

Bureau International des Poids et Mesures

# Consultative Committee for Photometry and Radiometry (CCPR)

Report of the 17th meeting  
(17–18 June 2003)  
to the International Committee for Weights and Measures



Comité international des poids et mesures

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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.

T.J. Quinn,  
Director BIPM,  
November 2003

## **LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR PHOTOMETRY AND RADIOMETRY**

as of 17 June 2003

### **President**

Dr F. Hengstberger, member of the International Committee for Weights and Measures, CSIR-NML, Pretoria.

### **Executive Secretary**

Dr M. Stock, International Bureau of Weights and Measures [BIPM], Sèvres.

### **Members**

Bureau National de Métrologie, Institut National de Métrologie [BNM-INM], Paris.

CSIR, National Metrology Laboratory [CSIR-NML], Pretoria.

Helsinki University of Technology [HUT], Espoo.

Institute for Opto-Physical Measurements, Gosstandart of Russia [VNIIOFI], Moscow.

Instituto de Física Aplicada, Consejo Superior de Investigaciones Científicas [IFA-CSIC], Madrid.

Istituto Elettrotecnico Nazionale Galileo Ferraris [IEN], Turin.

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

Measurement Standards Laboratory of New Zealand [MSL], Lower Hutt.

National Institute of Metrology [NIM], Beijing.

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

National Measurement Laboratory, CSIRO [NML CSIRO], Lindfield.\*

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

National Office of Measures/Országos Mérésügyi Hivatal [OMH], Budapest.

National Physical Laboratory [NPL], Teddington.

National Research Council of Canada [NRC], Ottawa.

NMi Van Swinden Laboratorium, Nederlands Meetinstituut [NMi VSL], Delft.

Physikalisch-Technische Bundesanstalt [PTB], Braunschweig.

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

Swiss Federal Office of Metrology and Accreditation [METAS], Wabern.

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\* Since 1 July 2004, this laboratory is incorporated in the National Measurement Institute, Australia, NMIA.

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

**Observers**

Centro Nacional de Metrología [CENAM], Queretaro.

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

Standards, Productivity and Innovation Board [SPRING Singapore], Singapore.

## 1 **OPENING OF THE MEETING; APPOINTMENT OF THE RAPPORTEUR; APPROVAL OF THE AGENDA**

The Consultative Committee for Photometry and Radiometry (CCPR)\* held its 17th meeting at the International Bureau of Weights and Measures (BIPM), Sèvres, on Tuesday 17 June and Wednesday 18 June 2003. Four sessions were held.

The following were present: J. C. Acosta (IFA-CSIC), G. Andor (OMH), M. Ballico (NML CSIRO), J. Bastie (BNM), P. Blattner (METAS), L. P. Boivin (NRC), G. Brida (IEN), J. Clare (MSL), J. Dubard (BNM), N. P. Fox (NPL), F. Hengstberger (President of the CCPR), E. Ikonen (HUT), In Won Lee (KRISS), J. Metzdorf (PTB), P. Nemeček (SMU), D. Nettleton (NPL), Y. Ohno (NIST), T. J. Quinn (Director of the BIPM), K. Rochford (NIST), T. Saito (NMIJ/AIST), V. Sapritski (VNIIOFI), W. Schmutz (PMOD/WRC, expert of METAS), E. van der Ham (NMI-VSL), N. van Tonder (CSIR-NML), G. Ulm (PTB), A. J. Wallard (Deputy Director of the BIPM).

Observers: C. Matamoros (CENAM), F. Samedov (UME), Xu Gan (SPRING Singapore).

Also attending the meeting: P. Giacomo (Emeritus Director of the BIPM), R. Goebel (BIPM) M. Stock (Executive Secretary, BIPM), A. Samuels (BIPM), C. Thomas (BIPM) and Y. Yamada (NMIJ/AIST, at that time guest scientist at the BIPM).

Apologies were received from: A. Parr (NIST), J. Zwinkels (NRC), Y. Lin (NIM), A. Corróns (IFA-CSIC), M. L. Rastello (IEN).

The President opened the meeting, welcoming representatives and observers. He invited the BIPM Director to address the meeting. Dr Quinn welcomed all to the BIPM for this 17th CCPR meeting.

The President gave each attendee the opportunity to introduce him/herself.

Ms van Tonder was appointed as rapporteur.

The agenda was adopted; matters arising were added to item 15 (Other business) of the agenda.

The Executive Secretary presented the list of working documents to the meeting. Documents for the meeting are listed in Appendix 1; working documents on open access (underlined) are publicly available on the BIPM website, working documents on restricted access require password.

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\* For the list of acronyms, [click here](#)

## 2 APPROVAL OF THE MINUTES OF THE LAST MEETING

The minutes of the previous meeting was accepted without change.

## 3 CMCS AND THE CLASSIFICATION OF SERVICES IN PHOTOMETRY AND RADIOMETRY

The Joint Committee of the Regional Metrology Organizations and the BIPM (JCRB) made a recommendation to the Consultative Committees to form a Working Group on CMCs, in order to facilitate the inter-regional CMC review process. The terms of reference of these working groups are specific and are given in Appendix P 2.

The President suggested that the Working Group on CMCs should consist of the chairpersons of the Regional Metrology Organization (RMO) technical committees.

Dr Quinn noted that it is taking a long time for RMOs to review the CMCs and that it would be more effective if CMCs were dealt with within the CC meeting, as all the experts from the different RMOs would be present.

The proposal for creating a working group on CMCs consisting of the RMO technical committee chairpersons was accepted. The President will write to the RMO TC chairs and arrange a meeting to establish the working group (WG). The President requested attendees to inform RMO TC chairs of the establishment of this group, otherwise it may take until the autumn to get the working group going. The President also suggested that the chairmanship of the working group be rotated. This suggestion was accepted.

Dr Quinn said that the purpose of the Mutual Recognition Arrangement of the CIPM (MRA) was to establish an open and transparent system, and that establishing a working group to deal with CMCs was the most efficient way to achieve that.

Dr Thomas presented the new website of the BIPM Key Comparison Database (KCDB), which was launched on 4 March 2003. It provides access to Appendix B of the MRA. All comparisons undertaken since the MRA are listed under "Current" comparisons. When a comparison is repeated, the result of the previous comparison becomes listed under "Archive" on approval by the CCPR. The website also includes access to Appendix C and all the CMCs published for a national metrology institute (NMI) can be downloaded in A4 format.

Currently, the database contains the radiometry and photometry CMCs which were submitted in round 1 (10/2001) and round 2 (10/2002). There is a problem with the submission SIM.PR.2.2002 which contains CMCs for services which are part of round 2 and for some services which are not included in the first two rounds. Therefore COOMET and EUROMET have not yet approved this submission.

Dr Samuels suggested that round 2 service entries should be separated and submitted for approval, and that the additional entries should be held back until agreement on a further round 3

is reached. The President suggested that the definition of round 3 services should be referred to the Working Group on CMCs.

Dr Ohno said that different RMOs use different criteria to approve CMC claims. He inquired whether the working group on CMCs would establish guideline criteria. Dr Quinn noted that one of the terms of reference of the working group was to agree on detailed technical review criteria.

Dr Matamoros said that the technical committee (TC) chairpersons of RMOs have met and had agreed on round 1 and 2 services. Round 3 was not well defined. Although new services could be added to round 3, the round 3 services were agreed to by, at least, the APMP, EUROMET and SIM.

The President said that round 1 and 2 services were submitted simultaneously by all RMOs. Clear instructions were not given for the submission of round 3 services, and he was surprised when SIM submitted round 3 services.

#### 4 REVIEW OF PROGRESS IN THE LABORATORIES

The representative of each NMI present at the meeting gave an overview of its laboratory's reply to the questionnaire sent out prior to the meeting. The replies are given in working document [CCPR/03-03](#). The discussions that followed some of the presentations are reported below.

