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Welcome

Welcome to the first edition of the TracePQM Newsletter. The purpose of the newsletter is to keep our stakeholders and other interested parties informed about the progress of the project. We hope that readers of the newsletter will be stimulated to provide advice and feedback to the project team, thus ensuring that the project outcomes will have maximum benefit to the power quality community. In this first issue, for the benefit of those who are not familiar with EURAMET, we will introduce you to EURAMET and its research programme, EMPIR. There will be an introduction to the TracePQM project itself, its objectives and expected outcomes, and to some members of the project team. As the project progresses, future newsletters will provide summaries of notable technical results and developments. Of course, more detailed information about the project may be found on the project's website <http://tracepqm.cmi.cz>.

international recognition of national measurement standards and related Calibration and Measurement Capabilities (CMC). Through Knowledge Transfer and cooperation among its members EURAMET facilitates the development of the national metrology infrastructures. Its mission is to develop and disseminate an integrated, cost effective and internationally competitive measurement infrastructure for Europe, always taking into account the needs of industry, business and governments.

In 2017 EURAMET is celebrating its 30th anniversary: EURAMET was inaugurated on 11 January 2007. 20 years earlier, in 1987, its predecessor EUROMET was founded. For 30 years EURAMET and EUROMET have worked for closer collaboration and innovation in metrology. Today, EURAMET has 37 NMIs as members and almost 80 DIs as associate members. The capabilities of National Metrology Institutes in EURAMET member states vary from country to country. Some NMIs have just four employees, or are newly established, while others have almost 2000 employees and have been in existence for over 100 years. Some NMIs put the main focus on R&D while others are mainly service oriented.



Fig. 1 Metrology organisations



EURAMET is the Regional Metrology Organisation of Europe. It coordinates the cooperation of National Metrology Institutes (NMIs) and Designated Institutes (DIs) in Europe in fields such as research in metrology, traceability of measurements to the SI units,



Electricity and Magnetism

Technical co-operation within EURAMET is organised within Technical Committees (TCs). The TC for Electricity and Magnetism (TC-EM) and its sub-committee on Power and Energy is the most relevant for the work of the **TracePQM** project.



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

EURAMET coordinates metrology research across Europe to provide the high accuracy, low uncertainty measurements needed both now and in the future. Two research programmes are currently bringing together world-class measurement expertise in a series of targeted projects: European Metrology Programme for Innovation and Research (EMPIR) and European Metrology Research Programme (EMRP). **The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR participating countries.**

Horizon 2020 aims to reinforce and extend the excellence of the EU's science base and to consolidate the European Research Area in order to make the research and innovation system more competitive on a global scale. The EMPIR calls, launched between 2014 and 2020, have an allocated a total budget of 600M€.

EMPIR Joint Research Projects (JRPs) from these calls will focus on priority areas, known as Targeted Programmes (TPs), to address the EU's Grand Challenges in Health, Energy, Environment and Industry, and to progress fundamental measurement science. The inclusion of capacity-building activities in EMPIR is helping to bridge the gap between countries with emerging metrology systems and those with more developed capabilities.

The TracePQM project belongs to the Capacity Building aspect of the EMPIR programme. Joint projects such as this are referred to as Research Potential (RPOT) projects and are designed to build capacity for research in less developed NMIs.



TracePQM - Ensuring power quality for greener grids

Project 15RPT04, "Traceability routes for electrical power quality measurements", or **TracePQM** for short, is a joint research project aimed at improving the European measurement infrastructure for electrical power and power quality measurements. This will pave the way for increased adoption of renewable energy without a reduction in the quality of the electrical supply.

The Renewable Energy Directive requires the EU to fulfil at least 20 % of its final energy consumption with renewable sources by 2020. However, increasing numbers of decentralised renewable sources can cause a deterioration in the grid's power quality and demands are increasing for traceable, accurate measurements of power and power quality. Efficient measurement of power and power quality is challenging, and while several National Measurement Institutes have developed power and power quality measurement systems based on sampling techniques, the level of expertise and resources required mean that many NMIs do not yet have complete or operational systems. This project aims to develop a new, open system for sampled power and power quality measurements, accessible across Europe, which would reduce the burden of parallel development of similar capabilities.

