Bureau International des Poids et Mesures

Consultative Committee for Ionizing Radiation (CCRI)

Report of the 28th meeting
(8-10 June 2021)
to the International Committee for Weights and Measures

Comité international des poids et mesures

LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR IONIZING RADIATION as of 8 JUNE 2021

President

Dr Martyn Sené, National Physical Laboratory [NPL], Teddington

Executive Secretary

Dr Steven Judge, International Bureau of Weights and Measures [BIPM], Sèvres

Members

Bundesamt für Eich- und Vermessungswesen [BEV], Vienna

Czech Metrology Institute [CMI], Brno

Federal Agency on Technical Regulating and Metrology [Rosstandart], Moscow

Federal Institute of Metrology METAS [METAS], Bern-Wabern

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

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

National Institute of Metrology [NIM], Beijing

National Institute of Standards and Technology [NIST], Gaithersburg

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

National Metrology Institute of South Africa [NMISA], Pretoria

National Physical Laboratory [NPL], Teddington

National Research Council of Canada [NRC], Ottawa

Physikalisch-Technische Bundesanstalt [PTB], Braunschweig

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

Official observers

Central Office of Measures/Gtówny Urgad Miar [GUM], Warsaw

Centro Español de Metrología [CEM], Madrid

Ente per le Nuove Tecnologie, l'Energia e l'Ambiente -Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti [ENEA-INMRI], Rome

Government Office of the Capital City Budapest [BFKH], Budapest

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

National Institute of Metrology/Institutul National de Metrologie [INM], Bucharest

National Measurement Institute, Australia [NMIA], Lindfield

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

VSL Dutch Metrology Institute [VSL], Delft

Liaisons

European Commission - Joint Research Centre [JRC-Geel], Geel

International Atomic Energy Agency [IAEA], Vienna

International Commission on Radiation Units and Measurements [ICRU]

Invited to attend as observers

KACST

NSC IM

The 28th meeting of the Consultative Committee for Ionizing Radiation (CCRI) was held online from 8 to 10 June 2021.

The following were present:

J. Adams (NIST), J.-P. Archambault (NRC), R. Brettner-Messler (BEV), D. Butler (ARPANSA), C.J. da Silva (LNMRI/IRD), P. De Felice (ENEA-INMRI), J. de Pooter (VSL), K.C. de Souza Patrao (LNMRI/IRD), M. Embid Segura (CIEMAT), V. Finta (BFKH), R. Fitzgerald (NIST), C. Fréchou (LNE-LNHB), R. Galea (NRC), V. Gressier (LNE-IRSN), M. Groening (IAEA), S. Jozela (NMISA), M. Kamensky (SMU), J. Keightley (NPL), I.J. Kim (KRISS), M. Krivosik (SMU), T. Kurosawa (NMIJ/AIST), T. Matsumoto (NMIJ/AIST), M. McEwen (NRC), M. Milton (Director of the BIPM), T. Otto (CERN), P. Peier (METAS), R.D. Pepenene (NMISA), M. Pinto (ENEA-INMRI), S. Pommé (JRC-Geel), P.H.G. Rosado (LNMRI/IRD), A. Röttger (PTB), J. Rusňák (CMI), Y. Sato (NMIJ/AIST), M. Sené (CCRI President, CIPM), J. Šuráň (CMI), L. Szücs (BFKH), M. Szymko (GUM), R. Thomas (NPL), D. Thomas (NPL), R. Tosh (NIST), D. van der Merwe (IAEA), M. van Rooy (NMISA), A. Veres (LNE-LNHB) K. Wang (NIM), H. Zhang (NIM), J. Zhang (NIM).

Representatives of Institutes from Member States invited to attend as Observers: S. Alshahri (KACST), V. Skliarov (NSC IM).

Invited: M. Almurayshid (KACST), J.-F. Bottollier-Depois (ISO), S. Giblin (NPL), L. Karam (NIST), S. Mohamed (FANR), A. Villevalde (VNIIM), B. Zimmerman (NIST).

Also present: S. Bergstrand (Executive Secretary of the JCRB), D. Burns (BIPM), R. Coulon (BIPM), S. Courte (BIPM), S. Judge (BIPM, Executive Secretary of the CCRI), C. Kessler (BIPM), C. Michotte (BIPM), M. Nonis (BIPM), S. Picard (BIPM, KCDB Coordinator), P. Roger (BIPM), O. Werhahn (Future Executive Secretary of the JCRB).

1. Welcome (CCRI President, Martyn Sené)

A welcome greeting was extended to the Technical Committee (TC) chairs, Working Group (WG) members, institute members (including new members from the BEV, CMI, METAS, NRC and NMISA), observers, liaisons and BIPM staff in attendance.

The CCRI Mission Statement was highlighted: 'The mission of the CCRI is to discuss, foster, enable and coordinate the development, comparison and promulgation of national measurement standards for ionizing radiation. We aim to enable all users of ionizing radiation to make measurements with confidence at an accuracy that is fit-for-purpose'.

