CIGRE Study Committees A3, A2, A1 and B1

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

JWG N° A3/A2/A1/B1.44	**Name of Convenor:** Dr. Bartosz Rusek (Germany)
Technical Issues #[2]: 8, 9, 10	**Strategic Directions #[3]:** 1, 2
The WG applies to distribution networks[4]: Yes	
Potential Benefit of WG work #[5]: 1, 2, 6	
Title of the Group: Limitations in Operation of High Voltage Equipment Resulting of Frequent Temporary Overvoltage's	

Scope, deliverables and proposed time schedule of the WG:

Background:

In transmission and distributions systems the operating voltage can temporarily exceed the highest voltage for the equipment (Um). This statement results of following regulations and service examples:

1. The ENTSO-E Network Code on Demand Connection and the ENTSO-E Network Code on Requirements for Generators defines specific voltage ranges and time periods for the operation of equipment in the transmission grid and distribution systems. Some of demanded voltage ranges are above (Um) and can occur in emergency cases in transmission and distributions systems.
2. Due to massive integration of renewable energies, numerous utilities in high voltage systems frequently operate system and equipment near the Um. Therefore, depending on infeed fluctuation, the operating voltage can often exceed the Um.
3. The energization of very long high voltage cables (already compensated) can lead to TOVs exceeding the Um for number of minutes till the other end of cable is firmly connected to the grid. Such cases can occur many times a year.

According to the IEC 60071-1, operating voltage higher than the Um can be interpreted as temporary overvoltage (TOV) if its duration does not exceed 3600 s. Hence all three cases above are in line with insulation coordination standard. Nevertheless, the standard does not define the frequency of voltage stresses. Hence one can assume, that highly recurrent voltages above the Um stress the equipment more, than less frequent overvoltages resulting from disturbed conditions (like load rejection, earth faults, etc.). In such cases, the impact on the withstand voltages, lifetime of equipment and their switching capability is not considered so far. Moreover, the standard for circuit breaker IEC 62271 covers only the insulation lifetime test with 1 Minute test procedure. The ability to switch all kind of voltage and current stresses at operating voltage higher than Um is not tested. Nevertheless, it does not mean, that the equipment cannot withstand this kind of stresses.

In most of the cases, rated voltage of the high voltage equipment (Ur in IEC 62271) is equal to highest voltage for the equipment (Um in IEC 60071). This relation (Um=Ur) will be assumed for this study.

Scope:

The Working Group will investigate the influence of standard frequent TOV on the equipment, covered under B1, A1, A2 and A3 study committees (generators, power transformers, overhead lines, switching equipment, surge arrestors). This WG will not cover all TOVs that can arise in the power system such as harmonic resonances during transformer energization. This will be investigated under separate WG.

The main tasks of this WG are as follows:

1. Review the literature concerning the specifications of Ur, the background information for definition of standard waveforms for TOV, the experience with temporary operation with voltages above Um, the equipment limitations, the related Grid Codes requirements and the findings and recommendations from WG C4.46 and WG C4.48.
2. Conduct a survey among utilities asking for the typical frequency and magnitude of operating and n-1-condition voltage above Um, the service experience, the failure statistics and the mitigation measures with/for equipment exposed to these voltage stresses
3. Conduct a survey among manufacturers concerning the capability and limitations of equipment to fulfil its standard functions at frequent TOV
4. Based on survey results describe the equipment limitations and possible mitigation methods in different applications
5. Discuss the results in relation to standards considering especially frequency, magnitude and duration of TOV as well as combined voltage stresses resulting of simultaneous standardised waveforms for TOV and SOV (Switching Over-Voltage)
6. Recommend the areas for further work

Deliverables:

☒ Technical Brochure and Executive Summary in Electra

☒ Electra Report

☒ Tutorial[6]

☐ Webinar[6]

Time Schedule: start: December 2019 **Final Report**: December 2022

Approval by Technical Council Chairman:

Date: August 26th, 2019

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

Table 1: Technical Issues for creation of a new WG

1	Active Distribution Networks resulting in bidirectional power and data flows within distribution levels up to higher voltage networks
2	Digitalization of the Electric Power Units (EPU): Real-time data acquisition includes advanced metering, processing large data sets (Big Data), emerging technologies such as Internet of Things (IoT), 3D, virtual and augmented reality, secure and efficient telecommunication network
3	The growth of direct current (DC) and power electronics (PE) at all voltage levels and its impact on power quality, system control, system operation, system security, and standardisation
4	The need for the development and significant installation of energy storage systems, and electric transportation, considering the impact they can have on the power system development, operation and performance
5	New concepts for system operation, control and planning to take account of active customer interactions, and different generation types, and new technology solutions for active and reactive power flow control
6	New concepts for protection to respond to the developing grid and different generation characteristics
7	New concepts in all aspects of power systems to take into account increasing environmental constraints and to address relevant sustainable development goals.
8	New tools for system technical performance assessment, because of new Customer, Generator and Network characteristics
9	Increase of right of way capacity through the use of overhead, underground and submarine infrastructure, and its consequence on the technical performance and reliability of the network
10	An increasing need for keeping Stakeholders and Regulators aware of the technical and commercial consequences and keeping them engaged during the development of their future network

Table 2: Strategic directions of the Technical Council

1	The electrical power system of the future: respond to speed of changes in the industry
2	Making the best use of the existing systems
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, social and economic benefits 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 directions
5	Guide or survey related to existing techniques; or an update on past work or previous Technical Brochures
6	Work likely to contribute to improved safety.
7	Work addressing environmental requirements and sustainable development goals.