

**CIGRE STUDY COMMITTEE B4 - HVDC AND
POWER ELECTRONIC EQUIPMENT**
The 42nd Session Regular Meeting
Wednesday October 31, 2007
Osaka, Japan

MINUTES OF THE MEETING

Chair: Marcio Szechtman
Secretary: Willis Long

1.0 Opening Comments

Szechtman

Chair Marcio Szechtman opened the meeting at 0900, there were 48 persons in attendance. He acknowledged the hospitality of the Japanese National Committee and their sponsorship of the meetings. All arrangements are excellent, and we appreciate the hard work of all. The Japanese Regular Member of SC B4 and our host, Masahiro Takasaki, stated that it was their pleasure to welcome us to Japan, this was an historic opportunity as it is the group's second visit (previously as SC 14, in 1973). There followed introductions of attendees. Regular members not attending without apologies included V. Ramakrishna/India and Alberto Giorgi/Italy. Attendance at this meeting is as follows:

Attending Regular Members/Representatives

Australia/NZ	Nalin Pahalawaththa
Brazil	Sergio Espirito Santo
Canada	John McNichol (representing Mohamed Rashwan)
China	Hong Chao
Denmark	Poul Damgaard
France	Apologies from Samuel Nguéfeu
Finland	Jussi Jyrinsalo
Germany	Hartmut Huang
India	Not attending
Italy	Not attending
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	Apologies from Dirk Westermann
UK	Norman MacLeod
US	Stig Nilsson

Study Committee Officers

Chair	Marcio Szechtman
Secretary	Willis Long

Observer Members

Austria	Klaus Papp
Mexico	Jesus Gonzalez

WG/TF Conveners, AG Members		Guests	
Australia/NZ	Mohamed Zavahir	Canada	Murray Bennett Randy Wachal Dennis Woodford
Canada	Brett Davies Ani Gole Narinder Dhaliwal	Chile	Boris Munoz Juan Araneda
China	Guangfu Tang	China	Zhiyuan He
France	Milan Saravolac	Italy	Ugo Piovan
Norway	Kirsten Faugstad	Japan	Shoichi Irokawa Isao Iyoda Akira Kawaguchi Naotaka Okada Muraio Takeru Teruo Yoshino
UK	Bjarne Andersen	Korea	Heo Wooheng
US	Ivars Vancers	UK	Changjiang Zhan
		US	Duane Torgerson

2.0 Minutes of Paris 2006 Meeting

Long

The minutes were distributed following the September 1, 2006 meeting in Paris; the minutes and reports are on the SC web site. The minutes were accepted without revisions. *(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 Technical Committee Award for 2006 has been given to Kent Soebrink and Hakon Borgen for their work as Conveners and Special Reporters. The new Technical Committee Chair is Professor Klaus Froelich, Switzerland. He wants to have the SCs working on technological projects, for instance UHV, where it would be appropriate for several SCs to cooperate technically. This might also include the IEC for test procedures and designs. Marcio should be able to report more details in Paris in 2008. And, Bjarne Andersen has named next chairman of Study Committee B4, effective at the close of the 2008 meeting in Paris. Congratulations were extended to Bjarne.

4.0 Other Announcements

Szechtman

This meeting will feature a special session on converter transformers. Milan Saravolac was acknowledged as convener of Joint Working Group A2.28/B4, our SC appreciates the cooperation with SC A2 on this important topic.

