Bureau International des Poids et Mesures

Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV)

Report of the 10th meeting
(25–27 November 2015)
to the International Committee for Weights and Measures

Comité international des poids et mesures

Note:

Following a decision made by the International Committee for Weights and Measures at its 92nd meeting in October 2003, Reports of meetings of Consultative Committees will henceforth be published only on the BIPM website in the form presented here.

Full bilingual printed versions in French and English will no longer appear.

M. Milton,
Director BIPM

LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR ACOUSTICS, ULTRASOUND AND VIBRATION

as of 27 November 2015

President

Dr T. Usuda, member of the International Committee for Weights and Measures

Executive Secretary

Dr S. Picard, International Bureau of Weights and Measures [BIPM], Sèvres.

Members

Central Office of Measures/Glówny Urzad Miar [GUM], Warsaw.

Centro Nacional de Metrología [CENAM], Querétaro.

D.I. Mendeleyev Institute for Metrology [VNIIM], St Petersburg.

Danish Institute of Fundamental Metrology [DFM], Danish Primary Laboratory for Acoustics [DPLA], Naerum.

Instituto Nacional de Metrologia, Normalizaçao e Qualidade Industrial [INMETRO], Rio de Janeiro.

Istituto Nazionale di Ricerca Metrologica [INRIM], Turin.

Korea Research Institute of Standards and Science [KRISS], Daejeon.

Laboratoire National de Métrologie et d'Essais [LNE], Paris.

National Institute of Metrology [NIM], Beijing.

National Institute of Standards and Technology [NIST], Gaithersburg.

National Measurement Institute of Australia [NMIA], Lindfield.

National Metrology Institute of Japan, National Institute of Advanced Industrial Science and Technology [NMIJ/AIST], Tsukuba.

National Metrology Institute of South Africa [NMISA], Pretoria.

National Metrology Institute of Turkey/Ulusal Metroloji Enstitüsü [UME], Gebze-Kocaeli.

National Physical Laboratory [NPL], Teddington.

National Research Council of Canada [NRC], Ottawa.

Physikalisch-Technische Bundesanstalt [PTB], Braunschweig.

The Director of the International Bureau of Weights and Measures [BIPM], Sèvres.

Observers

Agency for Science, Technology and Research [A*STAR], Singapore.

All-Russian Scientific Research Institute of Physical Technical Measurements, Rosstandart [VNIIFTRI], Moscow.

Bulgarian Institute of Metrology [BIM], Sofia.

Bundesamt für Eich- und Vermessungswesen [BEV], Vienna.

Centro Español de Metrología [CEM], Madrid.

Czech Metrological Institute/Český Metrologický Institut [CMI], Brno.

Federal Office of Metrology [METAS], Bern-Wabern.

Instituto Português da Qualidade [IPQ], Caparica.

Institutul National de Metrologie [INM], Bucharest.

International Electrotechnical Commission [IEC], Geneva.

International Organization for Standardization [ISO], Geneva.

Kenya Bureau of Standards [KEBS], Nairobi.

National Physical Laboratory of India [NPLI], New Delhi.

Slovenský Metrologický Ústav/Slovak Institute of Metrology [SMU], Bratislava.

1 OPENING OF THE MEETING

The tenth meeting of the Consultative Committee for Acoustics, Ultrasound and Vibration (CCAUV) was held at the International Bureau of Weights and Measures (BIPM) in Sèvres from 25 to 27 November 2015.

The following were present:

R. Barham (NPL and EURAMET), S. Barrera-Figueroa (DFM), C. Bartoli (LNE), T. Bruns (PTB), W.-H. Cho (KRISS), S. Crocker (NIST), D. Dobrowolska (GUM), S. Dowson (NPL/IEC), G. Durando (INRIM), J.-N. Durocher (LNE), J.S. Echeverría-Villagómez (CENAM), V. Evora (NIST), M. Gaitan (NIST), C. Guglielmone (INRIM), R. Horiuchi (NMIJ/AIST), Y.-T. Kim (KRISS), C. Koch (PTB), J. Kolasa (GUM), H.S. Kwon (KRISS), M.J.T. Milton (Director of the BIPM), R. Nel (NMISA and AFRIMETS), H. Nozato (NMIJ/AIST), G. Ripper (INMETRO), S Robinson (NPL), D. Rodrigues (LNE), E. Sadıkoğlu (UME), E. Sandermann Olsen (BKSV-DPLA), A. Schiavi (INRIM), G. Silva-Pineda (CENAM and SIM), Q. Sun (NIM), T. Usuda (President of the CCAUV), C. Veldman (NMISA), L. Wu (NRC), P. Yang (NIM), A. Yankovsky (VNIIM), B. Zeqiri (NPL).

Observers: S. Cui (A*STAR), A. Enyakov (VNIIFTRI and COOMET), I. Godinho (IPQ), C. Hof (METAS), A.E. Isaev (VNIIFTRI), E. Lumnitzer (SMU, absent), A. Maina (KEBS), M. Nieves Medina (CEM), A. Nikolaenko (VNIIFTRI), P. Rosenkranz (BEV).

Guests: Y.-C. Huang (CMS/ITRI and APMP).

Also present: J. Miles (BIPM), D. Olson (Executive Secretary of the JCRB, NIST/BIPM), G. Panfilo (Incoming Executive Secretary of the CCAUV/BIPM), S. Picard (Outgoing Executive Secretary of the CCAUV/BIPM).

Excused: V. Pozdeeva (BelGIM and COOMET), T.R. Licht (BKSV-DPLA), L. Dickinson (NMIA).

2 WELCOME BY THE PRESIDENT

The President, Dr Usuda, welcomed the members to the meeting.

3 PRESENTATIONS OF SELECTED SCIENTIFIC TOPICS

A special seminar was held at the start of the meeting to celebrate the tenth meeting of the Consultative Committee for Acoustics, Ultrasound and Vibration. This technical session took place before commencing with the agenda for the 10th meeting of the CCAUV, and included a series of

short presentations with selected topical themes. A copy of each presentation is available on the CCAUV website. The presentations were as follows:

- *Introduction: The footsteps from the first to 10th CCAUV meetings and the future activities.*

  Takashi Usuda, CCAUV President, NMIJ (Japan). Document CCAUV/15-40.

- *Pressure calibration of microphones using calculable pistonphones*.

  Richard Barham, NPL (UK). Document CCAUV/15-42.

