

**CIGRE STUDY COMMITTEE B4 - HVDC AND
POWER ELECTRONIC EQUIPMENT
The 41th Session Regular Meeting
Friday, September 1, 2006
Paris, France**

Chair: Marcio Szechtman
Secretary: Willis Long

1.0 Opening Comments

Szechtman

Chair Marcio Szechtman opened the meeting at 0900. There were 67 persons in attendance. He welcomed all, with a special welcome to the attending new Regular Members (Messrs Madajewski/Poland, Oh/Korea, Meisingset/Norway, Damgaard/Denmark, Tsfasman/Russia, Alvira/Spain, Takasaki/Japan, Pahalawaththa/Australia-New Zealand, Espirito/Brazil, and MacLeod/United Kingdom). He then recognized and extended thanks to the retiring Regular Members in attendance (Gama/Brazil, Soebrink/Denmark, Papp/Austria, Zavahir/Australia-New Zealand, Borgen/Norway, Ivakin/Russia, Karoui/Belgium, Andersen/United Kingdom, Prasher/India).

There followed introductions of the persons in attendance. Regarding regular members of the Study Committee,:

Tang Guangfu represented Hong Chao, China

V. K. Prasher represented V. Ramakrishna, India.

Marcio gave special recognition to Dusan Povh, former chair of the Study Committee.

Attendance at this meeting is as follows:

Attending Regular

Members/Representatives

Australia/NZ	Nalin Pahalawaththa
Brazil	Sergio Santo
Canada	Mohamed Rashwan
China	Tang Guangfu ®
Denmark	Poul Damgaard
France	Samuel Nguefeu
Finland	Jussi Jyrinsalo
Germany	Hartmut Huang
India	V. K. Prasher®
Italy	Alberto Giorgi
Japan	Masahiro Takasaki
Korea	Tae-kyoo Oh
Netherlands	Yanny Fu
Norway	Magne Meisingset
Poland	Krzysztof Madajewski
Romania	Mircea Eremia
Russia	Grigory Tsfasman
South Africa	Andrew Williamson
Spain	David Alvira
Sweden	Victor Lescale
Switzerland	Dirk Westermann
UK	Norman MacLeod
US	Stig Nilsson

Study Committee Officers

Chair	Marcio Szechtman
Secretary	Willis Long

Observer Members

Argentina	Roberto Molina
Austria	Klaus Papp
Belgium	Karim Karoui
Mexico	Jesus Gonzalez

WG/TF Conveners, AG Members

Australia/NZ	Mohamed Zavahir
Brazil	Joao Barros
Canada	Brett Davies Ani Gole Narinder Dhaliwal
Denmark	Kent Soebrink
India	R. N. Nayak
Norway	Kirsten Faugstad
UK	Bjarne Andersen Nigel Shore
US	Aty Edris Ivars Vancer

Guests

Austria	Alexander Grisenti
Brazil	John Graham Carlos Gama Jose Jardini Geir Biledt Felipe Nobre
Canada	John McNichol Murray Bennett Randy Wachal Peter Kuffel Don Kell
Denmark	Peter Christensen
Germany	Peter Lips Georg Wild Dusan Povh Michael Weinhold
India	Rajesh Suri
Italy	Gianluca Bruno
Norway	Hakon Borgen
Russia	Lev Travin Victor Ivakin
South Africa	Leon Chetty
Sweden	Gunnar Asplund
UK	Michael Woodhouse
US	Neil Kirby Tom Weaver

2.0 Minutes of Bangalore 2005 Meeting

Long

The minutes of the meeting in Bangalore, India have been previously distributed and posted on the Study Committee web site along with all reports that were presented. There were no changes or corrections.

(Please note that all reports presented at this Paris meeting are on the SC web site, indexed according to the agenda item number.)

3.0 Technical Committee Activities Report

Szechtman

The 2005 Technical Committee Awards were given to Kjell Eriksson, Convener of Working Group B4-33, and John Vithayathil, Convener of Working Group B4-35. Proposals have been sent to the Technical Committee for the 2006 awards.

The Technical Committee last met in April, 2006 and will meet on Saturday, September 2, 2006 to discuss items arising from this Paris meeting and also the Preferential Subjects for 2008. Issues of concern include the recruitment of younger members, too many Working Groups in some Study Committees, and an update of the TC action plan. There is a concern that the TC should place more attention on technical matters. There is also a need for the SCs to plan more for future Electra articles. This Study Committee had a number of positive comments on the new poster session. It was mentioned that it provided a good introduction to the technical session that followed the next day. Marcio had requested that the location be close to where the contributors meet with the SC Special Reporters but this was not possible. Measures to improve this activity in future Paris sessions would include practical information on how to post the papers and a mechanism to capture information from the attendees.