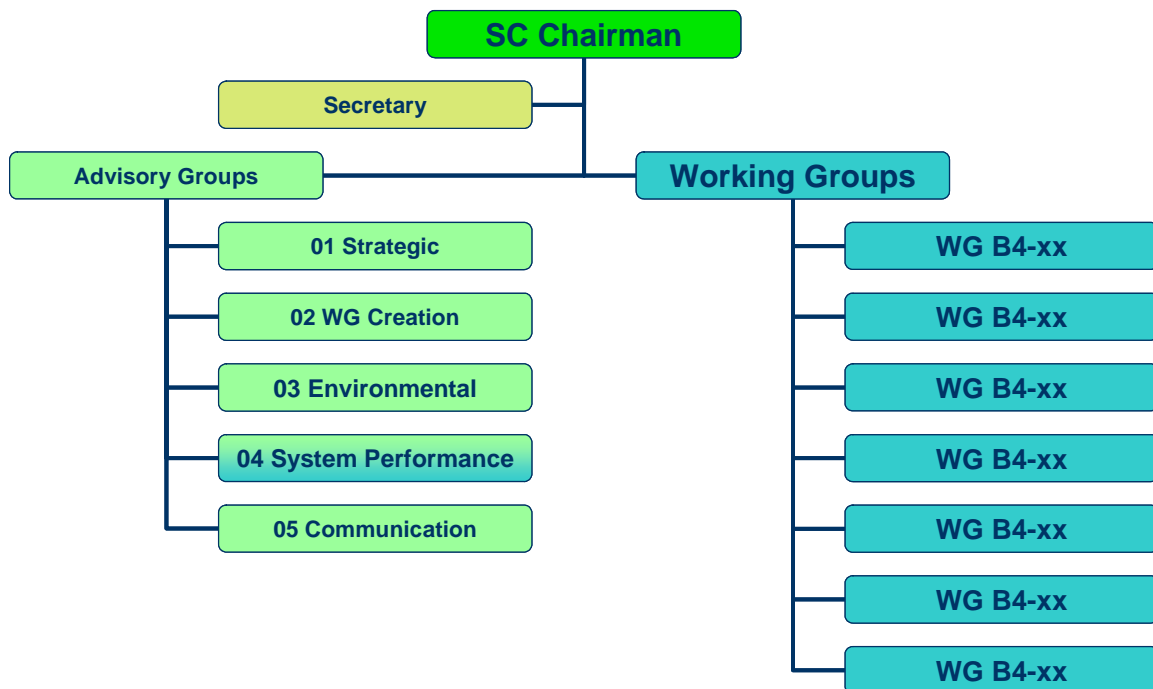
5.0 Strategic Plan and Advisory Groups

5.1 AG 01: Strategic Advisory Group

Zavahir

There were 13 attending the AG meeting. Mohamed reviewed the AG1 responsibilities and strategic objectives. One can view the AGs as icebreakers, which clear the road for the WGs. The development of a Skill Matrix is an action item, this will aid in staffing new WGs. It is recognized that the development and presentation of tutorials is important. We need to provide HVDC and power electronics equipment information to the public as well as to our technical colleagues. A 5th AG has been added, focusing on Communication. Jussi Jyrinsalo will chair the AG, membership includes the SC Webmaster, Narinder Dhaliwal.

Therefore, the current structure of SC B4 can be outlined as:



5.2 AG 02: Working Group Conception/Guidelines

Szechtman

This Advisory Group's task is to identify areas where new Working Groups should be formed. It is expected that the aforementioned Skill Matrix will assist them in finding active members for new WGs.

5.3 AG 03: Environmental Issues

Faugstad

See the report of WG B4-44.

5.4 AG 04: HVDC System Performance

Vancers

This group has been in existence since the 1970s. Their task is to accumulate HVDC system performance data and present this data in a paper in Paris. In 2005 the AG

received 30 reports, in 2006 27 reports. The AG also maintain the Compendium; CD copies are available from the AG. The AG has convened a task force on converter transformer failures. To this end they have circulated a survey, and intend to make that data compatible with the performance reports. Marcio commented that we are the only SC that collects performance data. The HVDC market is expanding, this will increase the amount of data to be collected by the AG and there will be a need to involve more AG members. It is important to watch the converter transformer failure data. Andrew Williamson presented a list of schemes absent from the Compendium (Basslink, Cross-Sound, Higashi-Shimzu, Lamar, Moyle, Three Gorges, etc.) Various meeting attendees volunteered to try to obtain the missing information. Nalin Pahalawaththa suggested soliciting data in a different format for VSC HVDC systems. He also raised the question of including performance data from other FACTS devices. The number of SVCs in operation is very large and some performance data is being collected by IEEE.

5.5 AG 05: Communication

Jyrinsalo

SC B4 WGs are expected to prepare Electra papers and brochures. An earlier survey showed interest in new WGs but few volunteers to do the work. SC B4 has had a number of successful tutorials with excellent attendance (55 at the tutorial held in conjunction with this meeting). Jussi would like to see 2 tutorials per year especially in new locations. There are many communication opportunities and needs. We should have new website information, and a target group survey. Narinder Dhaliwal stated that on the SC web site under Events one will find minutes/reports from last few years. There are presently limitations from CIGRE on file size, he asks that photos be lower resolution so as to fit. The website includes links to suppliers' websites. There are instructions to the WGs on how to use the WG areas, we need WGs to use their areas so we can ask for improvements.

