

# **CIGRE STUDY COMMITTEE B4 - HVDC AND POWER ELECTRONIC EQUIPMENT**

## **The 43rd Session Regular Meeting**

**Wednesday August 27, 2008**

**Paris, France**

### **MINUTES OF THE MEETING**

**Chair: Marcio Szechtman**

**Secretary: Willis Long**

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

#### **1.0 Opening Comments**

**Szechtman**

Chair Marcio Szechtman opened the meeting at 0900, there were 71 persons in attendance. Marcio noted that this would be the last session for him and for Bill Long to serve as Chair and Secretary of the Study Committee. Incoming Chairman Bjarne Andersen was at the head table assisting with the reports to be electronically projected. New members present were recognized: Regular Members John McNichol (Canada), Juan Araneda (Chile), Antonio Ardito (Italy), Jesus Gonzalez (Mexico), Thomas Magg (South Africa); Observers – Jorge Luis Aguero (Argentina), apologies from Cormac McCarthy (Ireland). There followed introductions of persons attending. Marcio extended a warm welcome to all, with special recognition to former SC chair Dusan Povh and former German regular member Peter Lips.

Attendance at this meeting is as follows:

#### **Attending Regular Members/Representatives**

Australia/NZ	Nalin Pahalawaththa	Japan	Masahiro Takasaki
Brazil	Wo Wei Ping	Korea	Tae-kyoo Oh
(representing Sergio Espirito Santo)		Mexico	Jesus Gonzalez
Canada	John McNichol	Netherlands	Yanny Fu
Chile	Juan Araneda	Norway	Magne Meisingset
China	Hong Chao	Poland	Krzysztof Madajewski
Denmark	Poul Damgaard	Romania	Mircea Eremia
France	Samuel Nguéfeu	Russia	Grigory Tsfasman
Finland	Jussi Jyrinsalo	South Africa	Thomas Magg
Germany	Hartmut Huang	Spain	David Alvira
India	V. K. Prasher	Sweden	Victor Lescale
(representing R. P. Sasmal)		UK	Norman MacLeod
Italy	Antonio Ardito	US	Stig Nilsson

### **Study Committee Officers**

Chair Marcio Szechtman  
Secretary Willis Long

### **Observer Members**

Argentina Jorge Luis Aguero  
Austria Klaus Papp  
Belgium Karim Karoui

### **WG/TF Conveners, AG Members**

Australia/NZ Mohamed Zavahir  
Canada Brett Davies  
Ani Gole  
Narinder Dhaliwal  
China Guangfu Tang  
Germany Dirk Westermann  
Norway Kirsten Faugstad  
UK Bjarne Andersen  
Nigel Shore

### **Guests**

Austria Alex Grisenti  
Brazil Jose Jardini  
Rui Jovita G. C. daSilva  
Antonio Carvalho  
John Graham  
Canada Bob Burton

Mohamed Rashwan  
Dennis Woodford  
Murray Bennett  
Rao Atmuri  
Chile Gabriel Carvajal  
Denmark Kent Soebrink  
Peter Christensen  
Germany Peter Lips  
Norbert Christl  
Georg Wild  
Marcus Haeusler  
Dusan Povh  
Ireland Maurice Smith  
Italy Alberto Giorgi  
Japan Isao Iyoda  
Takehisa Sakai  
Irokawa Shoishi  
Russia Lev Travin  
South Africa Andrew Williamson  
Chris DeKock  
Leon Chetty  
Collin Reddy  
Sweden Abhar Kumay  
Gunnar Asplund  
Switzerland Adel Hammad  
UK Carl Barker  
US Ram Adapa

## **2.0 Minutes of Osaka 2007 Meeting**

**Long**

The minutes were accepted without changes.

