CIGRE Study Committee C4

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG [1] N° C4.69	**Name of Convenor: Silverio Visacro** (Brazil) **E-mail address**: Silverio_visacro@hotmail.com and LRC@cpdee.ufmg.br	
Strategic Directions #[2]: 2		**Sustainable Development Goal #[3]: 9**
The WG applies to distribution networks: ☐ Yes / ☒ No		
Potential Benefit of WG work #[4] : 3,4,5,6		
Title of the Group: Quantifying the lightning response of tower-footing electrodes of overhead transmission lines: methods of measurement		

Scope, deliverables and proposed time schedule of the WG:

Background:

The response of tower-footing electrodes subjected to return stroke currents has great influence on the lightning performance of transmission lines (TLs), notably in their backflashover rate.

In this respect, determining which are the parameters that are able to consistently quantify this response, establishing the range of their acceptable values according to the TL features and defining how to measure them are issues of major practical interest for engineering applications.

Although this response is concededly different from that exhibited when electrodes are subjected to slow-varying currents, such as those associated to short-circuits, the low-frequency grounding resistance (R_{LF}) remains as the most frequently used parameter in procedures for estimating the lightning performance of TL towers. The harmonic impedance, notably in the range of 25 kHz (Z_{25kHz}), has also been used for this purpose, to prevent the need of disconnecting the shield wires (or electrodes) from the tower, during measurements. CIGRE TB 275 published in 2005, addressed these two types of measurements.

Since then, there have been significant scientific advances in the knowledge of the lightning response of electrodes and the impact of this response on the transmission line performance. This has shown the need to revise and complement the mentioned document. In particular, the limitations of the two parameters mentioned above to represent the lightning response of electrodes has been demonstrated. Furthermore, new resources for measurement and simulation of this response have provided elements to support a deep analysis of this picture to allow defining more adequate parameters for quantifying this response and the methodologies for their measurement. For instance, in the last years, a significant number of experimental results of measurement of the so-called tower-footing impulse impedance (Z_P) have been available and published.

Admittedly, the measurement of parameters related to the lightning response of tower-footing electrodes is a complex task. Several factors contribute to this picture, such as the need of very long distances between the tower and the auxiliary electrodes used in the measurements, the interference between leads of the measuring circuits (notably for measurements using high frequency signals) and the disturbances caused by spurious voltages in the ground, mostly associated with stray currents. Frequently, the application of the different traditional methodologies of measurement leads to different results and to uncertainties about the validity of the qualification they provide for tower-footing electrodes. The mentioned recent scientific advances have made it feasible to overcome the constraints resulting from these factors by using new methodologies and instrumentations.

The proposed WG aims achieving an articulate set of results, comprising guidelines for quantifying the response of tower-footing electrodes subjected to return stroke currents, by determining the most appropriate concise parameters to express this response, establishing the range of their acceptable values and defining the methodologies and instrumentation required for their measurement.

Scope:

1. Review the traditional and recent literature concerning…
   - Potential parameters of tower-footing electrodes for quantifying their lightning response, in terms of their impact on the TL performance, including Z_P, Z_{25kHz} and R_{LF}: *advantages and limitations*.
   - Methodologies and instrumentation for measurement of such parameters.
   - Analysis of the feasibility of measurement of parameters used for representing the lightning response of tower-footing electrodes and of their indirect determination from other measured parameters by using correlations.
2. Summarize, compare and analyze the available reliable results of measured parameters.
3. Appoint the most representative parameters and assess the acceptable range of their values for defined performance and features of the transmission line.
4. Define the methodologies for measurement of the appointed parameters and the corresponding instrumentation.
5. Develop guidelines for application of the appointed parameters in the assessment of the lightning performance of transmission lines.

Deliverables:

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

Time Schedule: start: November 2021 **Final Report**: December 2023

Approval by Technical Council Chairman:

Date: September 17th, 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.