

EUROMET Technical Committee for Electricity and Magnetism (TCEM) Report for the period 2006/2007

1. Introduction

The work within the TCEM is organised as follows: More general issues are under the responsibility of the Technical Committee, whereas technical issues are dealt with in the three sub-fields "DC and quantum metrology", "Low frequency" and "Radiofrequency and microwave". Activities concerning the iMERA project or the EMRP are dealt with in the iMERA Working Group of the TCEM. In the period under review, this group helped the drafting group for the EMRP in drawing up the grand challenge "Fundamental Metrology" and EM part of the EMRP.

CMC's and comparisons still dominate the work of the TCEM, but with a slightly decreasing tendency in favour of a closer co-operation in research. The number of ongoing comparison projects decreased by about one fourth. This will enable the TECM to strengthen its future activities more on scientific issues. The TCEM has been and is still strongly involved in the iMERA project and the EMRP activities.

2. Meetings

The **TCEM** met on October 19 and 20, 2006 in Thessaloniki, Greece. The meeting was hosted by EIM. Main topics of the agenda were

- reports on new developments within EUROMET and other regions, the CCEM and its working groups, the BIPM Electricity Section and the activities of the TCEM sub-fields
- a review of ongoing and new projects
- a technical talk on an inductance comparison
- an up-date on the ongoing iMERA and EMRP activities
- future activities of the TCEM in the iMERA project

The iMERA project and the EMRP occupied a large part of the discussion. The contact persons of the TCEM observe the development with great interest, the more as they believe, that the iMERA project could provide a good opportunity to strengthen the position of scientific metrology in Europe. The TCEM installed a restricted website on the EUROMET homepage where the contact persons can download the documents of the last two TCEM meetings.

The **iMERA Working Group** of the TCEM met three times on 15 July 2006 in Turin, on 18 October 2006 in Thessaloniki and on 13 March 2007 in Paris. Main topics of the discussion were

- update on the ongoing iMERA and EMRP activities
- results of the roadmapping process and conclusions to be drawn
- contribution of the TCEM to the EMRP
- Proposals for Joint Research Projects (JRPs) in the frame of the ERANET+ funding

A member of the TCEM was involved in drawing up the EMRP. In addition, the TCEM will be represented in the EMRP committee by two members and one deputy.



All the subfields of the TCEM held informal meetings on occasion of CPEM 2006 in Turin. The meeting of the **sub-field "DC and quantum metrology**" was held on 8 July. Besides a review of the ongoing projects and proposals for new projects, the availability of Josephson arrays and quantum Hall effect probes, the possible redefinition of the ampere and other electric units and contributions of TCEM members to the CPEM programme have been discussed. Some sixty participants from more than 20 countries participated in that meeting. In addition, special meetings were organised on Single Electron Tunnelling (SET) on 11 July and on the JRP "Binary Josephson array power standard" on 13 July. An International School on "Quantum Metrology and Fundamental Constants" is going to be organised by LNE and METAS in Les Houches, France from 1 October to 12 October. The next meeting of the subfield will be held from 25 June to 27 June 2007 at MIKES in Helsinki.

The **sub-field "Low frequency**" met on 9 July. The meeting had some 40 participants representing NMI's from Europe and many regions including APMP, SIM and COOMET. The meeting concentrated on a discussion of key comparisons for AC/DC voltage and current transfer and highlights from the laboratories. A questionnaire will be sent to participants on what resources they can make available to other NMI's. Discussion at this meeting suggested a power meeting is urgently needed. The next meeting will be held from 27 June to 29 June 2007 at MIKES, during the same week and just after the DC and quantum metrology meeting.

13 NMI's from Europe and outside Europe were represented at the meeting on the **sub-field** "**Radiofrequency and microwave**" on 9 July. The challenge of new technologies in electrical metrology at rf, microwave and higher frequencies was discussed, especially in the light of the EM roadmaps and the EMRP. The rf and microwave projects were reviewed and the status of GT-RF and EUROMET comparisons was discussed as well as the possibility to organise workshops at the coming subfield meeting. The next meeting is scheduled for 26 to 27 April 2007 at NMi-VSL in Delft, The Netherlands.

3. Projects

Detailed overview of the EUROMET Projects in the field of Electricity and Magnetism can be obtained from the EUROMET website. 10 projects could be completed in the period under review, among them 8 comparison and 2 consultation projects. Four new projects have been agreed upon, one comparison, 2 consultation and one cooperation in research project. The table below gives an overview of ongoing and completed projects.

	Comparison	Co-operation	Traceability	Consultation	Total
Ongoing	24 (31)	9 (8)	9 (9)	1 (2)	43 (50)
Completed	55	36	2	49	142
Total	79	45	11	50	185

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

In the period under review, the number of ongoing projects slightly decreased which is due to a decrease in comparison projects. But with about 50 % of the total number of projects, comparisons are still dominating. The large number of comparison projects reflects the



EUROMET, CCEM and BIPM comparison activities in the fields of DC&LF and RF. In the future, scientific cooperation among the European NMIs in the field of electricity and magnetism will concentrate on ERANET+ and – hopefully – Art. 169 activities.

4. Comparisons

Presently, 22 (25) EUROMET key or supplementary comparisons (10 KC's, 12 SC's) are active in the field of Electricity and Magnetism. The total number of comparisons sums up to 22 (22) KC's and 26 (25) SC's (Figures in brackets denote the numbers of the previous period). Besides this, the TCEM is or has been involved in a large number of BIPM and CCEM comparisons: 9 BIPM KC's, 53 CCEM KC's and 2 CCEM SC's.

