EMPIR Call 2020 – Fundamental, Industry and Normative

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

Title: Metrological characterisation of Electric Vehicle Charging Stations

Abstract

The Electrical Vehicle (EV) is an essential element of the European Commission's plan on electromobility to build a competitive and sustainable transport system by 2050. The EV need the development of an EV Charging Station (EVCS) infrastructure covering the charging conditions and correct, traceable and fair-trade metering of the electrical charging. Today, national regulations for EV metering exist, but are widely differing within the EU ranging from very strict regulations and hardly any regulation in some member states. Therefore, the overall goal is to develop traceable measurement and characterisation methods for EVCS and ensure its transfer to OIML TC12 for a possible integration in the recommendation for electricity meters (OIML R46) and to WELMEC WG11 (electricity subgroup) and to the European Commission Working group on Measurement Instrument (WgMI E01349) for use in guidelines and regulations such as the Measurement Instrument Directive (MID) and its related harmonised standards and non-harmonised verification procedures.

Keywords

Electromobility, electric vehicle, charging station, electrical metrology, test methods, conformity assessment.

Background to the Metrological Challenges

The sales of electric vehicles in Europe have reached 408000 units in 2018, 33 % more than in 2017. Electrical vehicles charging stations are a key element on electromobility development. However, the EVCS regulations are widely differing within the European Union (EU), ranging from very well-developed national regulations to hardly any regulations. In general, to measure the energy transferred to the EV the EVCS requires electrical energy meters to meet the requirements of 2014/32/EU Measuring Instruments Directive (MID) and to have an EU type examination certificate. However, this approach does not fit with the optimal design for mass manufacturing and operation required for developing ECVS infrastructure where the electrical meter needs to be integrated as an electronic component of the ECVS. In addition, the charging conditions of the EV can be very specific and need to be investigated and be considered in the specific regulation. The EVCS transfer of electrical energy to the vehicles must meet the European Directive 2014/32/EU (MID), but the specific DC commercial transfer of energy to the vehicles is not addressed in this directive and there are not harmonised standards for AC, both need the development of relevant metrology requirements.

Charging is a crucial topic for the success of electrification. With the right mix of infrastructure, electric vehicles could be competitive with vehicles powered by internal combustion engines, but with the added dimension of refilling comfort. Recharging a large battery pack presents a high load on the electrical grid, but this can be scheduled for periods of reduced load or reduced electricity costs. Intelligent load can be favoured at a time when the production of renewable energy is most important. In order to schedule the recharging, either the charging station or the vehicle must communicate with the smart grid (bi-directional transfer of energy combined with standardised protocols for smart-grid/smart-home interaction). A common European regulation ensuring fair trading of the products is fundamental to support manufacturing industry of EVCS. Currently, available methods are not specific to EVCS, conditioning the optimal design to take benefit of scale production, distribution and operation, testing EVCS manufacturer meters need to know the current and future regulations to design their products according to the requirements. Electricity suppliers need actual information of the future load produced by EVCS infrastructure, electrical vehicle suppliers need a quick and cost effective EVCS infrastructure developing to support this.

The legislation needs on EVCS are also stated by OIML TC 12, where there is a specific working group to include EVCS in the OIML International Recommendation OIML R46. OIML TC12 also confirmed that it is important to establish appropriate metrological regulations for electric vehicle charging stations and that EVCS are one of the key topics for the revision of the OIML R46 on electricity 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 metrology research necessary to support standardisation for the electrical vehicle charging stations.

The specific objectives are

1. To measure the equivalent electrical vehicle impedance as a function of time during the electrical vehicle charging for at least three of the most used combinations of charging conditions and vehicles covering the majority of energy transfer modes (normal, fast, ultrafast, etc.), environmental conditions and EV storage capacity for AC and DC charging.
2. To characterise by laboratory experiments the performance of EVCS concerning the main energy transfer parameters as energy, charging power, losses etc. at least at the same operation conditions as established in objective 1. The measurement results should be used to define the method, reference instruments, equivalent load characteristics and specifications to simulate EVs (dummy loads), and test conditions for laboratory certification of EVCS.
3. To carry out on-site simulation of EVCS performance of the main energy transfer parameters as energy, charging power, losses etc. at the different European sites' environmental operation conditions (with large variation on working temperatures). The measurement results should be used to define the method, reference instruments and equivalent load characteristics and specifications to simulate EVs (dummy loads), and test conditions for on-site verification of EVCS.
4. To elaborate guidelines for laboratory and on-site charging station characterisation and verification. The parameters to be addressed should be discussed with relevant regulatory bodies (WELMEC, OIML and EC Working Group on Measurement Instruments), SDOs (CEN-CENELEC, IEC, IEEE), manufacturers, utilities and other stakeholders.
5. To contribute to the standard development work of the technical committees OIML TC 12 and WELMEC WG11 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 (e.g. electric vehicles manufacturers, charging infrastructure providers, manufacturers of electric instruments), and in a form that can be incorporated into the 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 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. In particular, proposers should outline the achievements of the EMRP and EMPIR projects ENG04 SmartGrid, ENG61 FutureGrid, 14IND08 ELPOW, 15RPT04 TracePQM,16ENG04 MyRailS, 16ENG05 MICEV, 17NRM01 TrafoLoss, 17NRM02 MeterEMI, 18NRM05 SupraEMI, 19RPT01 QuantumPower and how their proposal will build on those.

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 automotive/electrical vehicle 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.