## **3.0 Technical Committee Activities Report**

**Szechtman**

Yanny Fu and Narinder Dhaliwal were recognized as recipients of the Technical Committee Award for 2007 for their work in investigating converter transformer failures. In 2002 there was significant restructuring of Cigre under the direction of TC Chairman Aldo Bolza. Included in that restructuring was a de-emphasis of joint working groups. In 2006 the TC chairmanship transferred to Professor Klaus Froehlich of Switzerland, and his guidance was that the TC should emphasize technical activities. A new Strategic Plan for the TC has just been released to the Study Committees (see the reports from this meeting). There is now approval to form joint working groups when appropriate, and some projects which might involve 3-4 or more SCs could be elevated to TC Projects. (There is one such project in place involving UHV ac and dc, this is in cooperation with the IEC.)

## **4.0 Strategic Plan and Advisory Groups**

### **4.1 AG 01: Strategic Advisory Group**

**Zavahir**

The group met with 14 attendees. SC B4 needs to incorporate the Technical Committee's new directions, although presently we are in good accord with them. The AG discussed current HVDC market needs, recognizing that HVDC activity is at a very high level. Are we addressing the needs of our Target Groups? What exactly is the role of B4? It was agreed that AG 01 will develop a new action plan. The other AGs are more in the background but are functioning well. Stig Nilsson will assume the post of Convener of this AG as Mohamed will become SC secretary.

### **4.2 AG 02 Working Group Conception and Guidelines**

**Damgaard**

The AG's activity and skill matrix survey resulted in 59 responses from 21 countries, an excellent response. A lot of information on areas of experience was captured. Bjarne noted that we should see five responses from each country represented by a Regular Member of the SC. Additional survey forms will be distributed at the Technical Session. It is expected that this information will be useful for staffing working groups.

### **4.3 AG 03 Environmental Issues**

**McNichol**

John McNichol is the new convener of this AG. Most of the activity is reported later under WG 44. A new JWG B4-B2-C3 on EMF and Ions is forming and B4 will chair this JWG, if approved.

### **4.4 AG 04 HVDC System Performance**

**Dhaliwal**

Narinder Dhaliwal is the new convener of this AG, which functions like a permanent WG and is unique to SC B4. In addition to collecting the traditional performance data they are gathering transformer failure data. Thanks were expressed to Murray Bennett who collects and tabulates the data. Thanks were also extended to the reporting systems along with the usual request for more reports (e.g., China and Quebec are encouraged to report). The total number of reports is trending up so this is good. Since 1983 AC equipment has been the most responsible for outages. More recently converter transformer failures are a major concern: the failure rate has been increasing since 2005. System operators are catching failures earlier with improved monitoring. Compendium updating is still an ongoing task of the AG. The question was raised regarding the inclusion of VSC converters. The answer is that the present reporting system should be OK.

### **4.5 AG 05 Tutorials and Communication**

**Jyrinsalo**

Additional survey results included suggestions for B4's action plan. There are strong values in B4's traditional activities including Technical Sessions, Working Groups, and Study Committee meetings; participation is seen to be valuable. Our recent tutorials have been very well received and well attended, reaching some 400 engineers in the past year. Thanks were extended to those persons making the presentations, they were recognized at this meeting. Improvements to the website are recommended. There were suggestions for future WGs with special interest in multi-terminal/meshed systems. Future plans are to survey customers (planners, HVDC users, academia, ---) and to add new material to our website. Bjarne expressed the hope that we can collect the tutorial presentations and make them available to others to present. Marcio noted that B4 is recognized by the TC as the leading SC in presenting tutorials.

## **5.0 Working Group Reports**

Marcio noted that several working groups completed their work and were disbanded this past year:

**B4-39 Integration of Large Scale Wind Power with HVDC and Power Electronics**, Bjarne Andersen/convener. There were 10 good contributors and 7 occasional contributors, Bjarne thanked them and said they were recognized in the brochure. Marcio expressed the SC's thanks to Bjarne.