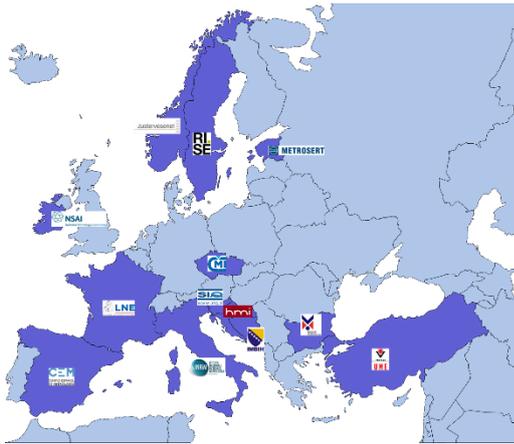


Fig. 2 National metrology institutes involved in TracePQM project

The project has a budget of just under 500 k€ and will run from June 2016 to Jun 2019. The project partners are 13 national metrology institutes, including several who already have state-of-the-art capability for PQ measurement and some who are only at the development stage.



Fig. 3 Photo of project team at kick-off meeting, June 2016

Objectives

The objectives of the project and the associated work packages (WP) are as follows:

To design a modular, metrology grade measurement setup for sampled electrical power and PQ parameter measurement, including a review of existing measurement and calibration methods, associated hardware and software, investigation of the optimum use of equipment already available within the

NMIs/DIs and extension of traceability for power and PQ measurements up to 1 MHz. (WP1)

To develop and validate a modular measurement setup for sampled electrical power and PQ parameter measurements, which can be easily established at NMIs/DIs and at other organisations.

The target uncertainties of the modular measurement setup are at least four times smaller than the tolerances specified in documentary standards for PQ meters, e.g. the target expanded uncertainties for the amplitude of voltage harmonics of the modular measurement setup are 1.25 % of the measured voltage harmonic for measured values higher or equal to 1 % of the nominal voltage and 0.012 % of the nominal voltage for measured values lower than 1 % of the nominal voltage. (WP1, WP2)

To develop an open software tool for instrumentation control, data acquisition and the calculation of electrical power and PQ parameters with full uncertainty estimation. (WP2)

To develop and make available a good practice guide for the assembly and operation of the modular measurement setup including the calibration of all components so as to establish full traceability to the SI of the electrical power and PQ parameters measured. The guide will include the manual for the open software tool to assist users in the extension and modification of the modular measurement setup. (WP3)

Each partner to develop an individual strategy for the long-term operation of the research capability developed during the project, including regulatory support, research collaborations, quality schemes and calibration services. (WP4)

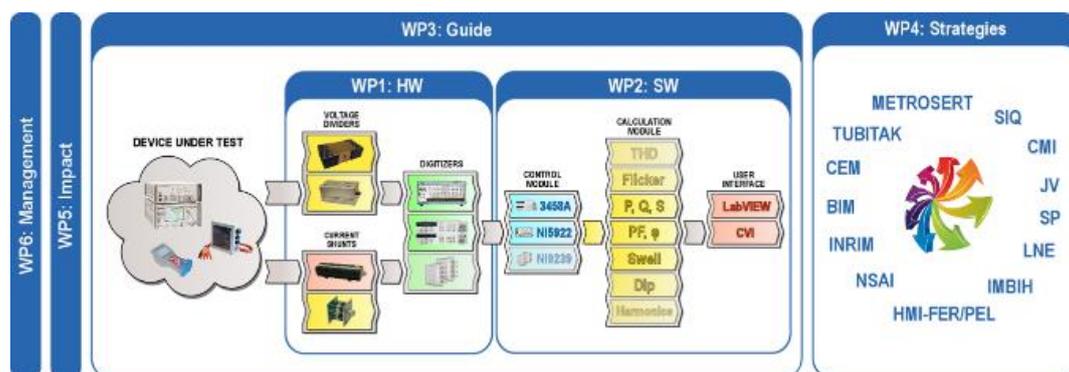


Fig. 4 Scheme of work packages

Straightforward Impact

The open software tool and good practice guide will be publicly available to all interested parties, i.e. NMIs/DIs, calibration laboratories, industry, universities and individual practitioners. They will serve both as a quick starting point for the establishment of an expandable modular sampling power and PQ measurement system and as a reference to speed up the design of a new system if required. The universal access to the open software tool and good practice guide and the easy-to-implement modular design of the power and PQ measurement setup will lead to the improvement of the power and PQ measurement capabilities within Europe, not only within the partner NMIs/DIs but also through the early uptake of the knowledge and project outputs by other interested parties, such as other NMIs/DIs or calibration laboratories.

