Bureau International des Poids et Mesures

Consultative Committee for Thermometry (CCT)

Report of the 24th meeting
(22–23 May 2008)
to the International Committee for Weights and Measures

Comité international des poids et mesures

Note:

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

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

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

A.J. Wallard,
Director BIPM

LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR THERMOMETRY

as of 22 May 2008

President

H. Ugur, member of the International Committee for Weights and Measures.

Executive Secretary

R.S. Davis, International Bureau of Weights and Measures [BIPM], Sèvres.

Members

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

Centro Español de Metrología [CEM], Madrid.

Conservatoire National des Arts et Métiers, Institut National de Métrologie [LNE-INM/CNAM], La Plaine-Saint-Denis.

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

Institute for Physical, Technical and Radiotechnical Measurements [VNIIFTRI], Rostekh-regulirovaniye of Russia, Moscow.

Istituto Nazionale di Ricerca Metrologica [INRIM], 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 Institute of Australia [NMIA], Lindfield.

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

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

National Physical Laboratory [NPL], Teddington.

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

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

Physikalisch-Technische Bundesanstalt [PTB], Braunschweig.

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

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

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

Observers

Centro Nacional de Metrología [CENAM], Querétaro.

Instituto Nacional de Tecnología Industrial [INTI], Buenos Aires.

Instituto Português da Qualidade [IPQ], Caparica.

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

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

The twenty-fourth meeting of the Consultative Committee for Thermometry (CCT)* took place at the International Bureau of Weights and Measures (BIPM), Pavillon de Breteuil, Sèvres, on 22 and 23 May 2008.

The following were present: M. Arai (NMIJ/AIST), T. Baba (NMIJ/AIST), M. Ballico (NMIA), M. Battuello (INRIM), S. Bell (NPL), D. Del Campo (CEM), V. Fernicola (INRIM), J. Fischer (PTB), Y. Hermier (LNE), K. Hill (NRC-INMS), J. Hollandt (PTB), J. Ishii (NMIJ/AIST), A. Kartal Doğan (UME), G. Kytin (VNIIFTRI), H. Liedberg (NMISA), G. Machin (NPL), M. Matveyev (VNIIM), P. Nemeček (SMU), C.W. Park (KRISS), F. Pavese (INRIM), A. Peruzzi (NMi VSL), O. Podmurnaya (VNIIFTRI), A. Pokhodun (VNIIM), D.C. Ripple (NIST), N. Sokolov (VNIIM), A.G. Steele (NRC-INMS), P.P.M. Steur (INRIM), G.F. Strouse (NIST), H. Ugur (President of the CCT), E. Van der Ham (NMi VSL), A.J. Wallard (Director of the BIPM), Li Wang (A*STAR), R. White (MSL), K. Yamazawa (NMIJ/AIST), I. Yang (KRISS), H. Yoon (NIST), Zundong Yuan (NIM), B. Yuryev (VNIIFTRI), Jintao Zhang (NIM).

Observers: M.E. Filipe (IPQ), L. Lira-Cortés (CENAM), E. Méndez-Lango (CENAM), R. Teixeira (INMETRO).

Invited guests: P. Bloembergen (retired from NMi VSL), J. Bojkovski (MIRS).

Also present: R.S. Davis (Executive Secretary of the CCT), L. Érard (CIPM), L. Mussio (Executive Secretary of the JCRB), T.J. Quinn (Director Emeritus of the BIPM), C. Thomas (Coordinator of the BIPM KCDB).

Absent: R. Benyon (INTA), J. Ranostaj (SMU), M. Tischler (INTI) sent apologies.

The President opened the meeting with words of welcome to new member CEM (Spain), to all delegates, observers, and to our distinguished guests including the CIPM Member and CCTF President, Mr Luc Érard. President Ugur noted with regret and some concern the second consecutive absence of INTI (Argentina). Mr Alan Steele (NRC) was appointed *rapporteur*.

The Agenda was approved, although it was decided to schedule Item 4.1 (Report on CCT-K5) immediately after Item 2 to accommodate the travel schedule of Mr van der Ham.

* For the list of acronyms, click here.

2 DOCUMENTS PRESENTED TO THE 24TH MEETING OF THE CCT

President Ugur explained that there are three ways to submit papers to CCT:

- if the author is a Member of a working group, documents are to be submitted through the Working Group Chair;
- if the author is part of a Delegation, documents may be submitted directly to the Executive Secretary of the CCT, or to the President of the CCT, or *via* a relevant Working Group Chair;
- if the author is not part of Delegation, documents should be submitted through the Head of Delegation.

Invitations from NMIs to make a brief presentation are extended; should be submitted at least one month in advance, and allow time on the Agenda; next time we may have a 3-day meeting, and we should have at least a few NMI summary presentations on a voluntary basis.

Publication of CCT online documents: At the last meeting Mr Fischer suggested that we should screen documents prior to making them publicly available; for this meeting, all documents are in the restricted area, until the Minutes are finalized and approved; this includes WG Reports, and other documents. Note that it is possible to have some documents remain in the Restricted area (such as drafts; Ms Bell indicated CCT/08-08 is an early draft and must not be un-restricted). Mr Davis suggested that approval to release documents should follow the submission path (eg WG Chair, Head of Delegation, etc); Mr White indicated that CCT/08-18 and CCT/08-19 are also drafts and are to remain restricted. Mr Hill indicated that a default to assume that documents remain confidential until a specific release to move it to the public portion of the website may be better; Mr Davis agreed and it is easy to do logistically. President Ugur would like one-by-one clearance as quickly as possible; Mr Davis said that this enables hyperlinks in the Report to the related documents, which is difficult to do after publication of the Report.

3 REPORTS OF THE WORKING GROUPS

3.1 Working Group 1: defining fixed points and interpolating instruments

Mr Ripple summarized the accomplishments of WG1, also summarized in the Report (CCT/08-15, on restricted access), highlights of which include:

- progress on the *Supplementary Information*, and the collective decision to publish the Blue Book and the Red Book online at the BIPM website,
- progress on impurities in fixed points (CCT/05-08 (restricted) and CCT/08-16),
- future work to draft tables of distribution coefficients and liquidus slopes.

There is a working arrangement with WG3 to use the posted document on uncertainties and to borrow freely to update the information in the Supplements. There is ongoing and useful interaction

with WG5, including meetings of Chairs, although there are some questions of overlap in the Terms of Reference (also applies to WG2). This may be discussed during Agenda Item 5.

President Ugur asked if a liaison with CCQM on analytical chemistry would assist the work on impurity analysis; Mr Ripple indicated that existing good working relationships among scientists is beneficial, although there is a need for greater rigor in the chemical analysis to help meet the stringent needs of the thermometry community. Mr Davis asked about the document concerning impurities in aluminium; Mr Ripple indicated that there is existing documentation on how to build cells and validate the uncertainty budget, recent publications in the open literature discuss the application of WG1 methods, and further discussions within the WG are ongoing, to monitor the application of CCT/05-08.