**BNM-INM:** Dr Bastie presented the progress made by BNM-INM.

The President asked whether the CIE function is being used with measurements performed on the BNM bilirubin radiometer. Dr Bastie confirmed that this function is being used.

**NRC:** Dr Boivin presented the progress made by NRC.

No comments were received on this presentation.

**CSIR-NML:** Ms van Tonder presented the progress made by the CSIR-NML.

No comments were received on this presentation.

**HUT:** Prof. Ikonen presented the progress made by HUT.

No comments were received on this presentation.

**VNIIOFI:** Prof. Sapritski presented the progress made by VNIIOFI.

No comments were received on this presentation.

**NIM:** A presentation on the progress made by NIM was not given as China was not represented at this meeting.

**IFA-CSIC:** Dr Acosta presented the progress made by IFA-CSIC.

No comments were received on this presentation.

**IEN:** Dr Brida presented progress made by IEN.

No comments were received on this presentation.

**KRISS:** Dr In Won Lee presented the progress made by KRISS.

No comments were received on this presentation.

**MSL:** Dr Clare presented the progress made by MSL.

No comments were received on this presentation.

**NIST:**

Dr Ohno presented the progress made by NIST (Gaithersburg).

Dr Boivin asked whether the dynamic range and resolution of the NIST HACR-II imply that a monochromator can be used. He enquired whether the geometry would be suitable and whether that was the intention. Dr Ohno replied that HARC-II can share sources with SIRCUS for continuous wavelength coverage, but use of a monochromator could be an option.

Dr Rochford presented the progress made by NIST (Boulder).

No comments were received on this presentation.

**NML CSIRO:** Dr Ballico presented the progress made by NML CSIRO.

Dr Ballico mentioned that NML CSIRO is refurbishing their cryogenic radiometer. Dr Quinn advised that a cryogenic radiometer would work significantly better if fitted with a cold shutter. Dr Fox mentioned that the cold shutter is such a long way away from the cavity of the BIPM radiometer that it should not be affected by condensation. Dr Quinn replied that condensation occurs at the baffles outside the cryogenic radiometer.

**NMIJ/AIST:** Dr Saito presented the progress made by NMIJ/AIST.

Dr Metzdorf commented that the PTB developed standard LEDs which had been used in a comparison that had worked well.

The President asked Dr Ohno what NIST's results were in terms of the stability of LED sources. Dr Ohno replied that temperature stabilized LEDs are extremely stable, even more stable than lamps. Problems are experienced with red and yellow LEDs when not temperature stabilized. Without temperature stabilization, forward voltage should be used for correction. NIST plans to develop such temperature-monitored standard LEDs for luminous flux as commercial integrating spheres often require bare LED standards for calibration of the sphere.

**NPL:** Dr Fox presented the progress made by NPL (see working document CCPR/03-09, restricted access)

During his presentation Dr Fox suggested that the number of participants in key comparisons should be reduced. This would result in a better reference value and it will allow for more such comparisons, as they would take less time. Prof Metzdorf commented, however, that reducing the number of participants in such comparisons would also result in more participants for RMO comparisons.

**METAS:** Dr Blattner presented the progress made by METAS.

Dr Ohno asked whether METAS performs flux measurements. Dr Blattner replied that flux measurements are performed for the calibration of anti-collision light systems.



**OMH:** Mr Andor presented the progress made by OMH.

No comments were received on this presentation.

**PTB:** Prof. Metzdorf presented the progress made by PTB. Dr Ulm presented the section on “Radiometry based on synchrotron radiation”.

No comments were received on these presentations.

**SMU:** Dr Nemeček presented the progress made by SMU.

No comments were received on this presentation.

**CENAM:** Dr Matamoros presented the progress made by CENAM.

No comments were received on this presentation.

**SPRING Singapore:** Dr Xu presented the progress made by SPRING.

Dr Boivin asked for clarification on whether SPRING implemented a quality system to support their capabilities as is required by the MRA. Dr Xu replied that the laboratory is not formally accredited but that it plans to apply for formal accreditation as soon as it can afford it. He said that there was a strong drive to review their procedures after the introduction of the MRA. As a result of this process their capabilities were improving.

Dr Quinn commented that key comparisons provide a difficulty for smaller laboratories to get into phase. These laboratories should arrange a bilateral comparison with laboratories who participated in the key comparison.

Dr Xu mentioned that many laboratories are still participating in comparisons which are not completed.

The President said that bilateral comparisons will be acceptable to get CMCs accepted in the database.

**UME:** Dr Samedov presented the progress made by UME.

No comments were received on this presentation.

Dr Metzdorf suggested that the report on the progress of the laboratories should be structured according to the service categories in the VIM list. For example, the definition of broadband radiometry is not always clear. It will be easier to compare the capabilities of the different laboratories if it is done according to the service categories in the VIM list.

The President replied that it can be done for the technical report. He asked for comments on the length of the presentations by the different NMIs. Dr Metzdorf said that the order of the questions in the questionnaire should be different. For example, the request for suggestions for collaboration projects with other laboratories is question number 10 on the list. It is the most important point on the list and should be listed as one of the first questions. Other laboratories should be requested to reply.

The President asked whether it is sufficient to ask for the documents and publish them on the website and let the laboratories draw their own conclusions, or whether the issues raised should be analyzed and reported upon.

Dr Ikonen replied that it would be helpful if somebody could in future look at the reports from the laboratories in advance and prepare a summary report of issues of general concern. It will require a lot of work but it will be useful to have such a report prior to the meeting.

Dr Xu added that the report should be divided into two parts, namely technical issues and general concerns. Dr Stock mentioned that a summary report was prepared for the previous meeting. The technical issues are too difficult to summarize, but the general issues that have been added to the agenda for this meeting can be summarized.

Dr Xu said that a decision should be made regarding the format of the presentations. Some laboratories prepared PowerPoint presentations and while others did not.

Dr Metzdorf proposed that the presentations of participants should be sent as PowerPoint presentations to the Executive Secretary prior to the meeting in order to avoid switching from one laptop to another during the meeting. It will also make it possible to present one sub-field after the other. Every NMI will not be forced to present every point, only the most important activities.

The President concluded that the feedback from the laboratories is useful but that the presentations should be improved. The non-technical part will be analyzed and a summary report will be prepared. This item will be added to the agenda for the next meeting. All participants were requested to provide PowerPoint presentations if possible (some may not be able to do so due to time limitations). The participants who presented presentations and who don't object to publishing them on the website, should forward them to the Executive Secretary. The password and username to access restricted documents can be obtained by CCPR members from the Executive Secretary.

## 5 REPORT FROM THE WORKING GROUP ON KEY COMPARISONS

The President suggested that Dr Parr be the chairperson for this working group. Dr Ohno will confirm with Dr Parr whether he is prepared to be the chairperson. If not, the President will continue to act as chairperson.

The President reported that papers published in *Metrologia* by Mr Cox outline the methodology of calculating the key comparison reference value (KCRV). Prof. Cox is a member of the BIPM Director's Advisory Group on Uncertainties. The Working Group on Key Comparisons (WG-KC) is waiting for further guidelines for adopting methods currently used in comparisons. The WG-KC made recommendations to individual task teams dealing with comparisons. Further meetings will be arranged to finalize the wording.

The recommendation of the WG-KC is to use a weighted mean with a cut-off for calculating the KCRV.

As an initial compromise, Dr Ikonen proposed that the CCPR ask the WG-KC to look at the possibility of defining the maximum weight given to an NMI in a comparison. The cut-off values are arbitrary at the moment. Some means to determine these values in advance is required. The maximum weight depends on the number of participants. The working group should decide on a criterion.

