Bureau International des Poids et Mesures

Consultative Committee for Thermometry (CCT)

Minutes of the 29th meeting
Session 2
4 November 2020

Due to the present pandemic, the 29th meeting of the CCT is held on-line.
It is split into five sessions spanning over October 2020 until February 2021.

These minutes will be incorporated at a later stage into the CCT's Report to the CIPM.

LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR THERMOMETRY

as of 20 October 2020

President

Y. Duan, member of the International Committee for Weights and Measures

Executive Secretary

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

Members

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

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

Centro Español de Metrología [CEM], Madrid.

Centro Nacional de Metrología [CENAM], Querétaro.

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

Czech Metrology Institute [CMI], Brno.

D.I. Mendeleyev Institute of metrology, Rosstandart [VNIIM], St Petersburg.

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

Instituto Português da Qualidade [IPQ], Caparica.

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

National Physical Laboratory [NPL], Teddington.

National Research Council of Canada [NRC], Ottawa.

Physikalisch-Technische Bundesanstalt [PTB], Braunschweig.

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

VSL B.V. [VSL], Delft.

VTT Technical Research Centre of Finland Ltd, Centre for Metrology / Mittatekniikan keskus [MIKES], Espoo

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

Official Observer(s)

FSB - Laboratory for Process Measurements [DZM/FSB-LPM], Zagreb.

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

The twenty-nineth meeting of the Consultative Committee for Thermometry (CCT) was held in five separate sessions via the web due to the pandemic crisis.

The following were present at the second session:

Z. Ahmed (NIST), I. AlFaleh (SASO-NMCC), M. Anagnostou (EMI), K. Anhalt (PTB), S. Bell (NPL), J. Bojkovski (MIRS/UL-FE/LMK), J. Brionizio (INMETRO), C. de Bruin (VSL), C. Byung-Il (KRISS)D. del Campo (CEM), Y. Duan (NIM), E. Ejigu (NMISA), L. Eusebio (IPQ), Y. Fan (NMC, A*STAR), R. Feistel (IWAPS), X. Feng (NIM), V. Fernicola (INRIM), S. Fil (NSCIM), J.-R. Filtz (LNE), C. Gaiser (PTB), R. Gavioso (INRiM), B. HAY (LNE), M. Heinonen (MIKES), M.-K. Ho (NMIA), M. Kalemci (UME), L. Knazovicka (CMI), L. Lira (CENAM), J. Lovell-Smith (MSL), A. Merlone (INRiM), M. Milton (BIPM), R. Mnguni (NMISA), T. Nakano (NMIJ AIST), H. Nasibli (UME), P. Pavlasek (SMU), J. Pearce (NPL), A. Peruzzi (NRC), A. Pokhodun (VNIIM), P. Rourke (NRC), S. Rudtsch (PTB), M. Sadli (LNE-Cnam), N. Sasajima (NMIJ AIST), P. Saunders (MSL), A. Shchipunov (VNIIFTRI), Y. Shaochun (NMC, A*STAR), G. Snijders (VSL), F. Sparasci (LNE-Cnam), R. Strnad (CMI), R. Teixeira (INMETRO), W. Tew (NIST), A. Todd (NRC), C.M.. Tsui (SCL), E. van der Ham (NMIA), M. Vinge (VNIIFTRI), L. Wang (NMC, A*STAR), E. Webster (MSL), R. White (MSL), , N. Yamada (NMIJ AIST), I. Yang (KRISS), H. Yoon (NIST), Z. Yuan (NIM), J. Zhang (NIM), D. Zvizdic (FSB).

Also present: S. Bergstrand (Executive Secretary of the JCRB), S. Picard (Executive Secretary of the CCT).

Excused: F. Jahan (NMIA), G. Machin (NPL).

The President of the CCT, Dr Y. Duan opened the meeting and welcomed the participants. Dr H. Yoon (NIST) was appointed *rapporteur* for the second session.

The agenda of the meeting was approved with no changes or additions [CCT/20-02].

2 CIPM Update

Dr M. Milton, Director of the BIPM reported on the CIPM meeting and described the work being performed at the BPIM [CCT/20-38].

