CIGRE Study Committee B1

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG N° B1.83	**Name of Convenor:** Christian RÉMY (FRANCE) **E-mail address**: christian.remy@prysmiangroup.com
Strategic Directions #[2]: 1	**Sustainable Development Goal #[3]: 9**
The WG applies to distribution networks: ☐ Yes / ☒ No	
Potential Benefit of WG work #[4] : 1,2,3,4,5,6	
Title of the Group: Grounding aspects for HVDC land cable connections	

Scope, deliverables and proposed time schedule of the WG:

Background:

The use of HVDC transmission lines has been increasing recently and especially those using underground cables. However unlike for HVAC links, there is few literature and guidelines which specifies or recommends how to properly ground this kind of system. HVDC grounding of cables is made to ensure:

- Safety aspect: Cable system shall not be a danger for third party in normal, fault or outage condition
- Integrity of the asset: cable system shall not be damaged in normal, fault or outage condition
- Cable system fault finding: grounding points generally give access to metallic screen and can be used to localize fault

These 3 aspects are taken into account when designing the grounding system of a HVDC land cable connection. The way to take them into account can be different depending on countries, utilities or cable manufacturers. It is then relevant to make a state of art of existing and current practices and to recommend the best ones.

Scope:

The WG will cover the following items:

1. List existing literature about grounding aspect
2. Present current practices, identify gaps and give recommendations which deal with:
   a. Defining objective of grounding long HVDC land cable connection
   b. Identifying parameters which influence grounding design, amongst them:
      - Configuration type : bipole, monopole, VSC, LCC, Harmonics etc… what influence on short circuit current and transient overvoltage
      - Consideration of parallelism (Overhead Lines, AC Railways, other induced voltage sources…)
      - Consideration of stray current (DC railways, gas pipe…)
      - Consideration of direct and indirect lightning strike
      - Consideration of sea/land joint specificities
      - Distance between grounding points
      - Distance between link box and joint pits (bonding lead length)
      - Number of link boxes: one per circuit or one per pole?
      - What maximal earthing resistance at grounding points?
   c. Simulating and modelling grounding system
      - What tools to perform calculation and simulation
      - Modelling of grounding system

d. Designing grounding system and defining each component
    - Bonding leads, link boxes, sectionalized/earthed joints etc…
    - Earth continuity conductor?
    - Earthing grid and realization (simple loop, additional rods…)
    - SVL/surge arresters
    - Temporary earthing leads to earth conductor during outage/repair
    - Electrode and metallic return (HVDC particularity)
    - Earthing of semi-conductive layer of the outer sheath when in the air (termination and tunnel)
    - Civil work (Earthing pits) design (fault containment, functionality)
    - Earthing of metallic components of FIMT and external fiber optic cables with metallic outer sheaths
e. Testing of grounding System to cope with constraints and expected functionalities
    - Qualification test
    - Routine and sample testing during manufacturing
    - After installation test
    - Maintenance test during system operation
f. Protection and maintenance of grounding system
    - Corrosion aspect/Stray current
    - Preventive and curative maintenance

The members of the working group shall be essentially composed of cable system manufacturers and utilities, with possible support from academy and institutes. Converter system expert(s) might also be invited to study influence of HVDC configuration on grounding system and simulating aspect if these skills are not already mastered by members of the WG.

Remarks:
The content will focus on HVDC long underground cable links. Submarine HVDC links shall not be prioritized since there is more experience with such links which are always solid bonding. However parameters for such grounding can also be explained (grounding at sea/land joint, grounding connection between metallic sheath and sea etc…).

Deliverables:

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

Time Schedule: start: Q4 2021 **Final Report**: Q4 2024

Approval by Technical Council Chairman:

Date: November 23rd, 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.