Prof. Metzdorf explained that the cut-off value defines either a state-of-the-art uncertainty or a limit to the weight given to the value of a participant. Mathematically there is no difference, but the meanings differ.

The President suggested that the WG-KC form a task team under Dr Ohno to investigate this. Dr Ohno replied that he agrees that a cut-off should be decided on before the comparison and accepted the task.

Dr Boivin enquired whether the WG can overrule the participants of a comparison. The President replied that participants in a comparison should agree amongst themselves on the criteria. It would be difficult for the WG-KC to overrule the participants if they all agree, but it may well be the case. A final decision on who overrules who has not been made. A situation where fixed rules are made should be avoided.

It was concluded that Dr Ohno prepares a guidance document which will be published on the Internet by the end of the year.

## 6 DISCUSSION OF THE STATUS AND RESULTS OF KEY COMPARISONS

### 6.1 Key comparison CCPR-K1, spectral irradiance

#### 6.1.1 CCPR-K1.a, 250 nm – 2500 nm

All the NPL second calibrations have been completed and all the lamps have either been delivered or are on their way to the laboratories. Five laboratories are expected to participate in the third round of calibrations which should be completed by the end of July 2003. The date for the supply of lamp calibration data to the NPL is October 2003. The Draft A report is expected in December 2003 and Draft B in May 2004.

About 350 calibrations over the full spectral range were performed at NPL for this comparison. Approximately 260 days were spent on performing the calibrations and 40 days were spent on maintenance of equipment. The cost of the calibrations carried out under the comparison is estimated at € 525 000 (or U.S. \$ 800 000). (see working document CCPR/03-10, restricted access)

The President complimented the NPL on the care taken and extent of the effort that went into this comparison. Dr Nettleton responded that the task of maintaining the MRA should be reconsidered. This comparison needs to be repeated every 10 years. NPL will not be able to convince its funding agency to spend another € 0.5 million in 10 year's time. How will the MRA be maintained? The PTB is in a similar situation with the photometric comparisons. This is a difficult future challenge.

The President replied that this was an important concern and that ILAC was made aware of the consequences.

Dr Quinn remarked that although it is expensive, it is very important to maintain the MRA. The efficiency of maintaining the MRA should be looked at.

Prof. Metzdorf mentioned that much technical progress can be attributed to comparisons. Progress would not have happened so fast if it was not for the comparisons. A comparison is a lot of work but it increases the efficiency of developments.

Dr Blattner enquired whether a scale change should be implemented before or after the comparison. Dr Fox replied that it should be implemented after the comparison. He added that the NPL established a new scale two year's ago. It demonstrated that the scale was stable over a long time and compared the old scale with the new one. The NPL ensured that the scale was stable and maintainable. A formal announcement of the new scale (showing the difference) was made last month. The quality system requires that the announcement of a change in scale to customers has to go through a formal process. The NPL is waiting for approval and is not undertaking any customer calibrations at the moment.

#### 6.1.2 CCPR-K1.b, 200 nm – 400 nm

Prof. Metzdorf reported that this comparison is similar to the NPL comparison, but has a smaller number of participants.

Lamps have been selected and pre-aged. Measurements against the black body were started again and are due for completion by the first week in July 2003. Lamps will then be sent to participants together with a power supply. All recalibrations should be completed by March 2004.

The PTB will participate in a bilateral comparison of the UV spectral irradiance scale with NMIJ/AIST in 2005/2006. Any other NMI having a UV spectral irradiance scale in two year's time is invited to participate in a bilateral comparison.

### 6.2 **Key comparison CCPR-K2, spectral responsivity**

#### 6.2.1 CCPR-K2.a, 900 nm – 1600 nm

Dr Ohno reported that 15 laboratories are participating in this comparison. A Draft A report was distributed on 5 March 2003. A weighted mean with cut-off (0.25 %) was used to determine the KCRV. Different methods to determine the KCRV were compared at the meeting on 16 June 2003. The proposal to use the median was discussed but consensus was not reached at this time. The removal of two photodiodes at 900 nm has been arranged. The issues will be resolved and a revised Draft A report to be submitted in the not so distant future.

#### 6.2.2 CCPR-K2.b, 300 nm - 1000 nm

Dr Stock reported that a number of issues had to be resolved after the circulation of Draft A report in April 2002. The choice of a KCRV had to be made depending on whether the CCPR 1999 decision to use a weighted mean with an uncertainty cut-off is valid for all CCPR key comparisons. If not, a choice will have to be made between the various possibilities.

The MSL discovered an error in its calibration report and asked for a modification of its results in the comparison. They believe that the pilot laboratory should have warned them prior to the distribution of the Draft A report because their results were obviously anomalous when compared to the reference value.

The NPL requested a review of all the participants' uncertainty budgets as the basis for continuing discussions and for the choice of the KCRV. NIST is strongly opposed to this idea. Some laboratories (for example HUT and MSL) consider it necessary to check the consistency of the stated uncertainties with the results of the comparison. Other participants believe that such a procedure will be too difficult to apply.

The PTB proposed a modified version of their uncertainty budget due to a reconsideration of the interpolation procedure. The uncertainties remain unchanged for many wavelengths, at some wavelengths they are slightly increased and in some cases, nearly doubled.

The PTB data analysis also indicated that one of the transfer detectors might have been unstable during the travel between the PTB and the BIPM. The responsivity ratio of the two trap detectors measured at the PTB was found to differ substantially from that measured at the BIPM. The BIPM results were confirmed by another participant. Since the results from the PTB were obtained with two different set-ups (monochromator-based and laser-based) which gave consistent results, the only explanation seems to be a dust particle on one of the two trap detectors while at the PTB. It is proposed that the corresponding data should be discarded or used with a larger uncertainty.

Most of the outstanding issues have been resolved and the BIPM will prepare the Draft B report.

#### 6.2.3 CCPR-K2.c, 200 nm - 400 nm

Dr Ulm reported that 14 laboratories are participating in this comparison. Each laboratory was required to buy a minimum set of transfer standards consisting of three single element detectors and a three element reflection trap detector. It is a star-type comparison (PTB-participant-PTB) carried out in three phases. The measurements will be completed by the end of August 2005.

#### 6.3 **Key comparison CCPR-K3.b, luminous responsivity**

Dr Stock reported that he had taken over responsibility for this comparison. NIST did not accept two data changes (by NPL and METAS) which were made after the distribution of the Draft A report. NIST will now accept an uncertainty change by NPL, but will not accept the data change by METAS which was based on the introduction of a new scale. This was accepted by METAS. The original METAS data as given in the Draft A report will be reported, but an appendix will explain the scale change.

The change of the METAS data leads to a change of the KCRV of only 0.03 %. The final report will be prepared and circulated to the full CCPR for approval.

#### 6.4 **Key comparison CCPR-K5, spectral diffuse reflectance**

Dr Ohno reported that 12 laboratories are participating in this comparison. Three Spectralon and three matte ceramic plaques are used as artefacts. The  $0/d$  or  $d/0$  reflectance factor should be reported from 360 nm to 820 nm in intervals of 20 nm. All samples should be measured at least once, and one of each type three times. Participants have the option of including additional samples for participating in a bilateral comparison with NIST.

Five of the 12 participants have returned the samples, and four participants have submitted the data. The measurements are estimated to be completed by December 2003.

Dr Clare and Dr Fox suggested that bilateral comparisons should be arranged using the extra reflectance samples to obtain information on how these samples perform. Dr Metzdorf said that the PTB performed measurements on these samples and experienced stability problems on Spectralon. He said that the results will probably be reported in the appendix, but not in the main report of the comparisons.

Dr Nettleton remarked that the bilateral cannot be reported to the BIPM after the event. Dr Ohno will convey these comments to Dr Early.