The highest priority for the future in WG1 remains the completion of the update to the *Supplementary Information*.

President Ugur asked if CCT or CIPM can do anything to assist; Mr Ripple wishes a careful reconsideration of the set of WG Terms of Reference to minimize obstacles to progress and duplication of effort; careful consideration on publication channels (eg web-based hyperlinked document versus printed versions) might assist users to understand the official nature of these Guides.

Mr Pavese led some discussion on the need for improvements in analytical chemistry, namely the effect of chemical impurities on substances used for the thermometric fixed points, to satisfy the needs of the thermometry community, possibly through more effective liaison with the CCQM and IUPAC.

3.1.1 *Mise en Pratique* Task Group

Document CCT/08-17 provides a comprehensive report from the *Mise en pratique* Task Group, which was charged to formulate an assessment and possible work plan for the next International Temperature Scale and to prepare and maintain the *mise en pratique* for the definition of the kelvin.

Mr Ripple provided a summary of the 2006 *mise en pratique* for the definition of the kelvin, including the technical annex with the specification of the isotopic compositions. The Technical Annex seems to be working in the way that it was envisioned and intended, and no changes are recommended at the present time.

Recommended extensions of the *mise en pratique* include:

1. a link to the *Supplementary Information for the PLTS-2000*,
2. a description of thermodynamic methods and an assignment of T values to fixed points, with uncertainties,
3. mathematical functions giving $T - T_{90}$ and related uncertainties,
4. a description of primary and interpolating gas thermometry at low temperature, and
5. a description of primary radiometric thermometry, and its approximation.

Item 1 is ready for inclusion. Items 2 and 3 will be voted on by the CCT by correspondence, following completion of the mathematical functions and uncertainties by WG4.

Future comparisons should identify the temperature scale being tested; Working Groups 1, 4, and 8 are requested to provide recommendations for needed comparisons to validate primary kelvin

realizations. The Task Group supports the efforts of WG5 in comparisons for high-temperature eutectics.

A brief summary of the "Towards ITS-XX" Workshop was given, including identified weaknesses of ITS-90 and the new perspectives that have evolved since that time, including mechanisms to deal with some weaknesses without the need for a new Scale. The recommendation, therefore, is that no new ITS-XX is required in the near future, since the need for a new scale is not as compelling in 2008 as it seemed in 2002 because of the alternate path for improvements offered by the *mise en pratique* for the kelvin. Nevertheless, there is a need for research for ITS-XX, particularly:

- to improve interpolation devices from Al to Ag to make things more robust than using high-temperature SPRTs,
- to assess published values of $T - T_{90}$,
- to explore new mathematical methods on construction of interpolating functions,
- to address unresolved issues for the fixed points.

A set of criteria to be applied for adopting a new temperature scale was presented, moving away from a calendar-based (expiry date) approach to a needs-based assessment; one significant goal is to complete the developmental scale work prior to the adoption of a new ITS including the derivation and validation of reference functions for industrial thermometers for simultaneous release and some form of international comparison to test the degrees of equivalence for proposed realizations of the new scale. Although it seems likely that new methods and measurements of thermodynamic temperature at very low and very high temperatures will come into use, the Task Group sees no prospect of dispensing with a defined practical scale in the mid-SPRT range, and notes that the proposed definition based on the Boltzmann constant affords opportunities for demonstrating that the ITS is a close approximation to thermodynamic temperature.

The Task Group posed three questions for the CCT on how to handle issues related to:

- supplementary information for primary thermometry,
- requirements for inclusion of a method in the *mise en pratique* for the kelvin, and
- managing the transition to primary thermometry, including the dissemination of multiple scales and education of our users on the transition.

There was immediacy of consensus within the CCT on the listed reasons for and reasons against the adoption of a new scale, and agreement that these items should be considered in future development and decisions, including the cost to industry and other users versus the benefits of implementing a change.

Mr Liedberg asked about practical implementation of the updated *mise en pratique*; Mr Ripple noted that the *mise en pratique* is envisioned to include thermodynamic temperature assignments, reference functions, and methods, and that ITS-90 and its relationship to primary thermometry is expected to remain as a valid approximation technique: no changes to ITS-90 would be the primary message to industrial customers.

President Ugur seeded discussions for Agenda Item 6 with examples from mechanical metrology (coefficients on thermal expansion, air density, and other parameters that must be accounted for in the user environment) and thermometry (where the importance of impurity correction and isotopic composition was revealed only as uncertainty levels dropped to the point where these became significant). Mr Quinn confirmed that there is a long time lag between the introduction of a new

scale and its adoption in industry. Director Wallard agreed with the cautious approach, and the provision of options on which method is being disseminated and/or used by given industrial clients requires and merits further thought. Mr Ripple noted that in the long term the management of the transition period must be resolved. Mr Steele commented on the need for harmonization of *mises en pratique* with CIPM oversight to ensure that there is a common implementation across units and Consultative Committees. Mr Hill commented that the periodic review and update of a published scale enabled the publication of the tabulated temperature differences between the old and the new scales; there is a challenge to ensure that the evolution of corrections is transparent and manageable over time. It is trivial to work backwards to ITS-27 and thermodynamic temperature based on current knowledge, since we have a frozen correction between ITS-27 and ITS-90; it would be more difficult, and is a document management problem, to ensure this type of continuity with a fast-evolving update cycle. Mr Fischer pointed out that the $T - T_{90}$ differences are not relevant for industrial users, then almost any scheme is workable; on the other hand, as the differences become relevant, it is essential to have a mechanism that guarantees consistency. Mr Quinn observed that there is no comprehensive guide to making a clock or making a frequency standard, but there is easy access to the published scientific literature, and that this might be a guide to the way that the temperature community approaches the development of its *mise en pratique*. Mr White pointed out that there are a few specific industrial applications where an understanding of $T - T_{90}$ is essential to advancing the state of the art; one example is in supercritical chemistry at 374 K, where thermophysical understanding is a requirement of the work.

3.2 Working Group 2: secondary fixed points and techniques for approximation of the ITS-90

The Report of the Working Group is available in the CCT documents as CCT/08-14 (restricted access). Mr Hill noted that the Working Group did not meet during TempMeko last year, due to his heavy schedule of commitments associated with organizing the conference; he offered his thanks to Mr White for acting as Chair of the last WG meeting during the 23rd meeting of the CCT.

There is a concern about the ability to respond to the task of updating the Blue Book, and the commitment to achieve the task. There was discussion on whether an approach of simply updating the references versus a complete revision of the content and methods. Progress has been made over the last several years, with new technical chapters under development and revision. The vision is to have a web-based document, where individual chapters can be brought online as and when they become available. Top priority was given to the chapters relevant to calibration of sensors, since these are the closest link to CMCs, and since it is in this area that the development of uncertainty budgets is most critical. Thermocouples and thermistors were treated first, and comments on the new chapters are invited and encouraged. Next in line is the development of a chapter on industrial resistance thermometry, and Mr White has volunteered to lead that effort.

