

**CIGRE STUDY COMMITTEE B4 - HVDC AND
POWER ELECTRONIC EQUIPMENT
Friday August 31, 2012
Paris, France**

MINUTES OF THE MEETING

Chair: Bjarne Andersen

Secretary: Stig Nilsson

Note: Reports presented at the meeting can be found on the SC B4 web site <http://b4.cigre.org>, go to Events and then Cigre Events, they are indexed according to the sections/subsections listed below.

Attendance at this meeting was as follows:

Attending Regular Members/Representatives:

Australia/NZ	Nalin Pahalawaththa	Korea	Tae-kyoo Oh represented by Bong Soo Moon
Austria	Alexander Grisenti	Netherlands	Kees Koreman
Brazil	Sergio Espirito Santo	Norway	Magne Meisingset
Canada	John McNichol	Russia	Grigory Tsfasman
Denmark	Poul Damgaard	South Africa	Thomas Magg
Finland	Pasi Yli-Salomäki	Spain	Eduardo Prieto
Germany	Carsten Bartzsch	Sweden	Victor Lescale represented by Abhay Kumar
India	R. P. Sasmal represented by Y.K. Sehgal	UK	Norman MacLeod
Italy	Antonio Ardito	USA	Hamid Elahi
Japan	Masahiro Takasaki		

Absent Regular Members:

China	Hong Chao	Romania	Constantin Bulac
Egypt	Awad Mohamed Mohamed	Switzerland	Sven Klaka

Study Committee Officers

Chair Bjarne Andersen
Secretary Stig Nilsson

Observer Members Attending:

France Géraldine Real represented by Johan Loncle
Ireland Cormac McCarthy
Poland Michal Kosmecki

Observer Members Absent:

Algeria Nadia Oulldali
Argentina Jorge Luis Agüero
Chile Gabriel Parada Olguin
Greece Athanassios Koronides
Saudi Arabia Mohamed Shaikh Al-Sitri
Slovenia Rafael Mihaloc

AG and WG Conveners Present

AG B4.01 Bjarne Andersen* UK
AG B4.04 Narinder Dhaliwal Canada
WG B4 - 38 Jose Jardini Brazil
WG B4 - 49 Stig Nilsson* USA
WG B4 - 51 Yanni Fu Netherlands
WG B4 - 53 Dan Kell Canada
WG B4 - 54 Les Recksiedler Canada
WG B4 - 55 Hamid Elahi* USA
WG B4 - 56 Philippe Adam France
WG B4 - 57 Randy Wachal Canada
WG B4 - 58 Kerstin Linden Sweden
JWG B4/B5-59 Kees Koreman* Netherlands
WG B4 - 60 Norman MacLeod* UK
WG B4 - 61 Jingxuan (Joanne) Hu Canada

*Listed above.

WG Conveners Absent

WG B4 - 47 Nigel Shore UK

Guests

Australia	Les Brand	Germany	Dusan Povh
	Marian Piekutowski		Hartmut Huang
Brazil	Carlos Gama		Herbert Gambach
	John Graham		Peter Lips
	Manfredo Lima		Dirk Westermann
	Marcio Szechtman	Ireland	Dilip Rozekar
	Wo Wei Ping	Japan	Salim Temtem
Canada	Bruno Bisewski		Isao Iyoda
	Jeff Coady		Takehisa Sakai
	Murray Bennett		Takeru Murao
	Rao Atmuri		Yoshinori Makino
	Vijira Pathirana	Korea	Jeong Woon Shim
	Mohamed Rashwan		Yong Ho Chung
China	Guangfu Tang	New Zealand	John Gleadow
	Junzheng Cao		Peter Griffiths
Denmark	Jesper Hjerrild		David Monk
	Kent Söbrink	Norway	Hana Assefa
	Peter Christensen	Russia	Lev Travin
	Philip Kjaer	UK	Carl Barker
		US	Mark Reynolds

1.0 Opening Comments Andersen

Chair Bjarne Andersen opened the meeting at 09:00. The attached revised [Agenda](#) for the meeting was shown. There were 72 persons in attendance.

