for the purpose of diagnostic testing during the life of the cable system. The work of this WG, that has the strong support of IEC TC 20, will fill the need of widely accepted guidelines.

Terms of Reference:

The work should be limited to HV and EHV extruded AC cables, but addressing both commissioning and diagnostic testing,

The WG shall:

- collect experience with PD testing, with respect to methods/equipment and results
- evaluate the added value of the PD testing at site for commissioning and diagnostic testing
- evaluate the applied technology, taking into account what previous CIGRE and ICC WG's have done so far

- recommend the protocol, to validate the on-site measurement results (calibration, sensitivity assessment)
- recommend guidelines for PD test procedures at site (voltage level, measuring time, measuring conditions)
- identify widely acceptable requirements for commissioning and diagnostic testing

7.2.11 WG B1.29 Guidelines for maintaining the integrity of XLPE transmission cable accessories

Convener: Eugene Bergin (Ireland)

This WG was launched last year, but the Convener faced medical problems that lead him to resign from this position. The Chairman said that the work should be pursued and decided to relaunch the WG for 3 years with a new Convener, Eugene Bergin (IE). He thanked the new Convener for his involvement.

The work is motivated by the occurrence of disruptive failures of cable end terminations, with consequent risks for personal and material loss and damage.

Terms of Reference:

The scope shall be limited to land XLPE cable systems at 110 kV and above. Priority shall be given to outdoor and oil-immersed terminations, but also joints (that are not directly buried) shall be considered.

The work shall concentrate on recent incidents, but near misses shall also be included in the analysis.

The WG shall:

- Review recent experience with failures of outdoor and oil-filled terminations
- Review the consequences of termination failures for cables within substations and outside.
- Examine the role of design, assembly and quality control in mitigating the effects of termination failures
- Examine the role of testing (development, type, routine & after-laying) and condition monitoring in minimising the incidence or severity of termination failures
- At the SC B1 meeting in 2010, the WG shall provide recommendations on possible extensions of work into joints (not directly buried), and accessories for oil-filled cable.

7.2.12 WG B1.30 Review of Cable Systems Electrical Characteristics

Convener: Christian Royer (Canada)

WG B1.30 was set up in 2008 and is due to present its final report in 2011.

The Convener was satisfied with the overall good progress of the work and with the good collaboration with WG C4.502 on "Power system technical performance issues related to the application of long HVAC cables" as there is a cross participation in the respective WGs.

The Chairman was happy with the WG progress and wished them good luck for the future.

It is now well known that underground transmission cables have significantly different electrical characteristics than overhead lines, and that these differences must be taken into account during cable system planning, design, and operation.

For all these topics, reliable input data are necessary and therefore accurate impedance calculations are of the highest importance. This is not always easy to achieve.

In-depth analysis of the topics related to cable integration in network may require sophisticated calculation computer programs and a detailed and reliable knowledge of the components and system characteristics at any time.

Terms of Reference:

- To prepare proper definitions for "Cable Characteristics"
- To list relevant cable systems types: cable construction, configuration of installation, bonding
- To list the information to be collected for each cable system study
- To review relevant formulae existing in literature
- To identify relevant missing formulae when necessary

- To establish if possible these formulae or propose alternate methodology
- If possible, to collect and analyse case studies

Scope of work :

- Paper cable systems (SCFF and HPFF) for land and submarine AC applications
- Extruded cable systems for land and submarine AC applications
- Power frequency
- Voltage range 45 kV and above

7.2.13 WG B1.31 Testing of superconducting cable systems

Convener: David Lindsay (United States)

IEC TC20 and TC90 has requested B1 to provide testing recommendations for HTSC cable systems, as the technology has made notable progress during the last years.

SC B1 launched a WG related to this topic, the report of which being expected in 2012.

Terms of Reference:

- 1.Scope of the WG should be limited to AC High Temperature Superconductors (HTS) only and exclude those materials considered Low Temperature Superconductors (LTS). Voltage range: 10 to 145 kV
- 2.Cryogenic cooling hardware is outside the scope. However, Performance specification, reliability, functional requirements should be addressed
- 3.The WG shall collect detailed experience from existing HTS cable projects.
- 4.The WG shall address HTS cable systems operating under normal and short circuit conditions – including cable, joints and terminations.
- 5.The guideline shall include considerations for all known cable design options including single-core, three-core and three concentric phases.
- 6.The guideline shall address those test requirements associated with design and operation of a pressurized piping and pressure-vessel system as applicable to HTS cable systems.
- 7.The WG shall recommend testing requirements and guidelines for HTS cable system in the following areas:
 - Type / Qualification tests
 - Factory Tests
 - After Laying Tests
- 8.The WG shall discuss and document the prospective of technology up scaling to 275 kV

7.2.14 WG B1.32 Recommendations for testing HVDC extruded cable systems for power transmission at a rated voltage up to 500 kV

Convener: Bjorn Sanden (Norway)

WG B1.32 was set up in 2008 and is due to present its final report in 2011.