The basic composition of the Working Group is formed from experts in the “mid-range”, with co-opted membership (Mr Fellmuth) for low temperature applications, and two co-opted memberships for radiation thermometry. With the establishment of WG5, specifically tasked with all aspects of radiation thermometry, it seems necessary to better utilize that resource to update that chapter in the Blue Book, perhaps going so far as to request WG5 to develop its own Guide.

This overlap in Working Group Terms of Reference has led to the suggestion that WG2 might more reasonably be considered as a discipline-based group of experts, with emphasis on mid-range

temperature measurement using contact techniques. Equally, there is a possibility to act more efficiently with WG3 in the production of uncertainty documentation in this same area, again with emphasis on industrial contact sensors.

Mr Hill has indicated his intention to resign both as Chair and as a Member of the Working Group, and encouraged broader discussion of the possible alternatives among the CCT membership.

Director Wallard very much welcomed the greater focus on uncertainty documentation, particularly with respect to devices under test and the question of how this should be incorporated in CMCs and scopes of accreditation. There is a wide community of interest who would appreciate authoritative guidelines on this topic. Mr Ballico and Mr Strouse indicated that Working Group 8 has taken on board a task to produce a harmonized list of typical device under test uncertainties for use in CMC review. Director Wallard appreciated the combined effort of NMIs and CCs to bring their technical expertise to bear on problems of this type, which represents a significant expansion of the role of the CIPM Consultative Committees – it is a trend that we cannot ignore. Mr Fischer agreed that maintaining a focus on user demand is a valid objective, and that merging WG2 and WG3 would not impair its achievement. Mr Ballico wondered whether we are not encroaching on the standards setting bodies' roles and responsibilities; Mr Hill pointed out that one member of WG2 is a member of the appropriate IEC Technical Committee, and that joint meetings and discussions have been held, resulting in IEC implementations of CCT recommendations.

Mr Hermier highlighted the very important role of the WG2 and its published documents, which are widely used in laboratories and in training programmes. Additional documentation on applications of sensor types would be very useful, but this represents a significant effort and may well go beyond the ability of the CCT to address. Mr Hill agreed that the community must be aware of the work load, and that web-based publication is already an essential mechanism for making our publications accessible, but further emphasizes that outreach to the relevant communities, with particular engagement strategies to ensure the involvement of the larger user communities.

Mr Hill stated that he remains very concerned with the title of the Blue Book, and strongly urged switching to something more descriptive and tutorial in nature, which would make the information accessible, useful, and desirable by the target audience. Mr Ballico agreed that the Blue Book is the interface between primary realizations and calibrations performed at the NMI level and the use and application of sensors at the client level, and thus there is an important role on standardization and ensuring that measurement capabilities that are fit for purpose are being established in the client community.

3.3 Working Group 3: uncertainties

Mr White summarized the activities of WG3, as available in CCT/08-18 (restricted access), including the focus on the SPRT Uncertainty Guide, gaps in our knowledge of uncertainty analysis, and issues related to Terms of Reference and work priorities.

There is an issue regarding how WG3 can best ensure consistency in uncertainty practice, particularly since it is dependent on the commitment of other working groups to observe and support the WG3 terms of reference, insofar as reviewing of documents related to uncertainty practice (eg the WG5 document) is concerned. As with the WG2 Chair's report, there is a concern about the potential incompatibility or overlap in the terms of reference; perhaps the terms need to be revised or perhaps an amalgamation of WGs would be the most pragmatic approach. The results from WG3

efforts can be taken as guiding principles that have broad applicability, but if the WG3 terms are altered to emphasize its oversight role for the other working groups, it would be essential to maintain a role in actively developing uncertainty documentation elsewhere since it is deemed unlikely that a hands-off approach can be successful in the longer term.

3.4 Working Group 4: thermodynamic temperature determinations and extension of the ITS-90 to lower temperatures

Mr Fischer summarized the report from the Chair as given in CCT/08-13, including information on recent research work included in the bibliography, the preparation of the document *Supplementary Information for the Realization of the PLTS-2000* (completed with particular thanks to Mr Rusby), and the preparation of spreadsheets on $T - T_{90}$ (which was given priority due to the role of this data in the *mise en pratique*).

WG4 strongly encourages other researchers to undertake investigations of thermodynamic temperature in a number of ranges where there is a paucity of existing data.

The intention and plan is to update the WG4 report and to implement the submitted tables as a part of the *mise en pratique*, with approval by the CCT to be obtained by correspondence. Mr Ripple asked if this should be done in two steps or one, depending on whether the new wording of the *mise en pratique* should be done simultaneously with determining the appropriateness and correctness of the treatment of the data by the Working Group; Mr Fischer agreed that there should be no problem to do this in two steps.

Mr Quinn spoke to the difficulty of performing absolute thermometry experiments, and acknowledged that the choice of treatment of the constant volume gas thermometry data is compatible with the way in which CODATA treated the discrepant data on G from PTB, where an estimation of the probability that given data sets are wrong was used to adjust the uncertainty of those data points during the fitting. The caution here is that it is urgent that there be more primary thermometry experiments performed by a method different from acoustic thermometry, particularly in the vicinity of the triple point of water, since there is a great danger that relying on only one technique could suffer from an unknown systematic error that introduces an uncorrectable bias.

Mr Fischer emphasized that the conclusion of WG4 on $T - T_{90}$ is a snapshot of the present situation and that these data are insufficient to propose a new revision of the temperature scale.

3.4.1 SI Task Group: redefinition of the kelvin

The SI Task Group (TG-SI) met twice (PTB Berlin, October 2006 and TempMeko Lake Louise, May 2007), and the report available as CCT/08-02 was summarized by Mr Fischer. The documents produced are: "Report to the CIPM on the implications of changing the definition of the base unit kelvin" and "Preparative steps towards the new definition of the kelvin in terms of the Boltzmann constant" (*Int. J .Thermophys*. – Proceedings of TempMeko).

3.5 Working Group 5: radiation thermometry

Mr Machin reported the activities of the Working Group as summarized in CCT/08-07, including the review and update of the Terms of Reference, the published uncertainty document in low

temperature radiation thermometry (completed and with special thanks to Mr Saunders), and the elaboration of the research plan for high temperature eutectic thermometry. The WG had significant input to improve the metrology underpinning an IEC standard on the use of thermal imagers for the monitoring and control of the spread of infectious diseases. There is good linkage with CCPR through joint membership in working groups and activities participation, as well as through a formal liaison relationship.

Priority activity for future work was identified to be documentation for primary radiometric temperature measurement as an input to the *mise en pratique*; next in order is updating the Red Book; lowest priority, with low enthusiasm, is providing input to the Blue Book. There is an intent to establish a subgroup within WG5 to draft out the Terms of Reference for the *mise en pratique* for the realization of the kelvin by the Autumn of 2008 and to produce a full draft of the text for consideration at the next CCT.