**B4-40 Static Series Synchronous Compensator (SSSC)**, Aty Edris/convener (not present).

**B4-41 Systems with Multiple HVDC Infeed**, Brett Davies/convener. Marcio said that this project took longer than expected as they did a lot of new development. The work is beneficial because of system examples that were contributed by key participants. Marcio expressed the SC's thanks to Brett.

### **5.1 WG B4-38 Simulation of HVDC and FACTS**

**Gole**

The WG has nine active participants and presently has a draft document with about 40 pages. Their target is to have all material together by June 2009 SC meeting. The emphasis is on study tools, the report will include a section on model validation along with numerous case studies. The WG needs help with contributions for modeling examples in addition to EMTP. Marcio emphasized that there are important expectations for the report to help system planners and others with less familiarity with HVDC models. Mohamed Zavahir suggested the development of tutorial materials would be useful.

### **5.2 JWG B2.17/B4/C1 Impacts of HVDC Lines on Economics of HVDC Projects**

**Graham.**

The JWG has just held what they expect to be their last meeting. Twelve alternative configurations have been studied. Costs were frozen as of January 2007, but there have been significant commodity cost shifts since that date. The technical brochure is now finished in draft form, and goes to technical review with 4 reviewers in October. It is interesting that corona losses begin to become significant at 3000 km. Voltage levels above 800 kV are an open question. Marcio congratulated John Graham and Jose Jardim for representing SC B4 so well in this JWG.

### **5.3 WG B4-44 Planning Guidelines Dealing with HVDC Environmental Issues**

**Faugstad**

The WG presented a colloquium paper at Osaka in 2007. It included survey information regarding electrode siting. The conclusion was that there are no environmental impacts from sea electrodes. With land electrodes there are concerns with corrosion, transformer saturation, and other items. The WG is collecting an environmental database, and will work toward developing environmental guidelines. Useful comments have been received from China and South Africa on their experiences with ground currents. Marcio commented that the paper was well received at the Osaka colloquium.

### **5.4 JWG A2.28/B4 HVDC Converter Transformer Test Procedures**

**Fu**

This JWG began in 2004, and has had 9 meetings. They have reached harmonized agreements: (1) there is a problem with converter transformers indicating the need for more work beyond this JWG, and (2) there is a need for a good test requirement to be implemented in the transformer design. They will have a document later this year for

review plus an Electra paper in early 2009. They have almost finished a tutorial PowerPoint presentation. Test recommendations are not agreed to, they want this developed from the system side relating to tests of other equipment. The JWG final report, targeted for March 2009, will not include test recommendations. Marcio emphasized that this is a very sensitive matter and we need to be cautious what we write. Our target is to look ahead to future projects – how to better design and test. Discussion followed: what is needed is ac and dc testing like valves. Do we understand the stresses? Are margins reduced? There is a need to move quickly here but we prefer that it not be via JWG; Marcio and Bjarne agree that it should be a B4 WG. Bjarne said we need to have WG participants from B4 identified and involved. Yanny will prepare terms of reference by October 1.

**5.5 WG B4-45 Technological Assessment of 800 kV HVDC Applications**  
**Rashwan**

All documents have been forwarded to the convener, R. N. Nayak, and will be ready for 60 day review as soon as he has approved them.

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

The WG held its first meeting last year, and hopes to finalize the work in two years. WG membership includes user and manufacturer perspectives. They will examine VSC performance and costs. An interesting question is how to assign economic benefits to control functions like reactive power control.

**5.7 WG B4-47 Special Issues in AC Filter Specifications for HVDC**  
**Shore**

This WG was formed to prepare an Addendum to a 1999 WG report. They have some excellent contributors with diverse representation. They are studying AC network impedance modeling and the inclusion of preexisting harmonics. There is a need for a specification that leads to intelligent decisions regardless of conditions; filters have a large impact on the converter station. They currently have 80 pages of text which needs editing, completion is expected by summer 2009. The WG has used a blog for communication and storage of information, this has been well used except for some blocking by companies' IT staff. The CIGRE website does not have this flexibility. Marcio extended compliments on a very good job.