4.0 Other Announcements

Szechtman

There were no other announcements.

5.0 Strategic Plan and Advisory Groups

5.1 AG 1: Strategic Advisory Group

Zavahir

The SC B4 strategic plan will be updated using information from the survey (see 5.5 below) which had been earlier distributed. Copies of the form were distributed at the meeting for persons not previously responding. This is the principal task of the AG and will be completed by the end of 2006.

5.2 AG 2: WG Conception and Guidelines

Soebrink

A task force is looking at new proposals for WGs. Guidelines for WGs have been developed to make it easier for new WGs to get started. The AG will do a gap analysis to see what activities are missing including whether there are new target groups that should be addressed? A major issue: is to identify new WG members and involve new experts.

5.3 AG 3: Environmental Issues

Faugstad

The AG is interested in any discussions that occurred during the licensing process. Also, has there been any related operating experience including results from any monitoring programs? For additional information please see the report from WG B4-44.

5.4 AG 4: HVDC System Performance

Vancers

TF 1 collects and publishes HVDC System Performance Data, TF2 updates the HVDC Compendium. There are projects that had transformer failures but did not report. There is a continuing effort to get the missing reports. The AG is preparing an Electra paper on performance data and expects to have it finished by the end of 2006. The AG would like suggestions for additional activities. They will not change the reporting system in order to have the ability to compare current with previous years. As HVDC Voltage Source Converters are now in operation that data will be included. There was a question regarding an interest in similar reporting for SVCs. This had been previously discussed, IEEE began compiling a data base but found minimal interest in reporting. It may be better to begin collecting data on TCSC performance as there are few enough installations that the activity could be manageable.

5.5 Tutorials and Communication/Web Site

Jyrinsalo/Dhaliwal

Summarizing the survey results: 40 responses to date, from all over the world, with a wide distribution of responders. There is good interest in web site. Also indicated were interest in organizing local symposia and other events (some do happen), and in joint activities (e.g with C1). There was support for presentations/discussions of topics of current importance in B4. It was noted that B4 tends to emphasize HVDC more than FACTS. A successful Nordic 2-day workshop attracted 50 participants, including TSO staff. Interest from other countries will be pursued; good to have local presentations too. There was a web site demo, Narinder Dhaliwal expressed thanks to Manitoba Hydro for support in developing it. If there are HVDC meetings in the present attendees' countries information should be sent to Narinder for posting. There is a restricted access Members area (currently vacant) as well as restricted WG areas. All conveners have been informed of their passwords.

6.0 Working Group Reports

6.1 B4-38: Simulation of HVDC and FACTS

Gole

Ani Gole is the incoming convener of this WG, which met with 13 in attendance. Previous plans had included two guides but in view of the time lag and workloads of the WG members it was agreed that there would be a single guide. A set of core chapters with contributors' responsibilities was assigned. A spring 2007 meeting is possible depending on the progress of the chapters. The report will include a core set of study examples. It is expected to take two years to finish. Ani will review the WG Terms of Reference and give any (minor) modifications to Narinder for the web site.

6.2 B4-39: Integration of Large Scale Wind Power with HVDC and Power Electronics

Andersen

This WG was relaunched in Paris in 2004, and has had 5 meetings to date. There was good progress at this meeting. The WG is giving particular attention to a Benchmark model, and will do studies illustrating its use. They will meet next in Poland in November, 2006 when the draft document should be completed. It is expected to be ready for the SC 60 day review by the November, 2007 meeting in Japan. Bjarne requests additional information on present and planned windfarms and will provide a pro forma document for that purpose

6.3 B4-40: Static Series Synchronous Compensator (SSSC) **Edris**

The WG met with 6 members (out of 12) present. The final document is now 90% finished, and will be completed in draft form by end of this year, The WG expects to meet once more for their final document review. The SC can expect to receive the report for 60-day review in spring, 2007.

6.4 B4-41: Systems with Multiple HVDC Infeed **Davies**

The WG now has a 2-cable multi-infeed model. They have defined a new multi-infeed MIESCR. The previously described multi-infeed interaction factor (MIIF) is a key development. An Electra paper on interim progress will be submitted before the end of 2006. Brett showed a PowerPoint animation of rectifier and inverter commutation waveforms, including commutation failures, suitable for tutorial presentations. The WG will finish in 2007.

6.5 B4-43: Increased System Efficiency by Use of New Generations of Power Semiconductors **Westermann**

The WG's intent is to anticipate changes in the next generation of power semiconductors and project the impact of changes (e.g topologies, building blocks). They do not expect a revolution in loss reduction, but rather improved ratings and power density. The report should be finalized in November 06 and submitted for the 60-day review by the SC.

