

**CIGRE STUDY COMMITTEE B4 - HVDC AND
POWER ELECTRONIC EQUIPMENT
The 40th Session Regular Meeting
Thursday September 22, 2005
Bangalore, India**

Chair: Marcio Szechtman

Secretary: Willis Long

1.0 Opening Comments

Chair Marcio Szechtman opened the meeting at 0900. There were 49 persons in attendance. He welcomed the members, observers, conveners, and guests. He acknowledged with appreciation the work that V. K. Prasher and his staff have done to make the meetings and colloquium a success. It is important for the Study Committee to be here because of the power transmission developments in India.

2.0 Welcome Addresses

V. K. Prasher stated that it was a pleasure to welcome all to the meeting and to India. It has been his dream to have this kind of conference in India, provide exposure to this group for Indian colleagues. The tutorials were met with an overflowing response. Working Group meetings and the CIGRE Executive Council and Administrative Council meetings were all held in parallel. Bangalore is the home of India's IT industry. Silk products and thunderwood products are important here. He hopes the delegates get a glimpse of India's heritage and culture. Please note that the Colloquium on the Role of HVDC, FACTS and Emerging Technologies will follow the Study Committee meeting, and then technical and touristic visits are available. Thank you for coming so far.

Next there were greetings from Aldo Bolza, Chair of the CIGRE Technical Committee. He noted that he was happy to be here as it is not often possible to attend SC meetings. The success of the tutorials indicates the transmitting of technical information; similarly with the colloquium that follows. The planned growth of power transmission in India is impressive, and HVDC and Power Electronics are certain to play a major role. There is one piece of good news: the Administrative Council addressed the topic of renewal of terms of chairmen of SCs, and B4 Chair Marcio Szechtman is to be extended 2 additional years. He is doing a very good job and this is recognized by his colleagues.

There were introductions of the 49 persons in attendance (see the attendance list following). Regarding Regular Members of the SC:

Wentao Zhang represented Guangfu Tang (China)
 Claudio Pincella represented Giorgi Alberto (Italy)

Shyful Bahrin Ismail (Malaysia) did not attend

Jiri Pavelka (Czech Republic) did not attend

Karim Karoui (Belgium) did not attend

Marcio gave special recognition to former SC members Mata Prasad (India) and Chandra Krishnayya (Canada).

Attendance at this meeting is as follows:

Attending Regular Members/Representatives

Australia/NZ	Mohamed Zavahir
Austria	Klaus Papp
Brazil	Carlos Gama
Canada	Mohamed Rashwan
China	Wentao Zhang ®
Denmark	Kent Soebrink
France	Samuel Nguefeu
Finland	Jussi Jyrinsalo
Germany	Hartmut Huang
India	V. K. Prasher
Italy	Claudio Pincella ®
Japan	Toshiyuki Hayashi
Netherlands	Yanny Fu
Norway	Hakon Borgen
Romania	Mircea Eremia
Russia	Viktor Ivakin
South Africa	Andrew Williamson
Sweden	Victor Lescale
Switzerland	Dirk Westermann
UK	Bjarne Andersen
United States	Stig Nilsson

Guests

Brazil	John Graham
Canada	Chandra Krishnayya
	Narinder Dhaliwal
	John McNichol
	Dennis Woodford
Finland	Pehr-Olov Lindh
	Bo Wikstrom
India	R. S. Moni
	Rajesh Kumar
	Sanjay Mukoo
	Rabindra Nath Nayak
	Mata Prasad
Ireland	Paul Smith
Italy	Ugo Piovan
Japan	Masahiro Takasaki
Russia	Lev Travin
South Africa	Irma Emmanuel Lubini
	Tony Britten
	Leon Chetty
Sweden	Gunnar Asplund
	Abhay Kumar
Switzerland	Guido Schenk

Observer Members

Mexico	Jesus Gonzalez
Poland	Krzystof Madajewski

WG/TF Conveners, AG Members

Canada	Brett Davies
France	Milan Saravolac

3.0 Minutes of Paris 2004 Meeting

Long

There were no changes or corrections.

4.0 Technical Committee Activities Report

Szechtman

The new organizational structure of CIGRE is completed, there will be no further changes in SC B4 as we are in compliance with that structure. Planning for future ELECTRA issues is a concern as contributions are slow in coming. A 6 month or 1 year plan is needed from the SC WGs. It is acceptable to submit publications other than WG reports, e.g. articles on new applications or developments, etc. Marcio said we should target three publications per year from SC B4. Further to the Technical Committee report, the monitoring of WG productivity is important. Some work very hard while others progress more slowly; some members do a lot of work, some do very little. It is important to involve new/younger engineers, and the regular members should identify new talents and bring them to the WGs. Regarding papers, Marcio stated that those from the National Committees are not always of high quality. We cannot reject them but we can write to the National Committees pointing this out. Current data show CIGRE membership is 47% utility (this is good), 18% manufacturers, 12% universities, 11% research organizations, and 6% consultants.

