EMPIR Call 2017 – Industry, Fundamental, Normative and Research Potential

Selected Research Topic number: **SRT-n03**
Version: 1.0

Title: Electromagnetic Interference on Static Electricity Meters

Abstract

Smart electricity meters are currently being deployed by utilities across the EU. However, the accuracy of the energy readings from these static devices is crucial for correct billing, and, recent studies have shown that under certain grid interference conditions caused by modern power electronics, some static meters show significant errors in energy reading, despite the meters being certified according to existing harmonised standards. Therefore, new standardisation in static meter testing and verification via development of new instrumentation, test methods and signal processing techniques is needed to ensure present and future customer confidence in static meter energy readings used for billing.

Keywords

Static electricity meters, Smart meters, accuracy, EMI, electrical energy, metering, billing, utilities, legal metrology, type approval.

Background to the Metrological Challenges

The next generations of smart energy meters are currently being deployed by utilities across the EU. This has been facilitated by an investment of €45 billion by energy providers for the installation of 200 million electricity smart meters to supply at least 80 % of consumers with intelligent metering systems by 2020. Advantages of such smart energy meters are remote readouts, reporting electricity problems and providing consumption patterns, and should lead to better quality of supply and potential reductions in energy consumption.

Metering accuracy is the basis for confidence in correct billing, and static electricity meters should provide at least the same level of performance as the previous generation of electromechanical meters. However, evidence of problems due to increased conducted electromagnetic interferences (“conducted EMI”) effecting smart meter accuracy has been found. Modern sampling-based static meters may suffer from interference from ‘grid pollution’ caused by interferences created by for example domestic appliances, renewable energy source power converters used for grid connection, or power line communications (PLC) used for remote smart meter readout. These and similar cases have led to additional 2 kHz – 150 kHz test requirements during type approval testing for static electricity meters, however this has not completely resolved the problem.

The size and complexity of the problem of electromagnetic interference on static electricity meters requires a multi-disciplinary approach involving EMI experts and metrology institutes, in close liaison with Standards Developing Organisations (SDOs) and legal metrology organisations such as WELMEC and OIML. Furthermore, the nature and extent of the problem makes the development of a joint, common European solution an absolute necessity.

In response to the need expressed by CEN/CENELEC and IEC TC13, significant improvements are needed in the measurement of electrical energy by static electricity meters in terms of the presence of transient and impulsive type signals. New calibration techniques, measurement instrumentation (such as measurement test-beds and reference meters for use in consumer metering disputes) and signal processing techniques are also required for the accurate measurement of highly non-stationary waveforms and for testing and verification of electricity meter accuracy under these conditions. This should form the basis of a new standardised static meter type-test procedure under the governance of CENELEC, IEC, WELMEC, and OIML, in order to ensure present and future customer confidence in the accuracy of energy readings transmitted by smart meters.

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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 metrology research necessary for standardisation in the calibration and testing of static electricity meters and smart meters used to ensure accuracy in consumer billing for supplied electricity.

The specific objectives are:

1. To provide and characterise metrology grade sampling digitisers and transducers and use these to determine the nature of disturbing and interfering signals present in typical electricity networks, both in the lab and on-site. This should lead to the definition of accuracy boundary conditions for static electricity meters during use.
2. To develop novel and accurate measurement algorithms for AC power/energy measurement in the presence of highly impulsive signals. In addition to implement the algorithms in a reference signal analysis tool suitable for diagnostic use by non-specialist end users for the analysis of disturbing signals. Further to this, to develop and/or optimise non-stationary waveform transforms, such as time-frequency distributions and wavelets, in order to determine the parameters of typical disturbing signals such that they can be accurately classified and re-generated for type-testing of commercial smart meters.
3. To develop a standard measurement test-bed for testing static electricity meters with a target uncertainty of better than 0.1 %. The test-bed should use the outputs from objectives 1 and 2, and together with a phantom power arbitrary signal source should provide reference power/energy measurements to match in-service conditions.
4. To develop new type-tests and validated methods for determining electricity meter performance and to modify and characterise a reference “benchmark meter” for use in consumer metering disputes. This should include the identification of the most appropriate test signals and the testing of a range of static electricity meters using the test-bed developed in objective 3.
5. To contribute to the standards development work of the CEN and IEC technical committees, CLC/TC 13, CLC/TC 205A, and IEC/TC 13, IEC/SC 77A and the legal metrology organisations WELMEC and OIML to ensure that the outputs of the project are aligned with their needs, communicated quickly to those developing the standards and to those who will use them, and in a form that can be incorporated into the standards at the earliest opportunity.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 1.2 M€, and has defined an upper limit of 1.5 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 industrial partners that will receive significant benefit from the results of the proposed project are expected to be unfunded partners.

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 regulators, standardisation bodies or industry, 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.

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 power generation and supply 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.

Additional information

[1] CEN/CENELEC identified this topic as one of their priorities. Details are available at: https://msu.euramet.org/current_calls/pre_norm_2017/documents/SRT_related_CEN_priorities/cen_priority_014_2017.pdf