Dr Quinn asked whether the components of uncertainty were identified in the protocol guidelines, which was confirmed. He stated that it is very important as it puts one in a better position to take the weighted mean. Dr Boivin asked whether the uncertainty budgets themselves had been used or just the total uncertainty. Dr Quinn responded that the uncertainty budgets are not normally used, only checked for consistency. If there are any anomalies, the uncertainty budgets are consulted to identify the problem.

Dr Stock added that in many cases it is not possible to compare the uncertainty budgets as the components are very different.

Dr Nettleton suggested that the WG-KC should make a recommendation whether the uncertainty budgets could be done after the completion of the comparison. The President suggested that the participants agree on the main components of the uncertainty prior to the comparison. He said that participant's systematic corrections correspond to the different scales of the different laboratories and the uncertainty components are estimated very differently by the different laboratories. He advised the participants to review publications and to follow the WG-KC guidelines.

Dr Xu enquired whether a participant is allowed to change its value when the pilot laboratory found that one of its uncertainty components differ substantially from that of the rest of the participants. The President responded that under the strict MRA a change in the result (i.e. the value and its associated uncertainty) is not allowed after the publication of the Draft A report.

Dr Fox suggested that the WG-KC guidelines should include the possibility to change upwards before the publication of the Draft A report, and before the results are known. Dr Quinn remarked that before the MRA, the graph which showed the results of a comparison did not include the uncertainties. The inclusion of the uncertainties is a positive consequence of the MRA as it allows the discussion of the uncertainties.

The President said that as long as there remain internal consistence, it would be acceptable to use the information available to change results. Dr Metzdorf said that there are three scenarios before the publication of the Draft A report:

- 1) Only the pilot laboratory will evaluate the uncertainty budgets;
- 2) The WG-KC performs the evaluation;
- 3) All participants are informed and asked to evaluate each other's uncertainty budgets.

He suggested that the third option be followed before the publication of the Draft A report; otherwise the uncertainties should not be changed.

Dr Ohno reported that this issue was discussed at the WG-KC meeting. It was recommended that the data be distributed to all participants prior to the publication of the Draft A report in order to allow all participants to comment. Learning should be done prior to Draft A. When a laboratory receives comments, it can review the data and revise their uncertainty budgets before the publication of Draft A.

Dr Ballico said that a comparison evaluates a laboratory's ability to meet its stated uncertainties. Learning should happen after the completion of the comparison.

Dr Nettleton remarked that as long as the original values are included in the report and the process is transparent, changes before the publication of the Draft A report should be allowed. Dr Quinn mentioned that the values laboratories assign to certain parameters should be compared. The uncertainty estimation should be done in a comparable way. If not, it will be very difficult to calculate the values. Before the publication of the Draft A report the uncertainty budgets should agree.

Dr Boivin disagreed. He said that different laboratories use different methodologies and therefore have different uncertainty components. It is impossible to make a list of components for all laboratories. Even the same component affects different laboratories differently. It is difficult to assess whether an uncertainty component is reasonable for a specific laboratory.

The President noted that the main purpose of a comparison is to find the best representative KCRV. Incorrect results should not be included in the calculation. The submitted values still stand and will be included in the report. The same applies to the associated uncertainty.

All agreed with Dr Nettleton that the committee should not dictate to an NMI what its uncertainty should be and that the responsibility stays with that NMI.

## **6.5 Key comparison CCPR-K6, spectral regular transmittance**

Dr Bastie reported that results had been received from most of the participating laboratories. The stability of the glass filters is less good than expected considering the previous studies. The drift seems to be, at first order, proportional to time. The results of the comparison are likely to be slightly improved if a correction is applied to account for this effect. Draft A report should be completed by the end of this year. A report on the preliminary results is listed as working document CCPR/03-11 (restricted access).

## 7 DISCUSSION OF THE STATUS AND RESULTS OF SUPPLEMENTARY COMPARISONS

### 7.1 Supplementary comparison CCPR-S1, spectral radiance

Dr Sapritski reported that six laboratories are participating in this comparison. The spectral range of the comparison is 220 nm to 2500 nm. Tungsten strip lamps are provided by the participants themselves.

Two sets of lamps are used:

- two or three lamps at radiance temperature  $t_r(650 \text{ nm})$  of about 2100 °C for the region 220 nm – 350 nm;
- two or three lamps at radiance temperature  $t_r(650 \text{ nm})$  of about 2000 °C for the region 350 nm – 2500 nm.

The measurement sequence is: participant – VNIIOFI – participant. A comparison of the results between VNIIOFI and PTB was done. NPL, NRC and NIST are still to submit their results. The Draft A report is expected to be ready by December 2003.

### 7.2 Supplementary comparison CCPR-S2, aperture area

Dr Ohno reported that eight laboratories are participating in this comparison. Each participant should report the area for each of the four knife-edge and four land-type round apertures. All participants have measured the apertures and submitted data, except the NRC. The NRC requested to be last to measure because of the upgrades to their instruments, and has just received the samples. The results from NRC will be submitted within the next two months. The Draft A report will be published by the end of this year.

### 7.3 Supplementary comparison CCPR-S3, cryogenic radiometers, subsequent bilateral comparisons with the IEN and NMIJ/AIST

Dr Saito stated that NMIJ/AIST would like to withdraw from this bilateral comparison as a result of the technical problems experienced. The vacuum pumps of the cryogenic radiometer were not working well, therefore the system were not operating correctly during the measurement. The laboratory also experienced air conditioning problems at the time. A proposal to extract the NMIJ/AIST data from the report and to only publish the IEN data was accepted by the meeting. (see working document CCPR/03-05, restricted access)



## 8 DISCUSSION OF THE STATUS AND RESULTS OF RMO COMPARISONS

### 8.1 APMP

Dr Xu reported the comparison of UV responsivity of detectors proposed in Tokyo in 2001 is ongoing and includes eight participants. The SPRING Singapore is the pilot laboratory. The protocol was prepared and sent to the participants in 2002. The measurements started in January 2003 and involve the calibration of two sets of broadband UVA detectors (365 nm) irradiated with the UV light source (a medium pressure mercury lamp) provided. The comparison will be completed in 2004.

Dr Thomas remarked that this comparison is not in the database. Dr Quinn said that the RMO approves the comparison, but the BIPM should be informed. A formal procedure on how a region should go about arranging key comparisons is available.

### 8.2 COOMET

No report was presented.

### 8.3 EUROMET

Dr Brida reported that the following comparisons are in progress:

- EUROMET.PR-K6 of spectral transmittance (Measurements by NMIs completed);
- EUROMET.PR-K3.a of luminous intensity (Started in 2002, to be completed in 2003);
- EUROMET.PR-K4 of luminous flux (Started in 2002, to be completed in 2003);
- EUROMET.PR-K2.b of spectral responsivity (The photodetectors are being calibrated by the pilot laboratory, the IFA).

The following comparisons are planned:

- EUROMET.PR-K5 of spectral diffuse reflectance;
- EUROMET.PR-K1.a of spectral irradiance;
- EUROMET.PR-BK2.a.1 and -BK2.a.2 of spectral responsivity.

The following supplementary comparisons are planned:

- UV power meters;
- Luminance meters;
- High laser power.

A comparison of characterization techniques for filter radiometers has been proposed and a comparison of chromatic dispersion reference fibres is in progress.

#### 8.4 SADC MET

The President reported that only a few countries in this region have photometry and radiometry laboratories. These include Egypt, Kenya and South Africa. Supplementary comparisons will be arranged soon.

#### 8.5 SIM

Mr Matamoros reported that key comparisons will soon be arranged for spectral responsivity, luminous intensity and diffuse reflectance. All sub-regions of SIM will participate.

Mr Matamoros asked whether approved protocols can be published on the Internet. Dr Quinn replied that this can be done. It can be a CCPR document. Protocols should be sent to the Executive Secretary once approved for publication. It will be an unrestricted access document.

