Bureau International des Poids et Mesures

Consultative Committee for Photometry and Radiometry (CCPR)

Report of the 20th meeting
(17–18 September 2009)
to the International Committee for Weights and Measures

Comité international des poids et mesures

Note:

Following a decision of the International Committee for Weights and Measures at its 92nd meeting (October 2003), reports of meetings of the Consultative Committees are now published only on the BIPM website and in the form presented here.

Full bilingual versions in French and English are no longer published.

Working documents for the meetings are listed at the end of the report and those which the Consultative Committee decides are for public use are also available on the website.

A.J. Wallard,
Director BIPM

Version 2: amended 13 April 2011

LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR PHOTOMETRY AND RADIOMETRY AS OF 17 SEPTEMBER 2009

President

Dr F. Hengstberger, member of the International Committee for Weights and Mesures, GTMS (Pty), Pretoria.

Executive Secretary

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

Members

Centre for Metrology and Accreditation [MIKES], Espoo

Centro Nacional de Metrología [CENAM], Querétaro

Federal Office of Metrology [METAS], Bern-Wabern

Hungarian Trade Licensing Office [MKEH], Budapest

Institute for Optico-Physical Measurements, Rostekhregulirovaniye of Russia [VNIIOFI], Moscow

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

Istituto Nazionale di Ricerca Metrologica [I.N.RI.M], Torino

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

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

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 Institute, Australia [NMIA], Lindfield

National Metrology Centre [NMC-A*STAR], Singapore

National Metrology Institute of Japan, AIST [NMIJ/AIST], Tsukuba

National Metrology Institute of South Africa [NMISA], Pretoria

National Metrology Institute of Turkey [UME], Gebze-Kocaeli

National Physical Laboratory [NPL], Teddington

National Research Council of Canada [NRC-INMS], Ottawa

Physikalisch-Technische Bundesanstalt [PTB], Braunschweig

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

VSL [VSL], Delft

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

Observers

Commission internationale de l'éclairage [CIE], Wien

World Meteorological Organization [WMO], Geneva

1 OPENING OF THE MEETING; MEMBERS AND OBSERVERS PRESENT; INTRODUCTIONS.

The Consultative Committee for Photometry and Radiometry (CCPR) held its 20th meeting at the International Bureau of Weights and Measures (BIPM) headquarters at Sèvres, France, on Thursday 17 September and Friday 18 September 2009.

The following were present: G. Andor (MKEH), P. Blattner (METAS), J. Dubard (LNE), N. Fox (NPL), A. A. Gaertner (NRC-INMS), F. Hengstberger (member of the CIPM, President of the CCPR, NMISA), X. Huang (NMC-A*STAR), E. Ikonen (MIKES), B. Khlevnoy (VNIIOFI), S.-K. Kim (KRISS), D.-H. Lee (KRISS), Y. Lin (NIM), P. Manson (NMIA), P. Nemeček (SMU), K. Nield (MSL), Y. Ohno (NIST), A. Pons (IFA-CSIC), M. L. Rastello (INRIM), K. Rochford (NIST), T. Saito (NMIJ), V. I. Sapritsky (VNIIOFI), W. Schmutz (PMOD/WRC, expert of METAS), R. Sieberhagen (NMISA), K. Stock (PTB), K. Türkoglu (UME), G. Ulm (PTB), E. van der Ham (VSL), A. J. Wallard (Director of the BIPM), E. Woolliams (NPL), G. Xu (NMC-A*STAR), T. Zama (NMIJ), J. Zwinkels (NRC-INMS).

Observers: J. Bastie (representing CIE).

Guests: M. Smid (CMI).

Also attending the meeting: R. Goebel (BIPM), M. Kühne (Deputy Director, BIPM), M. Stock (Executive Secretary of the CCPR, BIPM), C. Thomas (Coordinator of the KCDB, BIPM)

Apologies were received from J. Campos Acosta (IFA-CSIC), G.T. Fraser (NIST), C. Matamoros (CENAM), N. Nel-Sakharova (NMISA), A. Razet (LNE), I. Ruedi (WMO) and Hsueh-Ling Yu (CMS/ITRI).

The President, Dr Hengstberger, opened the meeting, welcoming representatives and guests. He offered a particular welcome to BIPM Director, Prof. Wallard and to the BIPM Director Designate, Prof. Kühne.

Prof. Wallard welcomed all to the BIPM for the 20th meeting of CCPR. He announced that it will be his last CCPR meeting as BIPM Director as he will leave the position of Director at the end of 2010. He introduced his successor, Prof. Kühne, who arrived at the BIPM in April 2009. Prof. Wallard gave a brief outline of the professional career of Prof. Kühne mentioning particularly his activities related to EUV radiometry at the PTB laboratory at BESSY.

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

The President asked the participants to observe a minute of silence as a sign of honour and respect towards Dr Rainer Köhler (former Executive Secretary of the CCPR) who passed away in October 2008.

2 APPOINTMENT OF THE RAPPORTEUR AND FINALIZATION OF THE AGENDA

Dr Blattner was appointed as rapporteur for the meeting. The draft agenda (CCPR/09-02) distributed before the meeting was accepted by the members with no additional items requested.

3 APPROVAL OF THE MINUTES OF THE LAST MEETING

The President informed that the minutes of the 19th meeting were published on the BIPM website and that since 2003 paper versions were no longer provided.

Dr Zwinkels proposed to adopt the minutes without changes.

Decision D1: CCPR approved the minutes of the last meeting.

4 MATTERS ARISING FROM THE MINUTES OF THE LAST MEETING

The President reported the following actions arising from the minutes of the 19th meeting:

- **Item 9.1.5, Appointment of CIE and WMO as Observers to CCPR:** The President recalled that the CIE and the WMO now have observer status. Dr Schmutz represents WMO and Dr Bastie represents CIE. The President announced that a meeting on metrology and climate change will be held at the end of March 2010 at the WMO headquarters in Geneva. The meeting will be by invitation only, in order to have a target audience and target actions from that meeting.

- **Item 15.1, Initiative on biological and physiological quantities**: The President announced that a BIPM workshop on Physiological Quantities and SI Units will be held in November 2009 at the BIPM. Photometry and Photobiology is regarded as important and will be included in the workshop. Dr Ohno and additional experts will present recent activities related to photometry and radiometry.

5 DOCUMENTS PRESENTED TO THE MEETING

The President submitted the list of ten working documents to the meeting. The complete list of these working documents and those added after the meeting is given in Appendix P 1. The documents are available from the CCPR restricted-access website.

6 REVIEW OF PROGRESS MADE BY CCPR MEMBER LABORATORIES SINCE THE 19TH MEETING

The President commented that this agenda item is important for stimulating scientific exchange between the members. The detailed activity reports and the presentations can be found on the password-protected CCPR website.

CMI: Mr Smid presented the progress made by CMI.

IFA-CSIC: Mrs Pons presented the progress made by IFA-CSIC.

INRIM: Dr Rastello presented the progress made by INRIM including the work started in the framework of the European Metrology Research Programme (EMRP). In particular she outlined the Joint Research Project *"Candela: Towards quantum-based photon standards"*. Dr Rastello thanked Prof. Kühne for his efforts and support for the EMRP.

KRISS: Dr Lee presented the progress made by KRISS.

LNE: Dr Dubard presented the progress made by LNE.

METAS: Dr Blattner presented the progress made by METAS.

