

22 May 2013

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## 1. General Aspects

For the TC-EM community, 2012 was marked by a successful participation at CPEM'2012 particularly based on the results obtained in the frame of JRPs. Great efforts have been spent for the preparation of EMPIR (roadmapping). Good results were obtained for call 2012 in contrast to the lukewarm results for call 2011. As in the past, the TC-EM was also well occupied with routine affairs for MRA (comparisons and CMC review). TC-EM continues its initiative towards simplified and more efficient MRA procedures, particularly by preparing new propositions for simplifying CMC tables which have been discussed at the CCEM meetings in March 2013.

## 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.

	Comparison	Consultation	Co-operation & research	Traceability	Total
<b>On-going</b>	15 (15)	1 (0)	2 (3)	10 (11)	28 (29)
<b>Completed</b>	84 (81)	58 (59)	46 (45)	3 (2)	191 (187)
<b>Total</b>	99 (96)	59 (59)	48 (48)	13 (13)	219 (216)

(Figures in brackets denote the numbers of the previous period)

Like the preceding years, the total number of comparison projects continues to increase while the three other kinds of project (consultation, research and traceability) remain unchanged. Already pointed out in the past, the small number of traceability projects does not reflect the real situation in the EM field. Even with the new form, much more suited, it seems difficult for NMIs to formally declare traceability links to another NMI. Such links are submitted to change for market or financially reasons. Moreover, the risk of distorting the market (as encouraged by the MRA and the comparability of CMCs) was highlighted if too many formal traceability agreements were put in place. However, most of the NMIs have positively answered to a questionnaire about external traceability sources for their own calibrations services and / or identified in their CMC tables. From the answers, more than 60 traceability projects should be in fact expected!

## 3. Traceability landscape

The questionnaire aims at establishing what traceability links exist between NMIs, how they are changing with time, considering the available data on CMCs published in the KCDB before 2004 and how EURAMET TC-EM is then progressing. This exercise contributes for the analysis on the strong points / weak points of EURAMET organization.

The analysis of the answers to this questionnaire has been completed and results on the 2012 traceability landscape will be given at the time of the GA, including a comparison to the 2004 landscape which has been previously drawn up. The main conclusions are:

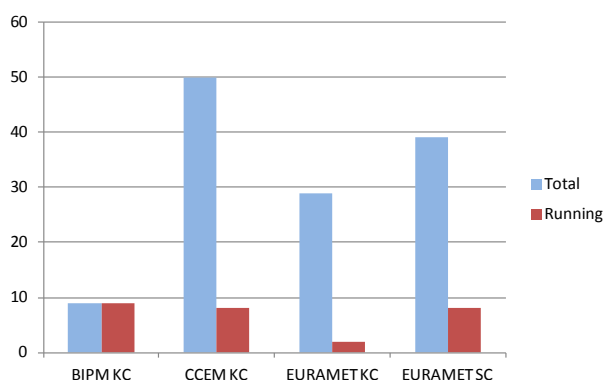
- The traceability links significantly exist between EURAMET NMIs and its number amounts to 72.



- The progress since 2004 is not so significant, and even slightly disappointing in respect with the aim of EURAMET at sharing traceability among NMIs: the links increase for RF quantities and DC voltage but significantly decrease for LF impedance, LF power and HV/HC. However the number of NMIs as traceability sources within EURAMET strongly increases
- The traceability needs towards non EURAMET institutes decrease.

## 4. Comparisons

During 2012, one key EURAMET comparison, 2 Supplementary EURAMET comparisons and 5 EURAMET comparisons outside MRA have been completed in the EM field, leading now to 11 active comparisons (2 KCs, 9 SCs) compared to 8 for the previous period. The total number of EURAMET comparisons listed in the key comparison data base sums up to 24 KCs and 36 SCs. Besides this, EURAMET is or has been active in a large number of CCEM comparisons: 9 BIPM KCs, 50 CCEM KCs. This situation is also illustrated in the following figure. The comparisons support the CMC entries of EURAMET members, published in the KCDB in the EM field, covering almost all the classified services (by the end of 2012 in EM: 3737 entries for EURAMET compared to 7091 entries for all the RMOs).