The traditional introduction of members, observers, working group (WG) conveners, and guests followed. Bjarne Andersen presented a list of people for [special recognition](#). He thanked outgoing members and observers and welcomed new members and observers, who will begin serving following the conclusion of the Paris 2012 CIGRE Session.

Bjarne Andersen recognized Professor Jose Jardini, Brazil Magne Meisingset, Norway, the 2012 Technical Committee Awards recipients from SC B4. He also recognized Stig Nilsson, the secretary of the SC, and Dr. Bill Long, the past secretary of the SC, who received the US National Committee Philip Sporn award in 2012. Stig Nilsson also received the IEEE PES FACTS award in 2012. Bjarne Andersen himself received the Uno Lamm IEEE PES award.¹

2.0 Minutes of Melbourne 2011 Meeting - Nilsson

The minutes were approved as written. The minutes are published on the SC website; see <http://b4.cigre.org/Events/Cigre-events/Archive> for a copy of the minutes.

3.0 Technical Committee Activities Report - Andersen

3.1 – 3.3: Bjarne Andersen updated the SC on the activities of the Technical Committee (TC). The TC activities report is attached. Klaus Fröhlich has just been elected as the new President of CIGRE. Mark Waldron, former Chairman of SC A3 has just replaced Klaus Fröhlich as TC Chairman and Yves Maugain has taken over from Philippe Adam as Secretary of the TC. Bjarne also updated the SC on other B4 activities and discussed the poster session, which was being run in parallel with the SC meeting. It was unfortunate but the schedules could not be changed to avoid the parallel activities.

3.4 Web Site

One of the key TC activities is to complete the work on the new CIGRE web site, which has been rolled out prior to the Paris meeting. Bjarne thanked Narinder Dhaliwal for his work in keeping the web site content up to date as long as he could remember. This role has now been taken over by Eduardo Prieto, who presented a “walk-through” of the [new web site](#), which is accessible using <http://b4.cigre.org>. **Note that there is no longer any www in the new name.** It was noted that the new website has a limit of 20 Mbytes for each individual file to be uploaded to the site.

¹ These are awards presented by the Power Engineering Society of IEEE.

Now that the website is operational, the SC has to provide the content. Nalin Pahalawaththa has been working with Narinder Dhaliwal and Eduardo Prieto plus AG01 members to develop a plan for what to feed into the new web site. He presented a brief summary of the web site [content plan](#) that has resulted from these deliberations. There will be both public and areas private for use by the SC members, observers and WGs. The private SC areas should be accessible by the regular members of the SC and the observers.

Action: The detailed plan will be sent out to the RMs and Observers by Nalin for comments and feedback.

Members and Friends of SC B4 will be asked to volunteer to help provide and manage the information for the website. The invitation will be issued when the consultation re the website has been completed.

4.0, Advisory Groups, Strategic and Action Plan

4.1 AG 01: Strategic Advisory Group

Bjarne Andersen presented a new organization [chart](#) for the SC. The chart shows that in addition to AG01 and AG04, two new advisory committees have been established.

- AG02 has been charged with the task to help co-ordinate the work performed by the WGs studying DC Grid issues. AG02 will be chaired by Mohamed Rashwan.
- AG03 has been formed to develop the new web site. AG03 will be chaired by Nalin Pahalawaththa. Eduardo Prieto, as the SC B4 Web Master will be within AG03.

4.1.1 Report from TF on “Recommendations of DC voltages for HVDC Grids”

Marcio Szechtman chaired a Task Force studying the pros and cons and possible approaches towards development of standard dc voltage levels for HVDC Grids. He [presented](#) the results of the Task Force’s deliberations. The task has not yet been concluded. Three options for taking the task forward were presented, as follows:

- Continue the work till higher degree of internal consensus is reached;
- Summarize the common points agreed upon and write an internal report; or an Electra paper.
- Based on a preliminary text produced by the TF, propose a JWG with SC C1 and C2 to go further in the subject, with the objectives to define a set of recommended DC voltages (including ranges, ampacity etc.) and to evaluate topologies and code requirements for DC grid applications. The JWG should also analyze the economic impacts and other benefits or drawbacks from this recommendation. The work needs to incorporate planners and operators viewpoints.

