



INTERNATIONAL ELECTROTECHNICAL COMMISSION

Systems Evaluation Group 4 - Low Voltage Direct Current Applications, Distribution and Safety for use in Developed and Developing Economies (SEG4)

SUBJECT

Confirmed report of SEG 4 meeting 2 held in Princeton (US), on 2015-05-18, 19

BACKGROUND

SEG 4 held a meeting in Princeton, New Jersey, on May 18 and 19, 2015. The meeting was jointly hosted by Emerge Alliance and SteelORCA. Emerge Alliance is an open industry association developing standards leading to the rapid adoption of DC power distribution. SteelORCA is a data center company developing and leading the use of DC current in data centers.

The next SEG 4 meeting will be held **on 28 and 29 October 2015, at the BUREAU OF INDIAN STANDARDS Manak Bhavan 9, Bahadur Shah Zafar Marg IN-110002 NEW DELHI**

Meeting attendance

Vimal MAHENDRU	IN	Convenor
Pierre SEBELLIN	IEC CO	Secretary

Members

Takashi ARAMAKI	JP
Dusty BECKER	US
Rocky BULDO	US
Brian DAVIES	US
Abdullah EMHEMED	UK
David GEARY	US
Kenneth GETTMAN	US
Debdas GOSWAMI	IN
Keiichi HIROSE	JP
Richard KABWEBWE	ZM

Tero KAIPIA	FI
Uwe LIESS	DE
Sara LISY	US
Micheal MODEL	US
Malcolm H.MULLINS	GB
Kishor NARANG	IN
Brian PATTERSON	US
Reinhard PELTA	DE
Jacques PERONNET	FR
Maarten REDDERING	NL
Stephen ROOD	US
Ravi SEETHAPATHY	CA
Rajendra SINGH	US
BJ SONNENBERG	US
JIM SPITAEELS	US
Harry STOKMAN	NL
Donald J.TALKA	US
Klaus VÄNSKÄ	FI

Guests:

Benjamin HARTMAN	US
Terence HILL	US
Vassilis KLEFTAKIS	GR (deputizing for SEG 4 member, Nikolaos Hatziargyriou)
Mitchell NELSON	US
Dennis ODDSEN	US
Joseph SUPPERS	US

Note 1: The clause numbering of these minutes is matching the numbering of the meeting agenda: SEG4/5C/DA

0 Pre-Meeting LVDC Workshop prior to the SEG 4 meeting

A half day workshop was organized before the meeting, with presentations from various LVDC consortia and companies. A small exhibition was set at the lunch area, and the host, SteelORCA organized guided tours in its data center laboratory as well as its new facility fully powered with LVDC.

The following presentations were made:

Emerge standards on LVDC, Ben Hartman, Nextek Power Systems

Emerge Alliance has developed two standards dedicated to DC installations in buildings which are designed to work as add-on to the regular AC installation design rules valid un USA.

See SEG4-2015-05-18-SteelOrca_Doc27_EMerge_Standards_on_LVDC_B_Hartman.pdf* for more details.

The transition path to DC, David Geary, DC-Fusion

Overview for the data centers with transition strategy, available products, and benefits analysis.

See SEG4-2015-05-18-SteelOrca_Doc28_DC_for_Data_Centers_D_Geary.pdf* for more details.

Resilient buildings through the use of DC, Terry Hill, Passive House Institute US

DC allows designing the electrical installation of a house or a group of houses as independent micro grids, which make them resilient to natural vulnerabilities (floods, typhoons, etc.). The concept is global and similar to passive houses.

See SEG4-2015-05-18-SteelOrca_Doc29_Resilient_buildings_T_Hill.pdf* for more details.