**5.8 WG B4-48 Component Testing of VSC System for HVDC Applications**  
**Guangfu**

The WG has held three meetings to date. Chapters 1-5 have been completed, 6 and 8 are well drafted for discussion. Chapter 7 needs more contributions. Completion is expected by the end of 2009. There is a question regarding how to deal with new topologies, as the stresses will be different. The planned approach is to account for common elements, and address new configurations as they arise. First you define the stresses, then you define the test.

**5.9 WG B4-49 Performance Evaluation and Applications Review of Existing Thyristor Controlled Series Compensation Devices (TCSCs)**  
**Nilsson**

This new WG had its first meeting this week, and has 6 members at present. They will investigate how existing TCSC systems are performing. There are presently 12-15

existing systems, with, at least one abandoned, and others perhaps not fully utilized. Additional applications are expected as ac systems evolve. They have received good data from the Brazilian systems, and are creating a template for reporting. The WG expects to conduct a survey and get results before end of 2008. They should have some results to report at the 2009 meeting of the SC in Bergen.

## **6.0 Future Meetings**

### **6.1 2010 Preferential Subjects**

**Andersen**

Brett Davies and Victor Lescale have agreed to serve as special reporters for the 2010 Paris meeting Technical Session. The preferential subjects that will be presented to the Technical Committee for modification/approval are:

1. Developments to meet market requirements
2. Operating experience and new projects
3. Project development issues

Comments were offered regarding economics (these can be incorporated into PS-3), and EMF and Ions (this will be included in a special session with B2 in a June colloquium in Croatia).

### **6.2 2009 SC Meeting in Norway**

**Meisingset**

The next meeting of the SC will be June 6-12, Hakon Borgen will be chair of the meeting arrangements. The current schedule is Bergen (3 days) and Ullensvang (1 day), a technical visit (Troll A rectifier station) and a colloquium (primarily invited papers with the main topics nearly set). There is possible cooperation with B1 for a cable session. Fifteen sponsors are committed. A link to the SC web page will be up soon.

### **6.3 2011 SC Meeting in Australia**

**Pahalawaththa**

Brisbane and Melbourne are the planned venues, the meeting will include a colloquium and interaction with other SCs. Suggested dates are late Sept or Oct. There will be a technical visit to Basslink or possibly another converter station. Nalin also mentioned that C1-C2-B1-B4 are being asked to participate in a symposium in Indonesia (Bali?) in March-April 2011. The theme will be system interconnections. Marcio said that they can consider a B4 presence via organizing a tutorial or offering several WG papers.

### **6.4 Other Future Activities**

There are presently no requests for future tutorials but we are ready to respond to invitations as there are many SC colleagues who have presented lectures.

## **7.0 New Working Group Proposals**

**Zavahir / Szechtman**

### **7.1 DC Fields and Ions.**

Terms of reference have been developed for an activity titled *Electric Field and Ion Current Environment of HVDC Lines*. The TOR was developed with assistance from Sarma Maruvada, Jose Jardini has agreed to chair the group. It will be led by B4 and may be a joint working group or a TC project, possibly with C4-B2-C3-B1. This will be discussed at a forthcoming TC meeting. Mohamed Zavahir suggested that the group propose to write a technical paper and a position paper. Bjarne is cautious of health issues and would not defend their inclusion in the TC meeting. It is best to present technical facts, what is it that is known? (A colloquium on power frequency electromagnetics is being organized in Croatia just in advance of our Norway meeting.)

## **7.2 HVDC Networks**

Gunnar Asplund presented ideas on configurations of possible HVDC networks. In Europe an 800 kV HVDC overlay solves a lot of problems but is not likely. But the interest in a DC network is real, as some decisions are close to being made (e.g., what voltage level?). In comparing multi-terminal links vs. networks, the latter could provide a reduction in the number of terminals. A switchyard with dc circuit breakers could provide improved reliability, you need never take down the network. Comments indicated that it was an interesting concept which could incorporate renewables and superconductivity. Gunnar is to draft terms of reference by October 1, to be circulated to the SC.