It is the view of the WG that the lack of operational experience above 150 kV and the limited number of tests at higher voltage levels are a scientifically weak basis for writing a new recommendation and that this must be reflected in the wording of the new recommendation. The WG had also thorough discussions on the use of the inverse power law.

The Convener considered that the revision was a little bit too early.

The Study Committee agreed and confirmed that the wording should reflect this status.

TB 219, published in 2003, deals with the same subject matter, but is limited to 250 kV. Today cable systems above that voltage are available. An update to 500 kV is needed.

Terms of Reference:

General scope of work :

- To prepare recommendations for testing of HVDC extruded cable systems at rated voltages up to 500 kV

The WG shall work in 2 steps :

- Review existing recommendation in TB 219 to higher voltage levels that may be required for commercial projects in the near future, e.g. 350 kV, and draw conclusions on applicability and modifications

- Develop a recommendation for rated voltages up to 500 kV

The work scope and structure shall to greatest extent possible follow the content and structure of TB 219, i.e.:

- A survey of existing laboratory and operational experience shall be carried out by WG members.
- The recommendation shall cover the voltage range where laboratory and/or operational experience exist. The WG shall, however, assess the impact of extrapolation of the recommendation to 500 kV.
- The recommendation shall consider both submarine and land applications, with due consideration to the aspects related to testing of long lengths of cables.
- The recommendation shall cover electrical, thermal and mechanical aspects.
- Where appropriate standards/recommendations exist, the WG shall recognise and refer to these, with particular attention to the specifics related to the electrical aspects of extruded DC cables. In case the existing standards not being appropriate, the WG shall identify this issue and either propose a resolution or refer the issue to the SC.

The recommendation shall at least cover :

- Prequalification tests, Type tests, Routine tests, Sample tests, and After installation tests
- The WG may consider a range of type approval and, if applicable, tests/verifications that may demonstrate the consistency between the prequalified system and the actual system to be supplied.
- The recommendation shall take actual operational and installation conditions into account (e.g. ambient temperature, polarity reversal, impulse level, etc.), when developing the test conditions and requirements.

7.2.15 JWG B1/B3.33 Feasibility of a common, dry type interface for GIS and Power cables of 52 kV and above

Convener: Pierre Argaut (France)

JWG B1/B3.33 was set up in 2009 and is due to present its final report in 2012.

The interface between cable terminations and GIS is ruled by existing IEC standards.

The WG is to, using a step-by-step approach, examine and evaluate the technical issues of a common, dry type interface for GIS and Power cables of 52 kV and above.

Draft terms of Reference:

The scope shall be limited to GIS connections for extruded cable systems for AC of 52 kV and above

The JWG shall:

- examine the conditions around the switchgear and the installations issues (also called site issues)
- consider the testing procedures for GIS/ T and cables (overlapping or missing items).
- propose measures to reduce the potential consequences of the GIS insulation failure.
- propose measures to reduce the potential consequences of the cable termination insulation failure
- review the existing standards ruling the qualifications and extension of qualification procedures applicable to GIS terminations.
- define the relevant qualification procedures needed if any.
- estimate the overall feasibility of the project and the cost involved.
- consider the impact of large cross sections
- consider safety during works
- identify the limit of suppliers' responsibility to be considered
- question the market based on the result of the above estimation
- recommend or not to go to a second step with the launching of a new WG B1.XX to go in detail in the design of the standard components (shape, dimensions, properties ..)
- develop recommendations to IEC SC 17C for requirements to be covered by the standard

The terms of reference will be fine tuned at the first JWG meeting with SC B3 before being submitted to the TC Chairman for approval.

7.3 Task Forces

The TFs are launched by the Study Committee 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. Task Forces do not publish any report in Electra.

7.3.1 TF B1.34 Mechanical forces in large cross section cable systems

Convener: Johannes Kaumanns (Germany)

The TF should address the mechanical effects:

- in installed large cross section cable systems,
- at transition points between different installation systems and study impact on accessories on normal and fault conditions.