MIKES: Prof. Ikonen presented the progress made by MIKES. He presented a theoretical study on linking laboratories to RMO and CCPR comparisons through bilateral comparisons. The mathematical expressions include contributions of the participants and of the link but the systematic and random components have to be taken separately into account.

MKEH: Mr Andor reported the progress made by MKEH.

MSL: Mrs Nield presented the progress made by MSL.

NIM: Mr Lin presented the progress made by NIM.

NIST: Dr Ohno presented the progress made by NIST Gaithersburg. Dr Rochford presented the progress made by NIST Boulder.

NMC-A*STAR: Mr X. Huang presented the progress made by NMC-A*STAR.

NMIA: Dr Manson presented the progress made by NMIA.

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

NMISA: Mr Sieberhagen presented the progress made by NMISA.

NPL: Dr Woolliams presented the progress made by NPL.

NRC: Dr Zwinkels presented the progress made by NRC.

PMOD/WRC: Prof. Schmutz presented the progress made by PMOD/WRC.

PTB: Dr K. Stock presented the progress made by PTB (Braunschweig). Dr Ulm presented the progress made by PTB (Berlin).

SMU: Dr Nemeček reported the progress made by SMU.

UME: Mr Türkoglu presented the progress made by UME.

VNIIOFI: Prof. V. Sapritsky presented the progress made by VNIIOFI.

VSL: Dr van der Ham presented the progress made by VSL (formerly NMi-VSL).

The President thanked everyone for the preparation of the reports and the presentations. He opened the floor for questions and comments to the presentations. No comments were received.

He stated that decisions on which presentations will be made openly available on the BIPM website will be taken later in the meeting; the others will remain protected by password.

The President concluded these reviews by remarking on how pleasing it was to see the impressive amount of development that has taken place over the past two years.

7 REPORT OF THE WORKING GROUP ON CALIBRATION AND MEASUREMENT CAPABILITIES (WG-CMC)

Dr Blattner presented the report of the Working Group on Calibration and Measurement Capabilities.

The working group met on 12 October 2008 at KRISS, Daejeon, Rep. of Korea. Representatives from APMP, EURAMET and SIM were present. No representatives were present from SADCMET and COOMET. The meeting was chaired by Dr Blattner. A second working group meeting was held in connection with the 20th CCPR meeting. No official representative from SIM was present.

It has been decided that the terms of the chairmanship shall be increased to 2 years. The next term is taken by AFRIMETS followed by APMP, COOMET, EURAMET and SIM. It has also been decided that the period between meetings shall be increased to 2 years and that the handover of the chairmanship shall be at the end of the corresponding meeting.

Dr Blattner stated that Revision No. 10 of the CCPR classification of services, dated January 2009, is now available from the KCDB website. The version includes new services in the field of LED measurements, luminous intensity (1.1.2) and luminous flux (1.3.2).

At the last CCPR WG-CMC meeting it was decided that the total spectral radiant flux of tungsten lamps and total radiant flux of LEDs should be included in the next revision of the classification list. It was also agreed that several quantities in the field of reference solar cells should be included. The detailed service descriptions will be elaborated by the participants of the proposed supplementary comparison on solar cells.

Within CCPR WG-CMC there was some discussion as to whether the quantities “refractive index of materials” and “angle of rotation of the plane of polarization” shall be part of the CCPR service categories. It was decided that the chair of CCPR WG-CMC shall approach CCL and CCQM to discuss the issue.

A task group, chaired by Mr Matamoros, has been created to define service categories for fibre optics. Several quantities including linearity, optical fibre length and polarization mode dispersion are under revision. The task should be accomplished within one year.

The guidelines on participation in key comparisons required to support CMC claims for the various service categories have been approved in the form of an Excel™ table. The table can be downloaded from the CIPM MRA policy document webpage[1].

Dr Blattner reported that there are no major outstanding issues with the regular CMC review process and few new CMC entries have been requested. NMIs can check the status of the inter-RMO process on the JCRB website http://www.bipm.org/JCRBCMCs/. If an NMI already has CMCs in the KCDB, all changes (additions, modifications, deletions) shall be made in the Excel™ table of the existing CMCs. This file can be downloaded from the JCRB CMC website using the "get published CMCs" link. The formatting of CMCs is described in the document CIPM MRA-D-04: "Calibration and Measurement Capabilities in the context of the CIPM MRA" available on http://www.bipm.org/en/cipm-mra/documents/.

The President welcomed the work done by CCPR WG-CMC. He emphasized that the objective of CCPR WG-CMC is mainly to coordinate and approve the definition of CMC service categories and to provide guidance on the range of CMCs supported by particular key and supplementary comparisons. With respect to other CCPR working groups, the WG-CMC has a unique role.

Prof. Wallard asked if the motivation to include new service categories was based on requests from accredited laboratories and industries.

Dr Blattner replied that photometry and radiometry is undergoing some important changes due to the phasing-out of classical incandescent light bulbs. New light sources need additional characterizations. He added that as solar energy becomes more important so will the related calibration and measurement capabilities.

Prof. Wallard asked if some cases appeared where claims by an accredited laboratory were smaller than those of the National Metrology Institute.

Dr Blattner replied that he is aware of only one specific case where an NMI provided a calibration certificate to another NMI, mistakenly including the CIPM MRA logo, declaring a calibration uncertainty smaller than the related CMC published in the KCDB. However corrective actions were taken by the quality management system of the NMI concerned. Dr Blattner declared that he had never faced a case where an accredited laboratory claimed smaller uncertainties than the NMI through which the laboratory took its traceability.

Dr Fox stated that it is not the responsibility of National Metrology Institutes to control the uncertainty claims of accredited laboratories.

8 REPORT OF THE WORKING GROUP ON KEY COMPARISONS (WG-KC)

Dr Ohno, chair of WG-KC, presented the report of the Working Group on Key Comparisons.

The main task of the WG-KC is to establish and maintain a list of key and other comparisons, to coordinate and schedule key comparisons, to provide supplementary guidelines on conducting

[1] www.bipm.org/en/cipm-mra/documents/cmc_excel_files.html

comparisons and to recommend general principles for the calculation of key comparison reference values in photometry and radiometry.

The last meeting was attended by 29 participants including all eight NMI members and one temporary member. No changes of permanent membership were proposed. MSL (pilot of 2nd round CCPR-K6) has become a temporary member. The current members are: KRISS, MIKES, MSL, NIST, NMIA, NMIJ, NPL, NRC, and PTB.

CCPR WG-KC requested approval for a change to the terms of reference specifying more precisely the beginning and ending of temporary membership.

Decision D2: CCPR approved unanimously a minor modification in the terms of reference of WG-KC specifying the time of starting and ending of the temporary membership (i.e. when the pilot of a CCPR KC distributes the call for participation and after publication of the final report of the KC).

In respect to CCPR comparisons Dr Ohno mentioned the final reports published since the last meeting:

- CCPR-K6, spectral regular transmittance, 380 nm to 1000 nm, pilot LNE, approved in October 2008;
- CCPR-K1.b, spectral irradiance 200 nm to 350 nm, pilot PTB, approved in September 2008.

8.1 Status of CCPR key comparisons

Dr Ohno presented the progress of the ongoing key comparisons:

CCPR-K2.a, Spectral responsivity 900 nm to 1600 nm (NIST, contact: S. Brown)

Draft B was distributed to WG-KC in July 2009 and approved by WG-KC in September 2009 with minor editorial changes. The final Draft B was sent to the CCPR Executive Secretary to be distributed for CCPR approval.