6.0 Working Group Reports

6.1 B4-34: Capacitor Commutated HVDC Converters

Barros

Marcio reported that convener Joao Barros received a few comments in the 60 day review period, they are presently being addressed and the final documents to be sent to Paris are nearly finished. This was originally a Brazilian WG expanded by 3 SC B4 members. Because of this cooperation it has had a short period of activity.

6.2 B4-38: Simulation of HVDC and FACTS

Gole

Ani Gole reported limited activities this past year. The WG has reviewed the study guide outline. The guide illustrates how to use modeling and simulation tools for HVDC/FACTS for various stages of a project. There is a wide range of tools and ample validation, however study examples are lacking. Marcio requested that a draft document be ready for Paris. He also noted that the WG did not meet here in Japan – this would have been important for local people. Stig Nilsson noted that reliability studies have been deleted from the work plan; it is important to identify failure modes.

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

Andersen

Bjarne reported that they are quite close to having a final document, it is expected by the end of January. The WG can claim 12 meetings but 6 were telephone meetings relating to studies. The WG includes 17 members, 10 major contributors and 7 occasional contributors. (They had 28 at one time.) The report includes six case studies. It will also have a bench mark model, a 300 MW wind farm located at the end of a long cable. Studies using this model are nearly complete and that will complete the report. Marcio asked if the report is directed at a non-technical target groups? Bjarne responded that it is a technical document.

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

Edris

Bill Long reported on Aty's behalf. The WG did not meet in Japan. The document is in its final stage, and submission for the 60 day review is expected by end of 2007.

6.5 B4-41: Systems with Multiple HVDC Infeed

Davies

Brett Davies reported that they are missing just 2 System examples, and anticipate the final report to be available for review by the end of 2007. There have been a recent Electra article and also a paper at this symposium. Marcio expressed thanks for the Electra article and the WG's excellent progress. Hong Chao commented that there are recent multiple infeed studies in South China, might they be included in the report? Marcio said they should be included, provided that Chao would be able to make this information available to Brett, in English, by mid-January.

6.6 JWG B2.17/B4/C1: Impacts of HVDC Lines on Economics of HVDC Projects

Graham

Marcio reported that there are three task forces: economics of converters, economics of HVDC lines, and integration of HVDC resources. The work should be finished in 2008.

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

Faugstad

Kirsten Faugstad noted that a questionnaire on ground return environmental experiences received 20 responses, and was the basis for a paper for the Osaka Symposium. The next activity is to collect information for an environmental database (especially for ground return). As the WG is to focus on developing planning guidelines for dealing with environmental issues, they request additional members. Marcio explained that the SC created an Environmental Advisory Group because environmental issues are a permanent concern. We began with this WG to get started, the intent is to then have additional WGs. Stig asked if we can invite other disciplines? Marcio said that Cigre has established SC C3 as the Environmental SC and at their beginning there was not great interest in joint WGs. Perhaps we can contact them in near future, when they are more established.

6.8 WG B4-45: Technological Assessment of 800 kV HVDC Applications

Nayak

Hartmut Huang reporting that there have been three meetings to date, a final meeting is set for Paris in 2008 to review the final version of the report. The WG is on schedule. The convener is from India, and there are two members from China, so countries with high 800 kV interest are represented. The report will include insulation coordination for different main circuit arrangements, control and protection, transmission lines, station layouts, design examples, and testing requirements. Marcio added that two previous WG documents dealing with 600 kV and above are useful for this WG. There has been some IEC criticism that HVDC voltages are not standardized but this is not true as we agree on 800 kV. Victor Lescale noted that there will be different BILs for different converter configurations, thus there is the ability to optimize the design.

6.9 WG B4-46: Voltage Source Converter (VSC) HVDC for Power Transmission – Economic Aspects and Comparison with Other AC and DC Technologies **Westermann**

Hartmut Huang reported for Dirk Westermann. The WG has six members and needs more. They have met once, and are focusing on the VSC as an embedded part of bulk power systems. They expect to develop guidelines to perform economic assessments as applied to typical application areas. Where is VSC technology best applied? Bjarne Andersen mentioned a need to agree on one unique name. Marcio proposed VSC HVDC. This led to a discussion of terminology: IEEE uses voltage-sourced converter (as proposed originally by Laszlo Gyugyi) not voltage source converter. Marcio has the opinion that the name of Voltage Source Converter is the appropriate one for Cigre; this was supported by Stig and Yanni, among others.