He stated that Belarus has recently joined as a member state and that now there are 102 NMIs, 156 designated institutes and 4 international organizations which are signatories of the CIPM MRA.

Dr M. Milton spoke about recent decisions of the CIPM that would directly concern the CCT. He stated that rules and procedures for operating Consultative Committees are stated in the CIPM D-01 and that on-line meetings now have been approved by the CIPM. He clarified that RMO Technical Committee chairs are always invited to participate in Consultative Committee activities

and that NMIs of member states can also request that one person from the NMI participate in the Consultative Committee meeting as observers. The CIPM has restated that decision making in the Consultative Committees is done by consensus, which was the case all along. The CIPM has also stated that all Consultative Committee meetings can take place on-line and that those meetings are considered full meetings of Consultative Committees.

Dr M. Milton also presented some points on the digital transformation project. The CIPM has a long-term goal to establish a framework for calibrations that are machine readable. These calibration certificates and methods of accessing them should be made to facilitate digital transactions. He stated that this did not consist of scans of physical calibration documents but digital calibration certificates which can be machine read and machine actionable. The KCDB will become made machine readable. As an example of this Dr S. Picard has been working in this project and both projects will be beta tested in near future. Interested parties are encouraged to contact Dr S. Picard. As part of this transformation, the SI brochure will be converted to machine addressable xml format.

The BIPM was active during the time of COVID confinement mandated by the French authorities. The BIPM sustained all key activities such as the Circular-T (UTC), World Metrology Day 2020 and the roll out of KCDB2.0. The BIPM engaged in offering on-line technical courses for capacity building. The BIPM also supported NMIs during this COVID pandemic by acting as a repository of NMIs' COVID response efforts and as an example, the CCQM performed pilot studies for analytes of COVID RNA and antibody systems.

Concluding, Dr M. Milton stated that the BIPM has developed new ways of supporting Consultative Committee meeting activities during this pandemic. The BIPM, for example, hosted 50 on-line meetings for the CCQM, and the members of the CCTF gave webinars which were posted on YouTube available for further comments from their members.

Dr M. Milton stated that BIPM is back to 100 % operational efficiency during the lockdown.

Dr Y. Duan thanked Dr M. Milton for his information and expressed his appreciation to the BIPM staff contributions, in particular during the pandemic crisis.

Dr H. Yoon (NIST) asked whether the digital calibration certificate is like blockchain technology. Dr M. Milton stated that use of blockchain might not be ideal as the DCC is computationally intensive. Dr Milton informed that a conference on this topic will be held at the BIPM in February. 2021.

3 JCRB Update

The Executive Secretary of the JCRB, Dr S. Bergstrand updated the CCT on the actions taken at the 42nd JCRB meeting held in September 2020 [CCT/20-39]. He stated that RMOs should work with Technical Committees to review key comparisons listed in the BIPM website that are older than 5 years. The relevant key comparisons of the CCT were marked. This information will also be conveyed to Dr Susanne Picard and can be obtained from her.

The old CIPM MRA documents which were spread out into 27 documents are being updated to just 6 documents: 3 policy documents and 3 guideline documents. The information contained in these documents have not changed. The policy documents have been approved by the JCRB and

the guideline documents are in the process of being approved. He anticipates that this second approval will occur in November 2020.

Due to the Covid pandemic the transition to 17025:2017 will occur in June 2021. He informed that the old JCRB CMC website will be closed no later than 30 June 2021. It remains only 5 active CMC submissions in the old website. The final date will be decided upon at the 43 JCRB meeting.

Dr S. Picard said that old comparisons had been addressed by Dr A. Peruzzi, chair of the CCT WG-KC.

4 Report from WG-CMC, Jovan Bojkovski (MIRS/UL-FE/LMK)

Dr J. Bojkovski stated that the most recent physical meeting of the WG-CMC was held during Tempmeko 2019 in Chengdu in China, and members from APMP, EURAMET and COOMET were present. An on-line meeting was held on 1 October 2020 and the next on-line meeting will be held on 26 November 2020 [CCT/20-37].