Project update

In WP1 a review of existing measurement setups, calibration methods and voltage and current transducers for the measurement of power and PQ parameters was conducted. The contradictory requirements on the setup design (to ensure both the lowest possible uncertainties and the highest possible bandwidth) cannot be met by a single measurement setup. Therefore the new design needs to consist of two setups, one of which

will cater for low frequency (LF) measurements at the best accuracy level and the other for wideband (WB) measurements, but with reduced accuracy. Based on the review of existing measurement setups three candidates of new LF system were identified (all of them based on Keysight 3458A samplers, but with different requirements on synchronization), only one candidate of new WB system based on NI 5922 digitizers was recognized. Calibration methods for current shunts and voltage dividers in terms of amplitude and phase angle error in frequency range up to 100 kHz were developed. Investigation of NI 5922 digitizers in terms of short term stability, temperature dependence and input admittance frequency dependence was conducted.

The review of existing systems and the initial setup design information have led to the proposal of a concept for the software structure in WP2 able to satisfy the different demands in terms of clock and trigger and to allow the handling of different samplers involved in the design of the two setups. LabVIEW (LV) and/or LabWindows/CVI linking to GNU Octave/Matlab for runtime data processing were agreed as the most suitable software environments for development of open modular SW tool. The DLL library for LV/CVI runtime communication with GNU Octave console process was developed. WP3 and WP4 were inactive during first nine months of the project.

In scope of WP5 the project website tracepqm.cmi.cz was created including a restricted area for consortium only. A half day Workshop on Power and Power Quality Metrology for the consortium was held in conjunction with the kick-off meeting to provide the partners with the necessary knowledge transfer to go ahead with the activities of the project. Another half day workshop related to power quality was organized by SIQ to deliver lectures to more than 30 participants from different Slovenian electricity distribution companies and companies that produce PQ instruments. The project was presented to the OIML TC 12 committee, EURAMET SC Power and Energy and was also introduced during 26th National Scientific Symposium "Metrology and Metrology Assurance 2016". An exploitation plan was produced.

Scheduled events		
Event	Date	Location
Mid-term meeting	Nov 2017	INRIM, Italy
Teleconference	Aug 2018	-
Final meeting	May 2019	TUBITAK, Turkey
Final workshop	May 2019	TUBITAK, Turkey

Collaborators and Stakeholder Committee

It is vital that the considerable resources allocated to the TracePQM project are used to their best advantage. This means that the project outcomes must be relevant to our stakeholders, the PQ measurement community. We are fortunate that a number of collaborators, organisations from outside the project partners, have offered to provide technical assistance to the project (See TracePQM website for details). We thank them for their assistance and look forward to fruitful collaboration with these organisations.

Collaborators:
National Instruments, Czech Republic
D.I. Mendeleev Institute for Metrology (VNIIM), Russian Federation
EURAMET TC EM Power and Energy Subcommittee, Europe
Fluke Calibration, United Kingdom

We have also established a **stakeholder committee** which will provide a formal and enduring link between the project partners and the stakeholders throughout the project. So far, we have twelve members on the stakeholder committee, including representatives from instrument manufacturers, distribution service providers, test laboratories, and academic institutions. Stakeholder committee members will be kept fully informed of project developments and are encouraged to provide feedback and advice.

Members of TracePQM Stakeholder Committee	
Jan Souček	MEGA - Měřicí Energetické Aparáty, a.s
Alexandru Stefanov	ESB Networks
Terence O'Donnell	UCD Energy Institute
John McAuley	Compliance Engineering Ireland
Irvin Sirotic	METREL d.d.
Andrei Klimenko	L-CARD
Alfonso Alcántara	Red Electrica de Espana
Marie Havlíková	Brno University of Technology
Plamen Tzvetkov	Technical University of Sofia
George Milushev	Unitech Control Ltd
Geoff Ives	Fluke Calibration
Tapio Lehtonen	VTT Technical Research Centre of Finland

INVITATION TO COLLABORATE:

The project consortium would welcome other organisations or individuals who are interested in taking part in the project, either as collaborators or members of the stakeholder committee. It is hoped that such co-operation will be of mutual benefit to the project partners and the co-operating body. If you wish to become a collaborator or join the Stakeholder Committee, or know of an organisation that might wish to do so, please make contact using the details given below.

Introducing the project team...