Dr Sené shared how he had been reminded in the last year just how important ionizing radiation metrology is in society: ionizing radiation metrology services were considered essential and needed to be maintained throughout the lockdowns due to the Covid-19 pandemic in 2020.

Delegates were reminded that CCRI webinars will continue, and recordings of previous webinars are available on the BIPM YouTube channel: https://www.youtube.com/c/TheBIPM/video.

A final note was that all reports received are available on the BIPM website (https://www.bipm.org/en/committees/cc/ccri/28-2021) but due to time constraints, it will not be possible to present all the reports at the meeting.

2. Opening Remarks (BIPM Director, Martin Milton)

Dr Milton gave a summary of membership and activities:

Currently there are 63 Member States as well as 39 Associates, with Estonia and Cambodia becoming respectively a Member State and an Associate in January 2021. Some 260 institutes participate in the CIPM MRA.

At the moment, there are 1710 on-going comparisons as well as 25 728 CMCs registered in the KCDB.

Looking to the future, the BIPM is actively working towards machine-readable products, such as xml versions of the SI brochure and findable and accessible data for key comparisons and publications.

3. Rapporteur

John Paul Archambault (National Research Council Canada) was appointed.

4. Approval of Agenda

Approved by all.

5. Minutes of the 27th meeting of the CCRI

The minutes of the 27th meeting of the CCRI were adopted.

Two items were mentioned:

Two new working groups have been established: the CCRI Radionuclide Therapy and Quantitative Imaging Working Group (CCRI-RTWG) and the joint CCEM-CCRI Task Group - Low Current Measurement (CCEM-CCRI-TG-LCM).

A list of major facilities has been collated and is available on the BIPM website; the COVID-19 pandemic has prevented activity to progress collaboration on the use of these facilities, but this issue will be revisited as constraints on travel ease.

6. Outcomes of the 2019-2021 meetings of the CIPM (CCRI President, Martyn Sené)

As with most activities, meetings of the CIPM had been moved to virtual platforms. Face-to-face interaction was missed, however the work of the CIPM has continued.

The CIPM strategy was being reviewed following the revision of the SI and five themes had been identified:

1. The evolving needs for metrology, including responses to cross-cutting international challenges such as health, climate and the environment, food and the digital revolution.
2. The most pressing scientific and technical challenges for metrology itself (including those catalyzed by the implementation of the new SI).
3. Relationships with other international organizations.
4. Encouraging inclusivity and wider involvement of states and economies in the Metre Convention.
5. Modernizing the operations of the organization.

Dr Röttger asked whether the sectoral challenge on food supply also covered access to clean water. Dr Sené said that the CIPM is currently operating at the level of broad challenges; some pilot projects will be selected for more detailed study, and the issue of access to clean water will be raised.

7. Reports from the CCRI Section Chairs

7.1. Section I: x- and gamma-rays, charged particles (Malcolm McEwen)

The CCRI(I) meeting saw seven new attendees (one from APMP, one from COOMET, three from EURAMET and two from GULFMET). The meeting had also been attended by representatives from liaison organizations and stakeholders: the ICRU, IAEA and AAPM. The ASTM and IOMP had been invited but did not attend. The question was raised about whether there is a better way to obtain stakeholder feedback for discussion at the meetings; Dr McEwen suggested surveys should be organized in the future.

The issue of virtual meetings was discussed, and a few concerns were raised:

- Nuanced conversation is lost during virtual meetings
- Four days with 3.5 hours/day of virtual meetings is tiring
- It is difficult to actively involve everyone on-line (but the opportunity is there)
- A hybrid approach of in-person and virtual may be the best option for 2023

The CCRI(I) highlighted that the BIPM Work Programme was valued by the members and that the BIPM IR Department staff had maintained services despite the constraints during the COVID-19 pandemic.

A discussion of the status of comparisons had showed:

- The BIPM services K1-K9 are continuing
- S3 (Co-60 high dose): the Draft A report is in progress
- RMO comparisons continue to face challenges related to transport of artifacts
- There is interest in a comparison of high-energy electron beams but little for proton beams (a reversal from 2019)

A discussion of the CCRI(I) Strategic Plan revealed the impact of the Covid-19 pandemic. It was common to have countries identifying ionizing radiation metrology as a priority and IR metrologists have been very dedicated in providing the services. A common concern was that austerity measures will be taken by governments when trying to attempt to return to balanced budgets.

Some good news was also reported by CCRI(I). The key comparisons seem to be in good shape, the RMOs are very active and the DIs with links to nuclear regulators have an important role to play in radiation protection metrology.

The idea of the European Metrology Networks (EMN) was reported, where NMIs and DIs are brought together with a range of governmental and external organizations to address specific topics. It was suggested that other RMOs could consider this approach.