There are currently 2908 CMCs by 66 countries in thermometry that are published in the database which is an increase from 2545 in 2017. He stated that there are 9 current CMC review protocols with an additional protocol one on thermal diffusivity which needs to be approved by the CCT. The members of this working group consist of TC-T chairs from RMOs.

During this most recent meeting, actions were taken to review submitted and future CMCs. Dr J. Bojkovski discussed proposals to decrease the number of categories and the numbers of CMCs. He stated that CMCs from AFRIMETS were usually accepted without further review since their submitted uncertainties are higher[1] as compared to other RMOs' submitted values. He stated that APMP and EURAMET have yearly reviews of CMCs.

Dr J. Bojkovski considered that to manage the CMC reviews, CMC submissions should be grouped and submitted within time slots. The CCT WG-CMC reviews will be performed once or twice per year. Requests for CMC reviews in the future will need to coordinate the submissions of CMCs with the meeting schedule of the WG. He stated that supporting documents for the CMCs (such as results of comparisons, quality system accreditation and peer review) should be submitted along with the request.

Most of the CMC review protocols are old and need revisions. Dr J. Bojkovski highlighted that RMOs treats some of the submissions in a non-harmonized way and that this will be addressed. Further, immediate action should be taken to modify CMC protocols for the industrial category and humidity. A CMC protocol is needed for air temperatures which should be checked with RMOs. The number of categories should be decreased, and as an example he stated that there are three categories for thermocouples which could grouped into one single category. The current approach is based on instruments but, in the future, a physical-quantity based approach could be adapted.

[1] According to the developed review protocol, note made by the *Rapporteur*.

New comparisons are needed to support CMCs. The supporting evidence for CMCs relies upon comparisons which are almost almost 20 years old, but it is not possible to carry out a comparison for every CMC. He asked whether CMCs for SPRTs could apply to thermocouples and what is an appropriate time interval for comparisons. He suggested that supporting evidence for CMCs for other types of contact thermometers can be obtained from comparisons of long-stem SPRTs, and that in humidity measurements, comparisons can be used to support measurements of other humidity measuring devices.

RMOs have informed that CMCs in humidity are sometimes approved without any comparison support, and that at least some comparison should be performed to approve CMCs. Members of the APMP had conveyed a template for humidity review protocols to the chair of the CCT Working group on humidity.

Dr J. Bojkovski made a request to CCT for a change of service category of IPRT to PRT by comparison. Dr S. Picard noted this service category change request.

Dr D. Zvizdic (FSB) stated that one needed to be careful about simplifications in CMC reviews but recognized that the workload in CMC reviews can be difficult to manage.

Dr Y. Duan observed that CMC review protocol for thermal diffusivity measurements need to be approved by the CCT. Dr Susanne Picard noted that the protocol has been on the restricted CCT website since October 2020. Dr J. Bojkovski indicated that the process started 2.5 years ago, and this request is just for approval by the CCT. Dr J.-R. Filtz (LNE) stated that CCT Task Group for Thermophysical Quantities will meet in January 2021 where this can be discussed. Dr J.-F. Filtz will distribute the protocol so that the members can review the protocol and vote by January 2021.

5 Reports from Regional Metrology Organizations

Dr Y. Duan asked Dr S. Picard to review the reports of the RMO TC chairs. Dr Y. Duan asked whether there were any questions to the CCT in the RMO reports. No questions from the RMOs were recorded. Reports from AFRIMETS [CCT/20-19], APMP [CCT/20-20], COOMET [CCT/20-21], EURAMET [CCT/20-22], GULFMET [CCT/20-23] and SIM [CCT/20-24] were briefly shown.

During the RMO presentation on EURAMET activities in thermometry, Dr D. Del Campo (CEM) informed that a Joint COOMET and EURAMET meeting will take place in 2021.