Bjarne Andersen urged the members of the SC to consider recommended dc voltages for HVDC Grids. Many organizations, including ENTSO-E and IEC are moving towards such standardization. If CIGRE could recommended voltages, and associated range and insulation

levels, were proposed for HVDC Grids, then these organisations would take CIGRE's work into account. Similarly, anyone planning a point to point HVDC scheme would have a choice of using one of these voltages for his scheme, thereby increasing the likelihood of being able to connect his scheme to a potential future HVDC grid, even though there could be no guarantee that doing so would be a straight forward process (since many other aspects are also important). Bjarne felt that too many voltage levels have been proposed by the TF, and that the voltages are too close together. He suggested that some rethinking might be needed.

Mohamed Rashwan stated that the DC grid work is what is driving the need for standards. The VSC technology is the driving issue.

Carsten Bartzsch stated that cables for up to 600 kV DC are available.

It was also noted that in AC systems, the ratio between standard voltage levels are not really the square root of 3. 380 kV has become 400 kV; 500 kV has increased to 550 kV etc.

DC cable ratings of 320 and 500 kV have been driven by the cable technology. The cable ratings might in fact be the real driving force since a lot of effort is required to qualify a new cable design. Dennis Woodford expressed the view that since all VSC systems include cables, 320 kV would have to be one of the standard dc voltage levels.

Bjarne asked if there was any opposition to him proposing following option 3 and initiating discussions of a JWG with SC C1 (and possibly SC B1) to deal with the subject. No objections were raised.

4.2 AG 04: HVDC System Performance

Bruno Bisewski presented the [AG04 report](#) on behalf of Narinder Dhaliwal. One of the problems encountered by AG04 is the lack of participation from the owner/operators of dc systems. In particular, reports from China are needed. Also, the compendium listing DC systems around the world is not up to date beyond 2007. Assistance from the suppliers is needed to get the project listing up to date. Bjarne Andersen urged the RM from China to assist in obtaining performance reports from China. It was also noted that IEEE has a listing of dc projects, which might be useful to AG04 too.

Post Meeting Note: Anyone willing to lead or participate in the task of bringing the Cigre Compendium up to date is asked to contact Bjarne.

The definitions for performance information is included in a Technical Brochure (TB). The changes to the performance report form that were made to include VSC systems will require a change to the TB or a new TB number.

Action: Bjarne Andersen will get the information from CIGRE Paris and let AG04 know if a new TB number is needed or the old TB can be revised.

The transformer survey was not included in the report. This is needed. Narinder will be asked to supply this information. It was noted that the problems are not necessarily associated with the oldest projects but with some projects in a specific age category.

4.3 TF on review of existing Technical Brochures to determine the needs for updates

Dirk Westermann reported on the efforts of his ad hoc committee's [review of old TBs](#). It was felt that 2 out of 11 TBs need to be updated. A more in-depth review of the TBs will be undertaken by the Volunteers, to identify the TBs for which new Terms of References should be produced to enable WGs to perform the update work.

4.4 Strategic Plan

The existing strategic plan is listed in the SC web site; see <http://b4.cigre.org/Technical-activities/Strategic-Plan> for a copy of the plan. The plan is due to be re-evaluated, and potentially re-issued in 2015.

4.5 Action Plan

John McNichol presented the latest draft of the revised [action plan](#). John described the organization of the plan and requested feedback from the SC Members and Observers.

Action: The revised action plan will be sent out to the RMs and Observers in a few weeks for comments. All RMs and Observers are requested to review and respond.