- *Heat conduction correction in reciprocity calibration of microphones, ambiguities and recent findings.*

  Erling Sandermann Olsen, BKSV (Denmark). Document CCAUV/15-41.

- *Using the water tank transfer function to suppress the reverb distortion of signal during calibration of underwater receiver.*

  A.E. Isaev, FSUE VNIIFTRI (Russia). Document CCAUV/15-43.

- *Characteristics of Sounds Emitted During High Resolution Marine Geophysical Surveys*.

  Steven E. Crocker, NIST-USRD (USA). Document CCAUV/15-44.

- *Investigation of equivalency between dynamic and static acceleration calibrations*.

  Hideaki Nozato, NMIJ (Japan). Document CCAUV/15-45.

- *Report on Recent Research Activities of KRISS*.

  Wan-Ho Cho, KRISS (Republic of Korea). Document CCAUV/15-46.

- *Environmental conditions during key comparison transportation*.

  Julian Haller and Christian Koch, PTB (Germany). Document CCAUV/15-47.

4 WELCOME BY THE BIPM DIRECTOR

The Director of the BIPM, Dr Milton, welcomed the delegates to the 10th meeting of the CCAUV. He also welcomed Dr Usuda, the new President of the CCAUV, and thanked the departing Executive Secretary, Dr Picard, who is taking over responsibility for the KCDB. The new Executive Secretary of the CCAUV will be Dr Panfilo.

Dr Milton updated the meeting on new developments in the CIPM and BIPM.

There are seven new members of the CIPM and new Presidents have been appointed to several Consultative Committees, including the CCAUV. Revision of the CIPM MRA is under way and is on the agenda later in the meeting.

A new RMO has been established and provisionally recognised. GULFMET brings together the National Metrology Institutes (NMIs) of the United Arab Emirates, Kingdom of Bahrain, Kingdom of Saudi Arabia, Sultanate of Oman, State of Qatar, State of Kuwait and the Republic of Yemen.

Dr Milton noted that the theme for World Metrology Day 2015 was the "international year of light", and that the theme in 2016 will be "metrology in a dynamic world".

The BIPM is undertaking a significant amount of work to improve its website. CCAUV members were encouraged to seek detailed information about the activities of the BIPM from this source.

There has been a proposal for the BIPM to expand its work to provide assistance to Member States and Associates with emerging metrology systems. This involves the BIPM Capacity Building and Knowledge Transfer Programme (CB&KT), which will provide training in international metrology for individual NMI staff, NMIs and RMOs to increase their understanding and capability with regard to engagement in the world metrology system, with the aim of strengthening the capacity of the international metrology community to operate the world-wide measurement system on an equitable cost-shared basis. There is a project within the CB&KT for "Metrology for Safe Food and Feed in Developing Economies".

Finally, plans for the revised SI to be implemented in 2018 are making progress. It is anticipated that the revisions will be adopted at the 26th CGPM in November 2018. Measurements of the Planck and Boltzmann constants are now sufficiently accurate to advance the process towards the revised SI.

5 APPOINTMENT OF A RAPPORTEUR

Dr Barham and Mr Robinson from NPL were proposed as the Rapporteurs. This was approved by the meeting.

6 APPROVAL OF THE AGENDA

Dr Usuda suggested adding an extra item to the agenda in section 9 on the revised SI Brochure.

The agenda was approved with the extra item added.

7 REPORT OF THE 9TH MEETING OF CCAUV, 2013

The essential actions and decisions arising from the 9th meeting of the CCAUV 2013 are summarized below. Dr Picard went through these for the benefit of the meeting. All actions and decisions had been completed.

Actions

CCAUV9/A1 To provide contributions for a poster on the CCAUV to be presented at the next CGPM in November 2014, including photographs, drawings, examples of impact, or other material.

CCAUV9/A2 The KCWG and the SPWG will continue working as two separate working groups. An occasion for a joint meeting should be managed and good communication between both groups should be encouraged and ensured.

CCAUV9/A3 Terms of Reference on a review of the CIPM MRA are expected to be drafted by the CIPM at the end of 2013. Once issued, these will be communicated to the CCAUV for comments and discussion.

Decisions

CCAUV9/D1 The explicit calculation of bilateral Degrees of Equivalence (DoE) in future Key Comparison reports is, from now on, voluntary. However, it is mandatory to give the equations and other necessary information so that the bilateral DoEs may be calculated. This also holds for RMO comparisons.

CCAUV9/D2 Thomas Bruns stepped down as the chairman of the Key Comparison Working Group (KCWG). Gustavo Ripper will now chair the KCWG.

CCAUV9/D3 The Draft B report of CCAUV.A-K5 should present data in the traditional way by giving discrete data. The method of using reference curves will be discussed within the community on a broader basis.

CCAUV9/D4 The Final report of CCAUV.U-K3 is awaiting approval from the KCWG. It will be sent to the CCAUV for formal approval before the 28 November 2013.

CCAUV9/D5 The INRIM is volunteering as the second linking participant for the planned CCAUV.U-K3.1 comparison.

CCAUV9/D6 The commencement of key comparison (KC) CCAUV.V-K3 was formally agreed.

CCAUV9/D7 The commencement of KC CCAUV.U-K4 was formally agreed.

CCAUV9/D8 The preparation of KC CCAUV.W-K2 was agreed. A questionnaire will be sent to potential participants during 2014.

CCAUV9/D9 The CCAUV supports observer status at the CCAUV to the Kenyan Bureau of Standards (KEBS), and a recommendation will be addressed to the CIPM before the end of 2013.

CCAUV9/D10 The next meeting of the CCAUV is provisionally scheduled for October 2015.

Dr Picard noted that the report of the 9th meeting of the CCAUV, held in 2013, had been circulated to CCAUV. There being no further comments, the report was confirmed and Dr Picard thanked Dr Koch and Dr Scott for their efforts as Rapporteurs for the last meeting.

8 CIPM MRA REVISION

8.1 Feedback from NMI Directors Meeting of October 2015

Dr Usuda pointed out that the material submitted during the CIPM MRA review is available on the BIPM website, including material from other CCs. The MRA workshop took place on 13–14 October 2015. Dr Usuda provided a short review of the operation and implementation of the MRA. The MRA participants include institutes from 57 Member States and 40 Associates. As of 5 October 2015, there were 1 356 comparisons in the KCDB (918 key comparisons, and 438 supplementary comparisons). More than 24 000 CMC entries are registered, with EURAMET having the largest number of CMCs. A total of 54 % of key comparisons are in the fields of electromagnetism, ionizing radiation and chemistry (and 59 % of CMCs). The totals for AUV are not that high compared to other CCs. The rate of growth of comparisons and CMCs is constant or slightly decreasing. The piloting of comparisons is shared reasonably evenly between the RMOs.

