CIGRE Study Committee B3

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

JWG [1]N° B3/D2.62	**Name of Convenor:** Nicolaie Fantana (DE) **E-mail address**: nicolaie.fantana@outlook.com
Strategic Directions #[2]: 1, 2	**Sustainable Development Goal #[3]: 9**
The WG applies to distribution networks: ☒ Yes / ☐ No	
Potential Benefit of WG work #[4] : 1, 4, 6	
Title of the Group: Life-long Supervision and Management of Substations by use of Sensors, Mobile Devices, Information and Communication Technologies	

Scope, deliverables and proposed time schedule of the WG:

Background:

Electrical equipment in substations for distribution of electrical energy, primary and secondary substations alike, are of great economic value for utilities and essential for providing electricity for all areas of modern life. The equipment presently used in such substations (typically <110kV) is ranging from established aged equipment to equipment utilizing digital and automation technologies. All those need supervision and asset management actions and efficient decisions during their entire life.

While in big HV substations the installation of permanent supervision/monitoring systems and sensors and use of advanced technologies is a small fraction of the asset cost, in distribution, especially secondary substations, this might be very different. Also, due to the large number of units distributed over large areas, obtaining life data for distribution equipment and keeping this data updated is presently costly. Smart technologies including new sensors working stand-alone or in a wireless sensor network, can allow to collect a lot of real-life data at many network locations. Similarly, humans equipped with mobile smart devices, helmets, smart glasses as well as robots and drones can collect large data amounts and also perform actions.

The resulting big volume of often multimedia data, which will result over the life of an substation equipment, needs proper data models to extract information, systematic management and validation, long time storage, easy retrieving for data processing. This data will be a valuable resource for machine learning and application of advanced statistical algorithms, and for better asset management, maintenance, and operation decisions.

The changes of the networks due to distributed energy resources and evolution of the power and automation equipment itself e.g. by use of build-in intelligence and sensors, more automation features, tendencies to intelligent and possibly autonomous substations, can offer also new ways to execute on-site activities and how an equipment might behave versus nearby humans or robotic devices, e.g. possibly inform on its status, previous operations or loading, encountered events or maintenance actions done or required.

Using smart advanced technologies, adding more artificial intelligence (AI) and expert support, advanced training using augmented reality (AR) and virtual reality (VR), increased use of autonomous intelligent devices such as robots and drones can allow to keep a desired balance and mix of human and robotic work.

Scope: of the proposed joint working group is to:

1. Identify **the utility needs regarding life-long supervision and management activities**, for equipment in substations for distribution, primary and secondary, which can benefit from state-of-the-art sensors, intelligent devices and information and communication technologies (ICT). Consider distribution system and equipment needs and specifics, in two main cases: (a) in modern networks, using advanced switchgear, build-in sensors and intelligence, communication, automation and with trends toward autonomy, and (b) older distribution networks and equipment technologies. Consider near and mid term needs for supervision, to allow optimized management and on-site activities, refurbishment, to avoid human and environmental hazards, for staff training and support, for use during normal and emergency situations.
2. Identify and revise the present **status and trends of sensors, intelligent devices, information and communication technologies and applications, usable for substation life-long supervision and management.** Consider fixed or mobile sensors devices, sensor networks, sensors built-in or attached to substation equipment, sensing by devices used or weared by humans, robots or drones. Identify the evolution of sensors and intelligence build in power equipment and possible new interaction possibilities of this equipment with humans and robotic devices. Identify potential benefit and limitations.

   Describe and match of the life-long supervision needs of distribution substations versus usable sensor, communication, on device processing, edge computing, cental analytics, storage and data handling technologies suitable for life-long management of distribution substations and equipment. Take into consideration presently usable and mid-term expected technologies.

   Identify proper architecture(s) for collecting, processing, long time storeing and handling of life time data, suitable for use with present and future sensing technologies.
3. **identify and analyze life-long data related aspects for distribution substations and equipment, technologies and challenges and make recommendations**. This will include: 1)How to effectively address equipment and substation many decades encompassing life data, in a sustainable and systematic way, in the view of the existing and upcoming large amounts of data over equipment's life. Consider discrete life **data, time series** and multimedia data from: supervision, inspection, events, operation, maintenance, environmental conditions, catastrophic situations, failures etc., as collected by smart sensors or sensor networks, human inspections, human activities such as work in the on-site, collected by robots and drones, etc.. 2) Consider and identify proper data models, consider long data storage aspects, data retrieval for processing and management, the possibility to have a digital equivalent of an installed equipment such that can handle relevant information, that can be aware on equipment's own status and history and which can possibly communicate with human and autonomous robotic devices. 3) Mention and recommend approaches and technologies suitable for the equipment life data needs, which can be used immediately or available mid-term. Refer to cybersecurity documents relevant for the related topics addressed.
4. **Identify the present situation and applications** using supervision, smart or mobile and ICT technologies used or tried world-wide for distribution equipment and primary and secondary substations needs. A world-wide survey will be issued and few examples of supervision and management cases will be collected and presented, including lessons learned, benefit or limitations.
5. **Conclude** and issue recommendations on the use of sensors, mobile devices and ICT and data technologies, data handling and applications, for lifetime supervision and management for distribution substations.

The WG will consider ongoing and past work in CIGRE to find proper contributing authors and cooperate with CIGRE A2, A3, B5 and D2.

Remarks:

Deliverables: ☒ Technical Brochure and Executive Summary in Electra ☒ Electra Report ☐ Future Connections ☐ CSE ☒ Tutorial ☐ Webinar **Time Schedule**: start: June 2022 **Final Report**: Dec 2025
Approval by Technical Council Chairman: **Date**: March 22nd, 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.