Some areas of concern were raised:

- The increased cost of Co-60 sealed sources
- There were no new developments presented related to radiation processing
- There is a lack of radiation processing activities in many laboratories
- Diagnostic radiology is an area of increasing focus by regulators
- There is a need to look at how a link is made between CCRI(I) members with IAEA SSDLs to avoid a 2-tier system
- EMNs could be misinterpreted and viewed as the way of “sharing out” calibration capabilities to realize cost savings

Three new members gave presentations about their institutes: the STUK (Finland), NSC-IM (Ukraine) and FANR (UAE).

One laboratory, ENEA (Italy), updated delegates on the renewal of their laboratory.

The idea of having a platform for early-career metrologists to present their work at the CCRI meeting was discussed. It would give junior researchers a chance to show their research and interact with an audience specialized in their field. This will be included in the BIPM webinar series later in 2021.

Some resolutions were recorded for section (I):

- Extend the initial validity period of KC from 10 years to 12 years, with emphasis on a risk-based approach to KC planning
- The chair is to liaise with APMP regarding an electron-beam comparison
- The reports of all comparisons, including supplementary comparisons, must be reviewed by the CCRI(I) and approved by the Section Chair before publication on the KCDB
- An *ad hoc* working group will be set up to develop a report on the role of sealed radiation sources in CCRI(I) activities
- An *ad hoc* working group will be set up to consider options for making laboratory reports available in the public domain, in the context of open science
- An *ad hoc* working group will be set up to assist with implementation of ICRU/ICRP Report 95
- The CCRI-RMOWG will be asked to look at leadership development/training in addition to technical knowledge transfer
- The CCRI will be asked to consider developing Key Performance Indicators (KPIs) for NMIs/DIs to be included in reports

Dr Sené asked whether the problem of transporting artefacts applied to other technical fields. Dr Milton said that it was a common problem but there is a treaty that could be used. The difficulty with the treaty is that the NMIs are required to be designated by their countries to work under this treaty. Dr Milton will provide further information on the treaty to the CCRI Executive Secretary to be forwarded to delegates.

Dr Sené asked about the risks associated with the period of validity of comparisons Dr McEwen responded that it was important to consider the time delay before the next comparison; on-going monitoring of capabilities is essential but a change in mind-set is needed. Dr Milton said that this was a problem facing all consultative committees: how long after a key comparison can the result be accepted as valid? The period should not be too long, but it would depend on the field.

Dr Karam pointed out that large-scale key comparisons are just one way to demonstrate continued competence, bi-lateral and supplementary comparisons can also be used.

7.2. Section II – Measurement of radionuclides (Lisa Karam)

The CCRI(II) ten-year strategic plan for comparisons was discussed, but much of the future depends on the availability of different radionuclides. CCRI, supplementary and RMO comparisons were all discussed during the meeting.

Part of the CCRI(II) meeting was spent identifying stakeholder' needs and highlighted:

- the need for radiation metrology to produce reference materials in the energy, environment and decommissioning sectors
- connections with the wider community (IAEA, UN, CTBTO)
- planning for eLearning to support NMIs/DIs

The CCRI(II) strategy includes improving measurement comparability, building metrology capabilities at NMIs/DIs through leveraging the BIPM services, improving the state-of-the-art and reviewing and updating actions in support of the CCRI strategy.

An example of the state-of-the-art is the Mini-TDCR being developed at the LNE-LNHB; in the long term, it may be possible to develop a portable version of the new ESIR that could be used for short-lived pure beta emitters and also avoid the need to despatch radioactive sources to the BIPM.

The future for the CCRI(II) sees the implementation and use of the KCDB exploiting the 'open data' concept, potential new members (Chile, Colombia, the CTBTO) and increasing cooperation within and beyond the CCRI (including the use of new approaches to radionuclide metrology such as mass spectrometry).

Some recommendations for the CCRI were made:

- All CCRI sections should continue the practice of reviewing all Draft B reports including RMO supplementary comparisons (this is in addition to the steps set out in the new guidance document CIPM-MRA-G11)
- The CCRI strategy should reinforce the critical role of the BIPM services
- A deputy chair should be appointed

Dr McEwen asked whether all the CCRI Sections agreed that all Draft B reports should be reviewed by the relevant Section. There was general agreement that although the CIPM-MRA-G11 guidance did state that RMO comparisons did not require oversight by the CC, the CCRI recommendation was that all CCRI Sections should continue to review and approve the reports. Dr Sené confirmed that the CCRI could adopt a policy that is more stringent than the guidance; Dr Milton said that most Consultative Committees had a similar policy as supplementary comparisons were linked to key comparisons, and it was important that international peer-review was visible.

It was agreed that:

1. All CCRI Sections should continue the practice of reviewing all Draft B reports.
2. The CCRI encourages all NMIs to use BIPM services on a regular basis.
3. Discussions should be held within Sections to appoint Deputy Chairs.

7.3. Section III – Neutron Measurements (Vincent Gressier)

Dr Gressier noted that the number of participants in CCRI(III) has increased (from 30 to 35) with the notable new participation of BARC. There have been no meetings of the CCRI Section III: Key Comparisons Working Group (CCRI-KCWG(III)) as the tasks are covered by the Section meeting. There are three on-going comparisons and three planned comparisons, however, there are currently no comparisons at the RMO level.

