CIGRE Study Committee B2

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG[1] SC/B2.95	**Name of Convenor:** Asif BHANGOR (Australia) **E-mail address**: bhangorian@gmail.com
Strategic Directions #[2]: 1,2,3,4	**Sustainable Development Goal #[3]:** 7,9,11,13

This Working Group addresses these Energy Transition topics:

	Storage
	Hydrogen
	Digitalization
X	**Sustainability and Climate Change**
X	**Grids and Flexibility**
	Solar PV and Wind
	Consumers, Prosumers and Electrical Vehicles
	Sector Integration

☐ **None of them**

Potential Benefit of WG work #[4] : 1,2,3,4,5,6

Title of the Group:
Impact of extreme weather events under climate change on high voltage overhead line design standards

Scope, deliverables and proposed time schedule of the WG:

Background:

Transmission and distribution overhead line (OHL) networks are exposed to severe climatic events including extreme wind, heatwaves, wildfires, floods, ice, snow storms and landslides. The increase in magnitude of such events due to climate change can cause environmental/infrastructure damages and affect safe operation/maintenance of the network, reliability and customer service, public safety, potentially giving rise to significant financial costs to the power network operators. Therefore, their expected evolution should be taken into account in the planning phase of projects.

Current practice in OHL design is based on existing standards that provide basis of selection of design parameters developed via the historical and statistical weather information available, assuming a stationary climate. Climate change may alter the mean, the variability and the extremes of relevant weather variables. Moreover, site-specific observations are often limited and, above all, in a changing climate, these observations can no longer represent accurate climatic data for a structural design. At the same time, weather station installations are now growing to become an acceptable practice on existing structures in overhead lines. This may provide new data that can be used for the correct correlation of historical and statistical weather information available in current standards.

Moreover, global net-zero targets and ever-increasing demand for new renewable connections necessitates the development of new transmission line construction. The IEA (International Energy Agency) estimates global demand to construct approximately 7.5 million kilometers of new transmission lines by 2050 (2 million km by 2030) and 81 million km of new distribution lines (14 million by 2030). Such development targets raise the issue of resilience of new and old transmission line assets exposed to extreme threats deriving from climate change to ensure the adequate level of reliability of supply for all customers. New

design approaches need to be considered and, consequently, new regulation and design standards will need to be adopted to cope with this unprecedented situation.

The need arises for the evaluation of all design criteria in OHL that are directly impacted by the increase in extreme events to address the intended reliability levels and safeguard against the probability of failure.

Purpose/Objective/Benefit of this work:

The scope of this WG will include:

1. to assess the weather-related criteria available in the published standards and the basis of the selection for the design parameters in relation to the required reliability levels.
2. to provide specific case studies for increasing the adequacy of the design parameters in line with the recorded and expected extreme events at global and local scale, considering their impact on the mechanical, electrical, structural and footing design including:
    a. *Wind load (including downbursts/ tornadoes/ synoptic winds etc.)*
    b. *Ice load*
    c. *Wet snow sleeve load*
    d. *Flood levels*
    e. *Fire*
    f. *Heat waves*
    g. *Landslides*
3. Prepare design criteria guidelines that address a standard set of design criteria using the above-mentioned weather-related events including:
    a. *Wind loading criteria*
    b. *Ice and wet snow loading criteria*
    c. *Various load combinations under extreme scenarios*
    d. *Reliability selection basis (e.g. return period selection and alternative probabilistic evaluation criteria)*
    e. *Structure soil/ interaction basis (e.g. in flood and extreme rainfall events)*
    f. *Temperature (maximum design temperature and ambient temperature)*
    g. *Basis of mechanical stresses in conductor selection under the extreme load scenarios including galloping causing flashovers and resulting dynamic loads*
    h. *Foundation selection criteria*

Scope:

- Provide a clear design basis of all key elements in the design of the transmission and distribution overhead lines affected by the extreme weather events.
- Provide guidance by carrying out a sample set of design calculations to showcase the effect of the existing design basis and the newly recommended design basis as per above.
- Provide supporting documentation and clear design basis from a global perspective for Operators, Regulators and Project Financiers participating in large transmission builds to achieve net zero targets thus removing ambiguity on required reliability levels considering climate change impact on new transmission build.

Remarks:

Excluded from Scope:

- Construction methodology;
- 3rd party infrastructure and public exposure to construction hazards;
- Artificial intelligence in design assessment with meteorological data;
- Review on operational maintenance procedures that may impact design procedures or design basis.

References:

- IEA, “Climate Resilience”, International Energy Agency, 2021.
- IEC TC-11 Overhead Lines
- CEN/TC 250/SC 1 N 1648, 2018. Project Team SC1.T5 “Climate Change”. Final Report.
- IEC 60826 “Design Criteria for Overhead Transmission Lines”
- CENELEC EN 50341 “Overhead electrical lines exceeding AC 1 kV - Part 1: General requirements - Common specifications” and part 2 and part 3 (National Normative Annexes)
- TBs from B2 dealing with this topic: 109, 178, 289, 291, 299, 344, 350, 410, 438, 485, 598, 631, 767, 838
- Green Book #11: Techniques for Protecting Overhead Lines in Winter Conditions
- Matsumiya, H., Challenges for mitigating natural disasters on Overhead Transmission Lines – Snow damage, Electra 332, February 2024

Deliverables:

☒ Annual Progress and Activity Report to Study Committee
☒ Technical Brochure and Executive Summary in Electra
☒ Electra Report
☐ Future Connections
☒ CIGRE Science & Engineering (CSE) Journal
☒ Tutorial
☒ Webinar

Time Schedule:

• Recruit members (National Committees, WiE, NGN)	Qtr 4 2024
• Develop final work plan	Qtr 1 2025
• Draft TB for Study Committee Review	Qtr 3 2026
• Final TB	Qtr 3 2027
• Tutorial	Qtr 4 2027
• Webinar	Qtr 1 2028

Approval by Technical Council Chair:

Date: April 19th, 2024

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

WG Membership: refer Comments at end of document

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.

Comments:

1) CIGRE Official Study Committee Rules: WG Membership

https://www.cigre.org/GB/about/official-documents

a. Only one member per country: by exception of SC Chair, WiE and NGN nominees.

b. WG nominees by NCs must first be supported by their National Committee (or local SC Member) as an appropriate representative of their country.

c. Acceptance of the nomination is granted by the SC Chair and advised to the WG Convener.

2) Collaboration Space

https://www.cigre.org/article/GB/collaborative-tools-2

CIGRE will provision the WG with a dedicated Knowledge Management System Space.

The WG will use the KMS for drafting collaboration, capture and retention of discussion and meeting records.

Official country WG Members will be sent registration instructions by the Convener.

Official country WG Members may request the WG Convener to allow additional access for an extra national subject matter specialist to aid in the work at the national level, including NGN members.