CCPR-K2.c, Spectral responsivity 200 nm to 400 nm (PTB, contact: L. Werner)

The measurements are complete, and the pre-Draft A process is in progress. Unfortunately the statistical consistency test failed. The pilot will discuss with participants corrections for the drift of transfer standards, possible removal of outliers, and possibly use of an alternative method for data analysis.

CCPR-K5, Spectral diffuse reflectance (NIST, contact: Y. Ohno)

Draft A was distributed to all participants in October 2008 and comments were received from MKEH, NRC, NPL, and MIKES in December. Draft A-2 in the form of Draft B is being prepared, to be distributed by the end of 2009.

Pilot comparison on spectral responsivity 10 nm to 20 nm (PTB, contact: F. Scholze)

The Draft B has been reviewed by WG-KC and the final report is to be published in the Technical Supplement of *Metrologia*.

2nd round CCPR-K6, Spectral regular transmittance (piloted by MSL)

The call for participants was distributed to CCPR members with a deadline of 12 September 2009. Twelve applications were received. The 12 participants of the 2nd round of CCPR-K6 have been finalized as MSL (pilot), A*STAR, MKEH, NIST, NPL, NRC, VNIIOFI, LNE, NMIJ, KRISS, PTB and NMISA. Therefore, no selection process will be required by the RMOs.

8.2 Status of CCPR supplementary comparisons

CCPR-S1, Spectral radiance 220 nm to 2500 nm (VNIIOFI)

The final report was published in August 2008.

CCPR-S3, Cryogenic radiometers (Bilaterals NPL-NMIJ, NPL-UME, NPL-A*STAR, NPL-CMI)

The reports are being produced separately for each participant. The Draft B Report of the bilateral comparison NPL-A*STAR was submitted to the WG-KC in July 2009. The review is in progress. Further reports for the other participants will be submitted separately.

8.3 Reports from RMO comparisons

This is reported under agenda item 13.

8.4 Proposals for new comparisons

The WG-KC proposed a comparison of spectral responsivity in the EUV (10 nm to 200 nm). PTB would act as a pilot. The comparison could start in 2019, after the successful completion of a pilot comparison.

Decision D3: The CCPR unanimously approved the comparison CCPR-K2.d of spectral responsivity (10 nm to 200 nm), to be piloted by the PTB starting in 2019 after successful completion of the pilot comparison.

Dr Fox stated that a task group chaired by NMISA will evaluate the prospect of a pilot comparison for spectral regular transmittance in the UV range. The initial proposed spectral range covers 200 nm to 400 nm, however the task group will consider advice on a reasonable wavelength range. The task group will also investigate the appropriate transfer standards.

8.5 Next round of comparisons

The WG-KC recommends that for the next round there will be only one CCPR-K3 comparison, called luminous intensity, and the details of the comparison (use of lamps or photometers) should be decided by the task group carrying out the comparison. The task group will be established by WG-KC and its proposal of comparison artefacts shall be submitted to CCPR for approval.[2] The CCPR approved this process.

[2] Correction: sentence amended on 13 April 2011

The President recalled that in 2007 both types of comparison (i.e. K3.a and K3.b) were retained. In its 2008 meeting, WG-KC changed its opinion to recommend only one comparison in order to reduce the workload of the NMIs.

Dr Blattner noticed that a comparison called luminous intensity should be on lamps because the quantity 'luminous intensity' is a property of a source.

Decision D4: With respect to the second round of key comparison CCPR-K3, the CCPR approved that there should be only one comparison called "luminous intensity" and that the dedicated comparison task group will decide on the type of standard to be used.

Dr Ohno presented the timetable for the next round of key comparisons.

Year (start of measurement)		KC quantity	Pilot
2011	**K6**	Regular spectral transmittance	**MSL**
2012	**K3**	Luminous intensity	**NRC**
2012	**K4**	Luminous flux	**NMIJ**
2013	**K2.b**	Spectral responsivity 300 nm to 1000 nm	**KRISS**
2013	**K2.a**	Spectral responsivity 900 nm to 1600 nm	**NPL**
2014	**K1.a**	Spectral irradiance 250 nm to 2500 nm	**NMIA**
2015	**K5**	Diffuse spectral reflectance	**MIKES**
2016	**K1.b**	Spectral irradiance 200 nm to 350 nm	**NIST**
2017	**K2.c**	Spectral responsivity 200 nm to 400 nm	**PTB**
2019	**K2.d**	Spectral responsivity 10 nm to 200 nm	**PTB**

The WG-KC will ask the pilots of CCPR-K3 and CCPR-K4 to prepare the "call for participation" as soon as possible so that the measurements can start in 2012.

The WG-KC notes the intention of RMOs to carry out the following supplementary comparisons:

- Solar reference cells (EURAMET)
- Wavelength of fibre optic source (APMP)
- OTDR length (APMP)

The WG-KC encourages an RMO supplementary comparison on "polarization mode dispersion" to underpin the review of related CMCs.

The WG-KC proposes the numbering format as CCPR-Kx.YEAR. The x number is the same as for the first round for each quantity. YEAR is the year when the comparison is registered in the KCDB.

Decision D5: CCPR approved unanimously the numbering format of CCPR KCs.

The President specified that the agreed form of numbering will not be applied retroactively to the current comparisons.

8.6 CCPR guidelines on comparisons

Guidelines for acceptance of key comparison participants (CCPR/09-07)

The final draft was approved by WG-KC at the end of July 2009 and then distributed to the full CCPR on 7 August for comments by 8 September 2009. Dr Ohno explained the minor changes decided during the CCPR WG-KC meeting with respect to the distributed documents: The caption of section one, "Prerequisite for participants", was replaced by "Acceptance criteria for participants".

Decision D6: CCPR approved unanimously the new guidelines on acceptance criteria for the participation in CCPR KCs, including the minor modifications made at the WG-KC meeting the day before the CCPR meeting.

Guidelines for CCPR comparison report preparation - revision 2

The draft of revision 2 of the guidelines was distributed to the members of WG-KC for approval before the working group meeting. Comments were received from one member and accepted by WG-KC.

Decision D7: CCPR approved unanimously revision 2 of the guidelines for the preparation of CCPR comparison reports.

Prof. Wallard asked about problems of linking comparisons.

Dr Ohno replied that this topic will be addressed by a newly formed task group ("RMO Linkage") to recommend calculation methods to establish the link between CCPR-KCs and RMO comparisons, including bilateral ones. The Task Group is chaired by Dr Woolliams (NPL). The results shall be included in a data analysis section of the new guidelines for RMO and bilateral comparisons.

Dr Ohno also stated that the WG-KC has agreed to establish a discussion group on comparison analysis, chaired by Dr Woolliams. This discussion group shall discuss various issues on comparison analysis with experts.

The President commented that the discussion group on comparison analysis should only be created on the condition that the new structure of CCPR is approved.

Dr Fox observed that only the concept of discussion groups needs to be approved by the CCPR, not the discussion group itself, as they are mandated directly by the corresponding working groups.

Prof. Kühne questioned the aim of discussion groups in general. The President replied that this will be discussed later in agenda item 9.

Dr Xu asked about the timeline for accomplishing the work of the task group on RMO linkage. Dr Ohno estimated that this would take about one year. He stated that the treatment of outliers will be discussed by the new discussion group with a high priority and that the result would be implemented into the next revision of guidelines for the preparation of CCPR KC reports.