(Omitted from this report was recognition of Bjarne Andersen and Mohamed Zavahir, who received the 2004 Technical Committee Awards, announced by letter to the RMs on January 12, 2005. Congratulation to both Bjarne and Mohamed.)

5.0 Strategic Plan and Advisory Groups

5.1 Status of Strategic Plan

Szechtman

Marcio briefly noted that in 2004 we restructured the SC with Advisory Groups, an Action Plan, and a Communication Plan. He added that in addition to the above, attracting and involving new members is as important as the technical work. Working Group members need to be responsive, accept responsibility, respond to e-mails, etc.

5.2 AG 1: Strategic Advisory Group

Zavahir

Mohamed expressed thanks to colleagues who have contributed to the AGs. They have focused on the Strategic Plan and especially discussed a communication strategy. They have also reviewed the stated objectives. The SC wants to have a regional focus around the world, and needs to expand B4's influence especially where technology can be implemented effectively (e.g., Indonesia, the Middle East). Targeted publications are needed, for instance to help introduce planners to HVDC. An action item is for AG 02 to help WGs be more effective including items such as member motivation. One plan is to develop a skill set matrix for RMs and experts – useful for example in determining what talent is available for a new WG. Also we want WG members to contribute, not just receive information. We need periodic progress reports from WG Conveners on the SC web site, perhaps resulting in an ELECTRA article on partial progress. Tutorials are very useful, one suggestion is to have PowerPoint presentations available for chapters of WG reports. (Marcio interjected that we should target one tutorial presentation per year.) As noted above, we want RMs to identify neighboring countries with HVDC/PE interest. Regarding preferential subjects, these should be discussed during the SC Paris meeting and perhaps coordinate with colloquia that accompany non-Paris SC meetings (e.g.,

Japan in 2007). Website development is important, as it is useful to outsiders as a first point of contact. Could there be interactive tutorials on HVDC/PE as part of our communication strategy? This will help us be more visible to our Target Groups. Manitoba Hydro will assist in implementing the changeover to the new CIGRE-based web site. Narinder Dhaliwal will take lead, with Marcio/Bill/Mohamed Zavahir/Jussi Jurinsalo participating. (There is a Communication Strategy let by Jussi as part of Strategic Plan.)

5.3 AG 2: WG Conception and Guidelines

Soebrink

A Task Force has prepared some guidelines but it is incomplete, as material to assist conveners needs inclusion. They expect to publish it soon. A Task Force on gap analysis will compare the scopes of the WGs vs. the scope of SC B4, to identify needed new WGs. (Please see New WG proposals, agenda item 8.0.)

5.4 AG 3: Environmental Issues

Faugstad

See the report from WG B4-44.

5.5 AG 4: HVDC System Performance

Fu

This Advisory Group was previously WG B4-04, it is now an AG by reason of its permanent nature. The AG assembles reliability statistics and reports them every 2 years via a paper in Paris. To date 22 of 28 links have reported their data for 2004. It is difficult to get all reports. The AG has a concern about identifying specific systems having failures – is it proper to disclose this information? The AG proposes to send a high-level CIGRE letter to CEOs of all HVDC users: to acknowledge with thanks those who report regularly, and encourage the non-responders to report their data. A discussion followed on whether to send letters to the RMs instead, and let them take action. The Compendium of HVDC schemes is almost updated, two are missing and will be added soon. There is a question whether to put this information on the SC web site, as it includes geographic information. Finally, there is an increased number of thyristor failures in the Nelson River system, the AG will investigate to see if there is a pattern.

5.6 Tutorials in Bangalore

Prasher

Six tutorials were held prior to the WG meetings. These were attended by a large number of students and engineers, the response was beyond the organizers' imagination. He wished to personally thank the faculty: Planning Aspects of HVDC Systems/Brett Davies; Terminal Equipment/Victor Lescale; New Developments in HVDC and Power Electronics/Dietmar Retzmann; Harmonics/Jiang Lin (70 attending!); VSC Transmission/Bjarne Andersen; HVDC Controls/Georg Wild (52 attending). Based on this positive response it is hoped to see this activity carried forward to other places.