The President asked all RMOs to submit all comparison protocols and final reports. Dr Nettleton said that protocols are usually being updated during the comparison. Dr Quinn replied that it is the content of the protocol that matters and not dates, etc. Dr Ikonen mentioned that it would be helpful if key comparison protocols were published on the Internet as it can be used as basis for bilaterals.

### 9 REPORT FROM THE UV WORKING GROUP

Prof Ikonen reported that two meetings had been held so far: the first meeting was combined with the NEWRAD conference at NIST in May 2002 and the second meeting was held on 16 June 2003 in Paris. (The minutes of this meeting is listed as working document [CCPR/03-07](#)).

The main point of discussion was the terms of reference of the Working Group on UV Radiometry (WG-UV) and its continuation. The meeting concluded that a proposal to continue with the work for one year will be submitted to the CCPR. The CCPR should also confirm the terms of reference.

The terms of reference are very similar to the terms of reference agreed on at the previous CCPR meeting and are as follows:

- to study the measurement problems in the UV range and encourage coordination of the work of NMIs in that field;
- to take initiatives aimed at improving world-wide equivalence in the field of UV radiometry, taking into account not only traditional techniques but also techniques such as synchrotron radiation, cryogenic radiometry and novel techniques for improving the stability of transfer standards.

The working programme includes the following points:

- Coordinated research in transfer detectors;

- A comparison in spectral responsivity.

Related to the second item, a new comparison of detector spectral responsivity over the wavelength region 10 nm to 250 nm was proposed in the WG-UV. The PTB will be the pilot laboratory and NIST and VNIIOFI, and possibly NMIJ/AIST, will participate. The comparison is still open to other participants. The objectives of the comparison are to test new technology and to test the equivalence of the new capabilities. It will be a key comparison since all CCPR participants are invited to participate and will be given a number.

The next meeting will be held in May 2004 at NIST prior to the CORM meetings. The WG-UV is open to all CCPR members and observers, but the chairperson should be informed in advance of the intention to participate.

The President remarked that considerable discussion took place within the WG-UV on whether or not to continue and on the proposal for the concrete activities to be developed into working programmes. In light of these discussions, he requested the meeting be given the go-ahead and proposed that the decision be reviewed at each subsequent CCPR meeting.

No comments were received and it was concluded that the CCPR meeting concurs with the WG-UV. The WG-UV can go ahead with its working programme as proposed.

The President recommended that in general, WG recommendations should be accepted by the CCPR. It will not be productive if all the issues are re-discussed at the CCPR meeting. All the experts are participating in the WG activities. He thanked the WG for their work.

Dr Fox proposed that Prof. Ikonen be formally co-opted onto the WG-UV. The proposal was accepted. Prof. Ikonen mentioned that he agreed to be the chairperson for two years and that the chairpersonship is still open. The President asked whether Prof. Ikonen is prepared to carry on with the work, to which he answered in the affirmative. Prof. Ikonen was therefore accepted as chairperson for the WG-UV.

## 10 LIAISON WITH CCT WORKING GROUP 5 ON RADIATION THERMOMETRY

Dr Fox reported that the working group investigates problems associated with radiation thermometry. The terms of reference can be found in document [CCPR/03-06](#). The working group set priority actions which should be looked at. The first priority is to determine the baseline parameters underlying the radiation thermometry scale realization with a rigorous standard approach.

The working group has had three meetings since its establishment in 1996. The progress to date include the establishment of a document describing and defining sources and sizes of uncertainties for radiation thermometry above 1000 °C, for inclusion as an annex to the “Supplementary Information for the ITS-90”.

The working group will also produce a document to discuss uncertainties in radiation thermometry below 1000 °C. This document is more difficult to produce than the first document due to the larger range of instruments and applications.

The working group considered the need for ITS-90 in the context of radiation thermometry and its uses. A comparison of filter radiometer calibrations, organized by the working group, demonstrated that interference filter radiometry is possible at the 0.1 % level.

Prof. Sapritski commented that radiation thermometry is the most important thermometric field. The working group measurement included detectors to investigate the size of source effect. Consistent results were obtained for radiance.

Dr Fox added that radiance activity is included in terms of eutectics for radiance and irradiance.

Prof. Sapritski noted that eutectics provide a good opportunity to utilize the different absolute and relative methods of thermodynamic measurements based on cryogenic radiometers, black bodies and synchrotrons to measure temperature.

Dr Boivin enquired whether commercial or custom made filters were used in the comparison. Dr Fox replied that the companies were given the specification for stability. Only one company was willing to provide a quotation. A batch of 10 filter radiometers proved to be stable. No information is available on the rest.

Mr Yamada explained that NMIJ/AIST did not submit the results of the comparison because the measurements were performed in the radiation thermometry section of the NRLM, which later merged with the ETL that includes the photometry and radiometry section. It became inappropriate for the radiation thermometry section to represent the newly formed NMIJ/AIST in a field in which they are not the best experts.

## 11 LIAISON WITH THE RMOS

The President said that the JCRB receives reports from the RMOs. All laboratories were reported on in general; no specific highlights of photometry and radiometry activities are given. Now that the WG-CMC is established, RMO TC chairpersons could be present at the CCPR meeting and could present reports. He asked the participants whether they would like to see these reports at this meeting in future.

Dr Nettleton supported the suggestion. He said that it would be good to share the experiences of the different regions. For example, how do the different RMOs perform CMC analyses? The information should be shared formally.

Dr Quinn said that the Consultative Committees are responsible for the key comparisons and the RMOs report on the regional comparisons at these meetings. The coordination of the RMO activities is the responsibility of the JCRB.

It was concluded that the report of the RMO activities will be very useful and should not take much time. It should also not interfere with the JCRB activities.

## 12 LIAISON WITH OTHER ORGANIZATIONS (WMO, CIE, CORM, ETC.)

### 12.1 WMO

Dr Schmutz gave a report on the relation of the CCPR's activities to the radiation issues of the WMO (see working document CCPR/03-08, restricted access). He mentioned that there is no official definition for the calibration of UV-A and UV-B meters.

Dr Quinn responded that the link to the International System of Units (SI) is essential and that the link with NPL is good. The traceability of environmental data should be linked to SI units.

Dr Fox said that in the near future the cryogenic radiometer may be able to work at the high power levels for which pyroheliometers are designed.

In response to the President's question, Dr Quinn replied that the MRA includes the IAEA as an independent organization. PMOD/WRC is represented on the CCPR through METAS and is a designated institute of the MRA. He also noted that the WMO is a large organization which cannot be represented at all levels.

The President suggested that Dr Fox represent the CCPR on the expert team for radiation members together with Dr Schmutz. The nomination was accepted by both of them.

### 12.2 CIE

Dr Bastie reported on the activities of CIE Divisions 1, 2 and 6 relevant to the activities of the CCPR from 2001 up to the beginning of 2003 (see working document [CCPR/03-02](#)). The major fields of activity related to the CCPR are (in decreasing importance):

- Photometry (visual photometry devoted to improve knowledge about the human visual system, and physical photometry related to the measurement of photometric quantities of LEDs and flashing lights, and to the use of detectors as transfer standards for photometry);
- Action spectra (six TCs from Division 6 are working on the best method to obtain action spectra and on the standardization of action spectra for plants, immediate pigmentation darkening, hyperbilirubinemia and UV disinfection);
- Photobiological measurement (five TCs from Division 6 are working on the mean effects of solar radiation for several photobiological effects, personal dosimetry for UV radiation and the disinfection of air and water);
- LEDs (photometric measurements of LEDs, LED arrays or LED clusters, and the color rendering of white LEDs);
- Instrument characterization (four TCs of Division 2 are working on methods and measuring techniques to characterize tristimulus colorimeters, spectrophotometers measuring transmittance and reflectance, luminance meters, illuminance meters and UV radiometers);
- Colorimetry (the CIE publication 15.2 "Colorimetry" which forms the basis of the color system for colorimetry, is being updated, and the color matching functions are being improved);

- Optical properties of materials (the calibration methods and photoluminescence standard for total radiation factor measurement, and measurement of the spectral coefficient of retro-reflection);
- Detectors (two TCs of Division 2 are working on detector linearity and spectral responsivity measurements respectively);
- Determination of measurement uncertainty of photometry (Division 2);
- Vocabulary matters (Division 2).