There are two key comparisons in the final stages: CCRI(III)-K9.AmBe.1 is a subsequent comparison of K9 for neutron emission rate comparison in which the Draft B report has been commented on and is awaiting approval as a final report. CCRI(III)-K9.AmBe.2 is a second subsequent comparison to K9 for participants who could not participate in the original comparison. The Draft A report was sent out in April and the Draft B report is in preparation.

CCRI(III).K9.Cf is a key comparison for neutron emission rate, using a ^{252}Cf source. The comparison started in 2016 and all participants have completed their measurements. Most of the laboratories have submitted their reports to the pilot.

CCRI(III).S1.H*(10) is a supplementary comparison for ambient dose equivalent meters. There have been delays sending around the two survey-meters due to the pandemic, so the end of the activity is scheduled for September 2022.

A number of future comparisons (key and supplementary) were discussed:

- CCRI(III).K12 – fluence measurements in mono-energetic neutron fields
- CCRI(III).S1.Hp(10) - Comparison of Hp(10) calibration factor using laboratories standard methods
- CCRI(III).K8.2024 – thermal neutron fields
- Pilot study relating to Au-activation in thermal neutron fields
- Pilot study to determine the variation of the neutron energy distributions from ^{241}AmBe sources (due to changes in ISO-8529-1)

A seminar by the IAEA highlighted emerging requirements and the need for involvement of metrology institutes in three key sectors (Boron Neutron Capture Therapy (BNCT), Laser facilities and Fusion) as well as in the measurement of specific neutron cross sections.

It was recommended that the CCRI Strategy includes BNCT more explicitly, as the KRISS and NMIJ are heavily involved. It was also recommended to study the impact of the new operational quantities and to emphasize that the main challenges of neutron metrology still remain, such as extending the energy and intensity range of neutron metrology.

Dr McEwen asked how measurement standards could be developed if facilities were being shared. Dr Gressier responded that facilities would have to allow sufficient time for metrologists to develop their capabilities. The role of the CCRI would be to help facilitate the administrative arrangements for sharing laboratory space and time.

Dr Karam asked about the difficulties of sharing or transporting sources, and whether transfer chambers had been considered as an alternative approach. Dr Gressier explained that transporting sources was difficult, even the legislation for shipping containers may differ from country to country. The option to use transfer chambers to avoid shipping sources had not been considered yet.

Dr Butler asked about the impact of the decision to remove ‘dose equivalent’ as a service category; Dr Gressier said that CCRI(III) considered the topic closed and the new service categories had been adopted for neutron metrology.

8. CCRI Future Plans

8.1. Discussion of CCRI Strategy (Martyn Sené)

Dr Sené set out that the CCRI strategy aims to provide a view of the drivers for CCRI’s work, the end users we support and the challenges they face, our vision and mission, our strategy and activities to support the strategy out to 2028 and beyond. The strategy was developed by CCRI members in consultation with the wider ionizing radiation metrology community and

key stakeholders and was first published in 2018 - and adopted formally at the CCRI meeting in 2019. This was an excellent piece of work and set out the main themes and direction for CCRI's work.

However, whilst such strategies take a long view, they also need to be living documents.

Hence over the last 18 months we have completed a light touch review and updated the strategy. The current version of the CCRI Strategy is document CCRI/2021-04 on the CCRI working documents area of the BIPM website.

This draft 2nd edition of the CCRI Strategy has been updated to reflect new developments in the field of ionizing radiation metrology and in the stakeholder community. It also responds to the wider CIPM strategy focused on the five areas of international challenges, the most pressing scientific and technical challenges for metrology itself, relationships with other international organizations, encouraging inclusivity and wider involvement in the Metre Convention, and modernizing operations.

A questionnaire had been circulated in June/July 2020 and the results identified fifty specific items that the new version of the strategy tries to address.

As in the first edition, the overall aim of the second edition is to improve global comparability of measurements, to build capabilities of smaller NMIs/DIs, to progress the state-of -the-art, to expand the coverage of services supported by CMCs and, new for this edition, to coordinate the introduction of the SI Digital Framework in ionizing radiation metrology.

The CCRI Section chairs fed back on the consensus from the section meetings, and the following issues for the CCRI strategy were identified:

Section I: Ensure the role of the European Metrology Networks in outreach/co-ordinating activity is stated clearly.

Section II: Some editorial changes to the document and action tables, noting that the BIPM services (SIR, SIRTI, ESIR) should be referenced explicitly in the text.

Section III: The importance of BNCT should be included. The impact of new operational quantities (ICRU Report 95) should be noted as an issue to be studied for radiation protection.

Dr McEwen asked about the real need for machine-readable calibration reports. For example, in dosimetry, the whole data chain cannot be digitalized, so clients may not see any benefits. Dr Sené said that experience had shown that when technology is adopted by the broader community, many tend to adapt and adopt. The timescales for the new technology will certainly depend on the field.

