

CIGRE Study Committee C4

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

JWG 1^{N°} C4/B4.72	Name of Convenor: Qingmin Li (China)	
Strategic Directions #²: 1,2,3,4		Sustainable Development Goal #³:7,9,11,12
The WG applies to distribution networks: <input checked="" type="checkbox"/> Yes / <input type="checkbox"/> No		
Potential Benefit of WG work #⁴ : 1,2,3,4,5		
Title of the Group: Lightning and Switching Induced Electromagnetic Compatibility (EMC) issues in DC power systems and new emerging power electronics-based DC equipment		
<p>Scope, deliverables and proposed time schedule of the WG:</p> <p>Background:</p> <p>DC/HVDC networks are becoming more common both for the transport sector and for renewable energy. DC transmission and distribution technologies are being extensively developed worldwide and they have utilized new emerging power equipment, such as power electronic transformer and energy routers. However, all of these sources and equipment are predominantly based on power-electronics and the level of immunity required against Electromagnetic Emissions (EM)/Disturbances may be a lot higher than for purely AC systems.</p> <p>EMC considerations have been considered by SC B4 for the new emerging DC electronic-based equipment. However, potential lightning current intrusion caused by direct or induced lightning may present greater EMC challenges to emerging DC systems, especially to the secondary systems. The DC secondary systems normally cover the control, communication and protection units positioned inside the valve house or placed in the DC switching yard. In addition, there is currently a lack of research publications on the switching and lightning induced EM disturbances in DC secondary systems. These include induced disturbance on secondary systems due to electromagnetic emissions arising from valve switching, from DC breaker operation and from lightning induced disturbance.</p> <p>This working group proposes to consider an HVDC converter as a black box and intends to address lightning and switching induced EM disturbances/emissions in DC power systems and considers their impact on secondary systems external to the converter(s). These considerations would help to ensure a harmonious EM environment and the safe operation of equipment and components comprising the secondary system related to the primary DC power equipment and components. The mitigation measures against the emissions/disturbances should be proposed and corresponding protection design should be developed accordingly.</p> <p>In summary, there is a lack of research publications on switching and lightning induced EMI problems for the new emerging DC equipment. It is the objectives of the proposed working group to review recent researches and proposals in the estimation of EM disturbances due to lightning and due to switching operations in DC secondary systems and to propose a methodology for the establishment of appropriate limitation measures and protection designs.</p> <p>Scope:</p> <p>The aim of this Working Group will be to review the impact of EM disturbances caused by direct lightning strikes on DC transmission lines; induced lightning transients coupled to DC</p>		

transmission lines; and the EM disturbances induced by the sudden operation of power sources in DC secondary systems. No consideration of the EM disturbances generated by HVDC converter equipment, and the EMC issues related to HVDC converter stations will be considered. Since the frequency spectrum of the lightning and switching induced EM disturbances mainly appear in the range from tens of kHz to several MHz, the frequency of the EM emissions considered will not be lower than 9kHz. Additionally, the mitigation measures will be reviewed accordingly to ensure the safe operation of DC systems; especially the new emerging power electronics-based DC equipment.

The data to be used for analysis will be based on measurement campaigns done by academic institutions and/or owners of power installations. Data from manufacturers will not be actively sought but any voluntary contributions by manufacturers will be most welcomed. The specific objectives will be as follow:

1. Produce an inventory on the propagation characteristics in both conducted and radiated emissions caused by direct lightning and induced lightning affecting DC systems.
2. Produce an assessment of the severity of the impact of these emissions caused by direct lightning strikes and induced lightning on electronics-based DC equipment in the secondary system.
3. Produce an inventory of the mitigation measures on the EMIs caused by direct and induced lightning to ensure the safe operation of the new emerging electronics-based DC equipment in the secondary system.
4. Produce an inventory on EMC assessment of switching induced EMIs coupled to the secondary system.
5. Produce an inventory of mitigation measures on the switching induced EMIs coupled to the secondary system to ensure the safe operation of the new emerging electronics-based DC equipment of secondary systems.
6. Produce and summarize the main findings, identify open EMI issues, and make recommendations to address the open issues.

This JWG will establish liaison with IEC TC8/WG9 on DC EMC issues.

Deliverables:

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

Time Schedule: start: August 2022

Final Report: October 2025

Approval by Technical Council Chairman:

Date: April 13th, 2022



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.