The TF should discuss and conclude in 2010 on whether or not to install a full WG to address the topic.

7.3.2 TF B1.35 Cable rating

Convener: Frank De Wild (Netherlands)

The TF should review present status on rating calculations (IEC, ...) and recommend further work by B1 in area of cable ratings.

The TF should discuss and conclude in 2010 on whether or not to install a full WG to address the topic.

7.3.3 TF B1.36 Life cycle assessment and environmental impact of underground cable systems

Convener: Ray Awad (Canada)

Cable systems are more and more designed in a "green" way.

The TF should discuss and conclude in 2010 on whether or not to install a full WG to address the topic.

7.3.4 TF B1.37 Guide operation of fluid filled cable systems

Convener: Colin Peacock (Australia)

Within the last few years the availability of SCOF cables has reduced significantly as manufacturing has ceased. Nevertheless there are many thousands of kilometres of SCOF cables in service throughout the world that require ongoing maintenance, repair and diversion/extension (including the use of transition joints). It is proposed that a guide be produced to aid operators in the continued management of this type of cable system.

The TF should discuss and conclude in 2010 on whether or not to install a full WG to address the topic.

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

Convener: Willem Boone (The Netherlands)

The CIGRE/ICC JTF was launched in 2000 and the evaluation made in 2005 concluded that the cooperation should continue. A new evaluation will be done in 2010.

Four tutorials were delivered during the Fall meeting : Accessories for HV extruded cables (TB 177), Revision of Qualification procedures (TB 303), Statistics on AC UG Cables in power networks (TB 338), Update of service experience of HV UG and Submarine cable systems (TB 379).

7.4 Relations with other CIGRE Study Committees

SC B1 doesn't have at present formal relations to other SCs, however SC B1 has some common issues with other SCs (B2, B3, B4, C1, C3, C4, D1).

SC B1 is involved in several WGs where B1 experts are among the WG members to provide their expertise in the cable systems. These WGs are:

- **WG C4.207** "EMC of communication circuits, low voltage systems and metallic structures in the vicinity of power systems"
- **WG C4.502** "Modelling and analysis of the technical performance of electrical power networks with very long/large number of HV/EHV AC cable lines"
- **JWG D1/B1.20** " Water Tree Detection in XLPE insulation"
- **WG D1.23** "Diagnostics and accelerated life endurance testing of polymeric materials for HVDC application"
- **WG D1.24** "Potential of Polymer Nanocomposites as electrical insulation for highly stressed insulation material in AC and DC application"
- **WG D1.26** "Basic principles to determinate methane content of cross-linked solid extruded insulation of MV and HV cables"

7.5 AORC

SC B1 is a very good contributor to the AORC (Asia Oceania Regional Committee) as the AORC B1 panel, led by Ken Barber (AU) meets regularly with the experts from the AORC countries. In return, the experts provide subjects of interest for themselves that could be taken into consideration at the SC level.

Due to the world economic crisis, the AORC B1 panel didn't meet in 2009. The 2010 AORC meeting is planned in Korea.

7.6 IEC

The IEC TC 20 Chairman emphasized the importance to maintain close liaison between both organizations as IEC TC20 needs CIGRE SC B1 expertise for the development of particular technical matters necessary for either the preparation of new standards or the maintenance and revision of existing standards.

He was very happy with the excellent relations, and confirmed the need for the Chairmen to attend the annual meetings of the partner organization.

The IEC Chairman was happy with the launch of a WG on High Temperature Superconducting cables and asked to have an IEC expert involved. This request was accepted.

After giving examples of the relation between the work produced by SC B1 and the issue of standards by IEC (i.e. WG 21.03 producing Electra 151, this becoming a few years later IEC 62067), he introduced the existing and future consideration of SC B1 work by IEC TC 20:

- Present revision of IEC 60840 and 62067 with WG B1-06 Prequalification procedure, WG 21.09 After laying tests, TF B1-10 Thermal ratings of accessories
- Future revision of IEC 60840 and 62067 with WG B1-10 Update of service experience, WG B1-22 Workmanship of accessories, WG B1-24 Test procedures for HV transition joints
- Preparation of IEC TR 61901 with WG 21-14 Tests on laminated coverings, WG B1-25 Advanced design of laminated screens
- Revision of IEC 60287 with WG B1-03 Large conductors and screen losses, WG B1-08 Multipurpose or shared structures, WG B1-23 Impact of EMF on current ratings and cable systems, WG B1-26 Earth potential rises in specially bonded screen systems