In the continuity of actions taken last years to improve the comparison process (shortened duration, more labs in capability to be pilot ...), a comparison toolbox is being developed thanks to the efforts of the dedicated task force with members from INRIM, LNE, METAS and VSL (see documents and the organisation on the TCEM EURAMET website). Our plan is to complete this toolbox in 2013. In addition, a group of experts composed of the members of the above-mentioned task force and of two statisticians from INRIM and LNE has been created with the aim at providing comparison pilots and associated support groups with extra support (difficult data analysis ...).

Moreover, the TC-EM has actively contributed to the CCEM WGLF Workshop on international comparisons (designs, data analysis, and reporting) held at CPEM'2012. They were 5 talks in total: 4 from METAS and INRIM, 1 from NPL as WGLF member&chair).

## 5. CMCs

### 5.1 EURAMET EM CMCs

The set EURAMET.EM.8.2012 was fully published on 6 March 2013, which ends a period of more than 16 months required for the whole process (preparation, reviews, publication). Indeed, this set was started on 17 Oct 2011. 15 NMIs submitted in total 191 new entries (incl. 83 matrices) and 147 modified entries (incl. 11 matrices). In addition, for 59 entries (10 matrices) the scope was reduced, the uncertainty was increased or editorial modifications were applied. 159 entries (5 matrices) are announced for removal from the KCDB. In February 2012, the entries were reviewed by the members of the working group on the analysis of CMCs and the entries which successfully passed the

EURAMET review process were submitted on August 2012 to the inter-RMO review for approval. 3 RMOs reviewed the set and this Inter-RMO review process was ended on 19 December 2012 (nearly 12 months).

The next run dealing with the set EURAMET.9.2013 was started on 18 March 2013. This run is dedicated only on a cleaning up of the CMC tables and on extending the use of matrices: For this run, new entries or improved entries were not allowed. Using the current format, the NMIs were strongly encouraged to use matrices as much as possible and to present a single CMC line (with a single matrix) for each sub-sub category whenever possible. This run was also considered as an opportunity for the NMIs to correct all the misprints and editorial typos, to increase uncertainty values or to reduce the scope of CMC entries, or to delete CMC entries, etc.

Great efforts have been spent by most of the NMIs in the use of matrices. 24 NMIs have indeed positively contributed to this run by creating or improving 438 matrices (121 matrices were deleted) and consequently the total number of CMC entries for EURAMET TCEM should be reduced by a factor of 2 and reach a value less than 1900.

Between 14 May and 15 June, all the entries and matrices will be reviewed by the members of the working group on the analysis of CMCs within EURAMET. Inter RMO review is not needed for this specific set (no new entries, nor improved entries) which should be then published during summer.

## **5.2 Inter-regional review of CMCs**

Following the decision taken with the other RMOs to share the inter RMO review, the TCEM was not involved in the unique inter-RMO review carried out in 2012 which concerns SIM (SIM.EM.6.2012: 92 new entries (incl. 49 matrices) from a total of 2 NMIs).

## **5.3 EURAMET TCEM proposition on how to simplify the CMC entries (follow-up)**

Following a first discussion among the RMO WG members in July 2012 (during CPEM'12), then some extra works and discussions among EURAMET TCEM members including the support and advices from the KCDB manager, a new proposition has been formulated to simplify the CMC entries in our field and submitted to the different CCEM WGs (WGLF, GTRF, WGRMO) for discussion at the CCEM meetings on 12 to 15 March 2013.

This proposition consisted in simplifying the CMC Excell tables by stopping the entry lines at the level of sub-categories in most of the cases and to strongly extend the use of matrices. Briefly, for each sub-category, a single line in the table could indicate the two extreme uncertainties and would be associated to one or several matrices presented on a separate attached sheet of the table and which correspond to the sub-sub categories. It is important to remind that the present CCEM service category list contains 12 categories, 49 sub-categories and 194 sub-sub-categories, according to which the CMCs are classified. In the same field of EM, the total number of published CMC entries amounts to nearly 7 000 (the half coming from EURAMET) while the number of matrices remains comparatively small (less than 500 but probably over estimated).

Four working documents have been submitted: 1) A revised short paper on the EURAMET proposal to simplify the CMC entries; 2) A proposed revising of the Supplementary Guide; 3) A proposed new template for CMC table; 4) The whole LNE CMC table in the proposed new format.

During these CCEM meetings, our proposition of new template and revised guide for simplifying CMC tables has been subject of several debates and finally was not approved by the CCEM.