6.10 WG B4-47: Special Issues in AC Filters **Shore**

Norman MacLeod reported that this is an updating of the report from an earlier WG. They are examining ratings of filters in the presence of background harmonics, specifications of network impedance, current-based harmonic interference criteria (IT), and ac/dc harmonic interaction. The group includes 17 members. Because of the members' heavy work load just now the final document is expected at the end of 2008.

6.11 WG B4-48: Testing VSCs for HVDC Applications **Tang**

Guangfu Tang reported work on developing a test philosophy and procedures for testing of components (dielectric, operational). They are proposing a revised title: Components Testing of VSC System for HVDC Applications. The WG will have a relationship with IEC WG 15, Electrical Testing of VSC Valves for HVDC Transmission. The WG now has 9 members and expressed a need for utility members. They expect the report to be finished in September, 2009. Marcio commended Tang for the excellent work to date.

Special Session on HVDC Transformers

6.12 HVDC Converter Transformer Failures Survey **Dhaliwal**

Narinder Dhaliwal reported that their survey resulted in 29 responses: 12 systems reported no failures, 7 systems reported single failures, 11 systems reported prevent failures, and 3 systems reported multiple failures. Many large systems were not

reporting. The majority of single failures are in valve windings, and prevent failures are usually in tap changers. Single-phase 3-winding transformers seem to have the highest failure rate, likewise larger transformers. The IPP system has 21 years of service, 1-phase 3-winding transformers, and no failures. Is it a good design or is it because it is operated at less than its maximum rating?

**6.13 Transient and Steady State Electric Field Distribution,
800 kV Transformers**

Piovan

Ugo Piovan presented experimental data for oil/pressboard insulation for the time to reach dc steady-state stress distribution after voltage reversal. The key question is what test voltage waveform and oil will best approximate the actual stress distribution? Is a higher than normal longer time dc stress a valid test for a lower stress shorter time application? Oil conductivity has a large influence on stress distribution, and oil conductivity is affected by ageing. Also, new oils can differ markedly.

**6.14 JWG A2.28/B4: Converter Transformer Test
Procedures**

Saravolac

Milan Saravolac stated that the JWG has had 7 meetings since 2004. There are 17 members and a broad distribution. The performance data from 2005-2006 are better than from 2003-2004, perhaps the result of more careful monitoring of oil condition. The forthcoming design review guide is based on the 2002 Cigre document, it will be available after the 2007 Osaka meeting. The JWG has agreed to investigate test procedures which would be more appropriate for in-service conditions (therefore the Technical Brochure will comprise two main parts: Design Review and Improvement of Test Procedures). An unresolved question: is there a need for a voltage polarity reversal test? Thermal design also needs to be investigated. Milan expressed apologies to persons not permitted to join their closed meeting at Osaka, the JWG felt that they needed to concentrate on progress. They expect have a report and a tutorial available so as to conclude their work by the Cigre 2008 Session.

7.0 Future Meetings

7.1 2009 SC Meeting in Norway

Meisingset

Magne Meisingset announced that the SC will meet June 6-11, 2009 in Bergen and Ullensvang, Norway. Main sponsorship is provided by Nordic TSOs, and also consultants, research institutions, manufacturers. Time will be allocated for Working Group meetings, the Study Committee meeting, a Colloquium, and a technical visit to the Kollsnes rectifier station which supplies power to an offshore oil platform.

7.2 2011 SC Meeting in Australia

Pahalawaththa

Nalin Pahalawaththa extended an invitation from the Chairman of the Cigre Australian National Committee. Meetings would be held in Australia, which currently has three dc links; in addition, there is one in New Zealand. Incoming SC Chair Bjarne Andersen said

he welcomes invitation without reservations. Marcio accepted the invitation on behalf of the SC.

7.3 2008 Meeting in Paris

Szechtman/Long

According to the Cigre rotating criteria the Study Committee B4 meeting will be held on Wednesday, August 27, and the B4 Technical Session on Friday, August 29. The list of accepted papers (30 in total) is now on the SC web site. The Special Reporters have been selected, they are Yanny Fu and Narinder Dhaliwal. Thanks to both of them for accepting this major responsibility.

8.0 New Working Group Proposals

TCSC Performance

Nilsson

Stig Nilsson led this discussion. TCSCs have almost 15 years of experience from R&D to today's commercial applications. It is timely to examine this technology. The WG would examine reasons for installations, specifications, and performance in a case by case study. There is a Brazilian WG looking at TCSCs in that country, and we should coordinate with them. The WG terms of reference were approved for submission to the Technical Committee.

Other

Szechtman

The SC needs to nominate a representative as liaison to WG C2-13, Voltage and Var Support. Krystov Madajewski accepts this responsibility.

