

# CCT Report to CGPM

(2008-2011)

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# CCT Report for CGPM

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# Membership of CCT

President: Dr. Hüseyin Uğur, Turkey

CCT Executive Secretary: Alain Picard, BIPM

## Full Members (21):

- ▣ Agency for Science, Technology and Research [A\*STAR], Singapore
- ▣ Centro Español de Metrología [CEM], Madrid
- ▣ Centro Nacional de Metrología [CENAM], Querétaro, Qro
- ▣ Conservatoire national des arts et métiers/Institut National de Métrologie [LNE-INM/Cnam], La Plaine-Saint-Denis
- ▣ D.I. Mendeleev Institute for Metrology, Rostekhnregulirovaniye of Russia [VNIIM], St Petersburg
- ▣ Institute for Physical-Technical and Radiotechnical Measurements, Rostekhnregulirovaniye of Russia [VNIIFTRI], Moscow
- ▣ Instituto Português da Qualidade [IPQ], Caparica
- ▣ Istituto Nazionale di Ricerca Metrologica [I.N.R.I.M], Turin
- ▣ Korea Research Institute of Standards and Science [KRISS], Daejeon

# Membership of CCT

## Full Members (continued):

- ▣ 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 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 - Institute for National Measurement Standards [NRC-INMS], Ottawa, Ontario
- ▣ Physikalisch-Technische Bundesanstalt [PTB], Braunschweig
- ▣ Slovak Institute of Metrology/Slovenskí Metrologickí Ústav [SMU], Bratislava
- ▣ VSL [VSL], Delft

# Membership of CCT

## Official Observers (2):

- ▣ Centre for Metrology and Accreditation [MIKES], Espoo
- ▣ National Institute of Metrology, Standardization and Industrial Quality [INMETRO], Rio de Janeiro

# Working Groups, WG1

## WG1: Defining fixed points and interpolating instruments

WG1 is tasked to continue with the updates to the Supplementary Information for the ITS-90, collaborating with WG3, WG4, and WG5 in the incorporation of material on uncertainties, to coordinate a task group (including a representative from Working Groups 3, 4, and 5) formulating 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. This resulted in the preparation of the document “Mise en pratique for the definition of the kelvin”.

Triple Point of Water Task Group operates within WG1.

### Membership:

PTB (Chair), CENAM, INRIM, KRISS, LNE, NIM, NIST, NMIJ, NPL, SMU, UME, VNIIM, VSL

# Working Groups, WG2

**WG2: Secondary reference points and techniques of approximation to ITS-90**

WG2 is tasked to continue with the updates to the “Techniques for Approximating the ITS-90”, including advice on secondary fixed-point construction and operation.

Membership:

NMISA (Chair), CEM, CENAM, INRIM, KRIS, LNE, MSL, NIM, NIST, NMIJ, PTB, UME

# Working Groups, WG3

## WG3: Uncertainties

WG3 is tasked with continuing the production of a document on uncertainty budgets for contact thermometry, and to act in an oversight role for similar documents produced by other working groups.

### Membership:

MSL (Chair), CEM, CENAM, INRIM, IPQ, LNE, NIM, NMIA, NMIJ, NIST, PTB, SMU, UME, VNIIM, VSL



# Working Groups, WG4

**WG4: Thermodynamic temperature determination and extension of the ITS-90 to lower temperatures**

WG4 is tasked with continuing the production and dissemination of Supplementary Information for the PLTS-2000 and with monitoring progress on potential redefinition of the kelvin in terms of the Boltzmann constant.

The President of CCT has asked WG4 to establish a Task Group for the redefinition of Kelvin (TG-SI). The activities of this task group are given later. Definition of Kelvin Task Group (TG-SI) operates within WG4.

Membership:

PTB (Chair), INRIM, KRISS, LNE, MSL, NIM, NIST, NMIJ, NPL, NRC-INMS, CCT President, CCT Executive Secretary

# Working Groups, WG5

## WG5: Radiation Thermometry

WG5 is tasked with producing a document on uncertainty in radiation thermometry at temperatures below the Ag freezing point, with the coordination of thermodynamic measurement results at higher temperatures, with continuing the examination and coordination of activities related to high-temperature fixed points, and with providing appropriate input into the mise en pratique for the realization of the kelvin. WG5 is also tasked to provide formal liaison between the CCT and CCPR.

### Membership:

NPL (Chair), CEM, CENAM, INMETRO, INRIM, KRISS, LNE, MSL, NIM, NIST, NMC/A\*STAR, NMIA, NMIJ, PTB, SMU, UME, VNIIM, VSL

CCPR Liaison: NPL

# Working Groups, WG6

## WG6: Humidity measurements

WG6 is tasked with continuing production of the document on uncertainty in humidity, with the operation of CCT-K6, and with providing strategic planning information on future key and supplementary comparisons in the field.