The proposition fails not on the ability to search CMC values from the database but on the comparability of CMC values between countries (even if comparing CMC lines between countries

is not so easy with the present CMC database). It seems that the proposition comes too early compared to the project of recasting the CMC data base which is still under discussion.

## 6. Activities of the Sub-Committees

All the four subcommittees have been fully involved in the success of the CPEM'2012. One third of the contributions was coming from EURAMET TCEM (47 talks, 59 posters, 106/319 summaries in EM, (374 summaries in total)). They have taken advantage of this conference to organize as usual their own satellite expert meetings during which on-going and future comparisons were the main discussion subjects. Additional meetings have been also organised along this year especially to deal with EMRP call 2012, EMRP call 2013 and to establish roadmaps in the preparation of next EMPIR program. Below are the meetings planned in the first half of 2013:

- SC "RF and microwave" meeting: 22 and 23 April 2013, SIQ, Ljubljana
- SC "LF" meeting: 16 and 17 May 2013, PTB, Braunschweig
- SC "DC and Quantum Metrology" meeting: 21 and 22 May 2013, CEM, Madrid

### 6.1 Participation in the EMRP

The TC-EM community was involved in the elaboration of proposal for the following selected research topics in the three fields of 2012 EMRP call: Metrology for Industry II, SI Broader scope II, Open excellence call:

#### **Metrology for industry – II**

"Improved EMC test methods in industrial environments"

"Metrology for optical and RF communication systems"

"Nanoscale probing of transport across interfaces"

#### **SI broader scope – II**

"Quantum resistance metrology based on graphene"

"Traceable metrology for high frequency power in the millimetre-wave range"

"A quantum standard for sampled electrical measurements"

"Metrology for new electrical measurement quantities in high-frequency circuits"

"Automated impedance metrology extending the quantum toolbox for electricity"

#### **Open excellence call**

"Spintronic and spin-caloritronics in magnetic nanosystems"

"Nanoscale magnetic detection close to the quantum limit"

"Quantum optomechanics and quantum enhanced ultra-high precision measurements"

All of these selected topics came from the proposed topics discussed during the dedicated workshop, which was held on 17-18 January 2012 at METAS in Bern (35 delegates from 13 NMIs). **Seven** of the eleven proposals were selected for funding (title underlined).

With the same goal to coordinate the preparation of PRTs for the 2013 EMRP call, a PRT preparation workshop was held on 15-16 January 2013 at VSL in Delft within the SC "Power and Energy" community. Eleven potential PRTs were defined and drafted. Prior to this meeting, two other half-day meetings were held in 2012 (March and November) for starting the generation and collection of ideas.

## 6.2 Preparation for the next phase “EMPIR”

As already reported at the previous EURAMET General Assembly in May 2012, the TC-EM has elaborated five scientific-technical roadmaps to the future “EMPIR” and prepared explanatory and synthetic notes on the following topics which are in link to the pillars “basic research” and “grand challenges” and are related to the other modules of the work program (innovation, pre-normative and metrology capacity building) for some of them.

Topic	Main Module	Secondary module
1) Foundations of the SI, fundamental tests and quantum measurements	Science / Basic scientific metrology	
2) Nanoelectronics and nanomagnetism	Science / Basic scientific metrology	
3) Innovative calibration means in electricity /magnetism	Innovation	Capacity Building
4) Metrology for future applications of complex RF to THz systems	Science / Basic scientific metrology	Innovation + Pre-normative R&D
5) Power and Energy in an era of emerging smart grids	Science / Grand challenges	Pre-normative R&D

## 7. TCEM contact person meetings

The annual meeting of the TC-EM was held in Bratislava on 11 and 12 October 2012 (preceding by a WGSP meeting on 10 October). The meeting was hosted by SMU. 25 delegates representing 20 EURAMET members and one person from BIPM attended it. Seven other EURAMET members and one invited institute were not represented, partly due the economical reasons. 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 and news from the CCEM and JCRB
- 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 improvements about CMC tables and the review process
- Three technical talks (“The bolometer in terahertz frequency range”, “Application and possibilities of scanning transient microscopy”, “Phasor measurement unit calibration”)
- News from NMIs in form of a poster session (but remaining unsuccessful).
- EMRP (calls 2011 and 2012) and EMPIR (about which most of the contact persons had very few information and were very interested by the presentation of the outlines : motivation and drivers, general vision, key inputs, the corner stones and the four modules of the program).

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Trappes, 22 May 2013

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for Electricity and Magnetism