

CIGRE Study Committee B2

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

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| WG B2.89 | Name of Convenor: Bo Zhang (China) | |
| Strategic Directions #²: 3 | | Sustainable Development Goal #³: 9, 11 |
| The WG applies to distribution networks: <input type="checkbox"/> Yes / <input checked="" type="checkbox"/> No | | |
| Potential Benefit of WG work #⁴: 3, 4, 5 | | |
| Title of the Group: Impact of rain upon the characteristics of corona discharge from HV AC and DC overhead transmission lines | | |
| Scope, deliverables and proposed time schedule of the WG: | | |
| Background: | | |
| <p>The environmental effects generated by the corona discharge of overhead power lines, especially the audible noise, has become a key factor that restricts the design of power lines. Corona discharge is closely related to weather. Rain has the greatest and most frequent influence on corona discharge, which is the focus of research on the electromagnetic environment of transmission lines.</p> <p>The actual measurements show that the corona loss is increased regardless of AC or DC power lines when it rains. However, in contrast to AC audible noise, which is worst in heavy rain, DC audible noise is known to drop. The same is true for radio interference. Although there are plenty of experiences with AC corona effects, the variation of the corona phenomena at different stages of rain, such as rain onset, steady state rain, and the dry-off phase after stopping the rain, is not entirely clear, not to mention the DC cases. Limited researches have been found that focuses on the audible noise and radio interference at the beginning of rain, and also on DC lines increase. Furthermore, corona behaviour varies significantly at different rain intensities. However, the classification of rainfall intensity in the existing formulae for predicting audible noise and radio interference is rough. It is simply classified into light rain and heavy rain, or 1-2 rainfall intensities. Therefore, extensive tests and detailed studies were needed to give more reliable predictions of the corona effects of power lines.</p> <p>As the voltage level continues to increase, it is necessary to study corona discharge and its environmental effects of AC and DC overhead power lines during rain and in fair conditions. In the past ten years, China, Switzerland, Austria, Korea, and other countries have made great progress in this area, and their test and research results are available. Therefore, it is necessary to summarize these latest research findings from various countries.</p> | | |
| Purpose/Objective/Benefit of this work: | | |
| <p>This work is going to figure out the different AC and DC corona phenomena during rain compared to fair weather conditions, clarify the degree of the variation, and update the existing formulae for predicting audible noise and radio interference, which will provide basic technical support for the development of environmentally friendly overhead power lines.</p> | | |
| Scope: | | |
| The working group would investigate and report on: | | |
| <ol style="list-style-type: none"> 1. Review and compare the corona phenomena of AC and DC overhead power lines in fair weather and rainy conditions, and revise the prediction formulae of the corona parameters in the literature developed by different companies and working groups. | | |

2. Introduce the traditional and up-to-date methods to monitoring corona of overhead power lines, including corona loss, audible noise, radio interference, the corona current pulse, and the high-speed image of discharge, developed by China, Switzerland, Austria, South Korea and other countries in the past ten years.
3. Introduce the factors that affect corona discharge characteristics in fair weather and rainy conditions, such as the surface roughness, the rainfall intensity and the process of the rainfall from the beginning to the end of the rain. Introduce the variation of the AC and DC corona characteristics during the process of the rainfall and the corona characteristics in fair weather conditions.
4. Explain the different mechanisms of AC and DC corona discharge in rainy conditions and fair weather, and the relationship among corona current pulse, corona loss, audible noise, and radio interference. Explain why the corona loss is increased, regardless of AC or DC, when it rains. However, in contrast to AC audible noise and radio interference, which are worst in heavy rain, DC audible noise and radio interference are small during rain.
5. Review and update the formulae for predicting audible noise and radio interference considering the effects of the stages and intensity of rain, and those for DC power lines in fair weather conditions.

Remarks:

The work will be coordinated with the WG B2.83 “Mitigation of induced noises by corona activity in overhead AC and DC lines”, which analyzes the different alternatives to reduce audible noise. This new proposal is more detailed and focuses on the corona discharge at different rain conditions comparing it to fair weather conditions. In addition to the audible noise, it also pays attention to corona loss and radio interference.

The corona exists not only on conductors, but also from insulators near fittings. The corona from insulators can be reduced by optimizing the position and structure of grading ring as WG B2.80 “Numerical Simulation of electrical fields on AC and DC Overhead Line Insulator Strings” will cover. However, it is difficult to reduce the influence of weather on corona on conductor. Therefore, the WG just focus on the corona from conductors, while those from fittings and insulators will not be included.

This work is not a new research project, but a summary of the research achievements of high voltage transmission technology in the world over the past decade. Most of the tests, including those in laboratory and in actual lines, have been completed. China, Switzerland, Austria, Korea, and other countries have made great progress in this area, which will be included in the report.

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:

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| • Recruit members (National Committees) | Q4 2023 |
| • Develop final work plan | Q4 2023 |
| • Draft TB for Study Committee Review | Q1 2025 |
| • Final TB | Q3 2025 |
| • Tutorial | Q4 2025 |
| • Webinar | Q4 2025 |

Approval by Technical Council Chairman:

Date: August 10th, 2023



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

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| 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

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| | 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

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| 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)
- b. WG nominees 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.