Future requirements for key comparisons were discussed, with two possibilities identified:

- circulating a radiation thermometer and a single fixed point (Ag, Cu), and
- circulating fixed point cells at "intermediate values".

Issues to be resolved for constructing the key comparison(s) include the choice of the comparison scheme and artefact, linkage mechanisms to subsequent RMO key comparisons, the number of participants, and a possible time line for completion. One particular concern raised was that any future key comparison have a clear stated purpose, for example probing participants' ability to realize T_{90} or T, including notes on the level at which a dissemination capability can be tested in a given comparison architecture. Given the lack of detailed discussion on this concern, Mr Machin indicated that a new key comparison in radiation thermometry should not be expected within the next two or three years.

The high temperature fixed point research plan has five principal areas of investigation, the first three of which are underway:

- long term stability and robustness (INM),
- construction of "primary" cells for temperature assignment (NMIJ),
- the operational requirements of HTFP (NMIJ),
- a radiometric comparison for absolute radiometry improvements (PTB), and
- planning and performing T measurements (NPL).

3.6 Working Group 6: humidity measurements

The report of the Chair as summarized in CCT/08-20 was presented by Ms Bell on behalf of Mr Huang who sent his regrets on being unable to attend the meeting. The document on Terms and Definitions is at an early draft stage, while the document on uncertainties is further advanced but not yet complete. The key comparison CCT-K6 is near completion, and strategy for future humidity key comparisons is under discussion.

Mr Huang, within his report CCT/08-20, recorded his desire to resign as Chair of WG6 after a productive period since the founding of the Working Group in 1996. The Working Group expressed its thanks for his personal championing of activities such as the International Symposium on Humidity and Moisture, and his inclusive leadership style. President Ugur accepted the resignation with his personal thanks and admiration for Mr Huang's efforts.

Ms Thomas mentioned that there are more than 20 000 CMCs in the Key Comparison Database (KCDB), of which only 13 are in humidity, a fact that she finds somewhat surprising given the importance of this environmental control parameter. President Ugur observed that these few CMCs are therefore quite precious. It was noted that an increase in CMCs is anticipated following the successful completion of CCT-K6 and EUROMET.T-K6.

3.7 Working Group 7: key comparisons

Mr Steele summarized the WG7 activities, including the need for streamlined approval process for comparison protocols, the need for additional discussion and investigation on key comparison design, analysis, and linking (with a possible workshop to be conducted at a future CCT meeting), the need for technical criteria to determine whether a key comparison is due for repetition, and the production of a "lessons learned from key comparisons" document. There was good support for the notion of providing a forum for discussion of these topics within the context of the CCT by both President Ugur and Director Wallard, an idea already being implemented in approximately two-thirds of the Consultative Committees. It was noted with thanks that Ms Thomas provides support to the CCT key comparisons that goes far beyond her role as the KCDB Coordinator, assisting with production of linking graphs and more. Although the community benefits from this additional assistance, it seems necessary to inform and educate new Pilots on the need to complete all of the linkage computations and data presentation.

3.8 Working Group 8: calibration and measurement capabilities

Mr Strouse provided an overview of the WG8 activities as summarized in CCT/08-11. There are over 700 published CMCs in temperature and humidity in the KCDB, with 38 NMIs represented, and industrial CMC review protocols that already include requirements for Device Under Test (DUT) uncertainty components. New complete CMC review protocols are now in place for: industrial thermometers, triple point of water cells, and ITS-90 subrange calibrated SPRTs, augmenting the three older protocols for SPRT fixed-points, humidity, and radiation thermometry. Draft review protocols for relative humidity and high temperature fixed points are under way. A "WG8 Expectations" document has also been created that include specific advice and criteria to expedite the process. In the latest meeting, the classification of services was updated to make "2.8 Other measurement services" more useful. The projection is that over 300 CMCs will be submitted to the JCRB by the end of the year. A strong reminder to encourage RMOs to register all of their comparisons, both regional key comparisons and supplementary comparisons, was given.

Additional comparisons under consideration include an extension of CCT-K6 to 90 °C and a new version of CCT-K3 (likely to be designated as CCT-K8) that use SPRTs as a transfer artefact with NIST agreeing to act as Pilot. A new key comparison to address certification of fixed point cell CMCs may be required, for which fixed-point cells rather than SPRTs would be used as transfer artefacts, and the discussions are at a very preliminary stage with NMIA and NMIJ each agreeing to act as Pilot for one of the four fixed points in the series (Ar, Hg, Sn, Zn).

Mr Ballico (APMP) will end his term as RMO TC Chair at the end of December; his replacement will be named at a later date. Mr Bojkovski (EURAMET) will conclude his term in June 2008; his replacement will be Mr Buck.

WG8 is willing and able to organize a workshop in conjunction with the next CCT meeting on the technical aspects of selecting, designing, and using Key Comparisons in the CMC Review Process.

Mr Machin asked about the existence of a measurement category for thermodynamic temperature measurement, such as primary radiometry above the Ag point or the PLTS-2000; Mr Strouse indicated that there is no current champion, and encouraged volunteers to step forward.

Mr Ballico indicated that the humidity CMCs are generally quite complex and therefore compressed, in the sense that there are multiple points in a single CMC over a wide temperature range. Mr Strouse echoed this sentiment, noting that the humidity CMC review process is quite complex (although Mr Lovell-Smith created an easy-to-use spreadsheet to assist the process).

The Executive Secretary to the JCRB, Mr Mussio, reminded the CCT that if there are any issues related to validity of CMCs as a result of performance in a key comparison then the responsibility of the NMI includes informing the JCRB, through their RMO.

There is an open question on who can participate in key comparisons, although it is usually necessary to be a Member of the Consultative Committee. Some leeway is given (for example in the CCM) to allowing Signatories to the Metre Convention, particularly when they have Official Observer status and the appropriate level of technical competence.

President Ugur reported that he was placed in a difficult situation at the CIPM meeting when he was asked about a conflict between two RMOs regarding CMCs in thermometry. Mr Strouse indicated that although there had been a difference of opinion between two RMOs on the nature and process for inter-regional CMC review, it was not deemed important enough to involve the President, and that the outcome was very positive since it led to the creation of the formal review protocols that are working so well now. No further involvement by the President or the CIPM is required.

3.9 Working Group 9: thermophysical properties

Mr Baba summarized the activities of WG9 as available in CCT/08-22, highlighting the report of the *Ad Hoc* CIPM Working Group on Materials Metrology (Chaired by Mr Seton Bennett) and available as CIPM/2007-09, "Evolving Needs for Metrology in Material Property Measurements". Progress in the thermal conductivity pilot study using guarded hot plates, using the ISO 8302 standard measurement protocol, was shown. Progress in the pilot study on thermal diffusivity using the laser flash method for isotropic graphite and Armco iron was shown, as was progress in the pilot study on infrared spectral normal emissivity. New work item proposals are under consideration for gross calorific value (gas calorimetry) and total hemispherical emissivity.