8.2 CCAUV implications

Dr Usuda raised the discussion points generated by the MRA review that were relevant to the CCAUV:

- More effective management of KCs;
- Better visibility of services supported by CMCs;
- More efficient review process for CMCs;
- Support for States with developing metrology systems;
- Governance changes to the MRA through the JCRB and CIPM to enable more effective and timely operation.

Dr Usuda requested comments from the CCAUV, and a discussion ensued. Dr Bruns raised the issue of more even distribution of pilot laboratory responsibility. Although in general this is good development, it must not be allowed to degrade uncertainty and performance.

The issue of resourcing of KCs was raised and the accuracy of the high resourcing values that had been quoted for CCAUV.A-K3 (for pressure calibration of laboratory standard microphones type LS2P) was questioned. However, it was agreed that in general the CCAUV does not expend excessive resources compared to other CCs. Dr Milton said that a study has been made of the resourcing spent on KCs: this shows a wide variation but also that piloting does not in general take as long as perceived.

Regarding visibility of services, Dr Gaitan stated that NIST has carried out a survey of customers in the area of acceleration and vibration. Many customers require traceability for legal or regulatory reasons. The general view of the meeting was that although traceability to national (or international) standards is reasonably well understood and valued, the underpinning work to support the CIPM MRA and mutual equivalence is less well understood and valued. In particular, it was felt that accredited laboratories do not always appreciate the significance of the MRA and more education may be required. This could be done though the International Laboratory Accreditation Cooperation (ILAC) where traceability is requested, but the need for the national standards (from which

traceability is drawn) to be underpinned by the MRA (and CMCs and KCs) is a message that is not reinforced.

Dr Usuda requested that CCAUV members send him their opinions for consideration before the meeting of the 'Working Group on the Implementation and Operation of the CIPM MRA' to be held in March 2016. He will circulate a questionnaire to members.

Later in the meeting (Friday morning), Dr Usuda presented a draft questionnaire to the meeting. Key questions are concerned with which stakeholders value the CIPM MRA and refer to it. The questionnaire requests NMIs to obtain feedback from stakeholders, and seeks opinions on how to extend dialogue with important stakeholders, and how to reduce the workload caused by the CIPM MRA.

Dr Usuda will circulate and ask for feedback by the end of January 2016. NMIs will make suggestions for stakeholder engagement in their replies to the questionnaire before the deadline.

Some delegates expressed concern that the underpinning work and infrastructure of the MRA is not always visible to end users and some stakeholders may appreciate the value of having the metrology infrastructure in place without wanting or needing to know about the details. However, Dr Usuda pointed out that the CCAUV must make efforts to increase stakeholder engagement.

Suggestions for stakeholders that could be approached were industrial groups, regulators, standards bodies, accredited laboratories and ILAC.

8.3 KCDB revisions

Dr Picard reported on KCDB entries and the number of KCs and CMCs. The number of KCs is gradually increasing and CMC numbers are stable.

The KCDB is to be revised, based on input from the CCs. Suggestions include better search capability with a more flexible system and an improved graphic user interface (GUI). If a minimum investment is made, this would involve just a modest change to the GUI of the existing system. A more radical approach is to modernize the software with an improved web platform which could save time, avoid errors and improve data integrity. Options/benefits might include remote hosting, better web visibility, open data smartphone and tablet applications.

The 'Working Group on the Implementation and Operation of the CIPM MRA' meets in March 2016 and the deadline is to have outline Terms of Reference for the CIPM MRA by October/November 2016. Comments from CCAUV members are welcome.

9 REVISION OF THE GUM

Since Dr Harris (NPL) reported on the GUM revision at the last CCAUV, the first committee draft (CD) version was circulated and received more than 1000 comments. These will be considered by the JCRB, and in the meantime, the current GUM continues to be valid.

9.1 SI Brochure update

This is currently under revision. No changes are planned to the description of decibel or neper (relevant to AUV). All NMIs will get an opportunity to comment on the new version.

10 REPORT FROM THE WORKING GROUP ON STRATEGIC PLANNING (CCAUV-SPWG)

Dr Gaitan reported on the meeting of the SPWG which was held on 24 November 2015. At the meeting, there were presentations by Mr Barham (Airborne Acoustics), Dr Gaitan (Vibration), Dr Zeqiri (Ultrasound) and Mr Robinson (Underwater Acoustics).

Regarding growing issues and drivers of future work, for airborne sound, these included airborne ultrasound (its measurement and concerns about public exposure). Technical developments include optical methods for acoustics and new heat conduction corrections for low-frequency coupler calibrations.

The drivers of future metrology needs in the field of ultrasound include HIFU/HITU therapy, quantitative imaging, ultrasound elastography and the need for standards to cover applications at ever higher frequencies.

Drivers in vibration metrology include: extending the range of sinusoidal frequency calibration (50 kHz) to include phase; MEMS which use gravimetric-based measurements; new optical-based self-calibrating transducers; how to interface with dynamic pressure and force; and how to provide standards for high accelerations for the measurement of shock.

In underwater acoustics: drivers from regulation are increasing demand for absolute measurements, but traceability is weak at low frequencies (20 Hz – 1 kHz) whereas demand is highest. This highlights the need for a low-frequency key comparison in the next five years. Optical methods will become more commonly adopted for high frequencies, and new measurands such as sound-particle velocity will be required.

Dr Usuda raised the issue of the ToR for the SPWG, which had been discussed at the SPWG meeting (CCAUV/15-24). No major changes were made at the meeting, but Dr Usuda suggested that the last item (materials metrology) be deleted.

A discussion of membership criteria took place. Some modifications were suggested, but the SPWG membership will continue to be listed in terms of institutions rather than individuals.

A written report is available on the CCAUV webpages (CCAUV/15-29).

11 REPORT FROM THE WORKING GROUP ON KEY COMPARISONS (CCAUV-KCWG)

Dr Ripper reported on the meeting of the KCWG, which was held on 24 November 2015.

The guidelines for membership and ToR were reviewed in the meeting. Dr Ripper showed a list of current members; there are no current members with expertise in ultrasound or underwater acoustics, but extra experts are co-opted as a “Review Board” to act in this capacity.