Dr A. Peruzzi (NRC) asked about the APMP hybrid comparisons. Dr I. Yang (KRISS) stated that they are bilateral comparisons but based on commercial calibration certificates of the issuing NMI structured to reduce the workload on the issuing NMI. This type of hybrid comparison has been approved by the JCRB for other measurement categories. Dr I. Yang stated that in a hybrid comparison the issuing NMI considers measurements as the same as a commercial calibration. The two individual calibration certificates are then sent to a third party to have a blind comparison. The final report is written by the applicant NMI and then posted on the APMP website for comparisons. This database is made accessible for reviewers of CMCs. In this hybrid comparison,

the applicant NMI writes the report and reviewers of the CMC will see the report as evidence of their capabilities. Dr I. Yang stated that at present three comparisons are being carried out, and the pilot labs provide commercial calibrations. Dr D. del Campo (CEM) stated that this is already being used in EURAMET. Dr H. Yoon (NIST) asked whether the applicant NMI covers the cost of the calibrations. Dr I. Yang stated that the issuing NMI will be paid for the calibrations. Dr S. Rudtsch (PTB) stated that such hybrid comparisons have been performed at PTB for over 10 years. He stated that the applicant NMIs paid for the calibrations and submitted their own results to a third party for a blind, bilateral intercomparison. He confirmed that the PTB was quite satisfied with this type of hybrid intercomparison.

6 Report from TG-NCTh-ET, Zeeshan Ahmed (NIST)

Dr Z. Ahmed gave a presentation describing the work of the CCT Task Group on Contact Thermometry for Emerging Technologies [CCT/20-36]. The task group was formed in CCT 2017 and Dr Z. Ahmed reviewed the terms and tasks of the group. It comprises 18 members and work is progressing in this area in EURAMET member institutes, NRC, NIM and MSL, in addition to the work being done at the NIST. The task group has categorized measurements into two categories grouped into primary and ITS-90-based thermometers. He indicated that a draft report has been mostly completed where the main points were highlighted in the executive summary and in a table which listed the different technologies, their figures of merit and whether these are commercially available at present.

He highlighted various primary thermometers, notably on-chip, Doppler-broadening thermometry, based on wafer cells for time metrology. He informed that these are magnetic-field sensitive with further progress expected in the next 5 years. He described opto-mechanical thermometry which can be easily integrated into quantum information science. This is at an early stage of research. He also described light-scattering based thermometry. These sensors can be used for distributed sensing for both static and dynamic measurements, but these sensors are strain sensitive and detectors are complex.

Dr Z. Ahmed then described ITS-90-based thermometers such as fibre-optic based thermometry. These sensors are easy to package into existing technology but suffer from thermal hysteresis, with long-term drift that is poorly understood. On-chip photonic thermometry with uncertainties which are expected to be comparable to SPRTs or better were discussed, however, low-drift packaging needs to be developed and there is a lack of physics-based models. Furthermore, these devices require user training.

The task group has fulfilled all the set objectives but asks to continue with new tasks. These cover notably to publish the report (earlier cited) in the form as a review article, continue the literature surveillance and add to the current document. The group is also targeting to add best practices and with developing uncertainty budgets for these new thermometers.

Dr Y. Duan thanked Dr Z. Ahmed for this work and observed that the group has achieved the original goals of the task group and that the new tasks are constructive.

Dr P. Rourke (NRC) asked that optical refractive index gas thermometry be removed from the table in the report since it is already in the *Mise-en-Pratique*. Dr Z. Ahmed replied that this has already been addressed in a revised version of the document.

Dr S. Picard asked Dr R. White (MSL), in his role as deputy editor of *Metrologia* to possibly assist in the publication of the review article. He confirmed that he could assist in this regard.

7 CCT memberships

Dr Y. Duan invited Dr S. Fil (NSC "Institute of Metrology") to give a presentation to support the application of NSC "Institute of Metrology" (Ukraine) for full membership of the CCT [CCT/20-63].

Dr S. Fil presented first the historical work of her institute in Kharkov, Ukraine. They developed in 1947 an optical pyrometer for work in high temperature plasma measurements. There are 6 national standards for thermometry, and she reviewed capabilities in contact thermometry and in radiation thermometry. The institute has participated in comparisons within COOMET and have 73 published CMCs.

Dr J.-R. Filtz (LNE) asked whether they have any activities in the field of thermophysical quantities. Dr S. Fil replied that they can measure the heat of combustion and specific heat of solids.