Director Wallard has initiated discussions with VAMAS seeking to explore a formal liaison relationship between that organization and CCT Working Group 9, since there is evidence that improved metrology, with traceability to the SI and stated measurement uncertainties, can have an impact in material testing, interlaboratory proficiency tests, and industrial processes. This is at a very early stage, and is in keeping with the CIPM Recommendation that a watching brief be maintained in this field, with a decision on future actions, if any, to be reconsidered in three to four years. Mr Davis explained that much of material properties characterization is outside of the SI, and gave hardness, which uses a conventional scale invented by test equipment manufacturers, as a specific example. Mr Ballico indicated that most NMIs of which he is aware are at the very beginning of establishing SI methods for such testing.

4 DISCUSSION AND REPORTS OF CCT KEY COMPARISONS

4.1 Discussion of proposed key comparisons

There was an agreement on the need to begin a new version of CCT-K3. The new key comparison, to be called CCT-K8, will be conducted with NIST as the pilot laboratory.

Some relevant comments on the conduct of this comparison include:

- SPRTs will be used as transfer artefacts,
- circulation will use a collapsed star topology,
- the fixed points to be compared will be in the range from Ar to Zn,
- to maintain a manageable number of participants and to ensure effective linking to the relevant regional metrology key comparisons, participation from each RMO will be limited to:
  - greater of 20 % of maximum number of available members or 3;
  - final clarification of which laboratories can participate is required.

Mr Ballico pointed out that Regional Metrology Organizations should be involved in internal discussions to nominate participating NMIs from their Region, since those participating in the Consultative Committee key comparison will become responsible for running the RMO KC to promulgate the equivalence beyond the CCT-K8 circle.

President Ugur proposed that NIST, in their role as Pilot laboratory, should draft the protocol for approval by WG7 after first discussing and circulating to the confirmed list of participants. Mr Ballico wishes to observe a fairly formal process, particularly since there is a burden of responsibility to maintain capabilities and serve as links to their region. Mr Strouse indicates that the WG8 expectation is that all of the RMOs will select their participants wisely, and that the lessons learned in CCT-K3 will guide and improve the process. The Pilot was requested to circulate the first draft protocol to the Regions through the WG8 representatives; the Pilot agreed to circulate to WG8 regional representatives by the end of June 2008. Regional Metrology Organizations will select their representatives, who will have an opportunity to revise the protocol. After that agreement is reached, WG7 will approve the protocol and the key comparison will begin.

On the potential new key comparison to address the question of certification of fixed point cell CMCs, which is proposed to cover Ar, Hg, Sn, and Zn, it was agreed to run this as a four-part comparison, with as much commonality in the protocol as possible but with separate final reports to be produced as each individual result becomes available. This will be designated as CCT-K9, and the initial task falls to WG8 to work towards producing the overall scheme, the identification of individual pilots, and the first draft protocol.

4.2 CCT-K5: realizations of the ITS-90 between the silver point and 1700 ˚C using vacuum strip lamps as transfer standards

The Report is now finalized, with approval by all participants. Discussion in WG5 supports the final report. Discussion in WG7 indicates no requirement for further delay in publication on the KCDB.

Discussion of the results and their relevance to supporting CMC claims; the results are not at odds with existing published CMCs, although there may be some new capabilities that should be

supported with a new key comparison. This was raised and discussed during the Working Group 5 Report. The Pilot, Mr van der Ham, is working with the KCDB Coordinator to finalize the preparation of the publication, including the necessary linking to CCT-K5.1. President Ugur thanked the participants and the Pilot for bringing this long-standing activity to a successful conclusion.

4.3 CCT-K6: comparison of humidity standards

Ms Bell presented a status report for the ongoing CCT-K6 key comparison of dew and frost point values at temperatures of -50 ˚C, -30 ˚C, -10 ˚C, +1 ˚C, and +20 ˚C, involving ten participants. As it stands now, this comparison has taken much longer than envisaged due to a series of minor but lengthy instrument failures, none of which are believed to impact the comparison results (based on a careful series of instrument checks performed by the Pilot). The current expectation is to conclude all measurements in late 2008, with a Draft A Report to be produced by the end of 2008 and publication in the KCDB in 2009.

There was some discussion on the question of creating an extension of CCT-K6 to higher temperatures, with an upper limit of +90 ˚C, including speculation on who could serve as pilot or which laboratories could participate. There is no new method beyond what is being done in CCT-K6 already, but WG6 believes that there is a need to address high temperature dew point measurements within the Consultative Committee, particularly since regional comparison activities in the regions (especially EURAMET and APMP) are already under consideration and are in the planning stage. There are many more laboratories working at these higher temperatures now than there were at the original inception date of CCT-K6, which is one driver for the proposed extension.

Mr Ballico inquired about linking the results of the already-completed APMP-T.K6 key comparison with the main CCT activity. Ms Bell indicated that the documentation on long term stability or evolution of the national standards is essential in establishing the linkages, but that historical data are well known. The new extension is not currently intended to overlap the existing range of temperatures, although President Ugur suggested that having a single point of overlap might add a lot of value for little additional effort. Mr Ripple reminded the Pilot that gaining experience from the lessons learned in bringing CCT-K6 to a successful conclusion prior to launching into the extension might save time and avoid repeating mistakes. Ms Bell indicated that the major mistake in CCT-K6 seems to be related to the choice to use old instruments that were, as it happened, prone to failure. Mr Fernicola confirmed that there is no major concern from the point of view of the existing protocol that would not be greatly improved by choosing to use new instruments. Ms Wang indicated that there is significant pressure in the Regions to make progress, and that there are already delays in publishing CMCs as a result. Mr Hill encouraged the Pilot and noted that the pitfalls and extended timelines are not at all out of the ordinary given our experience with other CCT key comparisons. Mr Ripple indicated that the existence of a EURAMET Draft A Report for the extended range comparison should be taken as support for conducting an extension to CCT-K6. The CCT agrees that CCT-K6 should be extended, and that WG6 is tasked with finalizing the protocol, determining the timetable, and organizing the Pilot and list of participants.

5 REVIEW OF WG TASK DEFINITIONS, ROLES, RESPONSIBILITIES AND OPERATIONAL PROCEDURES

5.1 CCT Working Group 1: defining fixed points and interpolating instruments

Mr Ripple led the discussion on creating new Terms of Reference and a revised task list.

New title:

Working Group 1: defining fixed points and interpolating equations of the ITS-90 and the dissemination of the kelvin

New terms of reference:

The Terms of Reference for CCT-WG1 are to improve and document the techniques for using defining fixed points and interpolating instruments of the ITS-90 and to supervise the dissemination of the SI unit of temperature through the *mise en pratique* for the definition of the kelvin.