The tendency to bilateral comparisons is still increasing, because this type of comparison puts a lower workload on the pilot laboratories and at the same time can be completed in a much shorter time. As this tendency is unfavourable for the whole system, this point has been addressed at the last TCEM meeting, and laboratories were asked to avoid bilateral comparisons, if possible.

At the last meeting of the CCEM Working Group on Coordination of the RMOs, a discussion started about the impact of comparison results on the CMC claims of the participating laboratories. Document JCRB-11/7(a) establishes a chain of responsibilities for monitoring the impact of Key Comparisons (KC) and Supplementary Comparisons (SC) on CMC claims:

- 1. The NMI making the CMC claim has primary and principal responsibility.
- 2. Through its Technical Committees/Working Groups, the RMO should monitor the impact of KC and SC results on CMC claims for its member NMIs
- 3. The Consultative Committee Working Groups on CMCs are intended to:
 - provide guidance on the range of CMCs supported by particular key and supplementary comparisons;
 - identify areas where additional KCs and SCs are needed; and
 - coordinate the review of existing CMCs in the context of new results of KCs and SCs.

The CCEM WG RMO discussed at their meeting on 14 March a " Discussion document on Monitoring the Impact of Comparisons on CMCs" as a basis for a more fare-reaching document on this issue. Following this discussion, the CCEM decided to revise its Guidelines on Comparisons. The impact of the comparison results on the CMC claims will no longer be dealt with in the final report but in a separate comparison executive report.

5. Status of EUROMET EM CMC's

In January 2006 the CMC sets of the 4th round (10 countries submitting new and revised CMC's) were posted on the JCRB-website for Inter RMO Review (EUROMET.EM.3.2006). APMP, COOMET, SADCMET and SIM declared their readiness to review these sets. This review lasted until 4 August 2006, when EUROMET.EM.3.2006 was posted for final approval. On 2 November 2006 the CMC sets were published in the BIPM Data Base, two years after the Intra RMO Review has started!



Together with the CMC sets, we submitted an actual QS information of the submitting NMIs. It is not strictly necessary for the CMCs to be accompanied by the QS information when submitted to the Working Groups on CMCs as these working groups do not approve the CMCs for inclusion on the Appendix C of the CIPM-MRA but rather, recommend their acceptance to the RMOs. However, it is advisable that the QS information be included at the time of submission to the Working Groups on CMCs, as this information might be helpful to the reviewers.

At its meeting in October 2006, the TCEM decided to start a new round of CMC review. 15 countries submitted revised and new sets of CMCs with in total 643 CMCs and 59 matrices. The Intra RMO Review for these CMCs started on 9 February with a deadline 6 April.

6. Status of inter-regional review of CMC's

In March 2006, SIM asked for the Inter RMO Review of their CMC set SIM.EM.1.2006 with in total 218 CMC's from Brazil, Panama and the United States. This set was replaced by a revised set (SIM.EM.2.2006) which was submitted in May 2006. The TCEM agreed to do the Inter RMO Review with a due date end of August 2006. The deadline had to be prolonged two times until November 2006, because the communication between our reviewers and the submitting NMIs was very time consuming. In one case we did not receive any answer, so that the corresponding CMCs could not be approved.

In connection with the SIM review, two problems came up which need to be solved in a more general way. In one case, no agreement could be reached, because the uncertainties seemed to be too small. The submitting NMI therefore put the former CMCs in place which had even smaller uncertainties with respect to the submitted CMCs. In another case, no agreement could be reached on the uncertainty of a CMC claim which had been approved in former Inter RMO Reviews by different RMOs, EUROMET included. When we became aware of this, we finally approved this CMC, but we have still doubts about this small uncertainty.

In November 2006 CMCs from Belarus were posted on the JCRB website (COOMET.EM.2.2006). The TCEM agreed to perform the Inter RMO Review until the end of 2006. The revised CMCs were sent to the JCRB before Christmas 2006.

7. Changes in the Classification Scheme for CMCs

Several NMIs asked for slight changes in the classification scheme for CMCs. These changes were discussed at the meetings of the CCEM Working Groups on low and high frequency quantities (WGLF and GT-RF) and finally approved by the CCEM. The following changes were made:

- a new category 2.3 for resistance ratios was installed
- instrument transformers will only be dealt with in categories 8.3.4 (voltage transformers) and 8.6.3 (current transformers) and no longer in categories 5.3 and 6.3
- for calibration factor or effective efficiency (categories 11.1.3 and 11.1.4) the power level will be given as the "min" and "max" value for the measured quantity instead of the value of these quantities themselves.



8. iMERA and EMRP activities

The iMERA Working Group of the TCEM is of the opinion, that also in future the TCs should play an important role in the further development and the handling of the EMRP. It therefore acknowledges explicitly, that the TC structure was maintained in changing from EUROMET to EURAMET.

To meet the tight time schedule for the establishment of a programme of joint research projects intended for ERANET+ funding, the iMERA WG already started its discussion on possible JRPs. The iMERA partners were asked to make proposals for subject areas for which they seek cooperation with other iMERA partners.

Proposals for JRPs were also discussed at the iMERA WG meeting on 13 March in Paris.

Hans Bachmair

Braunschweig, 26 February 2007

Technical Committee Chairman for Electricity and Magnetism