CIGRE Study Committee B4

PROPOSAL FOR THE CREATION OF A NEW JOINT WORKING GROUP (1)

JWG* N° B4/B1/C4.73	**Name of Convenor :** Markus Saltzer (SWEDEN)
Technical Issues # (2): 3, 7, 9	**Strategic Directions # (3): 1, 3**
The WG applies to distribution networks (4): No	
Title of the Group: Surge and extended overvoltage testing of HVDC Cable Systems	

Scope, deliverables and proposed time schedule of the Group :

Background :

In 1991 a CIGRE Joint Working Group was established including members of the study committees SC33 Insulation Coordination, SC21 HV Cables, SC 14 DC Links and Power electronic equipment. Scope of the JWG was the evaluation of transient overvoltages on DC cable insulation and study of applicability of overvoltage limiting devices. Technical Brochure 86 was produced in 1994.

During this time the only systems considered where paper type cables (mass, oil, gas impregnation) and line commuted converter technology. Internal and external types of overvoltage were considered.

The meanwhile increasing role of extruded cables in DC transmission is addressed in TB496 and subsequent standardization efforts, which includes extruded cables up to 500 kV and respects LCC as well as VSC converter types.

However, TB 496 considers basically internal converter failures impact on the cable system by specifying a SIWL testing procedure. LIWL is considered optional and a specific test level or a method to achieve a test level for a specific project is not stated. Instead the necessity for a LIWL test is left for customer-supplier negotiations. If LIWL is required for a project a fixed peak voltage $U_P1 = 2.1\ U_0$ being opposite polarity to the DC pre-stress is specified.

Recently a couple of new demands or developments have penetrated the commercial projects,

- Overhead line – cable mixed system for extruded cable systems
- New converter generations, and topologies, such as e.g. half-bridge / full-bridge VSC type
- Multi-terminal HVDC systems and/or DC/AC mixed grid system.

Related to those demands and the above mentioned available recommendations from TB86 and TB496 a gap is observed, which is respectively

- For a different mixed OHL – cable system a large fluctuation in the demands of LIWL for the cable system has been anticipated depending on system layout (cable length, OHL tower design, grounding conditions) and regional parameters (lightning occurrence). It is currently left to supplier and customer to agree on lightning impulse testing levels. A recommendation on a method how to approach proper LI test levels based on project specific parameters would be desired in order to support customer and supplier.
- The new converter changes might lead to changed requirements on the cable system performance and therefore on the required testing as currently mentioned in TB496. This could be e.g. the case for VSC based recommended programs. An investigations about the relevance to update overvoltage programs, or. E.g. impulse

shapes, in VSC based cable systems.

- Similar as converter topology, new system connection types beyond a pure point to point connection (multi-terminal, mixed AC/DC) can generate overvoltage signals, which are altered to what is currently respected in TB496. An investigation about the relevance to update overvoltage programs, or e.g. impulse shapes.

It is therefore suggested to start a JWG B4/B1/C4, which is looking into surges and extended over-voltages for HVDC cable systems with a goal to output recommendations on

• Method for LI level determination in mixed OHL-cable systems based on project specific parameters

• Impulse and overvoltage shapes revisited, e.g. long impulse requirements, due to converter topology developments

• Impulse and overvoltage shapes revisited due to Impact of multi-terminal and DC/AC mixed grid systems.

Scope :

Looking into surges and extended over-voltages for HVDC cable systems with a goal to produce recommendations on

1. Method for LI level determination in mixed OHL-cable systems based on project specific parameters and make recommendations for testing
2. Impulse and overvoltage shapes revisited, e.g. long impulse requirements, due to converter topology developments
3. Impulse and overvoltage shapes revisited due to Impact of multi-terminal and DC/AC mixed grid systems.

Deliverables : Technical brochure with summary in Electra

Time Schedule : start : January 2016 **Final report** : 2017

Comments from Chairmen of SCs concerned : SC D1 will be invited to contribute where appropriate

Approval by Technical Committee Chairman :
Date : 08/12/2015

(1) Joint Working Group (JWG) - (2) See attached table 1 – (3) See attached table 2
(4) Delete as appropriate

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 within distribution level and to the upstream network.
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 (cf. 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