EMPIR Call 2019 – Energy, Environment, Normative and Research Potential

Selected Research Topic number: **SRT-g09**
Version: 1.0

Title: Metrology for future energy transmission

Abstract

Driven by the need for increased efficiency, transmission grid voltages have been pushed to ultra-high voltages (UHV), beyond 1000 kV. Metrological solutions for testing of grid components and grid condition monitoring are required in UHVDC, lightning impulse and High-voltage DC grid condition monitoring for the successful implementation of future UHV transmission grids.

Keywords

Transmission grids, Ultra-High Voltage (UHV), UHVDC traceability, UHV component testing, UHV lightning impulse, HV capacitors, partial discharge (PD), PD calibrators

Background to the Metrological Challenges

High voltage (HV) testing of transmission system components at present and future ultra-high voltage levels requires traceable calibrations and reliable linear extension methods. Currently, traceability is needed up to 2000 kV for DC and 2800 kV for lightning impulse (LI) measuring systems. When traceability is lacking, a linear extension of a factor of 5 is acceptable. However, the established methods and schemes do not yet cover UHV voltage levels. Working group 19 of IEC TC42 has been given the task to make recommendations for this extension, with support from a CIGRE group. For power grid energy measurements, a revision of the IEC TC38 standard IEC 61869 is on-going for DC voltage instrument transformers.

There is also a need for improved traceability of partial discharge (PD) measurements in HVDC transmission systems. In order to prevent the failure of future grids, new methods should be developed for detecting PD under DC stress in HV cable, for monitoring performance of new insulating materials which are introduced during GIS development and for monitoring PD in HVDC convertors where traditional methods cannot distinguish between PD and switching transients of IGBT in VSC converters.

Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on the traceable measurement and characterisation of components for future electricity grids and provide improved means for high voltage direct current (HVDC) grid condition monitoring.

The specific objectives are

1. To extend the traceable calibration of ultra-high voltage direct current (UHVDC) from 1600 kV to 2000 kV by developing new methods and hardware. In addition, to facilitate on-site measurements by developing a rugged modular voltage divider with an uncertainty smaller than 200 µV/V at 2000 kV and 40 µV/V at 1200 kV
2. To determine the lighting impulse (LI) voltage calibration for testing of UHV equipment and to investigate unexplained effects on measurements from front oscillations, corona, proximity and signal cable. Input should be given to IEC 60060-2 for time parameters and voltage measurement on ultra-high voltage above 2.5 MV, with an uncertainty for peak voltage better than 1 %
3. To develop a new method for linearity determination of HV capacitors by improving the calibration uncertainty for HVAC to 80 µV/V at 800 kV

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4. To develop partial discharge (PD) measurement techniques for testing of equipment under DC stress, with specific emphasis on detection and prevention of insulation failures in HVDC cables, gas insulated substation (GIS) and rectifiers. In addition, to design special PD calibrators of representative PD pulses associated with insulation defects.
5. To facilitate the take up of the technology and measurement infrastructure developed in the project, by the electrical power industry and to make recommendations to standards covered by IEC TC38, TC42, TC115, TC122 and TC22.

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the research, the involvement of the appropriate user community such as industry, standardisation and regulatory bodies is strongly recommended, both prior to and during methodology development.

Proposers should establish the current state of the art and explain how their proposed project goes beyond this.

In particular, proposers should outline the achievements of the EMRP project ENG07 HVDC and EMPIR projects 14IND08 ElPow, 15NRM02 UHV and 17NRM01 Trafoloss and how their proposal will build on those.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 2.0 M€ and has defined an upper limit of 2.3 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 35 % of the total EU Contribution across all selected projects in this TP.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Feed into the development of urgent documentary standards through appropriate standards bodies,
- Transfer knowledge to the energy transmission sector.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects (JRPs)”

You should also detail how your approach to realising the objectives will further the aim of EMPIR to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically, the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work.

Time-scale

The project should be of up to 3 years duration.