Working Group 1 is tasked to continue with the updates to the *Supplementary Information for the ITS-90*, collaborating with Working Group 3 and Working Group 5 in the incorporation of material on uncertainties.

Working Group 1 also coordinates a task group (including a representative from Working Groups 2, 3, 4, and 5, and the BIPM) that:

- monitors developments supporting a future International Temperature Scale,
- prepares and maintains the *mise en pratique* for the definition of the kelvin,
- monitors research conducted to support the *mise en pratique* and future temperature scales, and
- coordinates the presentation of CCT material on the dissemination of the kelvin by the BIPM.

5.2 CCT Working Group 2: secondary fixed points and techniques of approximation of the ITS-90

There was some discussion on the possibility of combining WG2 and WG3 or otherwise clarifying the roles and mandates, since it seems difficult to move directly to assigning tasks. There was no support for completely abolishing WG2, since its work to produce documentation is deemed necessary and desirable. There was discussion on the possibility of having WG3 serve more in an advisory capacity for uncertainty-related topics in the activities of all working groups. Mr White indicated that an oversight role would best be served by a smaller working group membership to avoid conflicts in terms of overlapping tasks, and further suggested that there might be advantages to rearranging the tasks of Working Group 2, to separate the secondary instrumentation tasks from the secondary fixed point tasks. Ms Bell pointed out that the Terms of Reference for all of the working groups are phrased as tasks, rather than more generic roles and responsibilities. Mr Hill agreed, and suggested that wording such as "providing guidance" might prove helpful, and notes that we have much better success when we create communities organized according to our specialized expertise in the different aspects of thermometry, and proposes that Working Group 2 could be made responsible for industrial contact thermometry, and could organize itself internally to handle different aspects of the work (eg thermocouples, resistance sensors, etc.). Mr Pavese agreed, noting that the title of the WG2 monograph – "*Techniques for Approximating the ITS-90*" – is now nonsensical, given the

existence of the *mise en pratique* for the definition of the kelvin, but that the efforts of this working group still have a place in terms of collecting everything that is outside of the defining instruments and fixed points of the scale. An additional task must be defined, however, to pass information from WG2 back to WG1 or to the Task Group on the *Mise en Pratique*. Mr Fischer proposed that the WG be charged with gathering and reviewing techniques and providing authoritative guidance for dissemination of temperature through contact methods. Mr Hermier agreed that limiting things to ITS-90 approximations may be too restrictive. Mr Machin agreed that expanding the responsibilities of WG5 to include secondary thermometry through non-contact methods is a possibility, although it would be seen as a lower priority than some of its other activities. Mr Bloembergen would prefer the mandate to be explicitly related to T_{90}; Mr Ripple supported the conclusion that industrial requirements remain focused on ITS-90, but that this mandate can be made explicit in the tasks. Mr Hollandt wished to clarify which working group will have responsibility for platinum resistance thermometry. Mr Hill explained that the common distinction rests on the use of standard platinum resistance thermometers calibrated and used as defining interpolating instruments for ITS-90, which is a Working Group 1 activity, and that all other cases (eg calibration of SPRTs by comparison, use of IPRTs) fall under Working Group 2.

New name:

Working Group 2: secondary contact thermometry

New terms of reference:

The Terms of Reference of CCT-WG2 are to gather and review techniques and provide authoritative guidance for dissemination of temperature through contact methods.

5.3 CCT Working Group 3: uncertainties

There was discussion on the remit of this Working Group as primarily an oversight group, reviewing advice and guidance coming from the other Working Groups to ensure that matters related to uncertainty are consistent across all documents emitted by the CCT. Mr Hermier suggested that all documents related to uncertainty should be reviewed by WG3 prior to publication. Mr Hill reminded the CCT that the principles abstracted from the production of the guidance document on uncertainties for SPRTs form a useful basis for other WG activities with a focus on uncertainty, but that the idea of having WG3 serve only as a review body after a substantial amount of work has been done elsewhere restricts the utility and influence of this expert body. Mr Pavese indicated that several other organizations suffer from a lack of consistency in reporting uncertainty in related but distinct areas, and that this need is felt elsewhere. Further, he advocated for the existence of an independent body charged with producing uncertainty documentation, citing the limited role that WG7 has in assisting or developing the uncertainty statements and analysis for key comparisons. Mr Steele agreed that the ability to influence and shape uncertainty budgets or analysis is severely hampered by acting exclusively as a review body, but that having an intimate and active role in the tasks of other groups would provide opportunities to correct that situation. President Ugur concurred, noting that the relative maturity of the different fields will have an impact on the amount of involvement for WG3 experts, citing as an example a larger role in WG9 developmental pilot projects, and a smaller role in WG1 research projects. The composition of WG7 should therefore be large enough to provide a sufficient body of experts to participate actively in a potentially very large number of projects.

New Terms of Reference:

The Terms of Reference of CCT-WG3 are to review and recommend methods for evaluating, combining and reporting uncertainties in temperature, humidity, and thermophysical properties measurements and to ensure consistency of CCT advice in matters related to uncertainty.

The new composition of WG7 will include one member drawn from the expert working groups, and a sufficient number of members to participate actively in the tasks.

5.4 Working Group 4: thermodynamic temperature determinations and extension of the ITS-90 to lower temperatures

Mr Fischer noted that the Terms of Reference are acceptable, and led the discussion on revising the task list.

New task list:

Working Group 4 is tasked with continuing to review measurements of $T - T_{90}$ and with monitoring progress on the redefinition of the kelvin in terms of the Boltzmann constant.

5.5 Working Group 5: radiation thermometry

Mr Machin led the discussion on the new Terms of Reference and task list.

New terms of reference: The Terms of Reference of CCT-WG5 are to study and advise the CCT on issues related to thermal radiation methods for temperature measurement and to develop and maintain an effective liaison with the Consultative Committee for Photometry and Radiometry.

New task list:

Working Group 5 is tasked with:

- the evaluation of thermodynamic measurement results at higher temperatures,
- the examination and coordination of activities related to high-temperature fixed points,
- providing appropriate input into the *mise en pratique* for the realization of the kelvin,
- provide where required updates for *Supplementary Information for the ITS-90*,
- where necessary, provide definitive guidance for secondary non-contact thermometry methods,
- support world efforts in thermal imaging standardization,
- generate appropriate uncertainty budgets for radiation thermometry.

5.6 Working Group 6: humidity measurements

Ms Bell led the discussion on the new Terms of Reference and the task list, which were substantially the revisions proposed by the WG6 meeting.

New Terms of Reference:

The Terms of Reference of CCT-WG6 are to advise the CCT on matters relating to humidity, to pursue harmonization relevant to the field of humidity measurement, and to develop and maintain an effective liaison with the international humidity and moisture community.

