CIGRE Study Committee D2

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG[1] SC D2.61	**Name of Convenor:** Anton Merkulov (Kazakhstan)
Strategic Directions #[2]: 1	**Sustainable Development Goal #[3]: 9**

This Working Group addresses these Energy Transition topics:

- [ ] **Storage**
- [ ] **Hydrogen**
- [ ] **Digitalization**
- [ ] **Sustainability and Climate Change**
- [■] **Grids and Flexibility**
- [ ] **Solar PV and Wind**
- [ ] **Consumers, Prosumers and Electrical Vehicles**
- [ ] **Sector Integration**
- [ ] **None of them**

Potential Benefit of WG work #[4] :

Commercial, business, social and economic benefits for industry or the community can be identified as a direct result of this work.

State-of-the-art or innovative solutions or new technical directions.

Guide or survey related to existing techniques; or an update on past work or previous Technical Brochures.

Title of the Group:
High Voltage Power Line Carrier Communications Current State and Future Application

Scope, deliverables and proposed time schedule of the WG:

Background:

High voltage power line carrier communicates is the oldest type of telecommunications used in power grids. Phase conductors of the high voltage power lines are used for transmission of different information signals such as voice, data, teleprotection. 20-25 years ago, a major part of telecommunication channels in electrical power grids were based on application of PLC technologies. In countries with historically developed electricity power transmission networks, large numbers of substations and large territories, the number of HV PLC channels can be in the thousands.

Despite the highest mechanical reliability and small cost, PLC channels provide initially small information throughput capacity. The reason is strictly defined possible operating frequencies from 40 to 500 kHz only and parameters of electromagnetics wave propagation along phase conductors. For this reason, and taking advantage of the technological evolution in the telecommunication sector, in the last 2 decades, telecommunications in power grids are mainly based on optical ground wires (OPGW) channels and application of different types of multiplexors and network equipment for higher information capacity.

Because of the rapid development of wideband technologies, many specialists predicted small interest to HV PLC and full replacement of HV PLC with other telecommunications technologies. However, a current observation is that HV PLC remains applicable, and in some countries the use has increased significantly. In some instances, parallel to the

installation of OPGW, new HV PLC terminals have been installed as back-up for the transmission of mission critical information – dispatching voice, SCADA and teleprotection.

The situation with HV PLC (High Voltage Power Line Carrier) is contradictory. Interest in HV PLC is limited, with few reports at CIGRE sessions, academic conferences, or in modern literature. The focus has shifted towards wideband telecommunications and IT, aligning with broader trends in digitalization. In power grids, equipment, including PLC terminals, typically remains in use for 15-20 years before modernization, leading to a gradual decline in expertise as older specialists retire or transition to other fields. Younger industry professionals are more focused on IT and lack skills in HV PLC, resulting in an increasing number of channels but fewer specialists.

Currently, no CIGRE working group exists for HV PLC. Historically, significant research on high-frequency path modeling and calculations was conducted between 1960-1980, with WG35.09 (on Digital PLC, 1999) of CIGRE later focusing on digital power line carrier applications. Despite being nearly a century old, HV PLC remains in use, with recent advancements like wideband digital power line carrier with packet switching and long-term condition monitoring. However, modern guides for applying HV PLC in contemporary power grids are lacking.

The proposed new Working Group aims to provide useful, up-to-date, and relevant coverage of the still-relevant HV PLC technology.

Purpose/Objective/Benefit of this work:

The objective is to review the current state of high voltage power line carrier (HV PLC) communications in power grids globally. This includes applications such as backup channels, specialized telecommunications for emergencies, ruggedized secure channels for accessing multiplexers and network equipment to ensure rapid recovery in case of cyber threats, and the use of HV PLC for monitoring overhead line (OHL) conditions. Additionally, the research will explore the application of a new class of digital PLC—wideband digital power line carrier with packet switching—for specialized coupling schemes like intra-bundle coupling, enabling megabit bitrates for HV PLC. The study will also forecast the future role of HV PLC in power grids.

The outcome of this work will be a specialized guide on HV PLC applications, which can be utilized by various professionals in planning and implementing telecommunications in power grids. This guide will help them leverage the benefits of HV PLC and accurately position its role in modern power grids.

Scope:

1. HV PLC key features, principles, fields of application.

2. Methods of HV PLC path calculations, coupling schemes, literature survey, possible scenarios of HV PLC applications for voice, data and teleprotection as main and back-up routes

3. Analyses of current state in HV PLC in countries worldwide and statistics of its application.

4. New technologies in HV PLC

5. New approaches for HV PLC applications

5. Definition of fields of HV PLC application in future, forecast of possible scenarios.

6. Frequency allocations and associated challenges

Remarks:

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 1 2026
• Final TB	Qtr 3 2026
• Tutorial	Qtr 1 2027
• Webinar	Qtr 2 2027

Approval by Technical Council Chair:

Date:02.10.2024

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.