EMPIR Call 2020 – Fundamental, Industry and Normative

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

Title: Metrologically proven LNG custody transfer methods

Abstract

The global Liquefied Natural Gas (LNG) custody transfer market has grown by more than 4 % in the past decade, totalling an estimated 70 billion euros in 2019. However, SI-traceable measurement methods for LNG energy transferred are currently lacking in internationally recognised standards. In support of this, ISO/TC 28 'Petroleum and related products, fuels and lubricants from natural or synthetic sources' WG20 'Dynamic measurement of Liquefied Natural Gas', ISO/TC 8 'Ships and marine technology' WG8 'Ship design', and industrial end users have expressed the need for metrologically proven LNG custody transfer methods, and associated datasets. But for LNG measurement methods to be readily adopted by standardisation bodies, the currently available measurement equipment needs to be validated and supported by robust reference measurement data and uncertainties.

Keywords

LNG, custody transfer, flow metering, density, GIIGNL, Coriolis, ultrasonic, densimeter

Background to the Metrological Challenges

Over the past decade, three EMRP and EMPIR research projects: ENG03 LNG, ENG60 LNG II, and 16ENG09 LNG III, have developed metrology for LNG flow, composition, and methane number measurements. Their methods have been included in the International Group of LNG Importers (GIIGNL) handbook and in ISO 21903:2020: Refrigerated Hydrocarbon Fluids — Dynamic Measurement — Requirements and guidelines for the calibration and installation of flowmeters used for LNG and other refrigerated hydrocarbon fluids'. However, although the GIIGNL handbook is widely accepted as a guide for best practice for LNG custody transfer, it is not a standard. In addition, although ISO 21903:2020 provides guidelines for the calibration and installation of flowmeters used for LNG, these methods need to be supported by reference datasets, before they can be widely adopted by industry.

For LNG custody transfer, it is currently not possible to cross-check manufacturers claims, nor to directly calibrate and quantify, the added uncertainty from water calibrations of ultrasonic and Coriolis mass flow meters used in the measurement of LNG flow. LNG flow occurs under variable environmental conditions (e.g. pressure, temperature), but the responses of industry-standard flow meters are typically calibrated on water at controlled ambient conditions. Therefore, in order to establish confidence in this flow metering technology, calibrations under cryogenic conditions, preferably directly with LNG, are needed as well as an industry-accepted quantified measurement uncertainty and associated data.

Cryogenic flow facilities are very limited across the world, and as such the measurement and validation of facilities and their associated equipment varies. In LNG industry, there is a need for reliable, and industry accepted, online cryogenic density measurements that are traceable to a primary standard. Indeed, the GIIGNL custody transfer handbook states the uncertainty for density measurement as 0.46 % (k = 2). But as previously stated the GIIGNL handbook is not an industry standard and therefore such targets for LNG custody transfer measurement methods need to be implemented in applicable international standards.

The maritime industry also needs an international standard to ensure that the fuel transferred during LNG bunkering is properly measured. In the case of LNG flowmeters used in LNG bunkering vessels, there are currently no guidelines or standards. ISO/TC 8 WG8 and ISO/TC 28 WG20 previously liaised on how to incorporate bunker delivery procedural issues into standards, and in 2017 ISO/TC 8 WG8 began working on this topic, but work is still on-going.

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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 of LNG custody transfer methods.

The specific objectives are

1. To demonstrate reliable use of ultrasonic and Coriolis mass flow meters in small-scale (< 400 m^3/h) and mid-scale (< 1000 m^3/h) LNG custody transfer with a target flow measurement uncertainty below 0.5 % (k = 2). This should include (i) the validation of primary standards for cryogenic flow meters, and (ii) the quantification of the uncertainty from alternative fluid calibration of LNG flow meters.
2. To develop testing procedures and subsequently perform testing of flow metering under variable cryogenic conditions, including investigations of (i) the reliability of alternative fluid calibration uncertainty, (ii) the effectiveness of meter insulation, and (iii) the reliability of meter diagnostics under variable cryogenic process conditions. Then using the data obtained, relate this to currently used type approval requirements of LNG flow meters and determine recommendations for adoption into applicable standards.
3. To validate the use of a primary densitometer for SI-traceable LNG density measurements and establish calibration standards for vibrating tube or other densimeters as secondary transfer standards. This should include a field comparison of the secondary transfer standard and a target uncertainty for online density determination below 0.3 % (k = 2).
4. To contribute to the standards development work of the technical committees ISO/TC 28 WG20 and ISO/TC 8 WG8, as well as GIIGNL 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. energy and maritime sector end users), and in a form that can be incorporated into the standards (and GIIGNL handbook) 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 projects ENG03 LNG, ENG60 LNGII and EMPIR project 16ENG09 LNGIII 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 energy and maritime 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.