5.0 Working Group Reports

Bjarne Andersen recognized the WG's that have [completed](#) their assignments and thanked the conveners for their leadership efforts. This included:

- JWG B4/B2/C3-50, Professor Jardini: Electric Field and Ion Current Environment of HVDC Transmission Lines.
- WG B4-44, Kirsten Faugstad: HVDC Environmental Planning Guideline. The TB is held up in CIGRE's printing cycle.
- WG B4-46, Dirk Westermann: Voltage Source Converter (VSC) HVDC for power transmission – Economic Aspects and comparison with other AC and DC technologies

5.1 [WG B4-38](#) : Simulation of HVDC and FACTS – Jardini

Work is actively proceeding towards the completion of this WG, with the draft TB being ready for the 60 day review before the end of 2012.

5.2 [WG B4-47](#) : Special Issues in AC Filter Specifications for HVDC – Norman McLeod reporting for Nigel Shore.

Work is proceeding only very slowly, but Nigel is hoping to provide a draft TB for the 60 day review before the end of 2012.

5.3 [WG B4-49](#): Performance Evaluation and Applications Review of TCSC Devices – Nilsson

The report has gone through the 60 day review and has been revised as necessary and is now awaiting the SC Chair's review.

5.4 [WG B4-51](#): Study of Converter Voltage Transients Imposed on HVDC Converter Transformer – Fu/Dhaliwal

The question was raised if we should approach SC A2 with a proposal for a new JWG. The consensus was that such a request would be premature.

5.5 [WG B4.53](#): Guidelines for procurement and testing of STATCOMs – Kell

Dan Kell stated that the WG has not sent out any surveys but is attempting to obtain the information without resorting to surveys. Kees Koreman asked if the results can be applied to other components. Dan Kell responded by stating that some of the results can be applied but not all.

A question was asked if the reasons for choosing STATCOM over the alternatives were addressed by the WG. Dan Kell stated that this has not been covered in detail.

5.6 [WG B4.54](#) Guidelines For Life Extension of Existing HVDC Systems – Les Recksiedler.

Bjarne thanked Les for taking over from Sasmal, who has recently been promoted within Power Grid India, and is now deeply involved in the investigations of the recent major power system disturbances in India.

The WG is going through the draft document and eliminating overlaps.

5.7 [WG B4.55](#): HVDC connected Wind Power Plants- Elahi

Hamid Elahi reported that the WG is trying to include system information but finding that information is difficult to obtain because of proprietary information barriers. Bjarne Andersen requested assistance from the manufacturers to obtain the needed information. Abhay Kumar stated that off shore dc grids do not have any users connected. It may not have to meet IEC standards in regards to for example harmonics. Hamid stated that the objectives of the work are to give the owners/operators the highest degree of flexibility. To accomplish this, the WG needs to understand the systems and their performance requirements.

Dan Kell expressed concern over the overlap between B4.55 and B3.36, of which Dan is a member. B3.36 will attempt to minimize the overlap, which has to be resolved by the people involved in the WGs. Bjarne Andersen will participate in the discussions between the two groups.

5.8 [WG B4.56](#) Guidelines for the preparation of “connection agreements” or “Grid Codes” for HVDC grids – Adam

Philippe Adam reported that there is an ENTSO WG active in the same area. He will try to

coordinate the work of B4.56 WG with this WG. Hamid Elahi requested to be included in the coordination effort.

5.9 [WG B4.57](#): Guide for the development of models for HVDC converters in a HVDC grid – Wachal

5.10 [WG B4.58](#): Devices for load flow control and methodologies for direct voltage control in a meshed HVDC Grid - Lindén

Kerstin Lindén was asked about the status of the WG B4.52 report. She stated that she hoped the report would be through final edits by the end of the year.

Kerstin Lindén indicated that the models developed by the WG will be flexible. She also recognizes that other WGs will have to adjust the models to fit their own needs.

5.11 [JWG B4/B5.59](#): Control and Protection of HVDC Grids – Koreman

Kees Koreman stated that the WG is at least for now focusing on the N-1 reliability criteria and not pursuing N-1-1 or N-2 contingencies.

5.12 [WG B4.60](#) Designing HVDC Grids for Optimal Reliability and Availability performance – MacLeod

5.13 [WG B4.61](#) General Guidelines for HVDC Electrode Design - Hu

Joanne requested help from the SC members to obtain information about electrodes built after the year 1997.