Dr Keightley said that the strategy does not seem to capture work in the emerging needs in medical isotopes. For example, the comparison timescales listed do not fit with the much faster timescales needed for some medical isotopes. After some discussion, the consensus was that the strategy is not meant to be exclusive, but only a broad overview to guide the community. As needs arise, the community must be able to adapt and allowed to solve the problems as they arise.

8.2. Communication plan and capacity building / knowledge transfer activities (Steven Judge)

This presentation was intended to start a discussion of a possible communication plan. Examples of previous successful communication campaigns were the introduction of ICRU 90, the adoption of nuclear decay data from the DDEP, the ISO4037 webinar and the radio-pharmaceutical workshop.

The aims of the communication plan are to support the strategy, to build the community, to publicize the value of our work, and to encourage and motivate our colleagues.

Some available tools include webinars, blogs, meetings, articles, the IAEA SSDL network, eLearning, the BIPM YouTube channel and workshops.

The CCRI communication plan was discussed supported by a discussion using the 'chat' facility on the pros and cons of social media; a summary is given at the end of this report.

Nominations are invited for people to join an International Steering Committee to advise the BIPM Secretariat on implementing the CCRI communication plan.

9. Reports from Technical Working Group Chairs

9.1. CCRI Radionuclide Therapy and Quantitative Imaging Working Group (CCRI-RTWG) (Brian Zimmerman)

The CCRI-RTWG is a new WG formed in 2020 and is aimed at ensuring therapies are safe and effective. It was established because radionuclide therapy treatment planning requires measurements of both radioactivity and radiation dosimetry.

The WG is a very diverse group including members from outside the NMI/DI community, such as clinical medical physicists and representatives from the IAEA.

The planned activities include advising NMIs/DIs, proposing new comparisons, developing a best practice guidance document, assisting in establishing inter-laboratory research, building links with appropriate stakeholders and reporting findings to the CCRI.

A workshop identifying the needs in radionuclide metrology in therapy is underway. It consists of a series of webinars and meetings to be held during 2021 and 2022. The first webinar was held in May 2021 and had approximately 90 participants.

Dr Otto commented that ICRU 96 will be published soon and will highlight the subject from the point of view of patient dosimetry.

9.2. CCEM-CCRI Task Group - Low Current Measurement (CCEM-CCRI-TG-LCM) (Stephen Giblin)

The Task Group was formed in 2020 to guide the introduction of new technologies for re-entrant ionization chambers used in radionuclide metrology. The aim is to write a best-practice guide. New members are always welcome.

The best-practice guide is to include sections on small current measurements, ion chambers, an overview of techniques for low electrical current measurement, a practical step-by-step guide and case studies.

The target date for a draft of the guide is the end of September 2021.

Dr McEwen asked about the range of currents that are being considered; Dr Giblin explained that the currents are in the fA to μA range.

10. Comments on written reports from international organizations

10.1. IAEA (Debbie van der Merwe)

Dr van der Merwe gave a brief summary of work in progress at the IAEA. The priorities for 2021 and beyond include new codes of practice, guidance for Secondary Standard Dosimetry Laboratories (SSDLs), the provision of laboratory services, organizing technical meetings and coordinating research. Further details are given in the IAEA report in the working documents for this meeting.

Dr Groening added that one of the IAEA's activities in radionuclide metrology is the development of reference materials for environmental protection.

10.2. ICRU (Thomas Otto)

Dr Otto highlighted the recent publication of ICRU-95 report 95: 'Operational Quantities for External Radiation Exposure'. He explained that the publication had been necessary due to changes patterns of exposure to ionizing radiation.

It was noted that the CCRI(I) will form an *ad hoc* task group to help communicate ICRU-95 to the user community. Dr Otto said that he would be available to give a webinar on the subject.

10.3. ICRM (Brian Zimmerman)

Dr Zimmerman confirmed that the two main conferences of ICRM were rescheduled to April 2022 (Low Level Radioactivity Measurements and Techniques) and March 2023 (ICRM conference).

The ICRM Working Groups remain very active and welcome new members (contact details are included in the ICRM report to this meeting).

10.4. JRC (Stefaan Pommé)

The JRC remains active in radionuclide metrology and is re-joining EURAMET.

11. Discussion of proposals for new liaison organizations

11.1. ISO Technical Committee 85 Sub-committee 2: Radiological Protection

Dr Bottollier-Depois had submitted a written application for the ISO Technical Committee 85 Sub-committee 2 to become a liaison organization to the CCRI, due to the common aims and activities. The proposal for ISO/TC85/SC2 to become a liaison member of CCRI was accepted, and the Sub Committee was welcomed as a new official liaison organization.

11.2. Comprehensive Nuclear-Test-Ban Treaty Organization Preparatory Commission (CTBTO)

The Treaty curbs the development of nuclear weapons and the improvement of existing weapons – it bans all nuclear explosions, everywhere by everyone. The Treaty has been signed by 185 states. Dr Sené explained that the CTBTO and the BIPM have agreed a Practical Arrangement which is awaiting signature; the Arrangement would allow the CTBTO to be represented on the CCRI.

