CIGRE Study Committee D1

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

WG D1.74	**Name of proposers:** Andrea Cavallini (IT)
Technical Issues #[2]: 3	**Strategic Directions #[3]: 1**
The WG applies to distribution networks[4]: Yes	
Potential Benefit of WG work #[5]: 3	
Title of the Group: **PD measurement on insulation systems stressed from HV power electronics**	

Background:

Fast rising voltages from switch-mode power electronics may result in increased partial discharge (PD) activity and more rapid deterioration of insulations in converter components and connected equipment. The introduction of wide bandgap switching devices like silicon carbide (SiC) will most probably aggravate these problems. PD inception voltages will often be lower and magnitude of discharges larger for fast switching voltage waveforms, compared to sinusoidal voltages.

Still, commissioning tests with PD measurement are usually done under power frequency sinusoidal stresses because the standardized tests are incompatible with switched voltages. Furthermore, the physics of the failure mechanisms introduced from these converter voltage stresses is poorly known. Another challenge is the increased content of high-frequency voltage waveforms, which calls for improved tools for analyzing how they propagate in the network and penetrate connected apparatuses. Additionally, the PD measurement is difficult because the frequency band of the excitation signal overlaps with the PD measuring frequency.

Considerable work is done on non-conventional PD detection, and high frequency detection is suggested and used for many apparatuses, like GIS and motors. There are also standards for testing of motors under harmonics from converter stresses. Nevertheless, there are IEC technical specifications for testing materials and insulations systems (like IEC TS 61934 in TC 112) available and for apparatus (like IEC TS 60034-27-5 in TC 2) in development.

In IEC standards, applied stresses are in the frequency range up to maximal 400-500 Hz and PD activity is measured with the conventional method, as described in IEC 60270.

The WG will investigate and propose methods for measuring PD and provide models for investigating insulation degradation in power equipment under converter voltage stresses. Possibilities for online and offline condition assessment under converter stresses will also be investigated.

Input from SCs B4, B2 and A1 will be sought as and when required.

Scope:

- Survey and possibilities for measuring PDs in power apparatus stressed with step voltages from power electronics.
- Extract features of PD signals (e.g. waveform and bandwidth) from insulation systems in relevant apparatus
- Investigation of wave propagation from power converters into networks and apparatuses.
- Investigation of voltage endurance for typical insulation systems to compare ageing from square wave modulated and sinusoidal stresses.
- Summarizing the results as basis for the development of standards for commissioning tests of electrical equipment under the influence of power electronic stresses.

Deliverables:

☒ Technical Brochure and Executive summary in Electra

☒ Electra report

☒ Tutorial[6]

☐ Webinar[6]

Time Schedule: Start Q1 2019 **Final Report**: End Q2 2022

Approval by Technical Council Chairman:

Date: January 28th, 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.