Sustainability through Minimization (Doing More with Less), Scott Zimmerman, JLC.TEC
A new concept of LED light was presented. It is based on the following observations:

* Document available on the collaboration tools and in SEG4/11/MTG

- At the end of it, the cost and environmental impact of a product is based on its weight, as the quantity of material is the key factor.
- In the current LED lamps, using the traditional lamp caps, most of the weight is not due to the LED but to the lamp cap and the driving electronics which converts AC to DC
The new concept is a lightning system without lamp caps and without AC/DC conversion.
For more details, see on the web site.
See SEG4-2015-05-18-SteelOrca_Doc30_LED_lamps_S_Zimmerman.pdf* for more details.

1 Opening and welcome

Mr Mahendru, the Convenor of SEG 4, welcomed the participants. He thanked Mr Patterson, SEG 4 member representing the US NC and Emerge alliance, and Dave Crocker, CEO of SteelORCA for hosting the meeting. He also thanked Emerson Network Power, Nextek Power Systems, Anderson Power Products, and dc Fusion which supported the meeting. Then he opened the meeting. Brian Patterson welcomed the participants and provided information about the global programme for the next two days. Dave Crocker welcomed the participants and presented the DC application being developed in the SteelORCA data center. The SEG 4 Members thanked the hosts for the organization of the venue.

2 Approval of the agenda

Document: SEG4/5B/DA

The secretary went through the agenda SEG4/5C/DA, the last version based on the circulated agenda under the reference SEG4/5B/DA. The agenda was approved.

Decision SEG4-201505-01: SEG4 approved SEG4/5C/DA

SEG4/5C/DA* is available in the IEC Collaboration Tools.

The attendance list was circulated for signature.

3 Approval of the minutes of the January 2015 meeting

Documents: SEG4/2/RM, SMB/5489/R

Mr Sebellin displayed the minutes of the 2015-01 meeting and mentioned that no comments were received. As no additional comments were submitted, the minutes were considered approved. Mr Sebellin then presented the report submitted to the SMB by SEG 4 following the 2015-01 meeting.

4 Review of SEG 4 Membership

Document: SEG4/6/INF

Mr Sebellin presented SEG4/6/INF, and highlighted the drastic increase of US members in SEG 4. The goal of engaging North American stakeholders in SEG 4 by organizing a meeting in this area was achieved.

5 Presentations

5.1 Opening remarks by the SEG 4 Convenor

Document: Doc01

Mr Mahendru introduced Doc01 and reminded the mission of SEG 4 with the key milestones of the work to be performed.

* Document available on the collaboration tools and in SEG4/11/MTG

5.2 Reinventing Building Power, B. Patterson

Document: Doc15

EMerge Alliance promotes a concept of hybrid (DC+AC) private and commercial building. The concept combines solar energy harvesting, batteries, and DC distribution re-using the existing building cabling. The buildings would run as autonomous micro-grids, linked to the global power distribution grid when needing missing energy or providing extra energy. An innovative concept was presented: The ENERNET. It is inspired for the Internet concept, but exchanging energy rather than information. Emerge Alliance has supported more than 50 DC projects including large size commercial and offices buildings (10000m²). Emerge Alliance has developed two standards for DC installations in buildings.

V. Mahendru: Most of the work of Emerge Alliance is towards data centers. Do you have expertise on other applications?

B. Patterson: Emerge Alliance has already extended its field of action to commercial buildings, and is now looking into houses and apartments.

H. Stokman: Where it is appropriate to convert to DC, the earlier is the better, because the higher the voltage, the more efficient the conversion.

5.3 LVDC: Opportunities for Transformation of Global Electricity, R. Singh

Document: Doc19

Most of the devices in a house are using DC power, while the building installation is delivering AC. This also applies to buildings used for other purposes: commercial, office, industrial, defense. There is the need to avoid the variety of AC voltages, frequencies and plugs systems. The technology for DC deployment is now ready. Solar panels and lithium-ion batteries will transform the energy market. The large national energy utilities will have their business model completely changed in the next decades, with distributed solar photovoltaic becoming the cheapest power source during the 21st century.

Vimal Mahendru: SEG 4 has to address all the use cases.