### **12.3 CORM**

Dr Ohno reported that the CORM (Council for Optical Radiation Measurements) was originally established as an advisory body to NIST. It is now a professional society for optical radiation measurements in the United States, and also has a number of international members. The CORM is not a standardizing body but a technical forum to exchange information between members. It publishes reports on photometric and radiometric needs every four to five years. The CORM has two major technical committees: Radiometry and Optical Properties of Materials. The Radiometry Committee has several subcommittees such as standard sources, photometry, displays, and measurements of LEDs.

The CORM holds annual conferences, occasionally in conjunction with CIE meetings. The CORM 2003 is being held in California and the theme is “Optics in the 21st Century”. The focus is on new technical areas such as medical optics, etc. The WG-KC is considering having its next meeting in conjunction with the CORM 2004 at NIST, Gaithersburg.

### **12.4 ORM Club**

Dr Fox reported that the Optical Radiometry (ORM) Club of the NPL holds meetings on general topics and has focused interest groups on: UV for medical applications, color, IR diffuse reflectance and pulsed sources. More information can be found on the NPL website ([www.npl.co.uk](http://www.npl.co.uk)). Brochures are published bi-annually. Subscription to the ORM Club is free and those interested to become a member should send an e-mail to Dr Fox.

### **12.5 UV community**

The global UV scale was established world-wide. A link between the electrical (power) and optical scale was established through an international comparison. The request for international equivalence started 1989. Traceability to the SI system is obtained through the PTB. Calibrations and measurements are regularly performed to check the scale. This year, these calibrations and measurements are piloted by the PTB. The scale is determined by those laboratories able to realize the scale. The process started before the MRA but is very similar.

## 13 MEMBERSHIP ISSUES

No requests were received for new members. No applications were received for observers to become members. Applications can be made through the website.

If required, an RMO TC chairperson from a country that is not a member of the CCPR will be invited to attend CCPR meetings.

## 14 IMPACT OF CHANGES AT BIPM ON WORK OF CCPR

Dr Quinn gave an overview of the funding and programme formulation of the BIPM.

A report by the CIPM in 1998 reviewed the international metrology and financial requirements. It stated that the need for international activity is increasing, most notably in chemistry and biotechnology. In 1999, a 4.5 % increased budget was requested at the general conference in order to get the BIPM started in the chemistry area. However, only an inflationary increase was approved.

The work demand on the BIPM has increased since 1999. A decision was made to restrict BIPM activities in traditional fields. Almost half of important measurement science (that is, chemistry) cannot be excluded. The BIPM cannot maintain work in all fields, and contribute effectively to science, comparisons and international collaborations. Also, without a chemical laboratory, BIPM's activities in this area cannot attract high level people.

In order to maintain the capabilities approved at the 21st General Conference in 1999, and to embark upon fully-financed extensions into organic chemistry, bio-analysis and medicine, an increase of € 1.9 million (20 % increase) is required from 1 January 2005 onwards. To maintain all of the current activities would require an increase of 12 % (€ 1.1 million). At the meeting of directors of NMIs in 2002, it was made clear that there is little chance of a 20 % increase. In December 2002, a budget and broad lines of future programme were submitted to the CIPM. An increase of only € 450 000 was considered possible.

All programmes were subsequently reviewed in terms of the needs of NMIs and not in terms of the importance of the technical field. All areas could not be reduced by 10 % as the BIPM was already functioning at a minimum in terms of intellectual and financial resources. A decision had to be made about what should remain. Staff members had to be considered and priorities evaluated.

In the past, the BIPM maintained the mean world lumen and candela based on incandescent lamps, but as almost all NMIs adopted the cryogenic radiometer as the reference for radiometric and photometric standards, this function is not as important as it was in the past. Therefore the photometry and radiometry programme will be terminated in 2004. This decision should not be perceived as indicating that the photometry and radiometry field is valued less than other fields.

The question that remains is what happens to the calibration service of incandescent lamps, which is used by more than 10 Member States. The BIPM cannot present a solution to this problem. No calibration service can be provided without the supporting facilities, therefore this service will cease. The BIPM will attempt to arrange for these calibrations at some NMIs within the relevant RMO, but NMIs cannot replace this free service. This problem remains unsolved. The senior staff at the BIPM will still provide a service to the CCPR, even without a laboratory.

The President asked for comments on this issue. He mentioned that the services of the secretariat will continue, but that the BIPM's services as a pilot laboratory for comparisons and for the calibrations of incandescent lamps will disappear.

Prof. Metzdorf asked about the number of photometric and radiometric calibrations performed per year. Dr Quinn replied that approximately 40 lamps (with a re-calibration period of four to five years) are calibrated for luminous flux, luminous intensity and color temperature every year.

Dr Fox mentioned that one of the strengths of the BIPM is that it maintained the world mean candela and that the reference standards were maintained very well over a significant time. He wanted to know what will happen to the lamps.

Dr Quinn replied that this has not been decided yet and asked for suggestions on what the lamps could be used for in future.

Dr Fox stated that it should be kept for historical records. The recent comparison did not show significant improvement; the results were very similar to the results of the previous years. The maintenance of these lamps is therefore very important.

Dr Quinn noted that the detector-based standards and the calibration of lamps will solve this problem. It is not important to have the lamps.

Prof. Metzdorf said that the lamps are important. In future, NMIs should be identified to do the BIPM work, whether it is free of charge or not. Maybe the lamps can be divided between three or four laboratories. These laboratories should study the stability of the lamps and the history of the unit. He inquired about the calibration service for approximately 40 lamps per year. Who will do the work and who will bear the cost for these calibrations?

Dr Quinn said that it will be most efficient if the BIPM performs these calibrations. This was conveyed to the directors of NMIs, but not accepted. The cost will have to be covered by the NMIs.

The President asked Dr Quinn if he is suggesting that the NMIs perform these calibrations for free.

Dr Quinn replied that the CCPR can make a recommendation, but not a decision. It is up to the NMI to decide whether or not to provide the calibrations free of charge.

Dr Fox stated that the use of lamps will provide no technical gain, only the preservation of history.

Dr Quinn stated that the BIPM equipment will be kept for the time being and will not be thrown away.

Dr Bastie mentioned that the result of a comparison is always compared with the previous result. Each time it was decided to replace the old KCRV with the new value. He suggested that the lamps are kept with the result of the key comparison.



The President noted that a calibration cannot be done with the lamps alone; a bench, power supply, etc. is also required. The lamps should be available to a new NMI. He enquired whether the BNM is a possible institution to do this.

Dr Bastie replied that the lamps should be available to people competent to use them. The decision is best left to the BIPM.

Prof Ikonen mentioned that the NMIs will have to bear the cost resulting from the closing of the BIPM calibration services and will have to bear more costs as the BIPM will not coordinate comparisons. The cost to pilot a comparison will therefore not be evenly shared between the participants.

The President inquired whether it would be possible to maintain accessibility to the BIPM photometric facilities to those who require them. Dr Quinn wanted to know when it will be used next for a comparison. The President replied that it will most likely be in 10 years' time.

Dr Quinn said that the lamps will be kept safely until required for use. A decision on what to do with the lamps will be made at the time of the next comparison. This decision was accepted.