Action: RMs and Observers to contact Joanne, if there are HVDC schemes with electrodes built since 1997 in their Country.

5.14 [JWG C4/C1/B4-604](#) Influence of Embedded HVDC Transmission on System Security and AC Network Performance – Sebastian Henry

No report given.

6.0 Future Meetings

6.1 [2015](#) India Meeting - Y.K. Sehgal

The location for the 2015 SC meeting will be Agra, India. The invitation was received earlier this year and sent to the RMs for electronic vote. The invitation was accepted by a clear majority of the SC members.

6.2 [2013](#) Meeting in Brazil – Santo

Sergio Santo presented the plans for the 2013 meeting in Brazil, which will be held between September 28 and October 4, 2013. Information about the meeting will be posted on

www.cigre.org.br/SCB4-2011. (The link was at the time of the meeting not operational but will be available in the near future.) The SC meeting with WG meetings and a colloquium will be held in Brasilia. Information about [Brasilia](#) was presented. Information about what to consider before going to [Brazil](#) was also presented.

The final part of the planned meeting will be a visit to the [Madeira project](#). This study visit will require air travel from Brasilia to Porto Velho; a city close to the construction site.

6.3 2014 meeting in Paris – Andersen

Bjarne Andersen announced that Thomas Magg and Norman MacLeod will be the special reporters for the 2014 meeting. He also listed the proposed preferential [subjects for 2014](#), which are covered in three broad areas.

- PS 1. HVDC
 - HVDC Project Planning, Environmental and Regulatory issues
 - HVDC for Integration of Renewable Resources
 - HVDC Technology Development including HVDC Grids
 - HVDC Project Implementation and Service Experience

- PS 2. FACTS
 - FACTS Project planning, Environmental and Regulatory issues
 - FACTS for Integration of Renewable Resources
 - FACTS for increased network performance
 - FACTS Project Implementation and Service experience

- PS 3. Other Power Electronic Applications
 - Converters for Renewable generation
 - Converters for Energy Storage

-

The proposed subjects were approved.

6.4 2015 Cigre [Symposium in Sweden](#) – Andersen/Kumar

The program for the symposium to be held in 2015 in Sweden was presented by Abhay Kumar. The symposium is supported by the Nordic national committees and will also be supported by SC B4. Bjarne pointed out that the main meeting for SC B4 in 2015 would be the meeting in India. Bjarne has asked for the meeting to be held in Sweden to be as early as possible, to give the maximum time between the two meetings.

6.5 Upcoming Tutorials – Andersen

Bjarne Andersen suggested that WG conveners should consider organizing tutorials after completion of the TB. For example, during the upcoming CIGRE meeting in Canada, WG B4-52 will present the results of WG B4.52's work on DC Grids, and WG B4-44 will present the work on

Planning Guidelines Dealing with HVDC Environmental Issues. WG B4-52 also organized such a tutorial in conjunction with the CIGRE Colloquium in San Francisco last March.

6.6 B4 Participation in Other Regional CIGRE Meetings – Andersen

An annual meeting is organized by the Canadian Cigre National Committee. This will be held beginning September 24th to 26th and has already 240 registered attendees out of which 90 are from outside Canada.

Ram Adapa announced that the USNC of Cigre on the subject of Smart Grids to be held in Kansas City on 28th to 30th October 2012.

7.0 New Working Group Proposals - Andersen

Bjarne Andersen presented ideas for [new WGs](#). A listing of 11 different objectives are included in the list as follows:

1. Update of TB 205 Fire Aspects of VSC HVDC
 2. Update of TB 113 Testing of HVDC Valves
 3. Recommended DC Voltage and Converter Topologies for HVDC Grids (JWG)
 4. HVDC Grid Fault Currents and Functional Specification for HVDC Breakers
 5. DC/DC Converters for HVDC Grids
 6. Insulation Co-ordination for HVDC Grids
 7. Connection of Wind Farms to weak ac networks
 8. Impact of AC System Characteristics on the Performance of HVDC schemes
 9. Functional Performance Requirements for Plug and Play converter stations for HVDC Grids
 10. Commissioning of VSC HVDC schemes
 11. Commissioning and Testing of HVDC Grids
- Kees Koreman is working on evaluating fault currents in DC Grids. Thus, #4 on the list above is covered already.
 - A question was raised about #2. The question was if the update of TB113 should also cover VSC valves. Mohamed Rashwan responded by stating that there is not a single type of VSC valve so this might be difficult. Abhay Kumar interjected that IEC TC22F is working on a standard for testing of VSC valves.
 - Nalin Pahalawaththa stated that in his view some work is needed covering power electronics systems in wind farms. Nalin offered to find someone who would be willing to convene such a working group.