6.6 JWG B2-17/B4/C1: Impacts of HVDC Lines on Economics of HVDC Projects **Graham**

The WG began its work in mid-2005. One area of concern is how to address T-off issues (e.g., small taps, passive loads). Are IGCT-based converters applicable? The WG has three task forces: HVDC lines, converter stations, and the integration of dc lines w/converter stations. They will need to look at various converter configurations (probably as many as 12). The WG will coordinate with B4-45 (800 kV). They expect to include a CD w/spreadsheet in the final report to be used to account for differing costs between countries.

6.7 WG B4-44: Planning Guidelines Dealing with HVDC Environmental Issues **Faugstad**

The WG will focus on HVDC converter stations, overhead lines and cables, electrodes, planning concerns, and as appropriate FACTS installations. A questionnaire is being prepared for distribution later this year, it will principally deal with earth electrodes. The WG will prepare a paper for the colloquium in Japan in November, 2007. Kirsten requests additional members of the WG.

6.8 JWG A2/B4-28: HVDC Converter Transformer Test Procedures **Fu**

This Joint Working Group began in 2004. There have been three turn-to-turn failures near the top on the valve side. There are also reported issues with leads and cleats, dc bushings, and copper sulfide. (Copper corrosion is not a new issue.) More knowledge of stresses is needed. Oil conductivity seems to be a major factor. These problems are not reflected in IEC Standards. A draft document on test procedures is planned for 2007, with the complete document finished in 2008. It is not only the higher voltage transformers that are failing. Despite the progress being achieved with the JWG activities, the issue of failures of converter transformers is still drawing attention from HVDC users. This matter should be analyzed in greater depth within SC B4.

6.9 New WG B4-34, Series Commutated Converter Stations **Barros**

This is a new WG which will make use of available material from the Brazilian National Committee work. They have had hands-on experience with the Garabi capacitor-commutated converter in the Brazilian system. Significant studies have been conducted. Three experts (from Finland, New Zealand, and Canada) have been appointed by SC B4 to review the work to date and to assist in producing a final CIGRE document. That document is expected in first half of 2007.

6.10 New WG B4-45, Technological Assessment of 800 kV HVDC Applications

Nayak

The WG has 10 members. Areas of interest include series/parallel connection options, insulation coordination, bushings. The WG plans to meet with the Converter Transformer Test Procedures JWG. January 2008 is the estimated date for the final report.

6.11 New WG B4-46, Voltage Source Converter (VSC) HVDC for Power Transmission – Economic Aspects and Comparison with other AC and DC technologies

Westermann

The WG is just being formed and has not met yet. They will investigate extra functions and benefits from VSC converters. Case studies will be included. The WG membership will be complete by January 2007, with September 2009 as the target date for the final report.

7.0 Future Meetings

7.1 2007 SC Meeting in Japan

Takasaki

Meeting planning is now going on. Working Groups will meet October 28-29-30, there will be tutorial presentations on October 30, the Study Committee will meet on October 31. Also meeting will be Study Committees B1, C1, and C5. These meetings will be followed by a joint Symposium on System Development and Asset Management Under Deregulation (proposed title). There will be a technical tour of the Kii Channel HVDC Link. The host city, Osaka, is reached via Kansai International Airport to which there are many direct flights. By March 1 the WG Conveners are requested to confirm their meeting schedules to Masahiro Takasaki with copies to Marcio and Bill.

7.2 2008 Meeting in Paris

Szechtman

The Special reporters will be Yanny Fu and Narinder Dhaliwal. The preferential subjects (approved at the Technical Committee meeting on September 2) are:

1 HVDC transmission projects including UHV applications

- *Operational Performance of existing HVDC projects, Upgrading/replacement of older projects and application of Reliability Centered Maintenance in HVDC system design;*
- *Feasibility studies of new HVDC projects;*
- *Planning, Design and Reliability criteria and characteristics of new HVDC projects, also including considerations on overload capabilities and market aspects;*
- *Issues and experiences with ground return and ground electrodes;*
- *New development such as:*
 - *Development of +/- 800 kV HVDC projects;*
 - *Development of VSC based HVDC projects;*

2 FACTS applications and new developments

- *Feasibility studies;*
- *Operational Performance and system impact of existing projects;*
- *New FACTS projects;*

3 New power electronic equipment development and applications

- *New development on power electronic devices;*
- *Power electronics applications in:*
 - *Distribution systems;*
 - *Wind Power;*
 - *Interconnections with renewable energy sources;*
 - *DC Grids for Urban applications.*

7.3 2009 SC Meeting in Norway

Borgen

SC B4 has been invited, to Norway for the 2009 meeting, the exact location to be resolved later. There could perhaps be some WG meetings on shipboard, and tutorials in Trondheim (a University town). Participation is expected from other Nordic countries with interest in topics including deregulation issues and high grid utilization. The Study Committee indicated their support and so the invitation was accepted.