In this section of each newsletter we will introduce several partners of the project consortium. In this issue we introduce you to the researchers of Czech Metrology Institute (CMI, Czech Republic), Bulgarian Institute of Metrology (BIM, Bulgaria) and Centro Español de Metrología (CEM, Spain).



CMI provides uniformity and precision of measuring instruments and measurement in all the fields of research, technical and economic activities in the range of Czech laws. CMI has wide experience in electrical quantities measurements for several decades and has the third widest coverage of electrical parameters in Europe, including quantum standards based on the AC Josephson Effect and the Quantum Hall Effect. CMI has wide experience in the use of sampling techniques for measurement of power, PQ, phase, impedance and other quantities, in simulations and uncertainty calculations, and in development of interactive measurement SW applications.

CMI has participated in many co-operative research projects related to TracePQM, such as iMERA+ Power and Energy, EMRP SmartGrids, SmartGrids II, Q-wave, AIM QuTE, NEW04, and EMPiR ACQ-PRO (WP leader).

Věra Nováková Zachovalová, Ph.D., is the TracePQM project co-ordinator. She joined CMI in 2005 where she is responsible for AC-DC transfer difference, AC voltage and current traceability and is also involved in power measurement and functional tests of PQ analysers. She has a long experience in development of SW applications for measurement automation and data processing.

Martin Šíra, Ph.D., has started work in metrology field in CMI in 2008. He was focused on Josephson Voltage System and Automated binary voltage dividers. Today he is involved in voltage sampling, dissemination of resistance, and power measurements. He also has long term experience with software tools, automation of measurement, mathematical modelling of physical experiments.

Stanislav Mašláň joined CMI in 2011. He is involved in LF impedance measurement, in development of the data processing and analysis algorithms, uncertainty analysis algorithms and in development of SW for various measurements automation.



BIM has activities and responsibilities in the field of scientific and legal metrology. National Centre of Metrology (NCM) is part of BIM, responsible for scientific metrology and maintaining national standards. NCM provides traceability in Bulgaria for all electrical and other quantities, both to other calibration laboratories and directly to end users.

In the field of power and energy measurements NCM, BIM maintains a complete range of standards – such as a precision power calibration system up to 100 A, a four Channel Power Calibrator, AC current shunts from 10 A to 100 A, and a wideband transconductance amplifier up to 100 A.

Antoaneta Yovcheva, Ph.D., is a head of Electrical Measurement Department at NCM, Bulgarian Metrology Institute (BIM). She has 25 years experience in the field of power and energy measurements. She is a contact person in TC-EM and also in TC-EM SC Power and Energy.

Radoslava Hadzhistoykova is a senior researcher in Electrical Measurement Department at NCM, BIM with more than 15 years experience in the field of AC/DC measurements. She has also a lot of experience on LF measurements and is a contact person in TC-EM SCs DC and Quantum Metrology and Low Frequency.

Tatyana Konstantiniva is a senior researcher in Electrical Measurement Department at NCM, BIM with 10 years experience in the field of electrical measurements in DC field. She has also a lot of experience on LF measurements.

Adelina Dimitrova is a junior researcher in Electrical Measurement Department at NCM, BIM. She joined BIM in January 2015. She is involved in PQ measurements.

CEM The Spanish Centre of Metrology (CEM) is the national metrology institute, responsible for the obtainment, maintenance and dissemination of the national measurement standards, the development of the Spanish calibration service and the maintenance of the legal metrology service.

CEM has wide experience in the development of quantum electrical standards (Josephson voltage standard and quantum Hall effect) and working with power standards. CEM has already established with approved CMCs a digital sampling power wattmeter.

CEM has participated in previous related projects such as iMERA-Plus: JoSy, SMART-GRID, Q-WAVE, AIM QuTE, and ACQ-PRO (coordinator).

Javier Diaz de Aguilar has more than 20 years of experience in electrical standards, first as head of the Electrical calibration laboratory at INTA (Spanish National Institute for Aerospace Technology) and since 2008 as head of the AC laboratories at CEM. He is the CEM representative on TC-EM SC Low Frequency and JRP coordinator of EMPIR project ACQ-PRO.

María L. Romero has more than 15 years of experience in electrical standards; she is the head of the Power and Energy Laboratory.

Raúl Caballero joined CEM in 2007. He is a scientist working in the ac-dc transfer difference and in AC voltage and current.

Yolanda A. Sanmamed, Ph.D., has joined CEM in 2006 and she is the head of the Impedance Laboratory.

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