New task list:

Working Group 6 is tasked with:

- production of the document on uncertainty in humidity,
- operation of CCT-K6,
- strategic planning of ongoing and future key and supplementary comparisons in the field;,
- clarification of quantities, units, symbols and realisations relating to humidity measurement,
- coordination with CCQM in areas of trace moisture in gases, and moisture in materials, as required, and
- convening the International Symposium on Humidity and Moisture (ISHM).

5.7 Working Group 7: key comparisons

Mr Ballico suggested a clarification in the Terms of Reference.

New Terms of Reference:

The Terms of Reference of CCT-WG7 are to oversee all aspects of key comparison documentation, starting with the protocol and ending with the Draft B Report and the KCDB entry, including the provision of advice to Pilots on the calculation of degrees of equivalence, key comparison reference values and linkage between RMO and CIPM key comparisons.

New task list:

Working Group 7 is tasked with:

- examining all relevant documents for each key comparison, starting with the protocol and ending with the Draft B Report,
- advising the pilot laboratory in preparing the text of the entry to Appendix B of the MRA as required, and to prepare a recommendation on these subjects for approval by the CCT, and
- advising the pilot laboratory in preparing a comparison status document.

5.8 Working Group 8: calibration and measurement capabilities

No changes were proposed for changes to the Terms of Reference.

5.9 Working Group 9: thermophysical properties

The Terms of Reference of CCT-WG9 are to advise the CCT on matters related to thermophysical properties, to assess the need for key comparisons in this field, and to develop and maintain an effective liaison with the international materials science community, including the Versailles Project on Advanced Materials and Standards (VAMAS).

5.10 Other matters related to Working Groups

Mr Steele asked about the need or desirability for creating a Working Group on Strategy, in line with the CIPM request. Director Wallard indicated that these groups are normally associated with roadmapping exercises, and which have been formed in other Consultative Committees in response to potential changes to the SI. The CCT has already addressed this latter issue through its Task

Group, but has no mechanism for looking ahead in a formal sense. President Ugur pointed out that the operation of the CCT is such that we respond quite quickly to new priorities, adapting our existing working group structure to accommodate these questions. Mr White noted that the task groups formed within Working Group 1 and Working Group 4 are already performing a foresight function. Mr Ballico indicated that perhaps one area not covered is the ability of the CCT to maintain a watching brief on industry needs and in particular the emerging and strategic needs of the industrial community. Since many of the larger NMIs have already undergone strategic exercises, it might be possible to gather this information together in part as an aid to smaller NMIs or developing economies and in part as a way to consolidate this information from the thermometry perspective. The experience in collecting such information within the CCPR was quite positive, for example. Mr Machin supported the suggestion, and indicated that some roadmaps in thermometry exist within both NPL and EURAMET, and that the creation and availability of a high level roadmap from an independent body such as the CCT may often have greater utility for national applications, such as identifying future research priorities, than one created in-house. President Ugur offered to collect the wider views by correspondence, and will determine whether an *ad hoc* group could combine such information into something useful, perhaps to be used as an input to the CIPM. Director Wallard indicated that this exercise might be most usefully conducted in a workshop format. Mr Hill pointed out that there are publications on roadmapping with the needs of the thermometry, thermophysical properties, and humidity communities captured within the Proceedings of the TempMeko 2007 Symposium. Mr Steele supported the idea of the President gathering information electronically, and Director Wallard suggested looking at the Terms of Reference for other Working Groups on Strategy as a useful starting point.

6 CHANGES TO WORKING GROUPS

6.1 CCT Working Group 1: defining fixed points and interpolating instruments

The NMi VSL and NIM will join WG1; the NRC will withdraw.

6.2 CCT Working Group 2: secondary contact thermometry

Mr Hill resigns as Chair, and NRC withdraws from the Membership. The CEM (Spain) and UME (Turkey) join WG2; CEM to be represented by Ms C. García. NIST also joins WG2 with Mr W. Tew as their representative.

Mr Liedberg (NMISA, South Africa) is elected Chair.

6.3 CCT Working Group 3: uncertainties

No withdrawals; the NIM joins CCT-WG3; Mr Chimenti, now retired, is replaced by Ms del Campo (CEM).

6.4 Working Group 4: thermodynamic temperature determinations and extension of the ITS-90 to lower temperatures

No withdrawals from CCT-WG4; the NIM joins CCT-WG4. Two changes to the Task Group: INRIM delegate Mr Merlone replaces Mr Steur (INRIM); Mr Gerasimov is replaced by Mr Pokhodun (VNIIM).

6.5 Working Group 5: radiation thermometry

No withdrawals from CCT-WG5; the UME joins and names Mr A. Diril as their representative.

6.6 Working Group 6: humidity measurements

Ms Bell was elected as the new Chair of CCT WG6, effective immediately. Mr Huang remains on the Working Group as the NIST delegate. The INTA becomes a full Member, with Mr R. Benyon as the delegate. The VNIIFTRI will join with Ms O. Podmurnaya as the delegate.

6.7 Working Group 7: key comparisons

The KRISS resigns its membership; the new Pilots will be added when named.

Mr Steele resigned as Chair, and Mr Ballico was elected as new Chair; the change becomes effective January 2009.

6.8 Working Group 8: calibration and measurement capabilities

The EURAMET will replace Mr J. Bojkovski with Mr W. Buck as their representative.

The APMP will replace Mr M. Ballico with a representative to be named later.

Mr Strouse commended Mr Bojkovski and Mr Ballico for their many years of dedicated service as founder members of WG8.

6.9 Working Group 9: thermophysical properties

The CENAM will join CCT-WG9 with Mr L. Cortés as their representative.

A Task Group on Strategy will be formed with Mr Pavese as Chair, supported by Mr Machin on compiling the Terms of Reference and President Ugur as the CIPM resource. Additional members can volunteer by correspondence, with participation encouraged from as broad a base as possible but most particularly from those NMIs and RMOs that have conducted strategic planning exercises with specific mention of thermometry. A workshop on steps to move forward is one expected outcome of this Task Group.

7 DISCUSSIONS ON ITS-20XX

Mr Ripple led a very useful discussion on the questions regarding the possible need for a revision to the International Temperature Scale. Topics discussed included the criteria for adoption of a new scale and what type of scale will be disseminated in the future. Several delegates asked whether this presentation could be placed among the restricted documents and, more generally, whether other presentations could be made available to the attendees. Mr Davis said that he would include .pdf versions of PowerPoint presentations made during the CCT meeting: these should be provided directly to him for grouping in a single zip file.

Consensus was established that the *mise en pratique* will briefly describe appropriate methods for primary thermometry, with selected references. No comprehensive guide to practice will be developed, unless the need for such a document becomes apparent in the future. No consensus has yet been obtained on the level of validation necessary for inclusion of a method in the *mise en pratique*, but this is not expected to be an issue for the next revision of the *mise en pratique*.

8 OTHER SCIENTIFIC TOPICS

No other scientific topics were discussed.