5.4 Access to electricity by appropriate technology, R. Kabwebwe

Document: Doc09

The electric power situation in Africa can be summarized as offering low access due to inadequate and aging infrastructure. The cost of electricity against income leads to vandalism and theft. There is a need for concerted effort to exploit renewable energies. The actions being taken address the cost structure of infrastructure setup and maintenance by the adoption of appropriate technology, in particular LVDC. The promotion of DC micro grids combining solar panels and batteries is an opportunity to transform cost into income. The time has come to rethink the electricity access concepts to offer a solution in the regions with a low demographic distribution of population.

5.5 SEG 4 Members personal experience

Mr Vänskä proposed to present the use of DC for marine applications.

The use of DC current is being introduced in ships. The concept is similar to hybrid cars, or fully electric cars. Boats are currently operating with electric engines powered by batteries. A fuel engine is also in the ship for batteries charging purposes. Another concept being investigated is fully electric ferry boats that would have rather short travels to commute between each side of a water channel. They would charge their batteries when docked for cars loading.

6 Break-out sessions

SEG 4 is structured in 6 working groups as per the table here under. The breakout sessions allowed each WG to meet separately. Following these sessions, the WG Convenors provided a report to the whole assembly. See these reports under item 9.

In the absence of Messrs De Kesel and Luber, the Convenor invited Messrs Patterson and Stokman to lead the discussions respectively in WG 3 and WG 4.

WP	Description	Convenor
1	Current Status; Standards and Standardization	Keiichi Hirose
2	Stakeholder Assessment and Engagement	Tero Kaipia
3	Market Assessment (€,£,\$)	Wim De Kesel
4	Collection and rationalization of current Voltage Data - LVDC	Georg Luber
5	Collection and rationalization of LVDC Safety data	Reinhard Pelta
	LVDC for Electricity Access	Debdas Goswami

7 Individual presentations from Experts

Document: Doc31

The Experts registering to SEG 4 are asked to provide a 3 slides presentation to introduce themselves. A template is available for this purpose.

8 Review of direction and actions for SEG 4

8.1 SMB Mandate

Document: Doc 02

This point was addressed in the opening remarks, and so not required to be addressed again.

8.2 Review of the request to standardize color coding for wires in LVDC

Document: Doc 10

Mr Pelta explained that the current standards does not require colours for DC cabling. To enable distinction between wiring of AC and DC installation the German NC proposed colours for DC. Initially Germany proposed red(+) , violet (-) and blue for neutral (as used also for AC). After consultations with cable manufacturer it became necessary to replace the colour violet for the negative conductor (L-) by the colour white.
Background: during its lifespan, the violet colour of the plastic material changes to a kind of grey or blue depending on the material. Grey is already used for AC conductor.
In order to overcome this, the German NC has submitted a proposal to TC3, who is responsible for such standardization but with the colour white for L-.

The DE proposal was presented to SEG 4 (Doc 10) in order to receive the advice and opinion of the members.

A discussion in SEG 4 took place which led to the following conclusions:

- - The color scheme specified in the future standard should allow an easy re-use and retrofit of the existing wiring in the buildings. For example, allowing the color to be only at the ends of the wires.
- - The color scheme should be adapted to color blind persons.
- - The color scheme should be different for low or high voltage (lethal or not)

Action to P. Sebellin: To inform TC3, copy Georg Luber about the suggestions of SEG 4

8.3 12V LVDC standard from Schneider India

Documents: Doc 11, SEG4/8A/INF

Vimal Mahendru introduced the draft and requested the SEG 4 Members to provide their comments before 30 June 2015.

Action to SEG 4 Members: To review the 12V LVDC standard and provide comments to P. Sebellin before 30 June 2015

8.4 LVDC mnemonic

Document: Doc 13

Mr Mahendru presented Doc 13. SEG 4 came to the consensus opinion that the LV letters arrangement was too much looking like a voltage spike, which is not representing the idea of the constant voltage observed in LVDC. The way the LV letters are arranged is looking too much like a waveform.

Mr Mahendru announced that he will go back to the communication agency and have the mnemonic adapted accordingly.

