

## **1. General Aspects**

2014 was marked by a successful participation of TC-EM community at CPEM'2014 in Rio, by significantly promoting the results obtained in the framework of the JRPs. Good results were obtained for the first EMPIR calls. The TC-EM was also well occupied with routine affairs for MRA (comparisons and CMC review).

## **2. Projects**

Detailed information about the EURAMET projects in the EM field is available from the EURAMET web-site and currently updated. An overview of the number of projects is given in the table below.

	<b>EURAMET Comparison</b>	<b>Traceability</b>	<b>Consultation</b>	<b>EMRP</b>	<b>Co-operation &amp; research</b>
<b>On-going</b>	14	12	1	18	1
<b>Completed</b>	79	1	58	15	47
<b>Total</b>	93	13	59	33	48

## **3. Comparisons**

During 2014, three supplementary EURAMET comparisons and one comparison not registered in the BIPM-KCDB have been completed in the EM field, leading now to 14 running comparisons (2 KCs, 11 SCs, 1 not registered in KCDB) and 79 completed comparisons including 14 comparisons not registered in the BIPM-KCDB. The total number of EURAMET comparisons listed in the key comparison data base sums up to 25 KCs and 40 SCs. Besides this, EURAMET is or has been active in a large number of CCEM comparisons: 9 BIPM KCs, 53 CCEM KCs and 2 CCEM SCs.

This year 2014 has shown no progress on the development of the comparison toolbox initiated in 2012 with the aim at improving the comparison process (shortened duration, more labs in capability to be pilot ...) because of lack of time (*i.e.* resources or financial funding) of the members of the dedicated comparison task force. The project has re-started since March 2015 thanks to the involvement of Jürgen Melcher from PTB who has accepted to chair this task force.

## **4. CMCs**

### **4.1. EURAMET EM CMCs**

The run for CMCs set "EURAMET.12.2014" launched in October 2013 has been reviewed in the usual two stages following an intra EURAMET review then an inter RMO review. This CMCs set has been published in the KCDB website on 26 January 2015. A new run for CMCs ("EURAMET.EM.13.2015") has been launched on 1<sup>st</sup> February 2015 with an expectation to get the CMC batch published on the KCDB by the End of 2015.



#### 4.1.1. EURAMET.EM.12.2014

##### **Intra RMO review**

The intra-RMO review of the CMC set EURAMET.EM.12.2014 was carried out between February 2014 and June 2014.

- 18 NMIs submitted in total 88 new entries (incl. 96 matrices) and 195 improved entries (incl. 94 matrices). (For details see table 1). In addition, for 56 entries (9 matrices) minor changes were proposed: the scope was reduced, the uncertainty was increased or editorial modifications were applied. 175 entries (incl. 41 matrices) are announced for removal from the KCDB.
- It should be noted that, for this run, NSAI/NML (Ireland) has proceeded to a cleaning-up of its tables and to the use of matrices (151 delete entries, 20 created matrices).
- All the entries were reviewed by the members of the working group on the analysis of CMCs.
- From the 514 reviewed entries 225 were approved as submitted, 68 were approved after modifications and 39 entries needed editorial changes (For details see table 2.). 14 entries were not approved and 155 entries will have to be definitively deleted from the KCDB.

The entries which successfully passed the EURAMET review process are submitted to the inter-RMO review for approval. The total amounts to 272 entries: 82 new entries and 190 improved entries (see table 3). No technical review is necessary for the entries asked for minor changes (the corresponding lines were hidden in the files submitted for inter-RMO review).

##### **Inter RMO review**

APMP and SIM have decided to share the inter-RMO review of the set EURAMET.EM.12.2014, while AFRIMETS has undertaken a complete review. These three RMOs reviewed 90 % of the 272 submitted entries and surprisingly some other entries.

RMO	AFRIMETS	APMP	SIM	TOTAL
Date for review announced	30 Sept. 2014	31 Dec. 2014	15 Dec 2014	
Report received	30 Sept. 2014	24 Dec. 2014	8 Dec 2014	
Percentage of entries reviewed (among the 272 entries)	74 %	52 %	39 %	90 %

From AFRIMETS review, among the reviewed 202 CMCs, 174 were approved as submitted, 2 were approved after minor modifications and 23 were not approved due to non submission of requested supporting documentation. Due to this unacceptable lack of answer, the three concerned NMIs will have to wait the next run to re-submit their CMCs not agreed by AFRIMETS (even if they were agreed by the other RMOs afterwards).

From APMP review, 43 new entries with 50 matrices, 98 improved entries with 46 matrices, and 27 minor changed entries with 6 matrices have been approved. 5 entries with 5 matrices have been deleted (not approved).

From SIM review, 79 entries were approved as submitted (incl. 39 matrices) and 26 (incl. 19 matrices) approved with comments.

#### 4.1.2. EURAMET.EM.13.2015

By mid of May, 14 NMIs submitted in total 37 new entries (incl. 53 matrices) and 129 improved entries (incl. 50 matrices). In addition, for 43 entries (2 matrices) minor changes were proposed: the scope was reduced, the uncertainty was increased or editorial modifications were applied. 30 entries are announced for removal from the KCDB. The intra-RMO review of this CMC set EURAMET.EM.13.2015 has just started and should be completed in July.

#### 4.2. Inter-regional review of CMCs

In 2014, EURAMET TCEM was involved in a single inter-RMO review which concerns the CMC set COOMET.EM.7.2014 (posted on the JCRB web site on 29 September 2014). In agreement with the other RMOs, it has been decided to share the inter-RMO review of this set between AFRIMETS and EURAMET (in total 63 entries and two matrices). The EURAMET part of the review was completed in time (December 2014) but has been extended until end of February 2015, EURAMET being asked to review CMCs which were not reviewed by AFRIMETS by lack of expertise in the considered field.