Bjarne mentioned that it would be very ambitious to launch all of these WGs at the same time. However, there is a lot of interest in the work of SC B4, and we seem to be able to attract many younger engineers, who would be able to make good contributions to the above subjects. The key to success would be that of finding good convenors of each WG.

Action: Bjarne Andersen will use a doodle tool to find out how the SC members would like to prioritize the proposed WG topics.

8.0 Reports from other Organization Liaisons (maximum 10 minutes each)

The following reports were presented at the meeting. No other reports have been received.

8.1 [IEC TC22F](#) – Travin

After the presentation, Bjarne Andersen thanked Lev Travin for taking the time to provide the IEC report.

8.2 [IEC TC115](#) – Povh

Dusan Povh pointed out that equipment standards are not within the scope of TC 115 but are dealt with using Joint working group arrangements as needed.

After the presentation, Bjarne Andersen also thanked Dusan Povh for taking the time to provide the IEC report.

8.3 IEC and IEEE - General

Bjarne re-iterated that a close working relationship between IEC and CIGRE is important to enable each party to understand what the other party is doing in the area of HVDC, FACTS and Power Electronics.

Liaison between IEC 22F and SC B4 is handled by personal contact between Lev Travin and Bjarne Andersen. Similarly, liaison between TC 115 and SC B4 is handled by personal contact between Dusan Povh and Bjarne Andersen. It was noted that it would be beneficial for any Cigre Member who actively participate in the IEC activities to provide feedback to AG B4-01.

Bjarne also noted that CIGRE and IEEE has a cooperation agreement, which will permit IEEE to use CIGRE documents for standards.

9.0 Reports from Other Committees or Research/non- commercial Organizations

No written reports received.

- Mohamed Rashwan reported that the Advisory Council of CIGRE is discussing a collaborative agreement with CIRED.
- Ram Adapa informed the SC about EPRI sponsored annual FACTS and HVDC conference in the US.

10.0 HVDC and FACTS Schemes under Construction or Planned

The following presentations were made.

- [10.1](#) Norway - Magne Meisingset
- [10.2](#) Siemens – Carsten Bartzsch
- [10.3](#) Alstom – Carl Barker
- [10.4](#) China - Junzheng Cao
- [10.5](#) National Grid - Ray Zhang (Presented by Norman MacLeod)
- [10.6](#) Tres Amigas - Mark Reynolds
- [10.7](#) New Zealand - Peter Griffiths
- [10.8](#) Pacific Intertie - Mark Reynolds
- [10.9](#) Italy - Antonio Ardito (written report only)
- [10.10](#) ABB – Abhay Kumar
- [10.11](#) TWE Project - Mark Reynolds

11.0 Operational Experiences of Existing HVDC and FACTS Schemes

Two written reports were submitted but not presented. One was for the [Sardinia](#) interconnection and the other was for the Italy to [Greece](#) interconnection.

12.0 Any other business

Dennis Woodford, who chairs the IEEE Uno Lamm HVDC award committee, solicited nominations for the IEEE Uno Lamm award. (Note that Marcio Szechtman is the chair of the IEEE Nari Hingorani FACTS and Custom Power award committees, and is also looking for good nominations for these awards).

13.0 Adjournment.

The meeting was adjourned at 17:25

Minutes submitted by Stig Nilsson, Secretary, Study Committee B4

A handwritten signature in black ink, appearing to read 'Stig Nilsson', with a stylized, cursive script.

Stig Nilsson

October 2, 2012