The CTBTO was welcomed as a new official liaison to CCRI once the Practical Arrangement is signed.

11.3. Other Proposals for new liaison organizations

The CCRI(I) is in discussion with the International Organization of Medical Physicists.

Dr McEwen asked about engagement of the CCRI and Sections in the development of ISO standards, as the processes used by ISO differ from the those in the metrology community. Dr Sené said that this was a general issue that would be raised at the next meeting of the CIPM.

12. Report from the BIPM Ionizing Radiation Department

Dr Judge gave a brief summary of the recent work of the BIPM Ionizing Radiation Department to complement the detailed written report available in the working documents for this meeting. The presentation included two short video clips prepared by the staff of the department.

12.1. Radiation Dosimetry:

Dr Burns gave an overall update on dosimetry services at the BIPM. Dr Kessler then provided an update on the MV high-energy photon services at DOSEO, including the launch of a new calibration service. Since 2017, four institutes have participated in the high-energy photon comparison service. A new secondary standard for MV photons was developed in 2020.

Mr Roger described the new medium-energy x-ray facility which included automation of the shutter mechanism and a high-accuracy optical positioning system.

12.2. Radionuclide metrology:

Dr Michotte provided an update on three comparison systems:

1. The SIR (established in 1976), for comparing standards of gamma emitters
2. The SIRTI (2009), for short-lived isotopes: fourteen NMIs from five RMOs have used the SIRTI over nine years. In 2021 a new remote SIRTI was developed along with procedures and video tutorials. Further testing will take place at the LNHB and the PTB will be the first participant.
3. The ESIR was launched in 2020 for comparing pure beta emitters. A pilot comparison is underway with promising results.

Dr Coulon provided an update on digitalization and automation of preparing SIR comparison reports, mentioning that 12 reports were produced in one year, and gave further details of the new ESIR system.

Dr Sené asked about the expertise needed by users of the remote SIRTI. Dr Michotte responded that the instrument itself will be familiar to many institutes in the field, and that the BIPM has provided video tutorials and can also communicate via webcam when running the system. The most difficult part of the system is tuning the threshold of the NaI detector, but a check source is provided to help.

Dr Keightley commented that it was good to see that the LNMRI/IRD will carry out a measurement of ^{56}Mn and that the NPL can also make a measurement to be a link to the SIR. Dr Michotte agreed and added that the LNE-LNHB will also provide a sample of ^{56}Mn.

13. Reports from Regional Metrology Organizations and Members / Observers

13.1. Outcomes of the RMO Working Group Meetings (Sibusiso Jozela)

Dr Jozela reported that he had taken over the role of Chair of the CCRI RMO Working Group on IR CMCs (CCRI-RMOWG) in 2020, when Dr Msimang had left to join the IAEA.

One of the main activities of the WG since 2019 had been updating the CCRI's rules for completing claims for CMCs; the new rules reflected the changes to the service categories (the intention being to reduce the number of CMCs and hence the workload for reviewers and for institutes claiming / maintaining CMCs). The rules had also been aligned to the new CMC data entry forms on the KCDB. Guidance on the new rules had also been captured in a series of presentations that could be translated into different languages.

EURAMET had put forward a new approach to entering data for CMCs in radionuclide metrology, the intention being that one CMC could contain information on services involving several radionuclides. The CCRI-RMOWG proposed that the new approach should be allowed but it would be optional, and institutes wishing to continue to use the existing interpretation of CMCs for radioactivity would be permitted to do so. EURAMET will test

the new approach and feedback to the CCRI-RMOWG; the rules and associated presentations will then be updated.

The CCRI-RMOWG had discussed the use of results from participation in IAEA proficiency test exercises to support CMC claims. The issue was that the reports provided by the IAEA were not originally intended for this purpose and did not include all the information normally given in comparison reports, such as the detailed uncertainty budget. The CCRI-RMOWG will request a meeting with the IAEA to discuss the additional details that may be included on the comparison and proficiency testing reports.

Dr Jozela added that the CCRI-RMOWG was developing a simple checklist to support CMC reviewers, and concluded by thanking the members of the CCRI-RMOWG for engaging, robust and constructive discussions.

Dr Galea, on behalf of SIM, thanked Dr Jozela for taking over the role of CCRI-RMOWG Chair in a seamless way.

Dr Sené said that he was pleased to note that guidance on entering CMC claims had been developed by the CCRI-RMOWG and was available on the new BIPM eLearning platform. He added his thanks to the IAEA for agreeing to meet to discuss the format of reports on proficiency test exercises.

The consensus of the CCRI was to adopt the EURAMET proposal as an alternative approach to CMCs for radionuclide metrology, noting that the existing approach remains valid.