Tasks of the KCWG include:

- Identify the need and feasibility of CCAUV key comparisons and supplementary comparisons
- Review (and approve) technical protocols for all comparisons that are intended to be used for the subsequent support of CMC claims (CIPM-KC, RMO-KC, Suppl.)
- Give advice on the analysis of KCs, calculation of KC-RVs, Linking procedures
- Review and comment on Draft B reports prior to submission and approval by the CCAUV
- Provide input to the SPWG on matters of KCs
- Give advice in cases of disagreement during comparisons.

In the last two years, four key comparisons were published in *Metrologia* and seven RMO comparisons were published. Four CCAUV KCs, eleven RMO comparisons and two pilot studies are currently in progress.

The work of the WG is efficient: a Technical Protocol takes two weeks for approval and a Draft B report takes 4 weeks. Authorship of Draft B reports will now include representatives of all participants.

There have been examples where comparisons have seen a change of status. EURAMET.AUV.V-S1 has moved from a supplementary comparison to a pilot study. Three SCs have been upgraded to KCs.

Three low-frequency vibration comparisons will be linked to CCAUV.V-K3.

There are a number of RMO comparisons that are a mixture of supplementary and key comparisons; the solution is to identify in the Technical Protocol what part of the comparison will be the key comparison, to which CIPM key comparison part it will be linked, and by which participants.

Consequences of the CIPM MRA revision:

- Naming of comparisons – repeat comparisons should be indicated by date in the name, although the CCAUV will not change its naming policy immediately.
- Validity – a decision on how long a KC is valid has been postponed for further consideration.
- Archives – transfer older KCs to the archive on the KCDB.
- Uncertainty budgets of participants should include all influences in their own budgets including influences of the device under test (e.g. from environmental variation).
- Better guidance provided on how to deal with correlation and MOCS (MOst Consistent Subset) and non-MOCS (outliers) in the KC analysis.
- Linking – RMO KCs must be linked to CCAUV KC – best to use two links.

The status of non-DI participation in comparisons was discussed. In general, it is a national decision. This may be acceptable for when a participating institute wants to become a DI, but still needs national support. It would be unlikely to be regarded as acceptable if the institute is not interested in fulfilling the responsibilities of a DI (providing traceable standards, etc.). Dr Milton stated that it is difficult to have rigid rules because there are CCs where the participation of non-NMI/DIs is allowed because of the high capability of the institute in question.

The use of templates and tools (spreadsheets) will be considered for harmonization of procedures for analysis and reporting.

A proposal was made for a KC on low-intensity shock calibration and a new KC to repeat CCAUV.V-K2 was proposed (see 12.2 below).

Dr Usuda initiated a discussion on KCWG membership. The KCWG keeps nominated individuals and maintains the members with "special skills" (e.g. mathematics). A written report from the KCWG is available on the CCAUV webpages (CCAUV/15-31).

12 CCAUV KEY COMPARISONS

12.1 Comparisons and reports in progress

12.1.1 CCAUV.U-K3.1

Dr Koch (PTB) reported on progress with the key comparison on ultrasound power which includes discrepant laboratories from CCAUV.U-K3 and which allows some extra laboratories to take part. Participants are INMETRO, KRISS, NMC A*STAR and PTB. However NMC A*STAR withdrew and INRIM provided an extra linking partner. Two laboratories had discrepant values: these will be addressed by RMO level comparisons.

All measurements have been completed, the Draft A report has been approved, and PTB (pilot laboratory) will submit the Draft B report to the KCWG in December 2015.

12.1.2 CCAUV.U-K4

Dr Zeqiri (NPL) reported on the status of CCAUV.U-K4, a comparison of calibrations of miniature ultrasonic hydrophones in the frequency range 0.5 MHz to 20 MHz. This has reached Draft A status and the comparison should be finalized by the end of 2015. Participants are: NPL (pilot), INMETRO, NIM, NMIJ and PTB.

12.1.3 CCAUV.V-K3

Dr Qiao Sun (NIM) presented progress with CCAUV.V-K3, a comparison of standards for low-frequency vibration in the frequency range 0.1 Hz – 40 Hz. The comparison has 14 participants and a Draft A report is in preparation.

12.1.4 CCAUV.W-K2

Mr Robinson (NPL) reported on progress with CCAUV.W-K2. The comparison has recently started in earnest with the Technical Protocol agreed, pilot lab calibrations have been completed and the hydrophones now being calibrated by the second participant. There are seven participants – NPL (pilot), INMETRO, KRISS, NIM-HAARI, NIST (USRD), TUBITAK-MAM and VNIIFTRI.

Mr Robinson raised the issue of the participation of laboratories that do not have NMI or DI status and reference was made to the earlier discussion (see section 11). Several laboratories are currently

applying for NMI status, and institutes from India and Italy might achieve DI status within the lifetime of the comparison and be able to join.

12.2 Future comparison proposals

12.2.1 CCAUV.V-K4

The proposal is for a primary shock comparison, proposed by Dr Sun (NIM). The comparison would use laser interferometry. An APMP pilot comparison in shock has been carried out and a report published. The meeting discussed Dr Sun's proposal to determine if there were interested NMIs. Those expressing an interest included CENAM, CMS, INMETRO, INRIM, KRISS, NIM, NMIJ, PTB and VNIIM (and possibly DFM, NMISA and NRC).

12.2.2 REPEAT OF CCAUV.V-K2 (WILL LIKELY BE DESIGNATED CCAUV.V-K5)

This proposal was raised in the KCWG meeting, and discussed under agenda item 11. However, the details are most appropriately included here. It was agreed that a new KC repeating (and perhaps expanding) the scope of CCAUV.V-K2 is required. PTB agreed to be the pilot laboratory. Potential participants include: A*STAR, BKSV, CEM, CENAM, GUM, INMETRO, IPQ, LNE, METAS, NIM, NIST, NMIJ, NMISA and VNIIM. The final participation will be agreed before the next meeting of the CCAUV.

12.2.3 FUTURE COMPARISONS FOR MICROPHONES

Dr Barham suggested that the next low-frequency pressure comparison should possibly be in two years' time when the heat conduction model underpinning low-frequency calibration is better established. This means that the comparison could start after the next CCAUV meeting.