Prof. Wallard asked about the review of CMCs in light of new comparison results. Dr Ohno replied that this point is addressed in the guidelines on CCPR comparison reports. After a final

report has been published, the pilot laboratory sends a reminder to all participants to check the consistency of their CMCs with the comparison results, and to reply to the participant's RMO TC chair about their evaluation and any proposed actions in case of inconsistency.

Prof. Wallard confirmed that although the CCPR procedures do not exactly follow the CIPM MRA flowchart for the processing of key comparisons, they reflect perfectly the intention of the CIPM MRA giving the main responsibility to the NMI and the monitoring task to the RMOs.

Dr Ohno replied that the idea of the CCPR guidelines is to avoid an additional administrative burden for the pilot laboratory.

Dr Ohno continued his report on WG-KC activities. The WG-KC agreed that the technical protocols of all key comparisons should request information from the participants to identify correlated and uncorrelated components of uncertainties.

Dr Ohno stated that new guidelines are under development: a guideline for RMO key comparisons and a guideline for CCPR and RMO bilateral key comparisons. Most of the contents will be similar to the CCPR KC guidelines, however some adaptations are necessary (N.B. no KCRV is calculated in RMO KCs). The contents will be developed with RMO P&R TC chairs. Finally, the WG-KC has been developing a general guideline document for preparing CCPR key comparisons. This document will provide general guidance on the process before the preparation of the report.

WG-KC agreed to recommend to CCPR that, in all future key comparison reports, only tables of unilateral degrees of equivalences (DoE) are included and that no bilateral DoEs will be calculated. The drafts of the new guidelines are to be revised accordingly.

The President commented that this item had been discussed during the WG-KC meeting in the presence of JCRB Executive Secretary Luis Mussio, and that the inclusion of unilateral DoEs only is also being considered in other Consultative Committees. He stated that the bilateral DoE values can be calculated from the unilateral DoEs, except for their uncertainty calculations in the case of correlations.

Decision D8: CCPR approved that for future KCs only unilateral DOEs should be calculated (unless JCRB requires otherwise).

The President thanked Dr Ohno for the extensive work of CCPR WG-KC.

Dr M. Stock proposed to publish all CCPR guidelines on the CCPR publications web page.

9 REPORT OF THE WORKING GROUP ON STRATEGIC PLANNING (WG-SP)

Dr Zwinkels reported the progress made by the Working Group on Strategic Planning. The working group was formed in 2005. The main task of the WG-SP is to maintain a strategic planning document for the CCPR, to advise the CCPR on the optimal operational structure, to monitor developments with respect to the future of the SI and to regularly review the *mise en pratique* for the candela.

Current members are INRIM, KRISS, LNE, METAS, MSL, NIST, NMIJ, NMISA, VSL, NPL, NRC-INMS, and PTB.

The working group has set up five task groups, the latest two established during the last two years:

- TG 1, Terms of reference: 6 members, chair: Dr van der Ham;
- TG 2, Membership criteria: 5 members, chair: Dr Blattner;
- TG 3, CCPR structure: 7 members, chair: Dr Fox;
- TG 4, future of the SI: 5 members, chair: Dr Rastello;
- TG 5, *mise en pratique* of the candela: 4 members, chair: Dr Ohno.

No progress was made in TG 1 and TG 2 as their subjects depend on the decision on the future CCPR structure (i.e. TG3), to be discussed and approved in agenda item 12.

TG 4 is preparing a position paper entitled "Radiometry, photometry and "the candela": evolution in the classical and quantum world". The paper will be submitted to Metrologia by February 2010. WG-SP has approved the outline of the paper (CCPR WG-SP/09-06).

Action A1: WG-SP TG4 is to distribute to the full CCPR the final draft of the position paper "Radiometry, photometry and "the candela": evolution in the classical and quantum world" for information and comments, around February 2010.

TG 5 is tasked with updating the BIPM Monograph (1983) *"Principles Governing Photometry"* which will become, in the future, the *mise en pratique* of the candela definition. The next version needs to take account of the proposed new explicit-constant formulation of the SI units, new developments in the field of photometry and radiometry and the new CIE recommendation for the mesopic observer function. The target date is end of August 2010.

At the WG-SP meeting in 2008 an experimental discussion group "DG1" on photon counting was established, chaired by Dr Rastello. DG1 has organized, in connection with the present CCPR meeting, a technical half-day symposium presenting the progress of the joint research project (JRP) *"Candela: Towards the quantum-based photon standards"*. The project is carried out within the framework of the European Metrology Research Program EMRP.

At the 2009 meeting, the WG- SP proposed to establish two additional technical discussion groups (NB The concept of discussion groups will be discussed in agenda item 12):

- DG2 (reporting to WG-KC), comparison data analysis, leader: Dr Woolliams
- DG3, fibre optics, leader Dr Dubard.

Dr Zwinkels noted that the WG-SP has discussed the proposed rewording of the candela definition (see agenda item 11).

The WG-SP recommended modifying the last sentence in the existing Terms of Reference in a way that the working group will not only monitor developments with respect to the future of the SI but also respond on behalf of the CCPR.

Decision D9: CCPR approved minor modifications in the Terms of Reference of WG-SP: WG-SP should not only monitor developments with respect to the future of the SI but also respond on behalf of the CCPR.

10 UPDATE ON THE EXPECTED CHANGES OF THE SI

Dr M. Stock gave a presentation on the status of the expected changes to the SI. In 2005 the CIPM recommended making "preparative steps towards new definitions of the kilogram, the ampere, the mole and the kelvin in terms of fundamental constants" (Recommendation 1 (CI-2005)).

Based on this recommendation, the CCU proposes to redefine the kilogram, the ampere, the kelvin and the mole in such a way that fundamental constants will be fixed (NB h, e, k, N_A). The proposal is to go from explicit unit definitions (which are based on an experimental realization of the unit) to explicit-constant definitions, which fix the numerical value of a constant. CCU also recommends rewording the definitions of all other base units accordingly. Finally, the CCU also proposes changing the order in which the base units are presented in the SI brochure (i.e. to start with the second, then the metre and then the kilogram).

There are some conditions for the changes:

- the transition from the present units to the new units has to be smooth to avoid step changes, i.e. sufficient knowledge of the numerical values of h, e, k, N_A in the present SI is necessary and therefore a sufficient number and quality of experimental results are needed for h and k;
- the possibility of practical realization and dissemination of the definitions is necessary. This will be described in a *mise en pratique* for each base unit.

Dr M. Stock outlined three experiments that have published results related to a new kilogram realization (Avogadro 2003, NIST watt balance in 2006, NPL watt balance in 2007). Until recently a large difference between the Avogadro and watt balance experiments had been observed. In 2009 the results of the Avogadro experiment were re-analysed and the data are now closer to the NIST experiment. However, there is still an inexplicable difference between the results of the NIST and NPL watt balance experiments. The NPL experiment has been terminated and the watt balance sold to the NRC, where it will be reassembled in 2010.

Dr M. Stock stressed that a certain number of long-term operational watt balances will be needed to ensure that the new definition can be realized. At present, only the NIST experiment is operational. Additionally, an international coordination of watt balances, possibly by the BIPM, will be required for mass dissemination. Finally, a pool of mass artefacts, which will be calibrated against all available watt balances, should be available at the BIPM.