9 CCT MEMBERSHIP APPLICATIONS

The CENAM (Mexico) has been observing and participating in the CCT for some time, and their application to join the CCT as a Member will be recommended for acceptance by the CIPM.

The application of MIKES (Finland) to become an official Member or Observer will be recommended for acceptance by the CIPM.

The NIS (Egypt) has applied for Observer status at the CCT. There was some discussion regarding their capabilities and involvement in thermometry activities, and it was noted that they are currently developing CMCs in thermometry (to be submitted through EURAMET), that they are engaged in a bilateral comparison of SPRTS with NIST in the CCT-K3 range, and that their Quality Management System has been reviewed by France. The CCT will invite them to attend the next meeting as a Guest and to make a presentation on their organization.

Director Wallard reminded the CCT that there is a responsibility to review the status of the existing Membership periodically, noting that the formal criteria are set by the CIPM and are freely available on the BIPM website.

10 OTHER BUSINESS

Recently, the CIPM has made it possible for its Consultative Committees to reward exceptional service by its most distinguished Members upon their retirement. This formalizes the longstanding tradition within the CCT and elsewhere of expressing our appreciation to those very long serving members who have served in exemplary roles. The CCT may make use of this mechanism in future, as and when the situation is appropriate.

President Ugur reminded the Chairs of Working Groups of the need to provide brief annual reports to assist his preparation of the CCT Report to the CIPM, in which major events are captured. A reminder will be sent to the Chairs by the Executive Secretary on behalf of the President.

11 REPORT TO THE CIPM AND RECOMMENDATIONS

The President of the CCT will recommend to the CIPM that laboratories be encouraged to engage in those priority areas of thermometry that have been identified and highlighted in the various Working Group Reports.

12 NEXT MEETING

Respecting the scheduled events of the iMERA Boltzmann Workshop to be held in Italy in September 2009, TempMeko 2010 to be held in Slovenia in May, the CGPM to be held in October 2011, where redefinition of the units may be expected (and the Convocation must be published in January of 2011), and the next Temperature Symposium to be held in the United States in March 2012, the next meetings of the CCT will be held in spring of 2009 and May of 2011 (dates to be confirmed with the BIPM), with satellite events to be scheduled in conjunction with the Boltzmann Workshop and the TempMeko Symposium.

The spring 2009 meeting will emphasize scientific discussions in a series of workshops, structured as two days of working groups, two days of workshops, and a one-day plenary session. Mr Ripple will collect ideas for workshop topics and leaders via correspondence. The plenary session will emphasize key comparison progress and breaking news from the working groups that require decision by or provision of information to the CCT. Papers to be considered (excluding Reports) must be submitted not later than one month prior to the convocation.

Mr A. Steele, *rapporteur*

May 2008, revised September 2008

APPENDIX T 1.
Working documents submitted to the CCT at its 24th 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=CCT).

Document CCT/	
08-01	CCT. — Draft Agenda, 1 p. (restricted access)
08-02	CCT Working Group 4 TG-SI. — Report of CCT Working Group 4 Task Group (TG-SI) to the CCT, J. Fischer, 2 pp.
08-03	NMIJ/AIST (Japan). — Limits to the SIE and thermal analysis on impurity effect evaluation, K. Yamazawa *et al.*, 10 pp.
08-04	PTB (Germany). — PTB-2006: A new ^{3}He vapor-pressure scale from 0.65 K to 3.2 K consistent with the PLTS-2000, J. Engert and B. Fellmuth, 1 p.
08-05	INRIM (Italy). — On the need to tackle GUM requirement to perform the corrections for recognised systematic effects: The effects of chemical impurities on the realisations of fixed points of the ITS-90, F. Pavese, 5 pp. (restricted access)
08-06	INRIM (Italy) *et al.* — Status of the progress towards the determination of the relationship between neon triple-point temperature T_{tp} and isotopic amount composition x, F. Pavese *et al.*, 4 pp. (restricted access)
08-07	CCT Working Group 5. — Working Group 5 Activity Report to the CCT, May 2008, G. Machin, 10 pp.
08-08	CCT Working Group 6 Task Group on Terms and Definitions. — Terms and Definitions Relating to Humidity Measurement, 5 pp. (restricted access)
08-09	NIST (United States). — Adjustments to the NIST Realization of the ITS-90 from 5 K to 24.5561 K, W.L. Tew and C.W. Meyer, 8 pp. (restricted access)
08-10	LNE-INM (France). — Pollution of aluminum ingot during the melting-freezing transitions, E. Renaot, 7 pp. (restricted access)
08-11 rev.	CCT Working Group 8. — Working Group 8 Report to the CCT, May 2008, G. Strouse, 5 pp.
08-12	Evitherm. — The evitherm Society plc: a renewed vision and new life for the Virtual Institute for Thermal Metrology, F. Pavese, 3 pp.
08-13 rev.	CCT Working Group 4. — Working Group 4 Report to the CCT, June 2008, J. Fischer, 17 pp.

Document CCT/

08-14 CCT Working Group 2. — Working Group 2 Report to the CCT, May 2008, K. Hill, 8 pp. (restricted access)

08-14.1 CCT Working Group 2. — Chapter on "Thermistor Thermometry" (see CCT/08-14 page 2), 9 pp. (restricted access)

08-14.2 CCT Working Group 2. — Chapter on "Thermocouple Thermometry" (see CCT/08-14 page 2), 22 pp. (restricted access)

08-15 CCT Working Group 1. — Working Group 1 Report to the CCT, May 2008, D. Ripple, 2 pp. (restricted access)

08-16 rev. NIST (United States). — Recommended List of Common Impurities for Metallic Fixed-point Materials of the ITS-90, D. Ripple *et al.*, 20 pp.

08-17 rev. CCT Working Group 1 *Mise en Pratique* Task Group. — Report from the *Mise en Pratique* Task Group: The next International Temperature Scale and the *mise en pratique* for the defininition of the kelvin, D. Ripple *et al.*, 8 pp.

08-18 rev. CCT Working Group 3. — Working Group 3 Report to the CCT, May 2008, D.R. White, 6 pp. (restricted access)

08-19 CCT Working Group 3. — Uncertainties in the Realisation of the SPRT Subranges of the ITS-90, D.R. White *et al*., 83 pp. (restricted access)

08-20 CCT Working Group 6. — Report of Working Group 6 on Humidity Measurements to the 24th meeting of the CCT, May 2008, P. Huang, 2 pp.

08-21 VNIIFTRI (Russian Fed.). — The VNIIFTRI magnetic temperature scale in the 0.3 K – 3 K range, D.N. Astrov, N.B. Ermakov and V.I. Sviridenko, 10 pp.

08-22 CCT Working Group 9. — Working Group 9 Report to the CCT (draft), May 2008, T. Baba, 2 pp. (restricted access)

08-23 VNIIFTRI (Russian Fed.). — Melting curve of ^{3}He with 0.2 % ^{4}He impurity, D.N. Astrov, N.B. Ermakov, 3 pp.