Dr Barham suggested that a repeat comparison of free-field calibration of microphones is becoming due, but a preliminary pilot study could be carried out, with NPL and DFM evaluating new optical methods and DFM and NMIJ considering extended high-frequency calibration. Such a pilot study might be completed before the next CCAUV meeting. The new KC could then consider (i) comparing reciprocity and optics at 1 kHz to 20 kHz and (ii) free-field reciprocity calibration at 20 kHz to 100 kHz.

The NPL agreed to prepare an outline for a new pilot study on the field calibration of microphones, considering both reciprocity and optical calibration techniques, and extended high-frequency calibration in a separate study.

13 REGIONAL METROLOGY ORGANIZATIONS

13.1 Report from the Working Group for RMO Coordination (CCAUV-RMOWG)

Mr Veldman reported that the RMO Chairs and other members of the RMOWG met on 27 November 2015. The RMOWG chair is to be rotated among RMOs every 4 years. (The new chair, Dr Sun, will start after the end of the CCAUV and the current chair, Mr Veldman, will maintain the vice chair position).

Service categories:

> There has been long process of change. Revisions have now been implemented, and fine adjustments will be made and circulated to the RMOWG.

Service categories for auxiliary equipment:

> It is agreed that these are needed to support the CIPM MRA, but it is best to keep service descriptions to a minimum, limited to services for which discrete certificates are issued.

Adoption of ISO 266 frequencies:

> These are not mandatory but should be used where appropriate (e.g. in KCs).

Matrix presentation of CMCs was considered:

> The problem here is that frequency is usually the only independent parameter. The CCAUV is satisfied with current situation.

A discussion of membership criteria took place. Some modifications were suggested on the chairpersonship role – it should rotate on an alphabetical basis amongst the RMOs.

A written report is available on the CCAUV webpages (CCAUV/15-30).

13.2 JCRB matters

The update was provided by Dr Douglas Olsen, the JCRB Executive Secretary.

Since the previous meeting of the CCAUV (2013), the JCRB has held meetings in March 2014, March 2015 and September 2015.

He noted that there was a total number of 24 183 CMCs (Physical: 18 280 and Chemical: 5903) Total CMCs for AUV stood at 1187.

There were 922 key comparisons (AUV: 44) and 421 supplementary comparisons (AUV: 13). A total of 10 % of Comparisons are more than 5 years old without completion (the figure is 6 % for AUV).

In terms of the JCRB CMC review process, it was noted that RMOs have indicated a willingness to review in 3 weeks, median for time from submission to publications is about 120 days; generally, the step taking the longest is the re-submission of revised CMCs.

It was noted that RMOs must pay attention to deadlines or they may suffer "loss of rights" for review later in the process. AUV is an area where this occurs more than average (APMP, COOMET and SIM have got worse in this respect but AFRIMETS and EURAMET have improved).

Recent resolutions of the JCRB:

Resolution 34/1: reports of Comparisons should include results of all participants including non-NMIs and DIs, but only the NMIs and DIs are to be used in KCRV and DoEs.

GULFMET has been granted provisional status as a RMO. Provisional status means that it can participate in JCRB meetings, but with no voting rights.

Since the last CCAUV in 2013, seven new CMCs have been published (one by COOMET, five by EURAMET and one by SIM).

During discussions, Dr Usuda reiterated to RMOs and TC chairs that the deadlines for CMC review must be met if "loss of rights" are not to be incurred. He added that it would be good to see some improvement in the statistics for AUV. Dr Milton mentioned the relevant page on the BIPM website that can be used to view the current CMCs under revision.

The document is available on the CCAUV webpages (CCAUV/15-51).

13.3 Report from Regional Metrology Organizations

13.3.1 SIM

Dr Silva Pineda, chairperson of the TC-AUV of SIM, reported on the activities of SIM, which is active in all fields of AUV. A number of projects, comparisons and collaborations are in progress. There are now seven participating NMIs in SIM: CENAM (Mexico), INDECOPI (Peru), INMETRO (Brazil), INM (Colombia), INTI (Argentina), NIST (USA) and NRC (Canada).

A written report is available on the CCAUV webpages (CCAUV/15-32).

13.3.2 AFRIMETS

Mr Riaan Nel (NMISA) and chair of AFRIMETS's TC-AUV Working Group presented progress within AFRIMETS. Three NMIs are active: KEBS, Kenya (acoustics and vibration), NIS, Egypt (acoustics), and NMISA, South Africa (acoustics and vibration). There have been no new CMCs published in the KCDB since last CCAUV meeting. KEBS has new CMCs currently at the intra-RMO review stage, and NMISA have new and improved CMCs to be submitted in the near future for acoustics and vibration. There is growing interest in artificial ear calibration, and in ultrasound and underwater acoustics capabilities.

A written report (CCAUV/15-34) and the presentation (CCAUV/15-35) are available on the CCAUV webpages.

13.3.3 APMP

Mr Huang (CMS/ITRI), chairperson of the APMP TC-AUV, reported on the APMP, highlighting activity in a variety of key comparisons. A total of 12 countries are active: NMIA (Australia), NIM (China), CMS (Chinese Taipei), Hong Kong (SCL), India (NPLI), Indonesia (KIM-LIPI), Japan

(NMIJ), Republic of Korea (KRISS), Malaysia (NML-SIRIM), Thailand (NIMT), Singapore (A*STAR) and Viet Nam (VMI).

The APMP TC-AUV anticipates several major challenges in AUV: in health for diagnostics, therapy and hearing assessment (acoustics and ultrasound); in industry for the automotive, aerospace and manufacturing sectors (vibration and acoustics); and environment in the areas of airborne noise, marine noise pollution and earthquake monitoring (acoustics, underwater and vibration).

APMP TC-AUV held a workshop in 2015 in Changsha (China) on acoustics and ultrasound metrology for health and medical related applications, involving eight NMIs and including a technical visit and hands-on training. The APMP task Force has five focus groups on: Energy Efficiency, Medical Diagnostic, Equipment, Climate Change, Food Safety and Clean Water.

The presentation is available on the CCAUV webpages (CCAUV/15-33).

13.3.4 COOMET

Dr Enyakov presented progress within COOMET on behalf of Valentina Pozdeeva. The NMIs from 15 COOMET member countries are represented in AUV. There are nine NMIs, (Azerbaijan, Armenia, Belarus, Georgia, Cuba, Moldova, Russia, Uzbekistan and Ukraine) that submit their AUV CMCs via COOMET, and six NMIs (Bulgaria, Germany, Lithuania, Slovakia, Romania and KDPR) that do this through other RMOs. Only three countries: Belarus, Russia and Ukraine have published their CMCs in AUV until now. COOMET NMIs have participated in 14 CCAUV key comparisons, and there have been six COOMET comparisons and two pilot studies.