### Membership:

NPL (Chair), CENAM, INRIM, INTA, KRISS, LNE-CETIAT, MIKES, MSL, NIM, NIST, NMIJ, NMC/A\*STAR, PTB, UME, VNIIM, VSL

# Working Groups, WG7

## WG7: Key Comparisons

WG7 is tasked with continuing the oversight of ongoing key comparisons, and with the production of guidance documents on comparison deviations. Including pilot laboratories of ongoing and completed CCT key comparisons in the membership of this working group captures and preserves the experience and lessons learned during previous comparison exercises.

### Membership:

NMIA (Chair), Pilot CCT-K1 (NPL), Pilot CCT-K2, (NRC-INMS), Pilot CCT-K3 (NIST), Pilot CCT-K4 (PTB), Pilot CCT-K5 (VSL), Pilot CCT-K6 (NPL), Pilot CCT-K7 (BIPM), Chair of CCT-WG3, Manager BIPM KCDB (non-voting), INRIM

# Working Groups, WG8

## WG8: Calibration and Measurement Capabilities

WG8 is tasked to continue with the creation of CMC review protocols and the review of fast-track CMC submissions for inclusion in Appendix C, along with the identification of new comparisons needed to support CMC submissions.

Membership:

SIM(Chair), APMP, COOMET, EUROMET, SADC MET

# Working Groups, WG9

## WG9: Thermophysical Properties

WG9 is tasked with continuing the production of a document on uncertainty, and with identifying and undertaking suitable pilot studies to establish the state of measurement and maturity of the field.

### Membership:

NMIJ (Chair), CENAM, INRIM, KRISS, LNE, NIM, NIST, NPL,  
PTB, VNIIM

# Activities of CCT, Key Comparisons

Completed, results are published in KCDB

- ▣ CCT-K1: Realizations of the ITS-90 from 0,65 K to 24.6 K (1997-2001).
- ▣ CCT-K2: Realizations of the ITS-90 from 13.8 K to 273.16 K (1997-1999)
- ▣ CCT-K3: Comparison of realizations of the ITS-90 over the range 83.8058 K to 933.473 K (1997-2001)
- ▣ CCT-K4: Comparisons of local realizations of Aluminum and Silver fixed points (1998-2000)
- ▣ CCT-K5: Realizations of the ITS-90 between 962 °C and 1700 °C using vacuum strip lamps as transfer standards (1997-1999).
- ▣ CCT-K7: Comparisons of water triple point cells (2002-2004)

# Activities of CCT, Key Comparisons

## In Progress

- ❑ CCT-K6: Comparison of humidity standards: dew and frost point temperatures (2003-). In progress.
- ❑ CCT-K8: Comparison of realizations of local scales of dew-point temperature of humid gas: 30 °C to 90 °C. (2011-). In progress.



# Activities of CCT, Other Events

Various CCT Working Groups have organized the following seven international meetings:

- ▣ 3rd International Workshop on Progress in Determining the Boltzmann Constant, held on 7 April 2008 at LNE-INM
- ▣ 4th International Workshop on Progress in Determining the Boltzmann Constant, held on 22 to 23 September 2009 at INRiM
- ▣ New Kelvin Dissemination Workshop, held on 27 to 28 October 2010 at NPL
- ▣ Dedicated sessions at the conference TEMPMEKO-ISHM 2010, held from 31 May to 3 June 2010 in Portoroz, Slovenia:  
Temperature Scales, Determination of the Boltzmann Constant,  
Thermodynamic Temperature Determination
- ▣ The second meeting of the Blackbody Users Group (BBUG)
- ▣ Workshop on planning the next steps of the HTFP research.
- ▣ International Workshop on High Temperature Fixed Points Solutions for Research and Industry, was held at KRISS, immediately after Newrad '08, on 17th Oct 2008.

# Outputs (2008–2011)

## a. Recommendations:

CCT in its 2010 Meeting has adopted three recommendations to be submitted to CIPM. CIPM has accepted all three recommendations in its 2010 meeting.