Dr M. Stock presented the history of measurements of the gas constant $R = k N_A$. In principle, a redefinition will be recommended by the CCT. However, it appears that only one experiment, based on acoustic gas thermometry (AGT), will reach the required 1 ppm uncertainty by the end of 2010. This date is the data deadline for the next adjustment of fundamental constants by CODATA.

Dr M. Stock outlined the timeline of the proposed redefinition:

March 2010:	CCM will discuss the *mise en pratique* for the kilogram
September 2010:	the CCU will make a recommendation to the CIPM

October 2010:	the CIPM will take a decision on the redefinitions and formulate a recommendation to the CGPM
Early 2011:	results of next CODATA adjustment
October 2011:	the CGPM will make the final decision

Dr M. Stock presented the proposed rewording of the candela definition which will bring it into the explicit-constant form. The subsequent discussion is reported in agenda item 11.

11 DISCUSSION ON THE PROPOSED REFORMULATION OF THE DEFINITION OF THE CANDELA

Dr M. Stock presented the definition of the candela proposed by the CCU, based on the explicit-constant approach:

"The candela, unit of luminous intensity in a given direction, is such that the spectral luminous efficacy of monochromatic radiation of frequency 540×10^{12} hertz is equal to exactly 683 lumens per watt."

The CCPR WG-SP proposes slight modifications removing the word "spectral" and replacing "lumen" by "candela steradian":

"The candela, unit of luminous intensity in a given direction, is such that the luminous efficacy of monochromatic radiation of frequency 540×10^{12} hertz is equal to exactly 683 candela steradian per watt."

The definition in the SI brochure will be followed by an explanatory note, mentioning the "fundamental" constant, which is fixed, and the present explicit-unit based definition:

"Thus we have the exact relation K_{cd} = 683 lm/W. The effect of this definition is that the candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian. This radiant intensity corresponds to a photon intensity of $(683 \times 540 \times 10^{12} \times 6.626\,068\,96 \times 10^{-34})^{-1}$ photons per second per steradian."

Dr M. Stock mentioned that the WG-SP has created a new symbol for the constant representing the luminous efficacy of monochromatic radiation of frequency 540×10^{12} hertz: K_{cd}. Furthermore, the WG-SP has proposed adding the last sentence, stating the equivalence of radiant intensity and photon intensity.

Prof. Kühne commented that the last sentence is just the result of a calculation that is well known.

Dr Zwinkels agreed that this information could also be in the *mise en pratique*. However, the additional sentence could help emerging fields, such as quantum radiometry, to find a position in respect to the SI. The constant would also demonstrate the linearity of photometry and radiometry over the 11 decades of optical power.

Prof. Kühne repeated that the additional sentence contains no new information. He thinks that it has *a priori* nothing to do with the candela definition, being the unit of a photometric quantity.

Dr Fox emphasized that this sentence would provide additional evidence, acting as a marker and indicator. It can show people working in emerging fields that their work is related to that unit and it can make a clear impact to the emerging industry and to the public.

The President added considerations on the duality of light, highlighting the two aspects of photons and waves.

Dr K. Stock stated that there was a general agreement within the WG-SP on the definition and the first two sentences. However, there are many people that would like to remove the last sentence.

Dr Fox queried the statement by Dr K. Stock on the level of consensus.

Dr Zwinkels agreed that many discussions had taken place within the working group. It was felt that the proposal was a compromise and it was endorsed.

Dr K. Stock repeated that he agreed with Dr Zwinkels, except on the last sentence. The last sentence was a compromise, but with a certain level of agreement only.

Dr Xu proposed integrating the last sentence into the middle of the previous sentence, to state that the radiation needs to have a certain radiant intensity and photon intensity.

Dr M Stock recalled that this proposition was already discussed in the WG-SP and had been rejected.

Dr Xu replied that the third sentence has no new information. To make an impact it would need to be integrated in the main part of the preceding sentence.

Prof. Kühne made a formal statement: The CCU was given the task of reviewing four base units by the last General Conference. The proposal was to move from explicit-unit to explicit-constant definitions. This was considered to be a major step. The CCU proposes having the explicit-unit definitions immediately after the official explicit-constant definitions. Therefore subsequent sentences are not really explanatory statements. He believes that the additional information needs to be incorporated into the second sentence.

Dr Fox believes that inclusion of the last sentence will not be a surprise to the CCU, as it is consistent with what the CCPR has explained to the CCU. It would allow an evolution to future possibilities without impacting on classical photometry.

Dr Saito commented on a change to what was discussed at the WG-SP meeting. At the meeting, he thought that the subsequent sentences would be in a separate explanatory section but not in the main part of the SI-Brochure. He believes that it is not necessary to have the last sentence in the SI-Brochure.

Dr Zwinkels stated that the last sentence expresses the ability of radiometry to go to very low power levels and it would not harm classical photometry. She expressed concerns about the field of radiometry being considered separate to photometry.

Dr Blattner stated that the last sentence has no benefit for users, neither in the field of photometry or in the field of quantum radiometry. Applications related to quantum radiometry never use the unit candela. He referred to the position paper of METAS, submitted to the WG-SP, on the candela definition.

The President asked for other observations with respect to the WG-SP proposal.

Dr Thomas (executive secretary of the CCU) noticed that replacing "lumen" by "candela steradian" is, in principle, not in line with the proposal of the CCU. All other definitions refer to a coherent derived unit (i.e. kilogram to joule, the ampere to the coulomb, etc). She encouraged the CCPR to propose this modification to the CCU as by doing so, the apparently circular reasoning through a derived unit is removed. Eventually the other units could follow the example of the candela.

Dr Thomas asked if the terms "luminous efficacy" and "photon intensity" are well established.

The President replied that those terms are well known in the field of photometry. They are also defined in the IEC/CIE International Lighting Vocabulary (ILV).

Dr Thomas replied that this information should be passed to Prof. Mills and to the CCU. She agrees that the newly defined symbol (K_{cd}) should be proposed for inclusion in the SI-brochure.

Dr Zwinkels asked if "photons per second and steradian" can be considered as a unit?

Dr Rastello observed that in the explicit-unit definition of the ampere, a similar formulation is proposed: "The ampere is the electric current corresponding to the flow of 1/(1.602 176 487 $\times 10^{-19}$) elementary charges per second."

Dr Thomas stated that there should not be a problem using "photons" as a unit.

Prof. Kühne suggested that "number of photons" would be more appropriate.

The President proposed consulting the CCU or the CIPM directly on this item.

Dr Thomas stated that the Planck constant, h, taken from the last fundamental constants adjustment of CODATA might be different from the value that will be fixed for the new definitions, since there might be further adjustments.

Prof. Kühne proposed including "xxx" at the end of the numerical value of h.

The President stated that the CCPR is aware that the numerical value of h may change. However, the rewording of the candela would only occur when the definitions of the other units are changed. From that moment on, h would be fixed to a constant without uncertainty.

The President asked the CCPR members if they agreed that he should summarize the previous discussion and send that information to the CCU and the CCPR members.

Decision D10: CCPR approved that the President will inform the CCU about the position of the CCPR in respect to the proposed rewording of the candela definition and the related subsequent text (see Action A2).