The recent 10th meeting of COOMET TC (22-23 September 2015, Moscow, Russia) agreed to provide guidance and consulting assistance for NMIs from Azerbaijan, Moldova and Uzbekistan to facilitate the development of improved metrological capabilities in the above countries.

A written report is available on the CCAUV webpages (CCAUV/15-37).

13.3.5 EURAMET

The report was presented by Dr Barham, Chair of TC-AUV. Three Sub-Committees (SCs) are organized under the EURAMET TC covering three technical areas: SC-A “Sound in Air”, SC-U “Ultrasound and Underwater Acoustics”, and SC-V “Vibration and Acceleration”. There are 26 members of EURAMET TC-AUV, and 21 NMIs and DIs have a total of 559 CMC entries approved and published on the BIPM KCDB.

Recent EURAMET projects include “Bilateral comparison in hydrophone calibration up to 50 MHz”, and “Reference data for pressure reciprocity calibration according to the standard IEC 61094-2:2009”. TC-AUV participates actively in the European Metrology Research Programme (EMRP). A number of Joint Research Projects (JRP) came out of the 2010 call: two from the 2011 call and a currently active JRP from the 2012 call. The last EMRP call was in 2013, and the programme has been superseded by the European Metrology Programme for Innovation and Research (EMPIR). Calls in 2015 focused on Health (on which much AUV activity is closely connected), the SI and Research Potential. Three joint research proposals in the Health call and one in the Research Potential call will be assessed for funding at the EMPIR review conference in November 2015.

EURAMET has been developing a Strategic Research Agenda to steer research within EURAMET generally. All TCs have been active in providing input in terms of priorities in the development of

the SI and contributions to the so-called 'Grand Challenges' in health, the environment and energy. The output from the exercise to review and revise the TC-AUV roadmaps in 2012 was used as the basis for developing the strategic priorities for TC-AUV in the 'Grand Challenge' and thematic areas of EMPIR.

The TCAUV and the three Sub-Committees meet typically on a yearly basis. The 2015 meetings were held at GUM (Poland) on 18-19 February 2015, and the 2016 meeting will take place at DFM (Denmark) on 24-25 February.

A written report is available on the CCAUV webpages (CCAUV/15-17).

13.4 Regional key comparisons and links to CCAUV comparisons: published, in progress or proposed

A total of seven RMO comparisons have been published. Three specific comparisons were described at the meeting:

- Dr Dobrowolska reported on COOMET.AUV.A.K5 (Poland and Ukraine).
- Dr Yankovsky reported on COOMET.AUV.V-K1.
- Mr Barham reported on EURAMET.AUV.A-K5 (12 participants – NPL pilot).

A full list is provided on the BIPM key comparison database.

13.5 Regional supplementary comparisons: published, in progress or proposed

A final report on AFRIMETS.AUV.A-S1 was approved with editorial comments. The final report will now be prepared for publication.

A short status report on EURAMET.AUV.A-S2 was provided. Unfortunately the reference microphones have been detained in customs in Brazil, which could risk their stability.

APMP proposed a new comparison on ultrasonic power (see CCAUV/15-06). It was undecided if this will be a KC linking to CCAUV.U-K3.1, or whether it is more a test of the equipment and capability. A decision will be made before registering the project. In preparation, reference standards have been prepared by NIM. NMIJ, NMIT and potentially NIST are likely to participate.

14 CCAUV MEMBERSHIP

14.1 Criteria for membership

Dr Usuda noted that the membership criteria are fully described in a document on the BIPM website (http://www.bipm.org/en/committees/cc/cc-criteria.html).

Membership criteria are currently under review by the CIPM.

14.2 Proposals for new members and observers

METAS is applying for full membership of the CCAUV. In support of this, Dr Hof presented the work of METAS (a full description is provided in the document CCAUV/15-14).

CMS-ITRI is applying for observer status of the CCAUV and Mr Huang gave a presentation of its work (a full description is provided in the document CCAUV/15-11).

In a closed meeting (without observers and guests), the applications were discussed. A number of CCAUV delegates spoke in support of both applications and it was unanimously agreed to recommend both applications to the CIPM. The process will now proceed to the CIPM for approval.

15 REPORTS FROM INTERNATIONAL OBSERVERS

15.1 International Electrotechnical Commission, TC 29

Mrs Dowson presented the update of activities in IEC TC29. The Technical Committee IEC/TC29: Electroacoustic was established in 1953 and the current scope is: "To prepare International Standards related to instrumentation and methods of measurement in the field of electroacoustics". IEC/TC29 currently has the following Working Groups and Maintenance Teams: MT 4 Sound-level meters; WG 5 Measurement microphones; WG 10 Audiometric equipment; WG 13 Hearing aids; MT 17 Sound calibrators; MT 18 Amendments of relevant IEC/TC29 standards with respect to developments on EMC; MT 19 Filters - Revision of IEC 61260:1995 Octave-band and fractional-octave-band filters; MT 20 Revision of IEC 60118-4, Induction loop systems; WG 21 Head and ear simulators; WG 22 Audio-frequency induction-loop systems and equipment for assisted hearing; MT 23 Revision of IEC 61265:1995 - Instruments for measurement of aircraft noise.

IEC/TC29 held its last Plenary session, together with meetings of its Working Groups and Maintenance Teams at the *Association Française de Normalisation* (AFNOR), in Paris on 16-20 November 2015. Eleven documents have been published since the last meeting of the CCAUV, and a further nine documents have been issued for review, comment and vote, where appropriate, by National Committees.

A written report is available on the CCAUV webpages (CCAUV/15-56).

15.2 International Electrotechnical Commission, TC 87

Mr Robinson gave an update of IEC TC87. There are eight active Working Groups: WG 3 High power transducers; WG 6 High Intensity Therapeutic Ultrasound (HITU) and Focusing transducers; WG 7 Ultrasonic surgical equipment; WG 8 Ultrasonic field measurement; WG 9 Pulse-echo diagnostic equipment; WG 13 Terminology; WG 14 Determination of ultrasound exposure parameters; WG 15 Underwater Acoustics. The last meeting of IEC/TC87 was held at the NPL (UK) in March 2015. Since the last CCAUV meeting, Switzerland, Denmark and Norway have moved from P member to O member status; Strategic Business Plan (SBP) SMB/4407/R. TC87 has been confirmed; a new Chairman is being elected in late 2015; a survey was undertaken to address

potential future activities for TC 87 to undertake - an *ad hoc* group will consider it further and report to TC 87 in due course; Interim WG meetings were held in Washington (USA) in December 2015. The next meeting will be held in Japan in September 2016.