13.2. Reports on JCRB decisions pertaining to the CCRI (Sten Bergstrand)

Dr Bergstrand reported on the work of the JCRB. The system for CIPM MRA documents had been revised, the structure simplified, and the content updated following extensive consultation. The new CIPM MRA documents are available on-line: https://www.bipm.org/en/cipm-mra/cipm-mra-documents/

After 20 years of use, the JCRB CMC website has been replaced by the new KCDB, but information can still be downloaded: https://www.bipm.org/JCRBCMCs/

The KCDB 2.0 has been operational since October 2019: https://www.bipm.org/kcdb/

As the CCRI decided on new service categories in September 2019, different options are now listed under Quantity/Medium/Source. CMCs based on the previous categories are still valid and entries remain in the database, but the search engine may not locate all the relevant entries as a result of the change in categories (it was, however, emphasized that all the information on existing CMCs is retained in the database, the issue being with the search engine and not with the content of the database). The KCDB Office may be contacted for advice on the procedures to follow. It was noted that new CMC entries must follow the new CCRI rules and service categories.

The CCRI expressed its thanks to Dr Bergstrand and wished him well for his return to his home institute.

13.3. RMO Technical Committee / Working Group Chair Reports

The TC-IR Chairs gave a brief summary of progress in their regions; further details are available in the working documents.

- AFRIMETS (Dr Jozela): The committee has not met since 2019, the next meeting is scheduled for July 2021

- APMP (Dr Butler): The APMP had been active in arranging comparison exercises and submitting / reviewing CMCs (details are given in the working documents). The committee had also been looking into ways to reduce the timescale needed for comparisons, including limiting the number of participants, finding approaches to reduce delays due to customs formalities, reviewing protocols in detail before the start of comparisons, devising templates for reports, simplifying the approach to linking supplementary to key comparisons, having multiple contacts for each participant, and using co-pilots to assist in running comparisons.

- COOMET: Dr Villevalde reported on behalf of COOMET. The committee had met in November 2020 involving eight NMIs. There is an active programme of regional comparison exercises in radiation dosimetry and radionuclide metrology. There are also plans to establish a transportable ionization chamber for radionuclide metrology, to compare short-lived radionuclides (similar in principle to the SIRTI but using a different detector).

  Dr Galea asked whether comparisons conducted using the COOMET instrument could be linked to the SIRTI. Dr Michotte replied that the SIRTI had been used at the VNIIM so a link can be made for some radionuclides.

- EURAMET (Dr de Pooter): The annual EURAMET TC-IR meeting had been held in February 2021. In addition to comparison exercises, there is an active metrology research programme, with calls for projects in metrology related to healthcare, environmental protection and fundamental metrology. EURAMET is also establishing European Metrology Networks (EMNs) with the intention of bringing together all the stakeholders in specific fields of metrology, including radiation protection and ionizing radiation for healthcare.

  Dr McEwen asked about the long-term status of the EMNs. Dr de Pooter explained that the EMNs would remain under the auspices of EURAMET and that they are intended to be self-sustaining.

- GULFMET (Mrs Mohamed): The TC-IR had recently been formed and the work programme was being developed.

- SIM (Dr Galea): The working group (MWG 6) meets every two years with the last meeting in 2019 in Brazil and the next meeting scheduled for November 2021. Members' activities continued through the pandemic although many had restrictions in place. Members have answered the call to pilot comparisons: the LNMRI/IRD (Brazil) will pilot a radioactivity comparison and the ININ (Mexico) will pilot a dosimetry comparison, both starting later in 2021.

13.4. Reports from Members / Observers

Many reports were sent to all three sections and to the CCRI meeting; the reports provide a valuable snapshot of activities in Ionizing Radiation Metrology around the world. Of note, Ukraine, who attended as an Invited Observer had submitted a comprehensive report on its activities in IR Metrology.

14. CCRI Committee issues

14.1. Applications for new members or observers

There had been no applications.

14.2. Appointment of Section and Working Group Chairs and deputies

Martyn Sené announced that Steven Judge will be retiring at the end of June 2021 and that he has been tremendously grateful for the work Steven has accomplished. He wished Steven a happy retirement.

It was noted that Malcolm McEwen and Lisa Karam had been appointed Chairs of CCRI(I) and CCRI(II) respectively at the 2019 meeting. Terms of office nominally run for 4 years. It was confirmed that they were willing to continue in these roles.

Steven's replacement was announced to be Vincent Gressier of IRSN and current chair of CCRI(III).

The new chair for CCRI(III) was proposed to be Andreas Zimbal of PTB, who accepted the nomination.

KCWG(I) – Malcolm McEwen remains the chair but stated that it would be a good time to have someone else take over, and that he would like to get more people involved in leadership of CCRI(I).

KCWG(III) –Andreas Zimbal will act as the chair, although it was mentioned that the KCWG(III) meeting has now been absorbed into the CCRI(III) meeting.

BSWG(I) – is currently paused but is expected to re-start soon.

CCEM-CCRI TG – Stephen Giblin will remain Chair until the end of the task.

14.3. CCRI resolutions

Dr Archambault summarized the resolutions and key points from this meeting, as shown in the table below.