### 5. Activities of the Sub-Committees

The activities of the four subcommittees (DCQM-„DC and Quantum Metrology“, LF-„Low frequency“, PE-„Power and energy“, RFMW-„Radiofrequency and microwave“ are largely dominated by R&D activities related to EMRP and EMPIR. As in the past CPEMs, there were highlighted at CPEM'2014 (Rio de Janeiro, 25-29 August) through key results obtained, for example about QHE in graphene, 1V pulse driven array, watt balance, SET current sources, CCC and low current amplifier, digital impedance bridge, synchrophasor (PMU), High current and voltage transformer, HF power standard, modelling of connector effects in millimetre band, *etc.*

Discussions on on-going comparisons, CMCs and Calibration guides were also held during some satellite experts meetings of CPEM in the framework of CCEM working groups, WGLF, GTRF and WGRMO, these three WGs being chaired by EURAMET experts. A EURAMET proposition to revise categories 8 and 9 of the classification of services has been presented and will be defended at the next CCEM meetings. As output of the on-going JRP “HF circuits”, the project on rewriting the VNA calibration guide cg-12.

#### 5.1. Participation in the first 2014 EMPIR call “Metrology for Industry”

The TC-EM community was involved in the elaboration of proposal for the following JRPs in the targeted program “Metrology for Industry” of 2014 EMPIR call:

Among the 33 selected research topics, **9** topics were coming from TCEM (from **13** PRTs discussed on January 2014). In almost the same ratio, among the 14 selected JRPs, 4 were coming from TCEM (in bold blue).

SRT-i11 Electromobility drive technology

SRT-i12 High frequency and dynamic measurements of functional materials

**SRT-i13 Metrology for 5G communications**

**SRT-i14 Metrology for the electrical power industry**

SRT-i15 Metrology for graphene characterisation

SRT-i16 Metrology for magnetoresistive sensor applications

**SRT-i17 Microwave measurements for planar circuits and components**

**SRT-i21 Metrology for manufacturing 3D stacked integrated circuits**

SRT-i33 Reliable diagnostic methods for enhanced traction batteries

Among the 9 research topics selected within the new program “Research Potential”, one was coming from TCEM and the corresponding JRP has got funding support:

**SRT-r01 Towards the propagation of ac quantum voltage standards.**

## 5.2. Preparation for the EMPIR calls 2015

As in the past six years with the same goal to coordinate the preparation of PRTs, a workshop was held on 27-28 January 2015 at PTB in Braunschweig (gathering around 40 attendees) to prepare PRTs for the 2015 EMPIR calls.

Identified PRTs are given in the table below:

Call	Provisional Title	Coordinator for PRT preparation
<b>Health</b>		
1	Metrology for hyperthermia	M. Hudlicka (CMI)
2	Metrology for Wireless Body Area Networks	D. Allal (LNE)
<b>SI</b>		
1	Towards nano scale traceable magnetic field measurements	H. W. Schumacher (PTB)
2	Metrology for electrical scanning probe microscopy	F. Piquemal (LNE)
3	Resistance & impedance metrology based on graphene	A. Manninen (VTT)
4	Metrological Application of spectrally pure Josephson-ac-voltages	R. Behr (PTB)
5	Quantum ampere II	M. Kataoka (NPL)
6	HF power measurements and THz	R. Dudley (NPL)
<b>Normative</b>		
1	Pre-normative standardization activities for graphene and 2D atomic materials	N. Fabricius (CENELEC, IEC)
2	EMC	F. Pythoud (METAS)
3	High voltage	A.P. Elg (SP)
<b>RPot</b>		
1	Traceability of electrolytic conductivity measurements	O. Power (NSAI NML)
2	Metrological Performance of Floating Gate Voltage References	O. Power (NSAI NML)
3	Digital power measurements	M. Šíra (CMI)

## 6. TCEM contact person meeting

The annual meeting of the TC-EM was held in Ljubljana on 16 and 17 October 2014 (preceding by a WGSP meeting on 15 October). The meeting was hosted by SIQ. 32 people representing 25 EURAMET members, one person from NIS, one person from NMIJ and one person from EURAMET secretariat attended it.

The main topics of the agenda were:

- Reports on new developments within EURAMET, the BIPM electricity section, the activities of the four TC-EM subfields;

- Review of ongoing and new projects related to research, consultation and traceability including discussion on technical guidelines;
- Review of on-going and new projects on comparison;
- Discussion on CMC tables : Present status on EURAMET.EM.12.2014, CMC inter RMO reviews in 2014, EURAMET CMC review group, feedback on WGRMO meeting CPEM 2014, Discussion on EURAMET paper: "Making the CIPM MRA sustainable: MRA Phase II;
- Six technical talks: 3 given by colleagues from SIQ, 1 each from NMIJ, PTB, and TCEM chair on behalf BIPM;
- News from NMIs in form of a poster session which has been successful in gathering 13 posters;
- EMRP/EMPIR calls : EMRP (2013+global), EMPIR work plan 2014/2015, Capacity building in the framework of EMPIR, Prenormative research project in EMPIR, First contributions of TCEM for EMPIR (SRA, calls 2014, Preparation calls 2015);
- Voting:  
Luca Callegaro (INRIM) was nominated by TCEM as candidate for being the next TCEM chair and finally was elected by EURAMET delegates. Paul Wright (NPL) was elected by EURAMET TCEM contact persons as the new SC PE convenor, succeeding Gert Rietveld (VSL).

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Trappes, 20 May 2015

François Piquemal  
TC-EM chair

