CIGRE Study Committee A3

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP

WG [1]N° A3.50	**Name of Convenor:** Paolo Mazza (ITALY) **E-mail address**: paolo.mazza@rse-web.it
Strategic Directions #[2]: 1, 2, 4	**Sustainable Development Goal #[3]: 9**
The WG applies to distribution networks: ☒ Yes / ☐ No	
Potential Benefit of WG work #[4] : 1, 2, 3, 4.	
Title of the Group: On-site calibration and verification of the accuracy of instrument transformers	

Scope, deliverables and proposed time schedule of the WG:

Background:

Instrument transformers accuracy is crucial for voltage, current and energy measurements in high voltage, for both traditional and new applications.

At present, instrument transformers accuracy is usually assessed at the Manufacturers' or third-party calibration laboratories; however, the need for on-site calibration is more and more felt due to:

- the use of instrument transformers in the framework of new applications (tariff metering, PQ measurement, PMUs…)
- the need to perform accuracy tests at commissioning level;
- the need to take into account possible issues due to the influence quantities in service conditions;
- the ageing of instrument transformers and the need for periodic calibration;
- the availability of instrument transformers based on new technologies and the need of new metrological characterization methods.

Both traditional methods based on comparison with reference measuring systems and new methods based on models are available, and the relevant equipment use either requires the outage of the concerned busbars or can be installed with live line working methods.

Some aspects have been shortly considered by IEC TC 38 JWG 55 during the preparation of the future IEC/IEEE TS 61869-21 (Instrument transformers - Part 21: Uncertainty evaluation in the calibration of Instrument Transformers) but the subject deserves a detailed analysis in order to prepare the evolution of the IEC TC 38 Standards.

Scope:

The working group would investigate and report on all aspects relevant to on-site calibration of instrument transformers, considering all the available technologies (inductive, capacitive, low-power, both passive and electronic), with particular, but not exclusive, reference to power frequency and power quality measurement applications, at frequencies at least up to the 50th harmonic.

In particular, the following items will be considered:

1. To present the technical background and the new applications that recommend the performance of on-site calibration.
2. To present the applicable international and regional/local technical Standards.
3. To present the accuracy requirements needed for each specific application.
4. To investigate the state of art of international regulation and/or network codes about this subject.
5. To present the technical state-of-art about the on-site assessment of the accuracy of instrument transformers (both calibration and verification of the accuracy, with instrument transformers in service or disconnected) and the international experience about this subject: methods by comparison and based on models will be considered.
6. To present the ongoing activities aimed at the on-site verification of the accuracy and calibration.
7. To analyse the benefits and limits of the available methodologies and technologies, (e.g., the impact of needing an outage versus verifying without an outage, at the voltage and current level(s) where the system naturally is);
8. To indicate the technical benefits and the opportunities for the evolution of power systems, in terms of management and observability, made possible by on-site calibration.
9. To evaluate the economic impact and benefit of the on-site calibration of instrument transformers.

Remarks:

The activity of the WG will be linked with the one performed by WG A3.49 “Aging effects on accuracy class of Instrument Transformers”. The working group will be supported by a liaison with IEC TC38, with particular reference to WG 47 “Evolution of Instrument transformer requirements for the modern market” and to JWG 55 “Uncertainty evaluation in the calibration of Instrument Transformers linked to IEEE/IMS/TC39 “Measurements in Power Systems".

The activity of the WG will consider the more recent advances in research, taking into account by considering the more recent technical and scientific literature and establishing links with the relevant past and ongoing research projects (see for example the EURAMET funded ones “Futuregrid II” (Metrology for the next-generation digital substation instrumentation), “IT4PQ” (Measurement methods and test procedures for assessing accuracy of instrument transformers for power quality) and “ADMIT” (Characterisation of AC and DC MV instrument transformers in extended frequency range up to 150 kHz).

SC B5 could provide a liaison Member related to the metering aspects.