Dr A. Pokhodun (VNIIM) stated that the institute has a good scientific school and that he supports Ukraine's application to be a full member of the CCT.

Dr H. Yoon (NIST) asked why did the institute wish to be a full member? Dr S. Fil replied that the institute would be able participate in CCT key comparisons. It would hence also be able to participate as a second linkage laboratory in the COOMET region for KCs. Dr Duan stated that he also supports this application and the establishment of a second lab in COOMET for key comparisons.

Dr A. Todd (NRC) asked about the staff in the thermometry lab. He asked about their technical qualifications and whether they perform calibration work or research work. She replied that there are 10 people working in the field of thermometry and that they perform both research and calibrations.

8 Scientific presentation, P. Rourke (NRC)

Dr P. Rourke gave the presentation "Temperature dissemination on a post-redefinition world" [CCT/20-53].

His talk highlighted issues that the CCT should consider after the redefinition of the kelvin. He pointed out that there is a formal CCT Declaration in 2014 of which parts are in included in the review article by M. Stock *et al.* on the revision of the SI. As stated in the review article, Dr P. Rourke described short-term, medium-term, and long-term tasks and goals. He stated that the short-term goal of developing *MeP-K* has been completed and determinations of $T - T_{90}$ and $T - T_{2000}$ are going on. He stated that in the medium-term future, direct thermodynamic temperature dissemination will start at the extremes of the kelvin scale but that this effort will progress to the

middle temperature region with primary thermometers gradually replacing other scale-based thermometers in this temperature region. However, in Dr P. Rourke's opinion this middle temperature region will mostly likely will be a patch work of direct thermodynamic and ITS-90 disseminations, and that the community will be in a mixed dissemination world where some labs will be disseminating thermodynamic temperatures and others ITS-90-based temperatures. In the long-term future, the article stated that a new temperature scale with improved thermodynamic consistency will be needed. He stated that there are weaknesses in ITS-90 and that reproducibility and accuracy of the scale are separable.

Dr P. Rourke described different routes to dissemination for ITS-90 and *T*. He stated that *T* can be realized by correction from T_{90} using consensus values of $T - T_{90}$ but this will result in larger uncertainties. He stated that in the future primary self-calibrating thermometers might appear on the scene. He illustrated T_{90} reproducibility using capsule SPRTs measured between 13.8033 K and 273.16 K. These examples were taken from a manuscript by Dr P. Rourke which will be soon submitted for publication. He stated that due to the interpolation functions and the choice of fixed points uncertainties between the fixed-point values can be larger than desired. He stated that replacement of mercury with xenon combined with the use of new interpolation functions would result in lower uncertainties between the fixed-point values even with the same reference function as ITS-90. He called this ITS-XX 'light' (resulting in T_{xx}) version of the scale which would be minimally disruptive. This removal of the mercury point could be forced on the temperature community due to the push for removal of mercury due to health and safety regulations. He also pointed out that primary thermometry can result in lower uncertainties than ITS-90, and techniques such as fast AGT (Gavioso *et al*, *Metrologia* 2019 **56** 045006) and SPRIGT (Gao *et al.*, *Metrologia* 2020 **57** 065006) could allow faster calibrations than other primary thermometry methods.

Dr P. Rourke also talked about a new proposal from Dr C. Christof Gaiser (PTB) for much lower uncertainties $T - T_{90}$ below 300 K which could be used for conversions from T_{90} to *T*. This proposal will be considered in the upcoming meeting of CCT WG CT which is chaired by Dr C. Gaiser. Dr P. Rourke concludes that direct *T* dissemination up to the Ne point can be performed with lower uncertainties than T_{90}, and even up to 54 K lower uncertainties than T_{90} are possible. He stated that lower uncertainties can be obtained with modified T_{xx} above 54 K. He stated that ITS-90 differs from *T* by 2 mK at 54 K to 8 mK at 150 K. At higher temperatures, ITS-90 above the freezing point of silver is non-unique due to the choice of either silver, gold or copper points as defining points which can result in difference of 100 mK at 3000 K. Difference can also occur due to the use of a c_2 constant which is different from the latest CODATA reference value.