6.0 Working Group Reports

6.1 B4-38: Simulation of HVDC and FACTS

Huang

Hartmut Huang reported on behalf of Dietmar Retzmann, Report Part 1 will deal with Simulation tools and Application Examples; Report Part 2: will provide Guidance for HVDC Studies. The WG now includes 23 members. The target date for the final reports is early 2006.

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

This WG was initiated in 2002, and restarted at the Paris 2004 meeting, There have been two subsequent meetings, and three future meetings are scheduled. The WG met 3 days in Bangalore. The membership is 28, of whom 10 are major contributors, 6 are occasional contributors, and 2 contribute minimally or not at all. The non-contributors are gradually being removed. The final report will include case studies, a benchmark model for studies (nearly ready), and sample studies. The target completion date is the end of 2006. Bjarne requested documentation from the RMs on the connection of >50 MW wind farms to distribution or transmission networks. Marcio questioned if there was coordination with SC C6 (Distribution Systems and Dispersed Generation)? Bjarne has tried and will retry. Claudio Pincella will help with liaison with SC D2 (Information Systems and Telecommunication).

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

Edris

No report.

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

The Multiple Infeed Interaction Factor (MIIF) is a new matrix calculation indicating how a small voltage change at one bus results in a voltage change at another bus. The Danish systems show strong interaction potential whereas the Nelson River inverters indicate a much weaker interaction potential. Commutation failure studies have developed a methodology whereby critical contour lines for same percent voltage drop result in commutation failures. A multi-infeed CIGRE benchmark model is nearly finished. The WG progress has been slowed as they are studying new ideas, not reporting on existing work. Marcio commented that this was very nice work and the speed of progress was not a concern.

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

The WG charge is to determine the impact of the rapid development of power semiconductor technology on power systems. Silicon carbide semiconductors are considered as they would provide a significant reduction in losses. A big question is will there be modules replacing individual power semiconductors? The WG is also investigating trends toward new applications. They will contact other SCs for their input. In response to a question about preparing an introductory ELECTRA article, Dirk replied that this might be possible in 6 months. It was agreed that this would be interesting to readers.

6.6 JWG B4-42: Impacts of HVDC Lines on Economics of HVDC Projects

Graham

This joint WG was formed in 2004, and has been slow to get started. The impact of IGBT converters is of interest. There are three task forces, economics of DC lines (creating a matrix of power/length/kV; economics of converter stations (matching the above matrix); and one to integrate the previous two into a more concise report. (It was commented that environmental concerns are important, e.g. meteorological issues.)

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

Rashwan

Mohamed reported on behalf of Kirsten Faugstad, this was the first WG meeting. A key discussion point is how are utilities handling environmental concerns and what are the issues. The WG will distribute a questionnaire asking utilities what environmental issues they face. A second questionnaire will focus on planned systems – what has been their experience re environmental concerns when addressing licensing issues? The WG requests membership from China and India, where major new systems are being considered (positive response from both RMs).

6.8 JWG B4/B2-17, HVDC Converter Transformer Test Procedures

Fu

This was the third meeting of this Joint WG. They have reviewed IEC draft standard 61378. They have sent out a reliability questionnaire, and have received to date 11 of 22 responses. The data show a significant increase in the annual failure rate. The rate not as high as for conventional ac transformers but the impact is high. There was a detailed report on India failures including dielectric, thermal, and component failures. A task force will address specifications for HVDC transformers accounting for interactions with converter stations. All work/final report is expected to be finished for the Paris 2008 meeting. (An interesting question considers the effects of energy trading ; does the number of failures correlate to the number of reversals of power ? This is not clear now.)

Marcio noted that the Brazilian National Committee has produced a nice report on Series Capacitor-Commutated Converters (in Portuguese). He wants to have this work represent SC B4 and published as a technical brochure. (General agreement.)

Also, as reported by various Convenors, there should be a limit in the number of participants in the groups, since many members act solely to receive information and do not contribute to the work. Convenors are authorized to keep only those members who truly provide contributions.

7.0 Future Meetings

7.1 2006 Paris SC Technical Session

Szechtman

There were 26 papers accepted out of 36 offered. Seven are on new technologies and projects; 10 are on issues concerning projects; 9 are on the role of HVDC and FACTS to assist system performance. The Special Reporters are Mohamed Zavahir and Kent Soebrink. The B4 Technical Session will be Thursday Aug 31. New for 2006, Wednesday Aug 30 will be a poster session for all SC papers, and the authors are to be

present. In addition, the scheduling of contributions to the Technical Session will be held same day, in the same room. The Study Committee meeting will be Friday, Sept 1.

