CIGRE Study Committee D1

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG [1]N° D1.76	**Name of Convenor:** Jelena Lukic (RS) **E-mail address**: lukicjelena@ieent.org
Strategic Directions #[2]: 1	**Sustainable Development Goal #[3]: 9**
The WG applies to distribution networks: ☒ Yes / ☐ No	
Potential Benefit of WG work #[4] : 1, 6	
Title of the Group: Tests for verification of quality and ageing performance of cellulose insulation for power transformers	

Scope, deliverables and proposed time schedule of the WG:

Background:

Quality of cellulose insulation is of interest for transformer end users. It is important for the discussion between transformer manufacturers and customers that expectations of material quality can be supported by standard tests based on common understanding of material behavior. This need is further accentuated by the interest to investigate possibilities to use cellulose insulation in combination with insulating liquids other than mineral oils to increase service temperatures.

Cellulose is not a material with uniform structure and chemical composition. Degradation may depend on raw materials and processing and may vary from one manufacturer to another. Ageing performance in an insulation system will also depend on the type of dielectric liquid. It is dubious if present accelerated test methods used for testing cellulose ageing in mineral oils is applicable for comparing performance between cellulose insulation systems with non-mineral oil liquids, as differences in temperature dependence of water absorption introduce other processes. There is a need to establish accelerated test methods for documenting ageing performance of cellulose insulation materials in different insulating liquids and to include liquid dependent ageing factors which are promoting oxidation and acid catalyzed hydrolysis, thus providing closer view on real ageing conditions of cellulose insulation in service.

Brochures 323 and 738 documents existing knowledge on ageing of cellulose insulation systems. It is shown that existing models (Ekenstam model) for calculating ageing is too conservative, as the level-off paper degree of polymerization (DP) is not considered. Better algorithms are needed for transformer life assessment.

Finally, there is a problem with quality verification based on DP measurement partly caused from unclear linking between functional properties as e.g. tensile or bursting strength, plastic deformation etc. and measured DP-values, and partly by problems with existing protocols for the DP method, observed with dried papers and their restricted dissolution in solvent.

Scope:

1. Investigate problems with present standard for DP measurement using viscosimetric method according to IEC 60450 and relations between functional mechanical properties of cellulose products and measured DP-values.

2. For end users there is a need to better verify quality of cellulose products used in transformers. Establish recommendations for simplified accelerated test methods for testing thermal ageing of liquid impregnated cellulose products. Investigate possibility to include liquid dependent acceleration factors in order to get better view on the quality of tested materials.
3. Investigate possibilities for introducing alternative algorithms for modeling cellulose ageing to improve transformer life assessment.

Deliverables:

☒ Technical Brochure and Executive Summary in Electra
☒ Electra Report
☐ Future Connections
☐ CSE
☒ Tutorial
☒ Webinar

Time Schedule: start in April 2021 **Final Report**: December 2024

Approval by Technical Council Chairman:

Date: March 28th, 2021

Notes: [1] Working Group (WG) or Joint WG (JWG), [2] See attached Table 1, [3]See attached Table 2 and CIGRE reference Paper: Sustainability – at the heart of CIGRE's work. [4] See attached Table 3

Table 1: Strategic directions of the Technical Council

1	The electrical power system of the future reinforcing the End-to-End nature of CIGRE: respond to speed of changes in the industry by preparing and disseminating state-of-the-art technological advances
2	Making the best use of the existing systems
3	Focus on the environment and sustainability (in case the WG shows a direct contribution to at least one SDG)
4	Preparation of material readable for non-technical audience

Table 2: Environmental requirements and sustainable development goals

	CIGRE selected the 7 SDGs that are the most relevant to CIGRE. In case the WG work refers to other SDGs or do not address any specific SDG, it will be quoted 0.
0	Other SDGs or not applied
7	**SDG 7: Affordable and clean energy** Increase share of renewable energy; e.g. expand infrastructure for supplying sustainable energy services; ensure universal access to affordable, reliable, and modern energy services; energy efficiency; facilitate access to clean energy research and technology
9	**SDG 9: Industry, innovation and infrastructure** Facilitate sustainable infrastructure development; facilitate technological and technical support
11	**SDG 11: Sustainable cities and communities** Increase attention on sustainable and resilient buildings utilizing local (raw) materials, power for electric vehicles, strengthening long-line transmission and distribution systems to import necessary power to cities, developing micro-grids to reinforce the sustainable nature of cities; protect and safeguard the world's cultural and natural heritage; reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and waste management
12	**SDG 12: Responsible consumption and production** E.g. Promote public procurement practices that are sustainable; address reducing use of SF6 and promote alternatives, encourage companies to adopt sustainable practices and to integrate sustainability information into their reporting cycle, address inefficient fossil-fuel subsidies that encourage wasteful consumption
13	**SDG 13: Climate action** E.g. Increase share of renewable or other CO_2-free energy; energy efficiency; expand infrastructure for supplying sustainable energy; strengthen resilience and adaptive capacity to climate-related hazards and natural disasters; integrate climate change measures into national policies, strategies and planning; improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
14	**SDG 14: Life below water** E.g. Effects of offshore windfarms; effects of submarine cables on sea-life
15	**SDG 15: Life on land** E.g. Attention for vegetation management; bird collisions; integration of substations and lines into the landscape

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.