CIGRE Study Committee C4

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP[1]

WG N° C4.48	**Name of Convenor:** Ivan Dudurych (Ireland) **E-mail address**: Ivan.Dudurych@Eirgrid.com	
Strategic Directions #[2]: 1,2		**Technical Issues #[3]: 6,8**
The WG applies to distribution networks[4]: Yes / ~~No~~		
Potential Benefit of WG work #[6]: 1,2,5		
Title of the Group: **Overvoltage Withstand Characteristics of Power System Equipment 35-1200 kV**		

Scope, deliverables and proposed time schedule of the Group

Background:

Currently there are no overvoltage withstand characteristics (OVWC) of power system equipment available that cover all the spectrum of the phenomena. Instead, we have several stand-alone standards and recommendations that cover only parts of the spectrum, e.g:

- IEC Standard 60071 defines insulation level for HV equipment, as a set of standard values that include: lightning impulse withstand voltage (LIWV) and short duration power-frequency withstand voltage (SDWV) for range I; and LIWV and switching impulse withstand voltage (SIWV) for range II.
- CIGRE WG 33.10 defines characteristics of temporary overvoltages (TOVs) versus time for EHV equipment from 345 kV and higher, and
- CIGRE TB 542 "Insulation Coordination for UHV AC systems" of WG C4.306 has a collection of data on overvoltage limits for UHV systems, but not as continuous time characteristics.

Power system equipment insulation design has been traditionally carried out based on the comparison of estimated lightning overvoltages (LOVs) and switching overvoltages (SOVs) with LIWV and SIWV accordingly. TOV characteristics, on the other hand, have been used in power system planning and operation for estimation of overvoltages that can arise on the system due to such phenomena as ferroresonance, and/or when a large amount of harmonics is present in the system voltage.

As new types of equipment have been continuously introduced in power systems, such as gas-insulated circuit breakers with very fast switching transients, or modern zinc-oxide arresters designed not only to reduce LOVs and SOVs, but also to withstand TOVs, it has become clear that assessment of overvoltages needs to be carried out in the entire time frame from microseconds to hundreds of seconds. Furthermore, advancements in high-speed measurements (e.g. phasor-measurement units – PMUs), and in electromagnetic transients (EMT) modelling of the complex transmission and distribution systems, indicate that higher overvoltages can exist in those time periods that are not covered by the traditional classification. With existing approach, overvoltages are partially defined in the following time frames:

- LOVs – *microseconds up to tens of microseconds*;
- SOVs – *milliseconds up to half a cycle of power frequency;*
- TOVs – *hundreds of milliseconds to hundreds of seconds;*

Time gaps clearly exist between each of these time frames and they need to be addressed.

Scope:
It is proposed to define the "Overvoltage withstand characteristics" of power system equipment that operates in the nominal voltage range 35 kV – 1200 kV versus time throughout the range microseconds to hundreds of seconds. The following stages of work are proposed:

- Collect real-world requirements for the overvoltage withstand characteristics for power system equipment rated from 35 to 1200 kV in transmission and distribution systems from around the world.

- Collect information about best practices on measurements, assessments, and EMT analyses of the overvoltage withstand characteristics of such equipment.
- Summarise the expert information from the above and propose a universal overvoltage withstand characteristics for power system equipment rated 35 to 1200 kV in a timeframe from microseconds to hundreds of seconds.

Deliverables:

☒ Technical Brochure and Executive summary in Electra

☒ Electra report

☒ Tutorial[5]

Time Schedule: start: October 2017 **Final Report**: October 2020

Approval by Technical Committee Chairman: M. Waldron

Date: 18/09/2017

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