CIGRE Study Committee C4

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG [1]N°C4.59	**Name of Convenor:** Chong Tong (CN)
Technical Issues #[2]: 8, 10	**Strategic Directions #[3]: 1,2**
The WG applies to distribution networks[4]: Yes	
Potential Benefit of WG work #[5]: 2,3,6	
Title of the Group: Real-time Lightning Protection of the Electricity Supply Systems of the Future	

Scope, deliverables and proposed time schedule of the WG:

Background:

It is widely recognized that lightning is a significant – if not the major – cause of electric power system faults. The deleterious effects of lightning can be minimized but cannot be eliminated in practice. Due to the huge number of crucial power grid devices, the number of failures/malfunctions is still considerable. To put this into context, at present, approximately 55% to 80% of the faults/interruptions in Chinese power grids are related to lightning, with similar percentage reported for Brazil and a rough estimate of 40% for the USA and Canada.

The electricity supply systems of the future with increased penetration of renewable energy sources (RES) and application of complex automation & digital technologies, will face important challenges regarding lightning protection. Centrally dispatched larger installations away from cities with an emphasis on transmission level flow is being replaced by dispersed renewable generation at distribution level at smaller scales is changing the conventional operation mode of power grids. The climate change leads to complicated meteorological conditions, resulting in a likely increase of the risk of adverse effects from lightning. Due to intrinsic volatility of renewable generation, long range & large capacity electricity transmission and cumulative & cascade effects, the electricity supply systems of the future is likely to face problems of local outages and threats of blackouts caused by lightning at an elevated level compared to the past.

For the purpose of improving reliability and resilience of such future grids, more adapted lightning protection technologies have been proposed and applied. Based on lightning detection & tracking, real-time preventive protection actions can be implemented. The expected goal is to minimize the impacts of lightning-caused disturbances, and to improve the general lightning performance of the future grid. In China and some other countries, projects and systems covering this type of lightning protection application have been widely developed and implemented in the field. The largest one concerns a power grid which supplies 26 GW load to a population of 11 million. The conventional protection against lightning is still most crucial. However, real-time protection (or active management of conventional protection) would provide more mitigation options in situations where conventional solutions are inadequate or cannot be achieved reasonably and economically.

The proposed working group will consider the challenges of lightning protection for existing and future power grids. The worldwide study aims at 1) collecting data on lightning-related faults of existing power grids and inferring the potential impact of these faults on the future grids with high proportion of renewable generation; 2) creating a lightning warning & risk evaluation model for future grids, identifying situations where conventional solutions are inadequate, and proposing a decision-making model for operation; and 3) investigating the existing real-time lightning protection measures which are based on lightning tracking and guiding the protection strategies.

This Working Group is expected to propose more adapted solutions compared to existing ones, so as to address the potential lightning disturbances and improve the general lightning performance of the electricity supply systems of the future.

Scope:

1. Collect worldwide data and investigate the proportion of lightning-related outages & disturbances of existing power grids (transmission systems & distribution systems). Analyse and classify the different kinds of lightning-caused outages & disturbances.

2. Analyse and infer the potential impact and consequences of lightning-caused faults on the future grids (including actively managed distribution systems & transmission systems and/or smart grids).

3. Define the concepts of static lightning performance and dynamic lightning performance of power grids. Recommend a lightning warning and risk evaluation model of the electricity supply systems of the future. Identify situations where conventional solutions are inadequate or unsuitable. Propose a decision-making model integrated with lightning detection and stability evaluation.

4. Investigate the application of lightning detection, location or tracking systems in real-world power system operation.

5. Investigate and revise the available real-time lightning protection measures which are based on lightning detection & tracking.

6. Analyze and evaluate the potential advantages, disadvantages and limitations of real-time or dynamic lightning protection modes. Provide guidance toward real-time lightning protection strategies of real-world power grids and future smart grids.

Deliverables:

☒ Technical Brochure and Executive Summary in Electra

☐ Electra Report

☒ Tutorial[6]

☒ Webinar[6]

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

1st WG meeting: October 2019 (SIPDA, Brazil)

2nd WG meeting: Q2/2020 (ILDC, USA)

3rd WG meeting: September 2020 (ICLP, Sri Lanka)

TB draft V1.0: Q4/2020

4th WG meeting: Q1/2021 (ICLPS, China)

TB draft V2.0: Q2/2021

Milestone report to C4: Q3/2021

5th WG meeting: October 2021 (SIPDA, Brazil)

TB draft V3.0: Q4/2021 6th WG meeting: Q1/2022 (ILDC, USA) TB finalization: Q2/2022 7th WG meeting: September 2022 (ICLP, South Africa) Final report: December 2022
Approval by Technical Council Chairman: **Date**: October 18th, 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.