Dr Fox mentioned that the cost to an NMI to calibrate 40 lamps is not that high in comparison with membership fees, but NMIs will soon want free calibrations for other photometric quantities. Free calibrations for all calibrations pose bigger problems. Should 10 lamps per year be calibrated for free by a number of laboratories? Where should the line be drawn? Is it possible to draw a line?

Dr Ohno asked how it would be possible for an NMI to provide free calibrations. NIST is not able to do so and it is likely to be the case with other NMIs as well. Smaller NMIs will have a bigger problem.

Dr Quinn said that the decisions taken by the big NMIs will result in a problem for smaller NMIs. There is no solution.

The President suggested that the calibrations be limited to, for example, three per laboratory for a limited number of years. Even this is not likely to be allowed by the CSIR-NML.

Dr Xu stated that the calibrations should not be a problem. The BIPM has closed its photometry laboratories. This fact should be accepted. The anticipated free calibrations services will not be provided in future and smaller NMIs should start to realize their own standards, which should not necessarily be a big problem.

Dr van der Ham asked what the current status of the BIPM photometry laboratory is. Is it closed already? Whereto will values previously traceable to the BIPM be traceable to now?

Dr Quinn replied that he has no information on what former clients are doing.

Prof. Metzdorf stated that the calibration work and additional work for pilot laboratories will be given to the bigger NMIs (namely BNM, NIST, NPL and PTB). These laboratories are usually the pilot laboratories. The possibility of providing services at no charge is difficult, if not forbidden by country laws. The PTB can, possibly, if required, offer the calibration at 50 % of the cost instead of 100 %. Different arguments can possibly be found for other NMIs and can be discussed at NIST or NPL. Is such a solution possible? The bigger laboratories have to carry some of these costs.

The President reasoned that the closure of the BIPM photometry and radiometry activities will be a positive point for smaller countries to improve their facilities. They should budget for improvements and in future not think of free services.

Dr Boivin asked Dr Quinn whether the BIPM laboratory equipment and laboratory space will be available for use to NMIs. Dr Quinn confirmed that it will be available.

Dr Boivin asked if it would be possible that the BIPM retains a core expertise and equipment to assist in international comparisons. Dr Quinn replied that the expertise will not be maintained as it is not feasible.

Dr Xu inquired about the cost of bilateral and regional comparisons. He stated that regional comparisons are not always available to every country and these countries therefore have to participate in more bilateral comparisons. Are the bigger NMIs always willing to participate in a bilateral comparison with a smaller NMI? Could a system be implemented to address this issue?

Dr Quinn replied that this issue is not solved formally. NMIs who participated in the key comparison are morally obliged to participate in the regional comparison. Those NMIs who participated in the regional comparison are in turn obliged to participate in bilateral comparisons.

Dr Fox stated that the NPL considers it a priority to participate in comparisons provided that it approves of the time scale. It is therefore encouraged and funded to participate in bilaterals. Regarding the cost of the calibration of the lamps: the participants may be worrying about a problem than may end up not being a problem. He suggested that the smaller NMIs should be left to decide what to do; any problems will be identified later.

Dr Quinn replied that the calibration costs are known, but the additional costs to the bigger NMIs are unknown. However, it will not be an enormous amount.

The President asked for final comments after the extensive discussion. He also pointed out that the laboratories had the opportunity to give feedback on this issue in the Questionnaire.

Prof. Metzdorf suggested that calibrations at NMI A for NMI B be carried out in the first four months of the year, and calibrations for NMI C at another part of the year. This may also lead to reduced costs in practice.

The President asked whether this arrangement would also apply to bilaterals. Dr Metzdorf replied that bilaterals do not happen that often.

Dr Ohno mentioned that NIST would also like to cooperate but its strict rules regarding fixed prices make this arrangement impossible. Issuing an official calibration report may then not be possible. He said the legal implications need to be investigated.

## 15 OTHER BUSINESS

### 15.1 Photobiology

Dr Bastie reported that measurements in the field of biology, health and safety are becoming increasingly important and need to be linked directly to the SI. The units of photobiological quantities can be linked to the SI in a similar way as the candela, which is one of the base SI units and also a photobiological unit.

In accordance with what's been done for the measurement of photometric quantities, it is possible to define a biological unit and determine a numerical value for the corresponding photobiological quantity using the following formula:

$$I_{bio} = K_{bio} \int_{\lambda} I_{e,\lambda}(\lambda) \cdot F_{bio}(\lambda) \cdot d\lambda$$

where:

$I_{bio}$  is the intensity of the photobiological effect,

$K_{bio}$  is a constant depending on the chosen unit for defining the photobiological effect,

$I_{e,\lambda}$  is the spectral radiant intensity of the radiation impinging on the photobiological receiver,

$F_{bio}(\lambda)$  is the action spectrum of the photobiological effect.

The action spectrum for the photobiological effect is defined in the same way as  $V(\lambda)$  by consensus among users.

At its 9th meeting, in 1977, the CCPR had a long discussion and offered a recommendation to the CIPM, which suggested that a particular choice of the action spectrum function without unit be made and to use for the photobiological unit the corresponding radiometric unit. In this way, the constant  $K$ , in the above equation, to 1.

The Working Group on Photobiological Quantities recommended that the CCPR make a formal recommendation to the CIPM to include this method of assigning radiometric units to photobiological (or weighted) quantities in the SI brochure. A new edition of the SI brochure is prepared by the CCU at the moment. The content of the information in the SI brochure should be:

- the definition of the photobiological quantity;
- the definition of the action spectra;
- the method of deriving units for photobiological quantities from SI units according to the recommendation of the CCPR (1977) using radiometric units corresponding to the various types of measurements.

The objective is not to introduce a new SI unit but to give practical advice on the measurement of photobiological quantities using the SI in order to avoid the proliferation of non SI units. (see working document [CCPR/03-01](#))

A decision was made by the CCPR meeting not to endorse action spectra. Whatever action spectrum is used should be clearly identified and if a standard exist, it should be used. The working group will circulate the draft report to CCPR members by the end of the year.

## 15.2 Reporting of comparison results in *Metrologia*

The BIPM has adopted a new editorial policy for the publication of the final reports of key, supplementary and MRA-related bilateral comparisons. Reports that have been entered (after approval by the CC) into the KCDB after 1 January 2002 will be published in a *Technical Supplement to Metrologia*.

When submitting a final report to the KCDB, authors will receive an automatic request to indicate whether they wish to have it published in the *Technical Supplement*. The title (including the comparison reference number) and abstract submitted by the author will be published as a one page entry to the *Technical Supplement*. A link to the final report will be made in Appendix B of the KCDB.

Comparison reports that contain new developments and that are not the run of the mill comparisons will still be accepted for publications in the printed version of *Metrologia*. Authors are welcome to submit articles via this route instead of having it published in the *Technical Supplement*. However, these articles will still undergo the normal independent peer review process and their acceptance will be subject to the Editor's approval.

The *Technical Supplement* will be accessible free of charge to all and will be available only as an electronic version via the BIPM website. References to the *Technical Supplement* will be made as follows:

Smith J., *Metrologia*, 2002, **39**, *Tech. Suppl.*, 03001

The code 03001 refers to the first article in the field of thermometry (code 030).

There are three advantages of introducing the *Technical Supplement*, namely; reports can be published very quickly, the report does not need to be re-written as it does not need to conform to *Metrologia* style, and it will have a citable reference.

## 15.3 Presentation on eutectic black bodies

Dr Sapritski reported that VNIIOFI is developing and optimizing large area high temperature fixed-point eutectic-based black bodies for applications in radiometry, radiation thermometry and photometry. These fixed points are based on Re-C (2748 K),  $\delta$ (MoC)-C (2856 K), TiC-C (3034 K), ZrC-C (3154 K) and HfC-C (3458 K).

A new black body for work with eutectics, the BB3500MP, has been developed.

