CIGRE Study Committee C6

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

JWG C6/B4.37	**Name of Convenor:** Prof. James Yu, PhD FIET (UK) **E-mail address:** yugem@hotmail.com	
Strategic Directions #[2]: 1, 2	**Technical Issues #[3]: 1, 3, 5, 6**	
The WG applies to distribution networks (4): Yes		
Potential Benefit of WG work #[6]: 1, 2 and 4		
Title of the Group: Medium Voltage DC distribution systems		

Scope, deliverables and proposed time schedule of the Group:

Background:
Many of the distributed energy resources (DER) and systems being deployed make use, in the first conversion stage, of power electronic converters that generate DC voltage rather than AC voltages. Wind and solar generators and battery energy storage systems are example of such DER. Similarly, transportation systems, industrial drives and data centres all use dc as the primary source of power. The conversion to and from ac voltage requires an additional step that can be avoided if dc distribution systems are deployed, resulting in reduced conversion losses. In addition, distribution losses are reduced and the distribution operation can be simplified by a DC network. The enabling technology to implement Medium Voltage DC (MVDC) power systems, such as semiconductor switches (IGBTs) and converter topologies (Modular Multilevel Converters, MMCs) are ready. It is important for CIGRE to represent the latest technology advancement to demonstrate the benefits and potential of these networks.

Scope:
This working group will build upon and leverage the expertise and knowledge from C6 and other Study Committees to present the potential advantages of a dc approach (MVDC networks incorporating DER) as an alternative to ac distribution systems. The following topics will be explored and elaborated within the WG.

1. Connection of DER and loads to MVDC networks – Wind, solar, storage, and power electronic interfaced loads: industrial (motors drives), commercial, transportation (electric traction systems), and data centres. New applications for isolated systems. DC bus architectures. DC microgrids.

2. Connection of the MVDC system to the transmission grid – AC transmission interfaces, HVDC transmission interfaces.

3. Operation of MVDC systems – Power management, energy balance and power distribution. Power sharing among DER and other generators and sources. Role of energy storage in balancing. Power management for quality of service, survivability and system stability. Fault behaviour: loss of DER (wind and solar generation); large variations of DER production; faults in the power electronic conversion systems. Protection systems.

4. Comparisons of Medium Voltage AC (MVAC) and MVDC systems – Network structures. Losses and efficiency. Differences, benefits and drawbacks.

5. Connection between MVDC and Low Voltage DC distribution systems – Power conversion topology and implementation for dc and ac loads, and for LV DER.

6. Multi-terminal MVDC grids – Structures. Control of power flows. Potential benefits and applications.

7. Experiences and examples of deployments. Case studies.

8. Guidelines and existing practices, techno-economic challenges and present and future solutions.

Joint work with other SCs:

Liaison experts from B1 concerning cable related topics, and from B2 concerning MVDC Overhead Lines will be invited. A close exchange with WG A3.40 on medium voltage DC circuit breakers is envisaged.

Deliverables:

☒ Technical Brochure and Executive summary in Electra

☒ Electra report

☒ Tutorial[5]

Time Schedule : start : August 2018 **Final report** : July 2021

Approval by Technical Council Chairman : M. Waldron

Date : 13/07/2018

Notes: [1] or Joint Working Group (JWG), [2] See attached Table 2, [3]See attached Table 1, [4] Delete as appropriate, [5] Presentation of the work done by the WG, [6] See attached table 3

Table 1: Technical Issues of the TC project "Network of the Future" (cf. Electra 256 June 2011)

1	Active Distribution Networks resulting in bidirectional flows
2	The application of advanced metering and resulting massive need for exchange of information.
3	The growth in the application of HVDC and power electronics at all voltage levels and its impact on power quality, system control, and system security, and standardisation.
4	The need for the development and massive installation of energy storage systems, and the impact this can have on the power system development and operation.
5	New concepts for system operation and control to take account of active customer interactions and different generation types.
6	New concepts for protection to respond to the developing grid and different characteristics of generation.
7	New concepts in planning to take into account increasing environmental constraints, and new technology solutions for active and reactive power flow control.
8	New tools for system technical performance assessment, because of new Customer, Generator and Network characteristics.
9	Increase of right of way capacity and use of overhead, underground and subsea infrastructure, and its consequence on the technical performance and reliability of the network.
10	An increasing need for keeping Stakeholders aware of the technical and commercial consequences and keeping them engaged during the development of the network of the future.

Table 2: Strategic directions of the TC (ref. Electra 249 April 2010)

1	The electrical power system of the future
2	Making the best use of the existing system
3	Focus on the environment and sustainability
4	Preparation of material readable for non-technical audience

Table 3: Potential benefit of work

1	Commercial, business or economic benefit for industry or the community can be identified as a direct result of this work
2	Existing or future high interest in the work from a wide range of stakeholders
3	Work is likely to contribute to new or revised industry standards or with other long term interest for the Electric Power Industry
4	State-of-the-art or innovative solutions or new technical direction
5	Guide or survey related to existing techniques. Or an update on past work or previous Technical Brochures
6	Work likely to have a safety or environmental benefit