Action A2: The President will inform the CCU about the position of the CCPR with respect to the rewording of the candela definition in "explicit-constant form". He will indicate that the CCPR basically agrees with the proposal with slight modifications (lumen expressed as candela steradian and removal of the word "spectral"). He will confirm that the quantity of "luminous efficacy of radiation" is well established in the field of photometry. In respect to the subsequent sentences (explicit-unit definition) he will explain that the constant K_{cd} has been introduced, the subscript "*cd*" representing the candela. He will inform the CCU about the reason behind adding an additional subsequent sentence expressing the radiant intensity as photon intensity, both quantities being well established in the IEC/CIE International Lighting Vocabulary (ILV). He will indicate that not all members agree on the necessity to add the last sentence. He will ask the CCU to assist on the correct formulation of the unit of the quantity "photon intensity" (whether it

should be “photons per second per steradian”, “number of photons per second per steradian” or just “per second per steradian”). The President will distribute its letter to CCU to the members of CCPR for information.

Dr Thomas thanked the President and the members of the CCPR for having discussed the proposed rewording of the candela definition in such detail and for preparing valuable input for the CCU.

12 FUTURE WORKING GROUP STRUCTURE OF THE CCPR

Dr Fox presented the new proposal on the CCPR structure prepared by the WG-SP TG3. One of the drawbacks of the present structure, which consists of three working groups and different task groups, is the difficulty in discussing horizontal and application related themes. Also, technical issues are often not addressed by the CCPR. In this context, the idea of setting up discussion groups within existing WGs and chaired by a member of that WG was discussed. They would need to report regularly to the corresponding WG. The membership criteria and meeting schedule should be flexible to ensure maximum opportunities to engage with appropriate experts, including expertise from industry and academia.

The President emphasized that some important communities are not represented around the table, despite of their important contribution and work related to photometry and radiometry.

Prof. Kühne stated that the concept of discussion groups is interesting. However, he noticed that the proposed new structure would be a significant change with respect to the CIPM’s policies. According to the guidelines it is the responsibility of the working groups to create task groups. He suggested raising the concept of discussion groups at the CIPM. Prof. Kühne did not want to take a position on whether it makes sense to set up these new groups. He commented that in the present CIPM guidelines they are not mentioned.

Dr Fox replied that the WG-CMC has a structure which is not covered by the present CIPM guidelines since its core role is related to coordination of RMOs. Its principle membership consists of the technical committee chairs of the various RMOs. These chairs and their host organizations were not necessarily members or observers of the CCPR. It was agreed that the chair of this WG would be one of the RMO chairs on a rotational basis and even if they are not a member of the CCPR they would report to the CCPR.

Prof. Kühne replied that the situation with the WG-CMC is different. Members of the WG-CMC are from the RMOs. The RMOs are responsible for nominating representatives to the WG-CMC. He emphasized that only NMIs and designated institutes are members of the CCPR and its substructures. With discussion groups the situation would be quite different. According to the latest proposal, discussion groups could include representatives from institutes, organizations and industry.

Dr Zwinkels suggested that membership of discussion groups could be handled on a case-by-case basis. Depending on the specific scheme it may be beneficial and necessary to invite external experts.

Dr M. Stock asked for clarification if the idea is to give external experts official member status for the discussion groups.

Dr Fox suggested that as a trial, workshops could be organized which were open to experts, under the umbrella of a specific discussion group.

Dr Zwinkels stated that the main motivation for discussion groups is that, at present, there is no forum for scientific discussion. This was the case in the former UV working group. The difficulty of the CCPR WGs is that they have clear and concrete terms of reference. Discussion groups could be handled more flexibly and less formally than working groups. Task groups also have very clear objectives and are not flexible enough. She admitted that membership criteria for discussion groups will have to be addressed. The core membership of the discussion groups would be members of the WGs. However, in order to ensure a broad range of expertise, it will be necessary to allow the inclusion of experts from various international organisations such as the CIE, ISO and academic institutions.

The President emphasized that within a task group it is possible to invite experts from outside. This was done in other fields, for example the CCQM. He believes that it is not necessary to ask the permission of the CIPM, but just to inform them. He repeated that discussion groups could be handled more flexibly.

Prof. Kühne stated that there is no problem creating groups according to the existing rules, providing the membership issue is addressed. He agreed that experts could be considered as invited guests.

The President thanked Prof. Kühne for his input. He said that the concept can be considered as an experiment and it could be used as a model mainly for modernizing the communication between communities. He repeated that the only critical point of the concept of discussion groups is the membership issue. All the other points are not really new. He agreed to inform the CIPM about the formation of different task groups.

Action A3: The President will inform the CIPM that different task groups are being formed within the CCPR according to the established CIPM rules. The task groups will, if necessary, ask advice from invited experts from competent institutions and organizations. The following task groups were established: Few photon metrology (within WG-SP), optical communication (WG-SP) and data analysis (WG-KC).

13 REPORTS BY RMO TC CHAIRS

13.1 AFRIMETS

Mr Sieberhagen made a presentation on the structure of AFRIMETS. He showed that AFRIMETS is divided into six sub-regions: CEMACMET, EAMET, MAGMET, SADCMEL/MET, SOAMET, and NEWMET. AFRIMETS has three Associate Members (LNE, PTB and NIRPS) and three observers (EURAMET, CAFMET and the Arab Federation of Metrology). AFRIMETS was officially accepted as a RMO by the CIPM in October 2008. Mr Sieberhagen explained that the general coordination work is carried out through several technical

committees that also deal with education, harmonization and metrology awareness. The technical coordination work is done in working groups. The AFRIMETS radiometry and photometry working group is made up of three NMIs: KEBS (Kenya), NIS (Egypt), and NMISA (South Africa). He stated that three comparisons are planned on luminous intensity, luminous responsivity and luminous flux.

The President stated that Tanzania is a member of both EAMET and SADCMEL/MET. They need to decide through which RMO they are going to submit CMCs. The intra-regional review would be carried out within AFRIMETS.

13.2 APMP

Dr Kim presented the activities of APMP. The organization has 24 members from 22 countries. At the last three APMP TCPR meetings, between 12 and 17 NMIs have participated. Dr Kim presented the statistics of published CMCs: 10 NMIs have published more than 250 entries in the field of photometry and radiometry. He mentioned that 8 key and supplementary comparisons are ongoing and that 7 are planned. He stressed that APMP TCPR has decided to begin their regional key comparisons 2 years after the related CCPR key comparisons.

13.3 COOMET

Dr Khlevnoy presented the activities of COOMET. One key and four supplementary comparisons are at present being prepared and have already been registered in the KCDB. An additional comparison of spectral regular transmittance has not been registered yet.

He mentioned in particular the supplementary comparisons of refractive index and of angle of rotation of the plane of polarization, for which CMCs have already been submitted within the CCL.

13.4 EURAMET

Dr Blattner presented the activities of EURAMET. He outlined the European Metrology Research Programme (EMRP). The EMRP is a metrology-focused European programme of coordinated research and development that facilitates closer integration of national research programmes. The EMRP will ensure collaboration between National Measurement Institutes, reduce duplication and increase impact (http://www.emrponline.eu). He stated that in the first phase, 21 projects related to 4 topics started in 2008. There is one accepted joint research project related to photometry and radiometry: T1.J2.3 which deals with fundamental aspects of quantum based photon standards.

