CIGRE Study Committee B1

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG [1]N° B1.80	**Name of Convenor: Cherukupalli Sudhakar (CA)** **E-mail address**: s.cherukupalli@ieee.org	
Strategic Directions #2		**Sustainable Development Goal #9:**
The WG applies to distribution networks: ☒ Yes / ☐ No		
Potential Benefit of WG work: #3, #5		
Title of the Group: Guidelines for Site Acceptance Tests of Distributed Temperature Sensing (DTS) and Distributed Acoustic Sensing (DAS) Systems when used for power cable systems monitoring		

Scope, deliverables and proposed time schedule of the WG:

Background:

Many utilities, and also wind energy producers are beginning to appreciate the benefits of Fibre Optic Distributed Temperature Sensing for detecting, locating, and monitoring hot spots along underground transmission and distribution cable systems both on land and in the ocean and assess how these hot spots can restrict the power transfer capability along these power corridors. Distributed Fibre Optic Acoustic Sensing Systems although widely used in the oil and gas industry is finding increasing interest and application to land and submarine cables as a surveillance monitoring tool, for example; as a mean of detecting if anybody is excavating and likely to harm the expensive buried underground cable asset or in the ocean if there is likelihood of a sea vessel activities over the power cables resulting in considerable asset damage. Furthermore, this technology has proven useful to locate cable fault with better precision and resolution compared to conventional TDR (Time Domain Reflectometry) techniques particularly on long cable installations undersea providing significant savings as well as on long cross-bonded cable systems where TDR has limitations. It is implied here, this applies to fixed DAS monitoring systems.

While the specification for these Distributed Fibre Optic Sensing Systems describe the needs of the industry and the manufacturing facility strives to prove their systems' capabilities under various operating conditions to yield the best spatial, temperature resolutions, and accuracy; the ability to confirm such performance in the field remains questionable. While manufacturer's claims of their system's accuracies are demonstrated amply during factory sometimes tests they have proven to have fallen short of expectations when deployed in the field. This has been attributed to a lack of systematic, clear, and meaningful tests undertaken in the field, such as a Field Acceptance test or a System Commissioning test. Moreover, quite often the obtained temperature alarm or "intrusion" alert has to be integrated into a power system's Control centre at the utility. This means transferring such "intelligence" in an accurate, reliable, and repeatable manner and factory tests today, do not address this need either.

The proposed Working Group is being set up to help define practical, meaningful, and realizable test methods that may be considered by the users to ensure a proper "end-to-end" tests of both these systems (DTS and/or DAS) in an efficient and cost effective manner to help improve the overall system reliability of the deployed systems. Lack of such assurance can be very costly to the utility adopting these technologies in the long term.

Scope:

The goal of this WG group will be to develop guidelines for suitable Site Acceptance Testing (SAT) of Fibre Optic Distributed Temperature and Acoustic Sensing Systems. It will cover land, tunnel, submarine, and long interconnector cables, as well as distribution applications.

1. Research and conclusion on existing literature within IEEE, IEC, SEAFOM, CIGRE, documents such as TB 756 and TB 773
2. Collate current practice used/applied where available on Site Acceptance tests of
   - DTS systems (if available)
   - DAS systems (if available), and
   - DTS+DAS Combined
3. List all the challenges/issues experienced with field deployment of DTS systems and impact of the lack of proper SAT procedures
4. List all the challenges/issues experienced with field deployment of DAS systems and impact of the lack of proper SAT procedures
5. Develop SAT methods to ensure system reliability over the life-time of the following systems;
   - DTS Systems
   - DAS Systems
   - DTS+DAS Systems
6. Develop methods to:
   - describe, document, and compensate for fibre couplings, optical attenuations resulting from joints, connectors, fibre placements.
   - confirm the accuracy of the positional (spatial) information along the monitored route (fibre length and cable length correction and GPS coordinates matching).
   - clearly identify cable sections that are buried in ducts, in horizontal direction drilled section, or an underground vault etc.
   - create reference spots for open trench configurations by e.g. application of ice spray or using PT100 probes (DTS), or tapping on fibre (DAS) in regular intervals,
   - perform real typical Third-Party aggression operations with an excavator or a drilling machine for example, and check for reliable automatic detection and alarms on DAS
   - test and ensure reliable and automatic fault detection and localisation along the cable route (DAS)
7. Ensure any intervening DTS/DAS system in the field that interconnects with the System Operator's (Energy Management System) is tested to prove that the data is accurate, reliable, and meeting user requirements while respecting all IT Security protocols.
8. Discuss the needs (if any) of system recalibration, its frequency, and why such recalibrations are necessary. For example, discuss a recalibration procedure to detect changes in depth of burial of submarine cables. List and discuss any limitations of recalibration requirements over the life-time of these sensing systems.
9. Collate any information on "parameters" that can influence the long-term reliability of derived intelligence on both systems; for example, can optical fibre exposure to heat and light cause aging in the optical fibre.
10. Identify any standard organisation in IEC, IEEE, FOSA that are developing or have developed such SAT and if used in the oil and gas industry how may they be adapted for the cable industry.
11. Discuss future possibilities and requirements for DTS/DAS Systems
12. Develop and present guidelines for Site Acceptance Testing of DTS, DAS, and combined DTS/DAS systems.

Members of this WG shall comprise a balanced group drawn amongst end-users (such as TSO, DSO, utilities), cable manufacturers, DTS/DAS suppliers, service providers, and consultants.

This scope of the WG **will not** include the application of optical fibres for communications of a) Partial Discharge data, b) sheath current data and similar applications.

Deliverables:

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

Time Schedule: start: Nov 2020 **Final Report**: Dec 2023

Approval by Technical Council Chairman:

Date: November 16th, 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

THESE TABLES HAVE TO BE FIXED

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.