Summary of Resolutions from the 28th CCRI Meeting (* denotes priorities identified by CCRI Section Chairs)

Session.Section	Resolutions / Key points	Date Completed
1.5	• Maintain the list of facilities on the BIPM website	
1.6	• Martyn Sené will raise the idea of access to clean water when discussing the sectoral challenge	June 9, 2021
1.7	• For CCRI Section(I), the initial validity period of Key Comparisons will be increased from10 to 12 years, with an emphasis on a risk-based approach to planning Key Comparisons • The chair is to liaise with APMP regarding an electron-beam comparison • *Ad hoc* WG to be set up to develop a report on the role of high activity sealed sources in CCRI(I) activities • *Ad hoc* WG to be set up to consider options for publications of lab reports in context of open science • *Ad hoc* WG to be set up to assist with the implementation of and questions regarding ICRU/ICRP Report 95 • The CCRI-RMO WG to be asked look at leadership development/training in addition to technical training • The CCRI to be consulted on the possibility of developing Key Performance Indicators (KPIs) to be included in reports from NMIs/DIs • The BIPM Director will provide relevant information regarding treaty to help simplify transport of artifacts (for dissemination by the CCRI Executive Secretary). • * The role of European Metrology Networks in outreach/co-ordinating activity should be stated explicitly in the CCRI strategy document	
1.8	• All comparison reports, including RMO supplementary comparisons, will continue to be reviewed by the relevant CCRI Section, noting that this is in addition to the requirements of CIPM-MRA-G11 • The CCRI strategy document should reinforce the critical role of the BIPM services in radiation dosimetry and radionuclide metrology	

	• * Editorial changes to the CCRI Strategy Document and changes to the actions should be made, ensuring that the SIR, SIRTI and ESIR are explicitly included in the text	
1.9	• * The CCRI strategy to include Boron Neutron Capture Therapy explicitly as the KRISS and the NMIJ are heavily involved, and it was identified by the IAEA as a need • * The impact of new operational quantities as an issue to be studied in radiation protection (not limited to neutrons) should be noted	
2.2	• The CCRI Strategy Document should state that the strategy is intended to be a broad overview to guide the community. As needs arise, the community must be able to adapt and solve the problems as they arise.	June 9, 2020
2.3	• Nominations are invited for people to join an International Steering Committee to advise the BIPM Secretariat on implementing the CCRI communication plan.	
2.7	• CCRI(I) will form a group to help communicate ICRU-95 to the user community (to support the implementation) • Dr Otto is available to give a webinar about ICRU-95	
2.12	• During the next meeting of the CIPM, the CCRI President will raise the broader issue of optimizing the engagement of the metrology community in the development of ISO standards	
3.8	• Dr Gressier has been appointed Director of the Ionizing Radiation Department at BIPM and Executive Secretary of the CCRI • Dr Zimbal (PTB) will be appointed as Chair of CCRI(III) • Deputy chairs to be appointed for all KCWG and CCRI Sections	

15. Any other business

No issues were raised.

16. Dates of next meetings

CCRI	5-9 June 2023
Section I	June 2023
Section II	Q1/Q2 2023
Section III	June 2023
RMO WG	to be confirmed

17. Closure of meeting

Dr Sené thanked attendees for taking the time to join the meeting, for their contribution to the meeting and to the work of CCRI; with particular thanks to the secretariat, chairs and others with important roles in the sections and working groups

He also thanked attendees for the time and effort they devoted more broadly to the work of ionising radiation metrology, in CCRI, in your home institutions and elsewhere.

Annex to the minutes of the 28th meeting of the CCRI: CCRI Communication Plan

This annex is a summary for the record of the comments from delegates on the CCRI communication, submitted using the 'Chat' function on the virtual meeting software.

1) Possible topics for webinars and/or eLearning:

- Electronic brachytherapy
- FLASH radiotherapy
- Proton / heavy ion dosimetry
- Radiation hardness testing
- ICRU 95
- How reproducibility of 0.03 % is achieved at the BIPM
- Dosimetry for medical imaging
- The steps needed to prepare for claiming CMCs
- GIT for software and document control (note: this proposal from Dr Pinto was supported strongly)
- Time-dependent dial factors for radionuclide calibrators

2) Proposals for improving / monitoring communication

- Monitoring the effectiveness of webinars – should include the number of views on YouTube as well as the number of attendees.
- The BIPM eLearning platform could be used for short video clips to demonstrate how to carry out tasks and to share experience. Producing professional-quality videos and other content was recognized to be difficult although there are examples of very successful Vloggers covering similar technical material and this approach is increasingly being used.
- EURAMET has experience of developing communication plans, a full stakeholder mapping study can be time-consuming. The webinars may be useful for a wider audience.
- Organizing continued, regular, communication requires effort; the BIPM Secretariat has some resources to support this (eLearning, webinars, blogs) but guidance from a small group of CCRI members would be useful to maintain momentum
- The IAEA said that some users would be looking for a recognized qualification and the community cannot offer this.