Preliminary bibliography:

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- Bergman, “In Situ Calibration of Voltage Transformers on the Swedish National Grid” in Faculty of Science and Technology. 1994, Uppsala University: Uppsala, Sweden.
- E. Anderson, J. Karolak, J. Wroblewski, A. Hyrczak, A. Ratajczak, R. Zajac, "Metrological Properties of High Voltage Instrument Transformers after Many Years' Service", presented at CIGRE general session, Paris, France, 2004
- P. Mazza, A. Andersson, U. Brand, G. Crotti, G. De Dona, N. Kuljaca, M. Giraud, A. Sardi, S. Weiss "On-Site Live Verification of HV Instrument Transformers Accuracy", presented at CIGRE general session, Paris, France, 2006
- F. Rahmatian, j. H. Gurney,j. A. Vandermaar: “Portable 500 kV Optical Voltage Transducer for On-Site Calibration of HV Voltage Transformers without De-Energization”, Paper A3-103, CIGRE 2006 General Session, Paris 2006

- P. Doig, L. Durante, “The CT Reclassification System” Power and Energy Magazine, IEEE, vol.4, no.6, pp.56-60, 2006
- Marcelo M. da Costa, João Cláudio D. de Carvalho, Pedro H. M. dos Santos, José Arinos T. Jr., Diogo B. Dahlke, Minoru Ikeda, Celso F. Melo «System for High Voltage Current Transformers Onsite Calibration» 17 th Symposium IMEKO TC 4, 3 rd Symposium IMEKO TC 19 and 15 th IWADC Workshop Instrumentation for the ICT Era Sept. 8-10, 2010, Kosice, Slovakia
- F. Rahmatian, "High-voltage current and voltage sensors for a smarter transmission grid and their use in live-line testing and calibration," IEEE PES General Meeting, Minneapolis, MN, USA, 2010, pp. 1-3
- T. Weiher “Instrument Transformer Testing in HV Systems Calibration of Split-Core Current Transformers” – Presentation, OMICRON Instrument Transformer Measurement Forum, 2011
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- E. Udren, F. Rahmatian, Y. Hu, V. Madani, D. Novosel “In-Field Synchrophasor System Calibration, Testing, and Application Validation Using High-Voltage Optical Sensors” CIGRE Session, Paris, France, 2012
- P. Mazza et al., "On-site verification and improvement of the accuracy of voltage, current and energy measurements with live-line working methods: New equipment, laboratory and field experience, perspectives," 2014 11th International Conference on Live Maintenance (ICOLIM), Budapest, Hungary, 2014
- Florian Predl, Dr. Michael Freiburg, Dr. Michael Krüger, “A New Approach for On-site Calibration of Voltage Transformers”, T&D World, May 5, 2015
- S. Konzelmann, E. Sperling, Mobiles dreiphasiges RC-Teiler Messsystem für Power Quality Messungen im Übertragungsnetz, VDE – Hochspannungstechnik 2018, 12.11.-14.11.2018, Berlin, Germany
- H. Goklani, G. Gajjar and S. A. Soman, "Instrument Transformer Calibration and Robust Estimation of Transmission Line Parameters Using PMU Measurements," in IEEE Transactions on Power Systems, vol. 36, no. 3, pp. 1761-1770, May 2021, doi: 10.1109/TPWRS.2020.3036605.
- F. Aminifar, F. Rahmatian and M. Shahidehpour, "State-of-the-Art in Synchrophasor Measurement Technology Applications in Distribution Networks and Microgrids," in IEEE Access, vol. 9, pp. 153875-153892, 2021
- F. Rahmatian, P. Mazza, CIGRE WG A3.31 “Accuracy and Calibration of Instrument Transformers with Digital Output” CIGRE ELECTRA N°319 – 2021

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) Q4 2023

• Develop final work plan	Q4 2023
• Tutorial	Q3 2024
• Webinar	Q3 2024
• Final TB	Q3 2025
Approval by Technical Council Chairman: **Date**: September 22nd, 2023	

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)

b. WG nominees 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.