Update on 2015-06-15: At the time of writing the minutes, Mr Mahendru has already requested the change and will submit the revised mnemonic at the next SEG 4 meeting.

9 Reports from the breakout sessions

9.1 WG 1 Current Status; Standards and Standardization

Document: Doc 21

Mr Hirose reported.

The main conclusion for the session is the need for power quality standards for LVDC

9.2 WG 2 Stakeholder Assessment and Engagement

Document: Doc 22

Mr Kaipia reported.

We know maybe 10% of the LVDC applications. There is a need to have a wider view. WG 2 has prepared a questionnaire to be published on the IEC web site. The SEG 4 Members found this was a very good idea, and asked whether the other WGs could submit additional questions to the questionnaire. T. Kaipia accepted with pleasure.

The first version of the questionnaire is available through: <http://www.dcfoundation.org/iec#>

9.3 WG 3 Market Assessment

Document: Doc 23

As Mr De Kesel could not attend the meeting, Mr Patterson was invited to convene the group and reported.

SEG 4 members agreed that we should try to have the segmentation matching the breakout sessions subjects of the Delhi conference.

WG 3 concluded that the LVDC conference and breakout session in New Delhi were the appropriate platform for capturing all use cases and market size assessment.

9.4 WG 4 Collection and rationalization of current Voltage Data - LVDC

Document: Doc 24

As Mr Luber could not attend the meeting, Mr Stokman was invited to convene the group and reported.

After the presentation, he concluded that the arguments behind the values are the most important. Regarding the questionnaire to gather information about the applications of DC current, it is better to have it hosted on the IEC web site.

Action to P. Sebellin: Can the IEC central office host a web questionnaire?

Update on 2015-06-12: At the time of writing the minutes, IEC central office has confirmed that it offers to host the questionnaire.

9.5 WG 5 Collection and rationalization of LVDC Safety data

Document: Doc 25

Mr Pelta reported. He noted a positive progress in the group membership. He pointed out the importance of the fault current detection to ensure safety of installations.

9.6 WG 6 LVDC for Electricity Access

Document: Doc 26

Mr Goswami reported.

There was a high interest from the whole community of Experts in SEG 4, whatever their country. Electricity access is agreed to be a key issue for LVDC.

10 Presentation of data collected through the Expert Input Exercise

Documents: Doc 06, Doc 07

Vimal Mahendru reported that a few answers were received which were not enough to allow extracting global facts and trends about LVDC.

Action P. Sebellin: To upload on the collaboration tools the answers received and the synthesis table.

11 New Delhi International Conference

The organization team had several conferences and the organization is progressing well. The programme is now finalized, most of the speakers have been found and confirmed, the logistics in Delhi is finalized.

Some actions are now needed to promote the event in order to ensure that the targeted audience will effectively attend.

Promotion actions/tools:

- Conference web site (www.lvdconference.com) the site is operational the registration form is working. Further work is needed to input the conference programme and the bios of the speakers.
- Flyer: a 4 pages flyer is under development. To be finalized for mid-June
- Poster: the visuals and text developed for the flyer is adapted to produce a poster promoting the event.

LVDC-Redefining Electricity

First International Conference on Low Voltage Direct Current

New Delhi

India

26 & 27 October 2015

www.lvdconference.com

The International Conference will be held at:

HOTEL – 'THE ASHOKA'

Diplomatic Enclave, 50 B, Chankyapuri,

New Delhi

www.theashok.com

12 Discussion about DC voltages

While the meeting was progressing, it appeared that addressing the DC voltages standardization was key issue for the quick development of LVDC products by the industry. The SEG 4 Convenor and Secretary proposed to amend the meeting agenda to spend some time discussing this specific issue. SEG 4 Members approved the proposal and Mr Mahendru proposed to address three subjects: Definition of LVDC, parameters for defining the voltages, urgencies for standardization. He opened the discussion.

