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

Selected Research Topic number: **SRT-n04**
Version: 1.0

Title: Support for standardisation of high voltage testing with composite and combined wave shapes

Abstract

The reliability of high voltage electricity grids depends upon the adequate testing of grid components, and such tests include the application of composite and combined wave shapes. Currently, however the traceability of composite and combined wave shapes is inadequate and can lead to incorrect test results. Therefore, improved metrology is needed in order to standardise high voltage testing with composite and combined wave shapes, and to provide input to the standards being developed by IEC TC 42 'High-voltage and high-current test techniques', in particular the IEC 60060 series. Such metrology should include traceable measurement systems and calibration services for composite and combined wave shapes, as well as the relationship between impulse voltages with High Voltage Alternating Current (HVAC) or High Voltage Direct Current (HVDC) measurements.

Keywords

High Voltage, electricity grids, combined wave shapes, composite wave shapes, IEC 60060, HVDC, HVAC, IEC TC 42

Background to the Metrological Challenges

As part of the production of equipment for high voltage electricity grids, dielectric testing is performed to verify that the equipment can withstand the operational environment. Such 'withstand tests' are performed using combined and composite waves, where lightning impulse (LI) or switching impulse (SI) waves are superimposed on AC or DC. The IEC 60060-1 standard allows separate measurements of either combined or composite wave shapes behind a blocking element and the calculation of the voltage on the device under test. This means that depending on the blocking element for the applied impulses (e.g. a spark gap or capacitor to block AC or DC voltage to the impulse generator) the stress on the equipment under test and the generating components can differ. Therefore, there is an urgent need for traceable measurement systems for composite and combined wave shapes that can be directly attached to the device under test.

The current IEC 60060 standard also allows voltage dividers and measuring systems used in test laboratories to be qualified by separate calibrations with HVAC, HVDC, LI and SI. However, these separate calibrations do not provide evidence for the ability of such voltage dividers and measuring systems to measure combined and composite wave shapes. Furthermore, there is currently no scientific evidence that HVAC/HVDC and LI/SI generation circuits do not interfere with one another. Thus, their relationship must be determined in order to provide traceable calibration services.

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 the standards being developed by IEC TC 42 'High-voltage and high-current test techniques', in particular the IEC 60060 series.

The specific objectives are

1. To reliably determine the relationship between impulse voltages with HVAC or HVDC measurements, and related detrimental effects due to combining wave shape tests.

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The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

2. To accurately determine the uncertainty of existing voltage dividers and measuring systems used in tests with composite and combined wave shapes. In addition, to relate the results to the requirements of current IEC 60060 standards.
3. To develop traceable measurement systems and calibration services for composite and combined wave shapes, with a target amplitude uncertainty of less than 2 %.
4. To provide input and contribute to a revision of the IEC 60060 series by providing the data, methods, guidelines and recommendations, for the questions raised in IEC TC 42. Outputs should be in a form that can be incorporated into the standards at the earliest opportunity and communicated through a variety of media to the standards community and to end users (e.g. industry and manufacturers of high voltage testing instruments).

The proposed research shall be justified by clear reference to the measurement needs within strategic documents published by the relevant Regulatory body or 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. The proposal must name a “Chief Stakeholder”, not a member of the consortium, but a representative of the user community that will benefit from the proposed work. The “Chief Stakeholder” should write a letter of support explaining how their organisation will make use of the outcomes from the research, be consulted regularly by the consortium during the project to ensure that the planned outcomes are still relevant, and be prepared to report to EURAMET on the benefits they have gained from the project.

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

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 0.8 M€, and has defined an upper limit of 1.0 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 30 % of the total EU Contribution across all selected projects in this TP.

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 high voltage industry and energy sectors.

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.