## **7.3 Imbedded HVDC**

It was proposed to consider issues regarding imbedding HVDC into AC systems, possibly jointly with C4. System studies would need to be included. No action was taken on this suggestion.

## **8.0 Reports from IEEE and IEC**

### **8.1 IEEE**

**Long**

The Power Engineering Society has changed its name to Power and Energy Society. The activity level in IEEE/PES is significantly below that of SC B4. The Working Group on HVDC/FACTS continues to present several tutorials annually at various PES meetings and conferences. The Annotated Bibliography has been brought up to date by graduate students at Western Ontario University. Marcio announced that the 2008 Uno Lamm HVDC Award was presented to Bill Long at the July Annual Meeting.

### **8.2 IEC**

**Travin**

Lev Travin is Secretary of IEC Technical Subcommittee 22F, Power Electronics for Electrical Transmission and Distribution Systems. They are primarily a standards-making organization. A new Technical Committee TC 115 has been established for HVDC Transmission for Voltages Above 100 kV. As this group is to address standards not presently covered it is anticipated that standards for UHV HVDC fall under its purview. As yet no Statement of Work has been produced. The status of other HVDC and SVC standards were reviewed (see the reports from this meeting). This includes WG 15 which is addressing the testing of VSC converter valves; there is some concern about the overlap between this group and our WG B4-48, Testing VSCs for HVDC Applications (see item 5.8 above). A pre-standard document HVDC Transmission using Voltage-Sourced Converters is on hold and not being developed as a standard because of a stated lack of technical experts.

## **9.0 Reports from Other Committees or Organizations (Electronic format reports only)**

No reports received.

## **10.0 Special Presentations**

Marcio asked Bill to read a tribute he has written in recognition of Clarence Thio's contributions to SC 14/B4 and his influence on Marcio. He has dedicated his term as SC B4 Chairman to Clarence. The tribute and a selection of photographs can be found in the reports from this meeting.

**11.0 HVDC and FACTS Schemes Under Construction or Planned** (Reports can be found on the SC website [www.cigre-b4.org](http://www.cigre-b4.org) indexed according to the sub-numbering indicated.)

- 11.1 Denmark/Poul Damgaard:
- 11.2 ABB/Victor Lescale
- 11.3 Siemens/Hartmut Huang
- 11.4 China/Tang Guangfu
- 11.5 Caprivi/Thomas Magg
- 11.6 Madeira/David Alvira
- 11.7 Norway/Magne Meisingset
- 11.8 China Southern/Hong Chao
- 11.9 Areva/Norman MacLeod
- 11.10 Transelec/ Juan Araneda

**12.0 Operational Experiences of Existing HVDC and FACTS Schemes**

(This report can be found on the SC website [www.cigre-b4.org](http://www.cigre-b4.org) indexed according to the sub-numbering indicated.)

- 12.1 Skaggerak/Poul Damgaard

**13.0 Official Transfer of Chairmanship to Bjarne Andersen**

Marcio extended thanks to all and expressed appreciation to the Study Committee members who have participated so faithfully in the work of the SC. Thanks were also extended to the Working Group and Advisory Group Conveners and Members for their diligent efforts and willing participation. Secretary Bill Long was also included in the comments of appreciation. Bjarne was welcomed into the leadership of the SC along with Mohamed Zavahir, incoming secretary. Bjarne commented that following Marcio as SC chair was a daunting task but he was happy to undertake it with the help of the aforementioned participants.

**14.0 Any other business**

None introduced.

**15.0 Adjournment**

The meeting adjourned with applause at 1715.

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

*Willis F. Long*

October, 2008