7.4 2011 SC Meeting in Australia

Pahalawaththa

The SC has received a letter of invitation from Australia for the 2011 meeting. The invitation is appreciated, no decision was taken.

8.0 New Working Group Proposals

Soebrink

a) There is a proposal to establish a WG on voltage source converter testing; a draft Terms of Reference have been prepared. Hartmut Huang reviewed the items of interest:

- Define components and subsystems
- Define operational and fault scenarios
- Create test procedures and philosophy
- Propose reasonable guidelines

Modification are needed in the wording of the TOR. Hartmut is to review and revise as needed (November target date). A convener is to be appointed, Hartmut will pursue this. *Note: See Section 9.2 of these minutes for additional information on this WG.*

b) There is also a proposal to recreate the earlier WG 14.30 which produced Technical Brochure 139 “Guide to the Specification and Design Evaluation of AC Filters for HVDC Projects” in 1999. Nigel Shore was chair of that WG and has drafted Terms of Reference to update the work in that original report. This new report would include:

1. Rating of filters in the presence of background harmonics
2. Specification of network harmonic impedance
3. Current-based harmonic interference criteria such as IT product
4. AC/DC harmonic interaction

It is projected to take two years to complete the final report. There is a wish to add members from India, China, and Brazil. This will become a new Working Group, B4-47 with Nigel Shore as convener. This proposal is approved for creating a supplemental document by vote of the SC, with the TOR to be submitted to the Technical Committee for approval.

c) There was a proposal by Gunnar Asplund for a new WG “HVDC imbedded in ac networks.” No action was taken as the number of new WGs being started is at the limit of our capabilities.

d) The idea of analyzing TCSC performance was again raised, since various commercial applications have taken place. Marcio asked Stig Nilsson to propose Terms of Reference for a new WG for the next SC meeting in Japan.

9.0 Reports from IEEE and IEC

9.1 IEEE

Woodford

This report was presented by Bill Long. At the 2006 General Meeting the Uno Lamm HVDC Award was presented to Gunnar Asplund, the Nari Hingorani FACTS Award was presented to Aty Edris.

Four new working groups are being set up. These include:

1. Task Force for topical and HVDC and FACTS Articles
2. Working Group on AC to DC Conversion
3. Working Group on Compensation and Interconnection of Wind Farms
4. Working Group on Life Extension of HVDC and FACTS Controls and Protections.

The March-April, 2007 issue of Power and Energy magazine will be devoted to HVDC, Bill Long and Stig Nilsson are guest editors.

9.2 IEC Subcommittee 22F

Travin

An IEC/CIGRE document “Guidelines for the design of ground and sea electrodes for HVDC links” will be published by the end of 2006 and will become an IEC pre-standard. Then a new Working Group on this topic will be formed. As discussed in the 2005 SC meeting in Bangalore, SC B4 was in charge of preparing a proposal for a Terms of Reference document concerning the creation of a new WG on Testing Standard for VSC converter valves for HVDC, which was done and presented to the SC. At the time of the meeting some comments from Magnus Lalander were brought up, changing the views

from IEC 22F. It was agreed that Marcio will write to Lev Travin asking for clarification of the procedure to be followed.

10.0 Reports from Other Committees or Organizations (Electronic format reports only)

- Manitoba HVDC Research Centre
- Australia/New Zealand

11.0 Special Presentations

Tribute to Dr. Hayashi

Takasaki

We note with sadness the untimely passing of the previous Regular Member from Japan, Toshiyuki Hayashi. We will miss his positive attitude, and ask to please extend the condolences of Study Committee B4 to his family and colleagues.

12.0 HVDC and FACTS Schemes Under Construction or Planned (Participants to provide electronic format reports with brief verbal summary, time permitting. The reports are included in the Meeting Reports file on the SC web page.)

- 12.1 Ivakin, projects in Russia
- 12.2 Tang, projects in China
- 12.3 Nayak, projects in India
- 12.4 Meisingset, projects in Norway
- 12.5 Mircea, projects in Romania

13.0 Operational Experiences of Existing HVDC and FACTS Schemes (Participants to provide electronic format reports with brief verbal summary, time permitting. The reports are included in the Meeting Reports file on the SC web page.)

- 13.1 MacLeod, Areva projects
- 13.2 Huang, Siemens projects
- 13.3 Lescale, ABB projects

14.0 Other Business

There was no other business.

15.0 Adjournment

Chairman Marcio Szechtman adjourned the meeting at 1730 with thanks to all who participated.

Minutes prepared by Bill Long, Secretary, Study Committee B4.

Willis F. Long
October, 2006