CIGRE Study Committee B4

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG [1]N° B4.91	**Name of Convenor:** Prof. Marco Liserre (GERMANY) **E-mail address**: ml@tf.uni-kiel.de
Strategic Directions #[2]: 1	**Sustainable Development Goal #[3]: 7, 9, 11**
The WG applies to distribution networks: ☒ Yes / ☐ No	
Potential Benefit of WG work #[4] : 1, 2, 4	
Title of the Group: Power electronics-based transformer technology, design, grid integration and services provision to the distribution grid	

Scope, deliverables and proposed time schedule of the WG:

Background:

An increasing integration of green energy resources, such as distributed renewable energy sources and electric vehicles, challenges the management of the distribution grids. It requires an extensive infrastructure upgrade, to avoid voltage limit violations or over loading of lines, which could lead to increased investment costs.

Power electronics-based transformers (PET), referred to also as Solid-State Transformers or Smart Transformers, allows better grid controllability and facilitate the integration of green energy resources, limiting or deferring the infrastructure upgrade. Power electronics-based transformer does not only perform the voltage conversion function, like conventional transformers, it also provides other services to the distribution grid, such as voltage and power flow control, conservation voltage reduction, variable voltage and frequency profiles, and power quality improvement. Moreover, it enables a DC supply for direct connection of DC resources (e.g., electric vehicle charging stations), both at low and medium voltage levels.

Several prototypes of PET are currently developed and tested in the world. However, at the moment, there is no guidelines, standards and grid connection rules for designing and integrating PET in the distribution grid.

Scope:

This WG will focus on providing guidelines for the PET design as well as its grid integration, and on grid services capabilities. In addition to a review of significant examples of PET prototypes, the TB will provide recommendations to the following:

- Topologies and architectures of PET considering different stages, converter technologies, transformation ratio and galvanic insulation
- Definition and control of PET stages
- Grid codes for connecting and operating the PET in AC and DC grids, at medium and low voltage level, and in radial and meshed configurations
- Type and factory tests for acceptance of PET in distribution grids
- Service provision for distribution and transmission grids at AC and DC sides
- Economical assessment and business cases (taking into account PET losses)
- Description of functional specifications needed to define a PET

Liaison experts from SC C6 and A2 will be invited.

Deliverables:

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

Time Schedule: start: 12.2020 **Final Report**: 12.2023

Approval by Technical Council Chairman:

Date: October 10th, 2020

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.