A written report is available on the CCAUV webpages (CCAUV/15-19).

Mr Robinson gave a brief description of the activities of IEC TC114 which covers "Marine Renewable Energy Devices". A standard is being developed for measurement of radiated acoustic noise from wave and tidal stream energy devices: IEC 62600-40 Marine energy – Wave, tidal and other water current converters – Part 40: Acoustic characterization of marine energy converters.

15.3 International Organization for Standardization, TC 43 SC3

Mr Robinson described the recent work of ISO TC43 SC3 "Underwater Acoustics". ISO TC43 SC3 met for the third time at TNO in Delft (Netherlands) in June 2014, and for the fifth time at University of Washington in Seattle (USA) in June 2015. TC43 SC3 now consists of four Working Groups. WG1 covers the measurement of noise from ships and has already published ISO PAS 17028 (essentially the same method as ANSI S12.64). The new standard, ISO 17208-1: "Quantities and procedures for description and measurement of underwater sound from ships – part 1: Requirements for deep water measurements used for comparison purposes" has reached the FDIS stage and should be published in early 2016. ISO 17208-2: "Quantities and procedures for description and measurement of underwater sound from ships – Part 2: Determination of source levels in deep and shallow water" is at the CD stage. WG2 covers underwater acoustic terminology and ISO 18405 - "Terminology for underwater acoustics" will soon be at the second DIS stage (for ballot in early 2016); WG3 covers measurement of noise radiated by marine pile driving and ISO 18406: "Measurement of radiated underwater sound from percussive pile driving" has reached the DIS stage with the ballot to be completed by early 2016; WG4 is at an early stage working on ISO 20073: "Standard-target method of calibrating active sonars for backscattering measurement". A key future work item is a standard on measurement of ambient underwater noise. The next meeting is scheduled to be held in London in June 2016. Participating countries are: Australia, Canada, Denmark, Germany, Italy, Japan, Netherlands, Norway, Russian Federation, United Kingdom, and USA. The secretariat is held by ANSI (USA).

A written report is available on the CCAUV webpages (CCAUV/15-18).

15.4 International Organization for Standardization, TC 108

Mr Veldman reported on progress within ISO TC108. The 33rd Meeting of ISO/TC108 "Mechanical vibration, shock and condition monitoring" took place in March 2015 in Paris, France. The meetings were hosted by the *Association Française de Normalisation* (AFNOR). The committee approved the extension of the chairmanship of Mr Torben Licht for another 3 year period.

Various sub committees (SC) and working groups (WG) met during this period, with the work programme of the SC 3/WG 6 "Use and calibration of vibration and shock measuring instruments" being the most relevant to the CCAUV.

Numerous standards are in preparation or are being maintained.

A written report is available on the CCAUV webpages (CCAUV/15-04).

16 REPORTS FROM INTERNATIONAL MEETINGS

16.1 IMEKO TC 22 activities

Dr Ripper reported on the IMEKO TC22 conference in Prague (Czech Republic) in September 2015.

The next meeting will be held in Finland in 2017. The next IMEKO World Congress will be held in Belfast in 2018.

17 PUBLICATIONS

There will be a special issue of *Metrologia* on dynamic measurement. The title will be "Measurements in a Dynamic World". Dr Usuda suggested some possible topics including CCAUV strategy and a paper from the EMRP IND09.

Dr Miles (who joined the meeting on Friday morning) stated that special issues (termed "focus issues") can be "virtual" so that they are gathered together electronically on the *Metrologia* website, even though they are submitted at different times.

18 RECOMMENDATIONS TO THE INTERNATIONAL COMMITTEE FOR WEIGHTS AND MEASURES (CIPM)

The recommendations concerning the application from METAS for full membership of CCAUV and CMS-ITRI for observer status of the CCAUV will be made to the CIPM.

19 OTHER ITEMS

19.1 CCAUV webpages and links

Mr Robinson noted that the section of the BIPM website on units in AUV is in need of modification because it contains a number errors and misleading statements. Mr Robinson offered to draft some replacement text with the help of Dr Bruns.

20 DATE OF NEXT MEETING

The following were the suggested dates for 11th meeting of CCAUV: 19-22 September 2017. The WG meetings and Workshops would be held on 19-20 September, and the CCAUV on 21-22 September.

The meeting closed at 12:15 on 27 November 2015.

Richard Barham, *Rapporteur*

Stephen Robinson, *Rapporteur*

Appendix 1

Working documents submitted to the CCAUV at its 10th meeting

Below all the working documents submitted to the CCAUV at its 10th meeting are listed.

Document CCAUV/	
15-01	CCAUV Draft Agenda 2015, T. Usuda
15-02	ISO Frequencies, I. Veldman
15-03	Actions and Decisions 2013, CCAUV
15-04	ISO/TC 108 and ISO TC 108/SC 3 LIAISONE to the CCAUV, I. Veldman
15-05	Status Report PTB, C. Koch *et al*.
15-06	Short report on CCAUV.V-K3 and Proposal for CCAUV.V-K4, Q. Sun
15-07	Final Report on AFRIMETS.AUV.A-S1, R. Nel
15-08	Status Report NMISA, I. Veldman
15-09	Summary of CCAUV comparisons, G. Ripper
15-10	IEC TC29 Report to the CCAUV, S. Dowson
15-11	Support to request of observership for Chinese Taipei, Y. C. Huang
15-12	Celebrative seminar at the occasion of the 10th Meeting of the CCAUV, T. Usuda
15-14	Support to request of membership for METAS, C. Hof
15-15	Status Report NPL, B. Zeqiri
15-16	Status Report NMIJ/AIST, R. Horiuchi
15-17	RMO Report: EURAMET, R. Barham
15-18	ISO TC43 SC3 Report to the CCAUV, S. Robinson
15-19	IEC TC87 Report to the CCAUV, B. Zeqiri and S Robinson
15-20	Status Report NMIA, L. Dickinson
15-21	Status Report NIM, Y. Ping *et al*.
15-22	Status Report INRiM, C. Guglielmone *et al*.
15-23	Status report USRD/NIST - Underwater Acoustic Metrology, S. Crocker
15-24	ToR and Guidelines for CCAUV SPWG – draft document, T. Usuda
15-25	Status Report CENAM, G. Silva Pineda *et al*.
15-26	Status report LNE, D. Rodrigues *et al*.
15-27	Proposal for membership of the RMOWG, T. Usuda

15-28 Status report UME, E. Sadigoklu et al.