A project in which NPL, PTB and VNIIOFI participated concluded that high temperature eutectic-based fixed points could improve the thermodynamic temperature measurements within the 2500 K to 3500 K temperature range to reach an uncertainty of about 150 mK to 300 mK with a reproducibility of 30 mK to 50 mK.

A significant improvement of the uncertainty of radiometric measurements can be achieved by using high-temperature fixed points; especially in the UV region where an uncertainty of 0.1 %

can be obtained by using crucibles with large openings filled with TiC-C, ZrC-C and HfC-C eutectics.

The photometric scale can be realized using Re-C and  $\delta(\text{MoC})\text{-C}$  fixed point black bodies and detector-based radiometry.

Comparisons of radiometric, photometric and temperature scales could be performed by exchanging cells instead of the tungsten and deuterium lamps currently used.

#### **15.4 Feedback to BIPM questionnaire**

Dr Quinn asked whether it is adequate notice to fix the date of the CCPR meeting six months in advance. The meeting can then be planned around a number of meetings which already have fixed dates. He suggested that the dates not suitable for the meeting should be submitted to the CIPM before its meeting in October.

A decision was made to fix the date of the meeting before the CIPM meeting in October.

#### **15.5 Document publication**

Dr Quinn requested the participants to give greater consideration to meeting deadlines for submitting replies to the questionnaire.

He asked whether the CCPR working documents should become publicly accessible. It was decided that the documents will be listed during the meeting as accessible either publicly or only to the CCPR participants.

#### **15.6 General**

Dr Boivin suggested that invitations to WG-KC meetings should include all participants in the CCPR meeting. Dr Quinn replied that there is not enough space in the venue and that it requires only a relatively small number of people to get into a subject deeply. To do otherwise will defeat the purpose of the working group.

The President suggested that if a CCPR meeting attendee is sufficiently interested in a working group meeting he/she should ask for permission to attend from the working group chairperson. Permission will not be unreasonably withheld.

Dr Ballico said that fairly significant issues that affect everyone are discussed at the working group meetings, especially at WG-KC meetings. One or two of these issues should be discussed during the CCPR meeting for an hour (for example the calculation of the KCRV and changes accepted to data before circulation of Draft A reports). The discussion behind the decision should be reported to the meeting. This will help participants to have ownership of the comments.

Dr Quinn responded that it is the working group's responsibility to solve issues and that the working group should be a representative group from the CCPR. The working group debates the issues and compromise. If the issues are discussed at the CCPR meeting, all the arguments will be re-done. The membership of the working group should be chosen such that the CCPR

meeting can accept the decisions. Only when a decision is not acceptable should the discussions be opened.

Dr Nettleton suggested that the membership of the working groups should be formalized. The concerns will be satisfied in this way.

Dr Boivin said that we should compromise by copying all CCPR participants when inviting WG-KC members and that the agenda for the meeting should be included in the invitation. Interested participants can then apply to attend.

Dr Quinn replied that the chairperson of the working group should inform the Executive Secretary which participants have accepted the invitation to attend a meeting. A registration form should be completed.

Dr Nettleton said that a workable size of working groups should be decided on. Dr Stock added that the membership of the WG-KC should be reconsidered from time to time.

It was concluded that the agendas to working group meetings will be circulated to all participants of the CCPR. The attendance of individuals as observers will be considered by the President. The reconsideration of working group membership will be a standard agenda item in future.

## **16 REPORT TO THE CIPM AND RECOMMENDATIONS**

The concern about the significant cost of comparisons will be reported to the CIPM. It may be that it is impossible to find a pilot laboratory to carry the cost (for example for CCPR-K1) of a key comparison. This will impact the frequency of comparisons.

A recommendation will be made to the CCU to include a method for assigning radiometric units to photobiological (or weighted) quantities in the new edition of the SI brochure.

The President will report on the importance of photometry and radiometry for the world at the CIPM meeting. The views aired in the questionnaire will be included as feedback.

## **17 DATE OF NEXT MEETING**

The participants agreed that the two-year cycle of the CCPR meetings is adequate. The 2005 meeting will be fixed with the scheduling of CC meetings by the BIPM. It is suggested that it

should be held in conjunction with the NEWRAD conference which will be held from 19 to 23 September 2005\*.

Dr Fox mentioned that Dr Boivin has attended the CCPR meeting for the last time and thanked him for his contribution on behalf of all the participants.

The President added that it is also Dr Quinn's last CCPR meeting and thanked him for his valued contribution over the many years. He also thanked the members of the BIPM's photometry section for their significant contributions to metrology and wished them well for the future.

The President thanked the participants for their contributions and closed the meeting.

Ms N. van Tonder, Rapporteur

May 2004

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\* After the CCPR meeting, the date for the NEWRAD conference has been changed to 17-19 October 2005. The next CCPR meeting is planned for the week of 24-28 October 2005.

**APPENDIX P 1.****Working documents submitted to the CCPR at its 17th meeting**

Open working documents of the CCT can be obtained from the BIPM in their original version, or can be accessed on the BIPM website:

<http://www.bipm.org/cc/AllowedDocuments.jsp?cc=CCPR>

Document  
CCPR/

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|--------------|---|
| 03-01        | BNM-INM (France). — Note on photobiological quantities, J. Bastie, 5 pp.  |
| 03-02        | CIE. — CIE activities relevant to CCPR activities, J. Bastie, 6 pp.   |
| 03-03 (rev.) | CCPR. — Replies to the CCPR questionnaire, 91 pp.   |
| 03-04        | BIPM. — Calculation of KCRVs in other Consultative Committees, M. Stock, 2 pp. (restricted access)  |
| 03-05        | BIPM. — Report on the bilateral comparisons of cryogenic radiometers BIPM-IEN and BIPM-NMIJ, Draft B, R. Goebel, M. Stock, 13 pp. (restricted access) |
| 03-06        | NPL (United Kingdom). — Activities of CCT WG5: Radiation Thermometry (incorporating former CCPR/CCT joint WG), N. Fox, 41 pp.                         |
| 03-07        | CCPR UV Working Group. — Draft minutes of the meeting of the CCPR UV Working Group, E. Ikonen, 2 pp.  |
| 03-08        | PMOD/WRC (Switzerland). — CCPR 2003 relation to radiation issues of the WMO, W. Schmutz (PowerPoint presentation) (restricted access)                 |
| 03-09        | NPL (United Kingdom). — NPL report on laboratory activities, N. Fox, 22 pp. (restricted access)   |
| 03-10        | NPL (United Kingdom). — CCPR-K1.a key comparison of spectral irradiance 250 nm – 2500 nm, N. Fox, 19 pp. (restricted access)                          |
| 03-11        | BNM-INM (France). — Preliminary results of CCPR-K6 (spectral regular transmittance), J. Bastie, 14 pp. (restricted access)                            |



**APPENDIX P 2.**  
**Consultative Committee Working Groups on CMCs**  
(from JCRB document JCRB-11/6(2) 2003-11-07)

**Terms of reference:**

To facilitate the Inter-regional CMC Review Process, it is recommended that each Consultative Committee form a Working Group on CMCs. The objective of the WG will be:

- a)* to establish and maintain lists of service categories, and where necessary rules for the preparation of CMC entries;
- b)* to agree on detailed technical review criteria;
- c)* to coordinate and where possible conduct inter-regional reviews of CMCs submitted by RMOs for posting in Appendix C of MRA;
- d)* to provide guidance on the range of CMCs supported by particular key and supplementary comparisons;
- e)* to identify areas where additional key and supplementary comparisons are needed;
- f)* to coordinate the review of existing CMCs in the context of new results of key and supplementary comparisons.

This WG should include representation from all RMOs that have NMIs active in the relevant technical area. WG membership is expected to come from the relevant RMO committees involved in CMC reviews; appropriate experts being chosen depending upon the particular field under review.