Dr Blattner presented further activities of EURAMET TC-PR. There are several new projects outside the framework of the EMRP. He mentioned in particular PR1101 *Future Trends in Radiometry and Photometry*, seeking to explore which avenues research and development within photometry and radiometry (PR) will take in the future. He also mentioned PR1107 *Standards for multimode optical fibre metrology* which aims to develop and to compare different kinds of multimode fibre standards for the different quantities. He invited NMIs from other RMOs to contribute to the project.

Dr Blattner spoke about a new proposal for a supplementary comparison on solar reference cells. The measurand of the comparison is the short cut current under standard test conditions. He invited interested NMIs to contact the pilot laboratory (PTB, Dr S. Winter).

Finally, Dr Blattner presented the new chairperson of EURAMET, Dr Leslie Pendrill, from SP (Sweden), succeeding Prof. Kühne.

13.5 SIM

There was no report from SIM. Dr Ohno expressed his regret about the lack of a SIM report. He mentioned that SIM-K4 is almost complete. SIM-K6 will start soon after CCPR-K6. There are several other comparisons scheduled within SIM.

14 REPORT ON LIAISON WITH CCT WORKING GROUP 5 "RADIATION THERMOMETRY"

Dr Woolliams presented the activities of the CCT WG 5. She reviewed the high temperature research plan consisting of six work packages:

- WP1: Establish long term stability and robustness of cells;
- WP2: Select, construct and compare reproducible cells;
- WP3: Specify operational characteristics;
- WP4: Establish world capability in absolute radiometry, including a pilot comparison of several laboratories measuring radiances at high temperatures;
- WP5: Assign definitive temperatures through a multi-lateral measurement campaign;
- WP6: Write *mise en pratique*.

Dr Woolliams stated that discussions were ongoing regarding the issue of thermal imaging standardization. The CCT-WG5 welcomed and supported the proposal of IEC SC65B WG5 to establish a sub-group to address this issue, firstly by developing a standard for the technical specifications of thermographic cameras, using, as a starting point, a recent Chinese standard. The issue of common vocabulary would also be addressed. The next step would be to develop a standard on how to determine these parameters.

There were also some discussions on a new temperature scale, as in the past, every 20 years, new scales were defined (1948, 1968, 1990). The general opinion is that ITS-90 does not have significant problems but dissemination and realization methods could be improved, particularly above the silver point. It was recognized that, particularly at high temperatures (above the melting point of silver), radiometric techniques for measuring thermodynamic temperature could, at some NMIs, obtain uncertainties comparable with, or superior to the ITS-90 scale. The community was therefore accepting a shift to direct thermodynamic temperature measurement, either directly, or mediated by determining the temperature of high temperature fixed-points (eutectic and peritectic based fixed-points).

Dr Woolliams stated that discussions on a *mise en pratique* with respect to radiation thermometry are ongoing. It will include direct and indirect (via fixed-points) measurement of thermodynamic temperature, as well as recognising the continued use of ITS-90. The *mise en pratique* will include supporting documentation on filter radiometry for radiance, power, and irradiance responsivity measurements.

The President thanked Dr Woolliams for the presentation and asked the members if they have related activities within their institutes. Representatives from NPL, VSL, VNIIOFI, PTB, KRISS and MKEH indicated that their institutes are active in this field.

15 LIAISON WITH OTHER ORGANIZATIONS (WMO, CIE, CORM, ETC)

15.1 WMO

Prof. Schmutz gave a report on the activities of World Meteorological Organization (WMO), relevant to the CCPR activities. The WMO is mainly organized through Technical Commissions. The most important Commission relating to the CCPR is the Commission for Instruments and Methods of Observations (CIMO). The WMO does not operate any calibration laboratories, but its members do. WMO has nominated different centres to carry out specific tasks, as required. An example is the World Radiation Center (WRC) at PMOD, Davos, which maintains the world standard group and serves as a calibration laboratory for national and regional calibration centres.

Prof. Schmutz continued his report on the activities of PMOD/WRC. He stated that PMOD/WRC is a designated institute of the Swiss National Metrology Institute (METAS) and has CMCs on total solar irradiance for direct (pyrheliometer) and global (pyranometer) radiation in the BIPM database. He presented some research activities on a cryogenic solar absolute radiometer (CSAR) to establish direct primary SI realization of solar irradiance.

Finally, Prof. Schmutz spoke about a WMO-BIPM workshop on “Measurement challenges for global observation systems for climate change monitoring: traceability, stability and uncertainty”, to be held on 30 March-1 April 2010, at WMO headquarters in Geneva, Switzerland.

The President said that in the 1970s there was no link between metrology and meteorology. He stated that it is a great development in the community. He welcomed that PMOD/WRC has published CMCs. He reminded the committee that PMOD/WRC has an official observer position in the CCPR and needs no further invitations for the CCPR’s meetings.

15.2 CIE

Dr Ohno reported on CIE activities. He emphasized that the link to the CIE could not be stronger, as the president of the CIE is Dr Franz Hengstberger. Dr Ohno made a presentation on the structure of the CIE, which is divided into 7 divisions. CIE Division 2 deals with physical measurements of light and radiation.

The President added that the link to CIE division 6 (Photobiology and Photochemistry) should be stronger in the future.

Dr Ohno also made a presentation about the new CIE Officers for 2011 to 2015: the CIE will be chaired by Dr Ann Webb, succeeding Dr Hengstberger. Dr Ohno will take the position of Vice-President Technical.

Dr Ohno reported on the CIE Board of Administration activities. The International Lighting Vocabulary (ILV) is now available as draft standard CIE DS 017.1/E:2009. The President added that the ILV will be made available as a free online version. In the future, a translation to other languages will be made available.

Dr Ohno invited members to participate at the CIE Conference *Lighting Quality and Energy Efficiency* to be held in March 2010 in Vienna (http://vienna2010.cie.co.at/).

Dr Ohno presented the new technical committees relevant to radiometry and photometry established since the last CCPR meeting:

- TC2-62 Imaging-photometer-based near-field goniophotometry
- TC2-63 Optical measurement of high-power LEDs
- TC2-64 High speed testing methods for LEDs
- TC2-65 Photometric measurements in the mesopic range
- TC2-66 Terminology of LEDs and LED assemblies
- TC2-67 Photometry of lighting and light-signalling devices for road vehicles

Dr Ohno also mentioned important activities in division 1:

TC1-69 is working on a new metric to extend the colour rendering index (R_a) to address problems with LED light sources. The goal is to publish the work by end of 2010.

TC1-58 has finished its work on the visual performance in the mesopic range. The recommended system is based on a weighted average between the photopic and scotopic spectral luminous efficacy function. This work will also impact the metrology of light and light sources. Therefore TC2-65 will define measurement requirements for implementation of the CIE task-based system for mesopic photometry and will consider the implications of the new system for mesopic photometry for existing Division 2 publications.

The President added that most people do not realize that up to now there was a gap in the measurement capabilities over the luminous adaption region of the human eye. In the past, everybody was using the photopic measurement system. With the new mesopic model the situation will change as there is now the possibility to scale from starlight adaption luminance to daylight adaption luminance. This might have an impact on photometry as new types of photometers will be constructed which need to be calibrated and traceable to international supported realizations of the SI units.

The President recalled the terms of the Memorandum of Understanding (MoU) signed between the CIPM and the CIE in May 2007, in which the CIE was given observer status in the CCPR. The official delegate from the CIE to the CCPR is Mr Bastie. Dr Ohno is the official delegate from the CCPR to the CIE.