7.2 2007 SC Meeting in Japan **Hayashi**
Study Committee B4 has been invited to meet November 4-10, 2007 in the Kansai area together with B1 (Insulated Cables) and C1 (System Development and Economics). Working Groups will meet November 4-5, the SC will meet Nov 6. These meetings will be followed by a Symposium on Power System Planning and Asset Management under Deregulation. (This schedule is still tentative.) Preliminary approvals have been obtained, and the Technical Organizing Committee is being formed.

8.0 New Working Group Proposals **Soebrink, Szechtman**

There are a number of areas of interest: VSC transmission, life cycle assessment, education, dc land cables, technical performance, and many others. It is proposed to create the following three WGs:

- (1) Study the performance of TCSC systems and applications, including valve testing. (Carlos Gama as Convener)
- (2) VSC applications for bulk transmission: technical aspects (Bjarne Andersen) and economic aspects (Dirk Westermann)
- (3) HVDC for 800 kV applications (R. N. Nayak, Mohamed Rashwan).

Other WGs which are of interest include:

- (4) Telecommunications at long distances (perhaps incorporate into the 800 kV WG, include the Telecommunications SC too)
- (5) Valve standards at 800 kV; also standards for other components
- (6) 800 kV Economics.

The names indicated above will work with Kent and Marcio to establish terms of reference by the end of 2005 to present to the Technical Committee in 2006.

9.0 Reports from IEEE and IEC

9.1 IEEE **Woodford**
Working Group activities were described in detail. The WG Economics and Operating Strategies will now be a venue for discussion (no reports/guidelines/standards to be prepared). The Uno Lamm HVDC Award was presented to Michael Woodhouse from Areva.

9.2 IEC **Travin**
This report is from Subcommittee 22F, Power Electronics for Transmission and Distribution. The document IEC 60619 Edition 2, Performance of HVDC Systems with Line Commutated Converters, has been released. A number of other reports are in progress.

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

- CRIEPI Japan/Hayashi

- EPRI China/Zhang
- Electrotechnical Institute Russia/Ivakin

11.0 HVDC and FACTS Schemes Under Construction or Planned (Participants to provide electronic format reports with brief verbal summary, time permitting.)

- 11.1 Prasher: India present and future projects
- 11.2 Huamg: Siemens projects: Basslink (Australia-Tasmania), China, Neptune (US), various FACTS /SVCs
- 11.3 Borgen: NorNed project to proceed, 580 km submarine cable/700 MW
- 11.4 Jyrinsalo: Nordic TSO wishes to reinforce 5 interconnections, some HVDC; A new Fenno-Skan cable; a Finland-Estonia cable; series capacitors and an SVC to increase the ac grid capacity.
- 11.5 Pincella: Sapei (Sardinia-Mainland) is in the tender stage, 500kV/1000 MW/420 km with a maximum depth of 1600 m. There is consideration of other N-S interconnections in the Mediterranean (to North Africa).
- 11.6 Williamson: Inga – South Africa and Angola – South Africa, both 3-terminal systems. There is a huge generation capacity in the Congo River. Eskom is conducting research on 800 kV at higher altitudes, also there are bush fire and telecom issues. It is not possible to design the lines to not flash over.
- 11.7 Andersen: There is significant Western Isles Windpower. The Isle of Lewis to Scotland link (54% load factor) is on hold because of the Environmental Impact Statement. In Africa the Caprivi (Zambia-Namibia) link is 200 MW/800 km, 3 options are being evaluated including long-distance dc and back-to-back + long-distance ac.
- 11.8 Lescale: ABB projects: Estlink Estonia-Finland; NorNed will be a symmetric monopole system, it will not operate monopolar; Vizag India; 3 Gorges.

12.0 Operational Experiences of Existing HVDC and FACTS Schemes (Participants to provide electronic format reports with brief verbal summary, time permitting.)

- 12.1 Hayashi: Control system replacement in Hokkaido-Honshu; Shin-Shinano pole reconstruction; operational issues.
- 12.2 Prasher: Transformer problems were reported to JWG B4/B2-17; a ground electrode is in a high resistivity region, there are problems with the transfer from ground to monopolar metallic return. Otherwise they are very happy with the rest of the system
- 12.3 Borgen: they have experienced a transformer fault in Skagerak pole 3 (insulation failure) this has reduced the trading capacity by 50%; there have been Fenno-Skan cable faults caused by ice movement, this appears to be a manufacturing fault.

13.0 Other Business

None reported.

14.0 Adjournment

Chairman Marcio Szechtman adjourned the meeting at 6:15 p.m. with thanks to all who participated.

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

Willis F. Long

October, 2005