12.1 The Experts agreed that the definition of LVDC may have following characteristics;

- There is a consensus that LVDC is DC voltage under 1500 V.
- There is a need to define an ELVDC: Extra Low Voltage Direct Current, which would be under 120V.
- ELVDC has to include a definition of power carrying capacity over the installation at given voltage levels.
- the utility will be impacted for the "last mile" of the distribution network; however, the 10 last miles may not be impacted.
- it was required to define voltage classes rather than voltages levels. There are likely to be several voltages levels, depending on energy required

12.2 Parameters for defining the voltages

- Voltage cannot be separated from energy
- There is no need to change the 120V threshold for ELVDC definition.
- There is a need to have categories of products for unique applications of non-standardized voltages that require trained professionals for installation and maintenance.
- The protection measures are key parameters for defining voltages. Depending on the voltage levels, there are thresholds leading to different levels of protection measures.
- The existing standardized wire dimensions for AC building installation shall be capable of handling future retrofit of LVDC systems.
- The parameters depend on the distribution topology: AC type or network style.
- The protective device availability is also to be considered.

12.3 Top priorities for LVDC standardization

- Establish LVDC and ELVDC voltage classes. The last slide of the WG 4 (Doc24) report was reviewed again, and found to be a very good base to establish voltage classes.
- Link the voltage classes to what need to be standardized and what need not to be standardized. (unique applications)
- The standards to be developed should lead to easy and quick conformity assessment.

13 Next meetings

Mr Sebellin distributed meeting feedback forms to the attendance. As the current meeting format of one day noon to noon seemed to be too short, Mr Mahendru asked the members present to indicate their position about the future meeting length. The answers showed an overwhelming support for extending the meetings to 1.5 day. Mr Mahendru would investigate with BIS about the possibility to extend the October on Thursday 29 October morning.

Action to SEG 4 meeting hosts: To confirm the availability of the hosting facilities for 1.5 day.

Update on 2015-06-11: BIS has gladly confirmed that it would extend its invitation to a 1.5 day meeting at its New Delhi facilities.

The actual meeting plan is as follows; see the changes in red to take into account the extension of the meeting length to 1.5 day.

Meeting #	Dates Finalized	Format	Host NC (City)
1	January 19-20, 2015 (Done)	Lunch to Lunch	IT NC (Milan)
2	May 18-19, 2015 (done)	Lunch to Lunch	US NC (Princeton)
3	October 28 and 29, 2015	morning to lunch next day	IN NC (New Delhi)
4	January 21-22, 2016	Lunch to 5pm next day	UK NC (Glasgow)
5	May 23-24, 2016	Lunch to 5pm next day	Possibly US, Canada or Mexico NCs
6	September 12-13, 2016	Lunch to 5pm next day	JP NC (Tokyo)

Messrs. Mullin and Emhemed announced that the January 2016 SEG 4 meeting would be hosted by the University of Strathclyde, in Glasgow. Mr Emhemed made a presentation of the meeting location and facilities. See Doc20*.

Mr Mahendru thanked the UK NC, Messrs Mullin and Emhemed for their support to the SEG 4 and in offering to host the January 2016 meeting.

14 Close of the meeting

Mr Mahendru warmly thanked all the SEG 4 members for their excellent and constructive contribution to the meeting. He also thanked the hosts that made this meeting possible.

The meeting was closed at 1:30PM.

Pierre Sebellin - Secretary of SEG 4

Annex 1: List of actions from the May 2015 meeting.

Annex 1
List of actions from the May 2015 meeting

Agenda item	Action description
8.2	<i>Action to P. Sebellin:</i> To inform TC 3, copy Georg Luber, about the conclusions of SEG 4
8.3	<i>Action to SEG 4 Members:</i> To review the 12V LVDC standard and provide comments to P. Sebellin before 30 June 2015
9.4	<i>Action to P. Sebellin:</i> Can the IEC central office host a web questionnaire?
10	<i>Action P. Sebellin:</i> To upload on the collaboration tools the answers received and the synthesis table.

Annex 2
Membership statistics

