EMPIR Call 2015 – Health, SI, Normative and Research Potential

Selected Research Topic number: **SRT-n11**
Version: 1.0

Title: Techniques for ultra-high voltage and very fast transients

Abstract

In standards for electricity distribution grids, there is a need for standardisation of Ultra-High Voltage transmission measurement techniques that will provide input for a unified view of atmospheric correction factors for high altitudes. This will also provide guidance to high voltage metrology in electrical equipment for medicine. There is also a need to provide input to measurements of Very Fast Transients (VFT), which is important for measurement of transmitted over-voltages, and also critical for insulation coordination of Gas-Insulated Switchgear (GIS) equipment. It will further provide input to Partial Discharge (PD) measurement techniques for equipment under DC stress, to detect and prevent insulation failures, e.g. for DC transmission and distribution using cables.

Keywords

UHV combined and composite wave shapes, medical electrical equipment, PD measurements, Atmospheric correction, Very Fast Transients

Background to the Metrological Challenges

Traceability of HV testing for high voltage equipment is an important tool to ensure high quality and reliability of the products qualified for Ultra-High Voltage (UHV). Calibration is hampered by the large size of equipment used to measure the high voltage quantities, and methods have been developed to extend validity of calibration. For lighting impulse voltage measurements, systems are typically calibrated up to 500 kV - 700 kV, together with additional measures to check the linearity up to 2500 kV. Research is needed to develop methods and equipment for calibration of voltage levels above 500 kV - 700 kV for Lighting Impulse (LI) or Switching Impulse (SI) and 1000 kV for dc, and especially in the case of combined wave-shapes or fast switching.

For medical diagnostic radiology, the adjustment of operating parameters for X-ray equipment is generally performed using a non-invasive measurement technique (IEC 61676), and the calibration of these instruments is fundamental. A traceable calibration of the dc acceleration voltage, with 1 ms rise and fall time, which is likely to involve VFT, currently does not exist.

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 metrology research necessary to support standardisation in ultra-high voltages and very fast transients relevant to the electrical power industry.

The specific objectives are

1. To provide a substantial contribution to the revision of Standards in the IEC 60060 series (High-voltage test techniques) and IEC 61676 (Medical electrical equipment – Dosimetry instruments used for non-invasive measurement of X-ray tube voltage in diagnostic radiology) by developing traceable measurements for the combined and composite testing methods. To provide contribution to pre-normative CIGRÉ working group D1.60 (Special requirements for dielectric testing of ultra-high voltage (UHV) equipment).

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2. To provide a substantial contribution to the work performed by IEC JWG 22 (Atmospheric and altitude correction), IEC TC28 (Insulation co-ordination), IEC TC36 (Insulators), and TC 115 (High Voltage Direct Current (HVDC) transmission for DC voltages above 100 kV). This could be done by analysis of the differences between IEC standards, e.g. 60071-2 and IEC 60060-1, to provide recommendations for a unified method.

3. To provide a substantial contribution to the work performed by IEC TC42 MT17 (Partial discharge measurements) on development of documents relating to measurement of partial discharges. To propose a partial discharge calibrator and to develop measurement methods for low level PD under 1 pC and on detection of PD under DC stress.

4. To support the work for requirements for transmitted over-voltages in IEC 61869-1. This translates as the system response to very fast transients (VFT), which is different between air insulated and SF6 insulated equipment. To recommend a standard measuring set up including a reference VFT measuring system of 100 kV, 1 GHz, to calibrate wideband sensors for sub-nanosecond transients used to measure VFT in GIS.

5. To work closely with the European and International Standards Developing Organisations, and the users of the Standards they develop, to ensure that the outputs of the project are aligned with their needs, communicated quickly to those developing the standards, and in a form that can be incorporated into Standards at the earliest opportunity.

The proposed research shall be justified by clear reference to the measurement needs within strategic documents published by the relevant Standards Developing Organisation or by a letter signed by the convenor of the respective TC/WG. EURAMET encourages proposals that include representatives from industry, regulators and standardisation bodies actively participating in the projects.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this. In particular, proposers should outline the work of the EMPIR project 14IND08 ElPow and how their proposal will build on that.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 0.4 M€, and has defined an upper limit of 0.5 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 30 % of the total EU Contribution to the project. Any deviation from this must be justified.

Any industrial partners that will receive significant benefit from the results of the proposed project are expected to be unfunded partners.

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 electricity and energy 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.