EMPIR Call 2016 – Energy, Environment, Normative and Research Potential

Selected Research Topic number: **SRT-g18**
Version: 1.0

Title: Multiphase flow reference metrology

Abstract

Multiphase flow measurement is a fundamental enabling metrology in subsea oil and gas production. However, it is subject to high uncertainty of measurement in the field which costs European industry billions of Euros in resultant financial exposure and production inefficiencies. To improve on this situation requires a reference measurement capability that is both accurate and repeatable, as well as comparable across different European facilities. EMRP project ENG58 will develop and pilot an approach to such harmonisation in Europe. However, the next vital step is to considerably widen the number of participating facilities, as well as the range of multiphase metering technologies, to which it is applicable.

Keywords

Multiphase flow; metrology; flow metering; uncertainty; visualisation; allocation, fiscal, Tomography, CFD modelling

Background to the Metrological Challenges

It is essential for Europe to maintain its leading position in the oil field, despite increasing competition from lower cost regions. R&D is critical to drive greater efficiencies in oil and gas production, to make it more competitive and improve its security of supply. In oil and gas production, multiphase flow measurement is now accepted as the norm. The earlier alternatives involving separation systems became unviable as new wells became deeper and more remote, favouring subsea processing over topside processing. The ability to provide real-time measurement has made multiphase metering technologies a vital enabler of subsea production. Multiphase metering is now relied upon for the monitoring of production and changes within reservoirs, as well as for process control of downstream fluids. In addition to fiscal taxation reporting, multiphase measurement is also required for allocation purposes (e.g. shared pipelines) at minimal financial exposure (the financial value associated with measurement uncertainty.

A major barrier to the ongoing development and improvement in multiphase metering technology is the lack of standardised procedures under which such instruments can be tested, for development, and evaluated for field conditions. Significant differences are known to result when instruments are commercially tested between different multiphase test laboratories under similar parametric conditions due to differences in test facility geometry, fluid properties and measurement uncertainty estimation. EMRP project ENG58 took the first steps towards achieving harmonisation between European multiphase reference laboratories through the world's first comprehensive multiphase intercomparison study however it is limited to only three laboratories and a single multiphase flow measurement technology in the transfer package. It is essential to involve more multiphase metering technologies as well as more test laboratories in order to achieve a comprehensive and reliable metrological reference network. This will take into account the different makes of multiphase flow meters used in the market and the technology used in them for working out the phase fractions.

State-of-the-art with regard to the overall global infrastructure is that there is no harmonisation of test methods (e.g flow rates, pressures and temperatures), fluids, parametric control, flow pattern determination or control and back-up modelling or methods of uncertainty determination across different facilities. Therefore, the 'state-of-the-art' in test loop infrastructure is characterised by numerous stand-alone test loops with little or no common referencing or standardisation between them.

The advancement in state-of-the-art that is required is the development of an established network of multiphase flow-loops able to follow a common protocol with regard to the test work that they carry out. In practice, this will mean that results obtained from any two or more of these labs will be comparable, i.e. any differences will be fully quantified and understood with regard to cause and effect.

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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 traceable measurement and characterisation of multiphase flow measurement with targeted uncertainties considerably below current state of the art.

The specific objectives are

1. To significantly extend the test envelope, in terms of flow rates, pressure (from 8 to 24 bar), and fluid properties, for which inter-comparability can be demonstrated across the network of laboratories with appropriate facilities.
2. To develop and evaluate protocols that work across meters incorporating a range of technologies (e.g. Venturi, cross-correlation, gamma ray absorption, electrical sensing, microwave and magnetic resonance technologies) thereby ensuring universal applicability and extending the range of metering technologies.
3. To incorporate appropriate leading-edge methods of flow pattern visualisation into intercomparison methods and new testing protocols.
4. To further develop modelling (e.g. CFD) techniques for significantly improving the metrological characterisation of multiphase flows.
5. To facilitate the take up of the technology and measurement infrastructure developed in the project by the measurement supply chain (instrument manufacturers) and end users (oil and gas industries) and to support the development of new standards (e.g. ISO standards) and guidelines for harmonised multiphase testing and uncertainty estimation and to provide input to improve regulations.

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the research, the involvement of the appropriate user community such as industry, standardisation and regulatory bodies is strongly recommended, both prior to and during methodology development.

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 project ENG58 and how their proposal will build on those.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 2.0 M€, and has defined an upper limit of 2.3, M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 35 % 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.

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 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.