- ▣ T1 (2010) on the Mission of the CCT
- ▣ T2 (2010) on Considerations for a new definition of the kelvin
- ▣ T3 (2010) on Climate and meteorological observations measurements

## b. Other Scientific Outputs:

13 papers prepared and presented by CCT members at various scientific platforms

# Outputs (2008–2011)

## c. Guidance Documents or Technical Reports (new or updated)

- ▣ Addendum to the Supplementary Information for the ITS-90
- ▣ Supplementary Information for the PLTS-2000
- ▣ Guidance Document on the Uncertainties in the realization of the SPRT subranges of ITS-90
- ▣ Techniques for Approximating the ITS-90 (Blue Book).
- ▣ Isotopic Effects in the Hydrogen Fixed Points: Report to the CCT
- ▣ Summary of Facts Relating to Isotopic Effects and the Triple Point of Water: Report of the ad hoc Task Group on the Triple Point of Water
- ▣ Methodologies for the estimation of uncertainties and the correction of fixed-point temperatures attributable to the influence of chemical impurities
- ▣ Uncertainty Budgets for SPRT Calibrations at the Defining Fixed Points
- ▣ Working document cataloguing the uncertainty associated with a radiation thermometry approximation of the ITS-90 below the silver point
- ▣ Uncertainty in the generation of humidity
- ▣ Report to the CIPM on the implications of changing the definition of the base unit kelvin.
- ▣ Uncertainty document in low temperature radiation thermometry
- ▣ Guide on thermistor thermometry
- ▣ Specialized fixed points above 0°C
- ▣ Thermocouple thermometry
- ▣ Industrial platinum resistance thermometry
- ▣ Heat pipe thermometry

# Redefinition of Kelvin

A new task group (TG-SI) was created within WG4 in response to the CIPM 2005 recommendation (CI-2005) and held its first meeting in October 2006. The Terms of Reference follow closely CIPM Recommendation 1 of 2005, (CI-2005), "Preparative steps towards new definitions of the kilogram, the ampere, the kelvin and the mole in terms of fundamental constants".

Membership:

Chair: Dr J. Fischer, PTB

Members: INRIM, KRISS, LNE-INM/CNAM, MSL, NIM, NIST, NMIJ, NPL, NRC-INMS, VNIIM, the CCT President and CCT Executive Secretary

# Redefinition of Kelvin, Output

- First major output of TG-SI was the report to the CIPM on the implications of changing the definition of the base unit kelvin which was delivered to CCU in May 2007.
- The necessary conditions to be met before changing the definition were updated in the Recommendation T 2 (2010) of CCT to CIPM: Considerations for a new definition of the kelvin. In the last 3 years there has been excellent progress in determining the Boltzmann constant  $k$  but CCT notes that the experiments currently underway to measure  $k$  need another two years before CODATA can recommend a robust value for  $k$  with a relative standard uncertainty about a factor of two smaller than the current  $u_r$  of approximately  $2 \times 10^{-6}$ .
- CCT recommends that before proceeding with the redefinition of the kelvin a relative standard uncertainty of the value of  $k$  of order one part in  $10^6$  be obtained, based on measurements applying different methods of primary thermometry, and equally important, that these measurements ideally include at least two fundamentally different methods such as acoustic gas thermometry and dielectric constant gas thermometry and be corroborated by other measurements such as Johnson noise thermometry, total radiation thermometry or Doppler broadening thermometry.

# CCT Strategy

The decision of forming a Task Group (TG) on “Strategy” within the CCT was taken at the 24<sup>th</sup> meeting in 2008, and the TG was initially formed by: F. Pavese (Chair), G. Machin (NPL) and H. Ugur (President of CCT).

- ▣ This initial group started its activities on October 2008 on input documents of the CCT President, namely concerning the CIPM strategy on science priorities of the BIPM (meeting of 14 October 2008).
  
- ▣ A ToR to exploit its duty, including the rules for membership was adopted. The ToR has defined a roadmap to arrive at a CCT strategy and to apply it in four steps:
  - Development of CCT mission to be approved by CIPM,
  - Development of the methodology for setting up the CCT strategy,
  - SWOT analysis,
  - Development of the CCT Strategy using the methodology developed and outcome of SWOT Analysis.

# CCT Strategy, Progress

The first step was completed in 2010.

A draft of the CCT Mission was prepared by the Task Group.

CCT, in its 25th meeting (May 2010), discussed and accepted the CCT Mission.

CIPM, in its 2010 meeting, approved the CCT mission.

Second step is going on.

A draft for the methodology in order to develop CCT Strategy was prepared by the Task Group and circulated for comments.

# CCT Report for CGPM

This is my last report to CGPM as the President of CCT

It was a privilege for me to take part in such a distinguished committee.

I sincerely thank all CCT members, laboratories as well as scientists, CCT secretaries, BIPM staff and CIPM members for all the support they have given me for 12 years in order to make CCT an efficient and highly productive committee.

**Thank You**