Dr P. Rourke stated that our customers can be confused between *T* and T_{90}. He stated that changes to revise the ITS to improve thermodynamic accuracy should be called the ITS-XX 'deluxe' which will have large effects on the community and that it should be considered whether the benefits of a new scale are offset by the costs of introducing the new scale.

Dr P. Rourke stated that even with the possibility of each NMI realizing a thermodynamic temperature scale, we want to avoid having separate scales at each NMI. To this end, KCs and CMCs will still be important and we can still use SPRTs as transfer standards. He stated that during this transition period, CMCs for both *T* and T_{90} should be developed. Such effort is led by the CCT WG on non-contact thermometry whose members are developing CMCs for *T* and T_{90}.

Dr P. Rourke concluded by stating that long-stem SPRTs are used in the industrially-relevant core customer range of 84 K to 660 °C, and that this region will be the last to be affected.

He stated that as we go away from prescribed scales, NMIs could perform *T* measurements and interpolations which are different from those in previously prescribed *T* scales.

8.1 Discussion

Dr W. Tew (NIST) commented that although the use of the xenon point would resolve issues with interpolations, no one has built an immersion type xenon cell to accommodate long-stem SPRTs. In his experience, non-immersion non-metal cells are more difficult to operate than a metal-immersion points. Dr P. Rourke agreed with Dr W. Tew's concerns pointing out Dr W. Tew's work on SF_6 cells and encouraged NMIs to perform research into immersion type xenon cells, perhaps modelled on similar argon cells.

Dr M. Sadli (LNE-Cnam) asked whether we can fix the high temperature region with corrected values of silver, gold, and copper fixed points in ITS-XX 'light' and would this then be considered ITS-XX 'deluxe'[2]? Dr P. Rourke stated that if any of the three points were to be changed then it would also affect the lower temperature SPRT reference points and would result in a larger disruption than at just the higher temperatures above the silver point.

Dr H. Yoon (NIST) asked whether we can fix the high temperature region and low temperature region separately? Dr P. Rourke replied that this could be possible but would need to be broadly discussed and coordinated with the CCT.

Dr S. Rudtsch (PTB) asked if we make a new scale with ITS-XX what are the costs associated with this action? He stated that more than 10 000 labs over the world with 100 000 instruments would need to be modified. He stated that only small number of users would be able to take advantage of such changes. Dr P. Rourke replied that the argument is quite valid and since the ITS-90 is deeply imbedded in the global measurement system, if the CCT follows its 2014 Declaration and in some years moves toward a new temperature scale, there are important issues, including downstream disruption, that should be kept in the forefront to shape the discussions.

Dr Y. Duan concluded the session by thanking all the presenters and attendees for their contributions and active participation.

9 Actions and Decisions

The following actions and decisions were identified during the session:

Actions

CCT29/A1. J.-R. Filtz (LNE) to communicate "CMC review protocol for thermal diffusivity measurements - Part 1" to the TG-ThQ members for consultation [CCT/20-49].

CCT29/A2. S. Picard to make available the minutes of the group meetings on the CCT restricted web.

[2] 'light' and 'deluxe' referring to the presentation, note of the *Rapporteur*.

CCT29/A3. S. Picard to collect comments from the CCT delegates on the proposal from WG-CMC on the modification of service 2.2.2.
CCT29/A4. S. Picard to collect comments from the CCT delegates on the member request expressed by NSC “Institute of Metrology” (Ukraine).
CCT29/A5. S. Picard to collect comments on the minutes from the first CCT session, date limit 1 December.
CCT29/A6. S. Picard to collect comments on “Guidelines for comparisons” [CCT20-51], date limit 1 December.

Decisions

CCT29/D1. To delay approval of “CMC review protocol for thermal diffusivity measurements - Part 1” [CCT/20-49] to the fifth session of the CCT.
CCT29/D2. To schedule the approval of the modification of service 2.2.2 on the third CCT session, 17 November 2020.

Dr H. Yoon,Rapporteur
November 2020