15-29 SPWG Report to the CCAUV, M. Gaitan

15-30 RMOWG Report to the CCAUV, C. S. Veldman

15-31 KCWG Report to the CCAUV, G. Ripper

15-32 RMO Report: SIM, G. Silva Pineda

15-33 RMO Presentation: APMP, Y.C. Huang

15-34 RMO Report: AFRIMETS, R. Nel

15-35 RMO presentation: AFRIMETS, R. Nel

15-36 Status presentation: NMISA, R. Nel

15-37 RMO Report: COOMET, A. Enyakov

15-38 NIM Training issue: On hearing testing, Q. Sun

15-39 NIM Training issue: On hearing testing (short version), Q. Sun

15-40 The footsteps from the first to 10th CCAUV meetings and the future activities, T. Usuda

15-41 Heat conduction corrections in microphone reciprocity calibration, E. Sandermann Olsen

15-42 Pressure calibration of microphones using calculable pistonphones, R. Barham

15-43 Using the water tank transfer function to suppress the reverberation distortion of the signal during calibration of an underwater sound receiver, A.E. Isaev and I.V. Chernikov

15-44 Characteristics of sounds emitted during high resolution marine geophysical surveys, S. Crocker

15-45 Investigation of equivalency between dynamic and static acceleration calibrations, H. Nozato

15-46 Activities at KRISS, W.-H. Cho

15-47 Monitoring environmental conditions during key comparison travelling standard transportation..., C. Koch

15-48 Status Report CMS, Y.C. Huang

15-49 Status Report DFM and BKSV-DPLA, S. B. Figueroa

15-50 Presentation of METAS, C. Hof

15-51 Highlights from the JCRB, D. Olson

15-52 Preparation of APMP Key comparison for US (ultrasound) power, Y.T. Kim

15-53 Update on EURAMET.AUV.A-K5, R. Barham

15-54 Short report of the progress of CCAUV.V-K3 / Proposal for Low-intensity shock Key comparison CCAUV.V-K4, Q. Sun

15-55 IEC TC87 & ISO TC43 presentation, S. Robinson, B. Zeqiri

15-56 IEC TC29 presentation, S. Dowson

15-57 Status of CCAUV.U-K3.1 Key comparison, C. Koch

15-58 LNE Status Report document, D. Rodrigues

15-59 ISO TC 108 presentation, I. Veldmen

15-60 NIST-USRD Activity Report, V. Evora

Appendix 2

LIST OF ACTIONS AND DECISIONS RECORDED FOR THE MEETING

Dr Picard went through the list of actions and decisions recorded for the meeting, as recorded by the Rapporteurs.

Actions of the 10th meeting of CCAUV

CCAUV10/A1 – Dr Usuda, President, to seek input from CCAUV members via a freeform questionnaire, on raising awareness of the CIPM MRA and its instruments such as the CMC database with consumers of calibration services. CCAUV members to provide their feedback by January 2016.

CCAUV10/A2 – The BIPM Director to re-iterate to NMI Directors that delegates nominated to attend the CCAUV meeting have ongoing executive responsibilities until the next meeting.

CCAUV10/A3 – PTB to prepare the outline and register a new CCAUV KC on acceleration sensitivity of accelerometers (see also CCAUV10/D6).

CCAUV10/A4 – NIM to prepare the outline and register a new CCAUV KC on low intensity shock calibration (see also CCAUV10/D7).

CCAUV10/A5 – NPL to prepare an outline for a new pilot study on free-field calibration of microphones, considering both reciprocity and optical calibration techniques, and in a separate study, extended high frequency calibration (see also CCAUV10/D3).

CCAUV10/A6 – NPL and PTB to review the definitions for AUV units given on the BIPM website, and suggest alternatives where necessary.

Decisions of the 10th meeting of CCAUV

CCAUV10/D1 – SPWG should be tasked with identifying needs of developing NMIs for participation in the CIPM MRA.

CCAUV10/D2 – The final report on AFRIMETS.AUV.A-S1 was approved with editorial comments

CCAUV10/D3 – A new pilot study on free-field calibration of microphones was agreed and will be developed by NPL (UK) and DFM and NMIJ will participate. The project is intended to inform a future KC (repeat of CCAUV.A-K4 with extension of scope)

CCAUV10/D4 – AFRIMETS.AUV.V-S2 will be upgraded to a KC with a new designation AFRIMETS.AUV.V-K3 to facilitate linking to the corresponding CCAUV KC.

CCAUV10/D5 – A new KC on the pressure calibration of LS2P microphones (repeat of CCAUV.A-K3) was considered, but will be postponed until new developments in low-frequency calibration are better established. It is likely that a new proposal for this KC will be developed for the next meeting of the CCAUV.

CCAUV10/D6 – A new KC on the acceleration sensitivity of accelerometers (a repeat of CCAUV.V-K2) was agreed. The following expresses interest in participation: NIM, VNIIM, PTB, INMETRO, CENAM, NMIJ, DPLA-BKSV, NMISA, LNE, METAS, GUM, CEM, IPQ, NIST, A-STAR. However, final participation will be decided by the pilot laboratory, considering the variety of facilities to be used and the geographic distribution of participants. Other laboratories interested in participating should make this known to the proposed pilot laboratory PTB (Germany).

CCAUV10/D7 – A new KC for low-intensity shock calibration was agreed. The following expressed interest in participation: NIM, VNIIM, PTB, INMETRO, CENAM, NMIJ, DPLA-BKSV, CMS/ITRI, NMISA, KRISS, NRC and INRIM. However, final participation will be decided by the pilot laboratory, considering the variety in facilities to be used and the geographic distribution of participants. Other laboratories interested in participating should make this known to the proposed pilot laboratory NIM (China).

CCAUV10/D8 – The CCAUV Delegates unanimously supported the applications for full member status of the CCAUV by METAS (Switzerland), and observer status of the CCAUV by CMS/ITRI (Chinese Taipei), and agreed to submit these recommendations for ratification by the CIPM.