9.0 Reports from IEEE and IEC

9.1 IEEE

Woodford

Dennis Woodford reported that the 2007 Uno Lamm HVDC Award was presented to Peter Lips, and the Nari Hingorani FACTS award was presented to Ani Gole. There is a new subcommittee, Integration of Renewable Energy into T&D Systems. There is a working group in the Substations Committee looking at performance of SVCs. The March-April, 2007 issue of IEEE/PES Power and Energy Magazine was devoted to HVDC technology. There were five articles and an opinion column, Bill Long and Stig Nilsson were guest editors.

9.2 IEC

Travin

A written report can be found in the SC web site among reports from this meeting.

10.0 Reports from Other Committees or Organizations (Reports on the SC web site)

Manitoba HVDC Research Centre et al/Ani Gole: Utilizing river flows for remote communities via submerged turbine-generator sets, 400 Hz supplied to VSC rectifier-inverter, convert to 60 Hz using power electronic building blocks.

11.0 Tributes to Friends Lost in 2006/2007

To Mr. Alain Le Du
To Prof. John Reeve
To Mr. Brian Rowe

by Philippe Adam
by Bill Long
by Bjarne Andersen

12.0 HVDC and FACTS Schemes under Construction or Planned (Brief presentations with complete reports available on the SC web site)

12.1 Sergio Espirito Santo/Brazil: a 6,400 MW N-S transmission system is planned and may be HVDC.

12.2 Poul Damgaard/Denmark: There is mercury arc valve replacement at Konti-Skan1, a new Store Baelte 600 MW link, and studies for the addition of a 4th pole for Skaggerak.

12.3 Jussi Jyrinsalo/Nordel: The Nordic TSOs are considering 5 grid reinforcements planned with at least 3 being dc cable. They will be adding FennoSkan 2, creating an unsymmetrical bipole. Nordel is studying SSO and nuclear plants, and also a large SVC to damp power oscillations. This will involve using phasor measurement units (pmu measurements).

12.4 Tae-kyoo Oh/Korea: A new cable link (100 km) to Cheju Island is planned, probably 250 kV.

12.5 Magne Meisingset/NorNed Cable: The cable failed during testing, it should be in operation by the end of 2007. The link is 580 km, +/- 450 kV, with +/- 6 pulse groups.

12.6 Juan Araneda/Chile: Transelec's Aysen-SIC transmission project will deliver hydropower from the South 2000 km to Santiago, 2300 – 2860 MW, 500 or 600 kV, construction to begin in 2009. The dc/ac decision has not yet been made.

12.7 Hartmut Huang/Siemens: The Neptune (New Jersey-Long Island) link was commissioned this summer. There is a 500kV/2500 MW project in India (target 2009) and an 800 kV/5000 MW project in China (target 2010). Other projects reported were BritNed, TransBay (San Francisco VSC, 400 MW +/- 200 kV), Spain-Mallorca.

12.8 Victor Lescale/ABB: The Sapei cable project will connect Italy with Sardinia, NorNed (reported earlier, see 12.5), 3 Gorges (3,000 MW) has been accepted, the Outaouais btb in Canada has extreme noise constraints, the Apollo valves are being replaced, Estlink has just finished blackstart testing, Sharyland is undergoing testing in the US, other upgrades mentioned. The 800 kV test circuit is now running.

12.9 Norman MacLeod/Areva: The HVDC de-icing rectifier in Hydro Quebec is being finished, also noted are the Saudi-Emirates and China-Russia BTB links.

12.10. David Alvira/Spain: The Spain-Baleares Islands (Mallorca) dc link will use a return cable to avoid environmental discussions, the station on Mallorca will be entirely indoors, the link will control the Mallorca frequency.

13.0 Operational Experiences of Existing HVDC and FACTS Schemes (Brief presentations with complete reports available on the SC web site)

13.1 Poul Damgaard/Skaggerak: Link 3 had 4 transformer failures, and was out of operation 42% of the time. They must have spares.

13.2 John McNichol/Nelson River: one valve had 48 thyristor failures.

13.3 Lev Travin/Russia: Status of HVDC and FACTS projects.

14.0 Other Business

There was no other business

15.0 Adjournment

Chair Marcio Szechtman extended thanks to Dr. Naotaka Okada for his good assistance with the reports and to Dr, Masahiro Takasaki for all of the excellent arrangements.

Marcio adjourned the meeting at 1730.

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

Willis F. Long

December, 2007