The basic idea of the MoU is that the CCPR will inform the CIE about new aspects of unit definitions. The CIE will provide input to the CCPR on measurement quantities and action

spectra including mesopic and radiometric action spectra. The President recalled that there was a consultation of the CCPR on the new version of the International Lighting Vocabulary (ILV). In the opposite direction, he will inform the CIE about a possible new formulation of the candela definition.

Action 4: CCPR President to inform the CIE about the possible new form of the definition of the candela.

15.3 CORM

Dr Ohno informed the committee about recent activities of the CORM (Council of Optical Radiation Measurements). In 2008 a workshop on solid state lighting standards was held. In 2009 a workshop on solid state lighting measurements and standards will take place. There will also be a joint meeting with the Inter-Society Colour Council. The topic will be on lighting in artistic, commercial and retail spaces.

The CORM 2010 annual technical conference will be held in Las Vegas on 17-19 May 2010, and will focus on the optical characterization of phosphors and converters following the Light Fair International conference.

15.4 Other organizations

Dr Fox outlined some activities of the Optical Radiation Measurement (ORM) Club programme of the NPL. There is some consideration being given to reorganizing the ORM in order to broaden its membership.

The President asked the members about other organizations that could be of interest to CCPR. There were no comments.

16 MEMBERSHIP ISSUES FOR CCPR AND ITS WORKING GROUPS

The BIPM Director received a letter from the Director of IPQ, Portugal, asking for observer status. The President proposed making an approach to IPQ to ask for a presentation at the next CCPR meeting on IPQ's scientific work related to photometry and radiometry.

No other requests for CCPR membership were made.

The President invited the NMIs to reflect on their own membership status. If some observers are involved in activities strongly related to photometry and radiometry that are extending into research, they should apply for full CCPR membership. Likewise, if members feel that their NMI's research activities have been significantly reduced or abandoned, they are invited to revise their status and eventually to return to observer status. Instead of having formal discussions within the CCPR meeting it would be preferable if such changes could be initiated by the members themselves.

The WG-KC has added MSL as a temporary member because they are piloting the next round key comparison on spectral transmittance. There is no change in the chairmanship of the WG-KC, Dr Ohno (NIST) continues to chair the WG.

There is no change of membership within the WG-CMC. AFRIMETS will chair the WG during the next term until the next regular CCPR meeting.

There is no change within the WG-SP. Dr Zwinkels (NRC) will continue to chair the WG.

17 ANY OTHER BUSINESS

The President informed the committee that the BIPM now offers certificates of appreciation for long term contribution to Consultative Committees. This year he is in the privileged position to hand over such a certificate to Mr Jean Bastie for his exceptional contributions, not only to the CCPR, but also to the whole scientific field of radiometry and photometry. Mr Bastie participated for the first time to a CCPR meeting in 1971. He contributed significantly to the appendix on photochemical and photobiological quantities in the SI brochure. Mr Bastie will continue to be available to the BIPM as representative of the CIE within the CCU.

Prof. Ikonen reported that the proceedings of the last NEWRAD conference in Daejeon, Rep. of Korea, have now been published in a special issue of *Metrologia* (Volume **46**, Number 4, August 2009). He stated that the dates of the next NEWRAD have been agreed as 19-23 September 2011 in Grand Wailea Resort, Hawaii (http://newrad.mlml.calstate.edu/).

18 REPORT TO THE CIPM AND RECOMMENDATIONS

The President undertook to prepare the report to the CIPM and to circulate the draft to all CCPR members for comment before submission to the CIPM.

19 NEXT MEETING DATE

Dr Fox proposed that the next CCPR meeting should be held in the second quarter of 2012 so that it would not clash with the Newrad conference. The President and Prof. Kühne agreed that spring 2012 is an acceptable date.

There are two opportunities to hold WG meetings in 2010 in connection with conferences:

Dr Fox proposed to have the CCPR WG meetings at the NPL, close to the International Symposium on the Science and Technology of Light Sources (LS12-WhiteLED), to be held on 11-16 July 2010 in Eindhoven, The Netherlands.

Dr Blattner proposed to have the CCPR WG meetings in connection with the CIE Division 2 symposium 2010 to be held from 31 August to 3 September 2010 at METAS, in Wabern, Switzerland (http://www.d2symp.ch/).

The CCPR decided by formal vote (12 against 4) to have the next WG meetings at the NPL, Teddington, during the week of 5-9 July 2010.

20 CLOSING OF THE MEETING

The President thanked the participants for their contributions and closed the meeting at 12h30.

APPENDIX 1.
WORKING DOCUMENTS SUBMITTED TO THE CCPR AT ITS 20TH MEETING

Documents restricted to Committee members can be accessed on the restricted–access CCPR website. There are no open working documents of this meeting.

CCPR/09-01	Convocation
CCPR/09-02	Draft Agenda – V1.0
CCPR/09-03	Schedule of CCPR working group meetings – V1.0
CCPR/09-04	Report of the 19th CCPR meeting 2007
CCPR/09-05	Questionnaire on laboratory progress
CCPR/09-06	Guidelines for CCPR Comparison Report Preparation – rev. 2, WG-KC
CCPR/09-07	Guidelines for Acceptance of Participants for CCPR Comparisons, WG-KC
CCPR/09-08	Announcement of 2nd CCPR KC of spectral transmittance, K. Nield, Y. Ohno
CCPR/09-09	Abstract from the preliminary CCU report, I. Mills
CCPR/09-10	Proposal on future CCPR structure, N. Fox, WG-SP TG3
CCPR/09-liaison-CCT-WG5	Report liaison CCT-WG5
CCPR/09-liaison-CIE	Report liaison CCE
CCPR/09-liaison-WMO	Report liaison WMO
CCPR/09-pres-CMI	CMI activities presentation
CCPR/09-pres-IFA-CSIC	IFAC-CSIC activities presentation
CCPR/09-pres-INRIM	INRIM activities presentation
CCPR/09-pres-KRISS	KRISS activities presentation
CCPR/09-pres-LNE	LNE activities presentation
CCPR/09-pres-METAS	METAS activities presentation
CCPR/09-pres-MIKES	MIKES activities presentation
CCPR/09-pres-MSL	MSL activities presentation
CCPR/09-pres-NIM	NIM activities presentation
CCPR/09-pres-NIST	NIST activities presentation
CCPR/09-pres-NIST-Boulder	NIST Boulder activities presentation
CCPR/09-pres-NMC	NMC activities presentation

CCPR/09-pres-NMIA	NMIA activities presentation
CCPR/09-pres-NMIJ	NMIJ activities presentation
CCPR/09-pres-NMISA	NMISA activities presentation
CCPR/09-pres-NPL	NPL activities presentation
CCPR/09-pres-NRC	NRC activities presentation
CCPR/09-pres-PTB	PTB activities presentation
CCPR/09-pres-UME	UME activities presentation
CCPR/09-pres-VNIIOFI	VNIIOFI activities presentation
CCPR/09-pres-VSL	VSL activities presentation
CCPR/09-report-CENAM	CENAM progress report, C. Matamoros
CCPR/09-report-CMI	CMI progress report, M. Smid
CCPR/09-report-IFA-CSIC	IFA-CSIC progress report, A. Pons
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CCPR/09-report-MKEH	MKEH progress report, G. Andor
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CCPR/09-report-NMC-A*STAR	NMC-A*STAR progress report, G. Xu
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CCPR/09-WG-CMC	WG-CMC report
CCPR/09-WG-SP	WG-SP report