BUREAU INTERNATIONAL DES POIDS ET MESURES

Comité Consultatif pour les Rayonnements Ionisants

Section II (Measurement of Radionuclides)

29th Meeting (5-7 June 2023)

BIPM, Sèvres, France (with virtual option)

Redacted Minutes

Chair Dr Lisa Karam (NIST)
CCRI President Dr J.-T. Janssen (NPL)
CCRI Executive Secretary Dr Vincent Gressier (BIPM)

Participants:

First Name	Last Name	Organization	Country	In person /virtual
Hesham	Alhamdan		Saudi Arabia	Virtual
Mehenna	Arib		Saudi Arabia	Virtual
Dirk	Arnold	PTB	Germany	Virtual
Christophe	Bobin	LNE-LNHB	France	In person
Robert	Brettner-	BEV	Austria	Virtual
Ryszard	Broda	POLATOM	Poland	In person
Marco	Capogni	ENEA-INMRI	Italy	Virtual
Mauro	Carrara	IAEA	International	Virtual (tbc)
Pierluigi	Carconi	ENEA-INMRI	Italy	In person
Seán	Collins	NPL	United Kingdom	Virtual
Romain	Coulon	BIPM	International	In person
Pierino	De Felice	ENEA-INMRI	Italy	In person
Ryan	Fitzgerald	NIST, KCWG(II) Chair	United States	In person
Raphael	Galea	NRC, SIM TC chair	Canada	In person
Stephen	Giblin	NPL	United Kingdom	Virtual
Vincent	Gressier	BIPM, CCRI Executive	International	In person
Nikolaus	Hermanspahn	CTBTO	International	In person
Sanghoon	Hwang	KRISS	Republic of	In person
J.-T.	Janssen	NPL, CCRI President	United Kingdom	In person
Lisa	Karam	NIST, CCRI(II) Chair	United States	In person
John	Keightley	NPL	United Kingdom	Virtual

Karsten	Kossert	PTB	Germany	Virtual
Matej	Krivosik	SMI	Slovakia	In person
Devendra	Kulkarni	BARC	India	Virtual
Juncheng	Liang	NIM	China	In person
Aurelian	Luca	IFIN-HH	Romania	In person
Stéphanie	Maniguet	BIPM	International	Virtual (tbc)
Carine	Michotte	BIPM	International	In person
Zakithi	Msimang	IAEA, SSDL network	International	Virtual
Youcef	Nedjadi	IRA	Switzerland	In person
Virginia	Peyrés	CIEMAT	Spain	In person
Stefaan	Pommé	JRC	Belgium	Virtual
Johnny	Rangel	LNMRI/IRD	Brazil	In person
Anuradha	Ravindra	BARC	India	Virtual
Yasushi	Sato	NMIJ	Japan	In person
Jana	Sochorová	CMI	Czech Republic	In person
László	Szűcs	BFKH	Hungary	Virtual
Milton	van Rooy	NMISA	South Africa	Virtual
Freda	van Wyngaardt	ANSTO, CCRI(II) vice	Australia	In person
Zhijun	Yang	NIM	China	In person
Tomasz	Ziemek	POLATOM	Poland	Virtual
Brian	Zimmerman	NIST, RTQI WG	United States	In person
Ming	Zhang	NIM	China	Virtual

Abbreviated Agenda

First session (5 June): Welcome, organization and comparisons [joint with KCWG(II)]

1. Welcome [CCRI President J.-T. Janssen and Section Chair L. Karam]
2. Appointment of *Rapporteur* F. van Wyngaardt, ANSTO
3. Changes to and approval of agenda Approved
4. Key Comparisons WG Report [Coordinator R. Fitzgerald, NIST]
   - 3 KCWG(II) meetings since last CCRI(II) meeting, all online (20-22 April 22, 12 December 22, 23 May 23)
   - MMM is now available under CCRI guidance documents on the BIPM website. The MMM should not be used to claim CMCs for radionuclides not measured at laboratory
5. Status of comparisons as indicated on KCDB (start year) or with publication since 2021
   - CCRI(II) comparison validity of 15 years (20 years under exceptional circumstances; very rare)
   - Comparison supports a CMC only if nothing substantial in the lab has changed
   - Degrees of equivalence in the KCDB: at 13 years after a comparison, CCRI Executive Secretary provides warning to NMI, at 15 years the DoE are removed from KCDB. Similarly, for RMO comparisons. Time starts when the measurements in the lab are complete. If several participants, time starts when the final participant has completed their measurements.

- 13 comparisons approved for equivalence with measurement year 2008 or before. New comparisons underway for Cd-109, Zn-65. Comparisons superseded by SIR comparisons (Am-241, Eu-152, Fe-55, I-125, Ir-192, Mn-54, Se-75, Y-90). Comparisons expired (Pu-238, Sr-89, Tl-204).
- Once CMCs are published, there is no need for a new comparison for the same quantity. Capability is maintained through Quality Management System and reviewed every 5 years.

a. CCRI (key and supplementary comparisons)

i. Ongoing Lu-177 SIR comparison BIPM.RI(II)-K1.Lu-177
   - DECISION: keep KCRV unchanged for now, calculate degrees of equivalence for all participants

ii. CCRI(II)-K2.Tc-99: Measurements in Progress (2012)
   - KCWG(II) to decide by the end of the year whether to remove this comparison from the KCDB.

iii. CCRI(II)-K2.Cd-109.2021: Draft A (2020)
   - A workshop is being planned for September/October 2023 for participants to present their methods and learn from one another.
   - Link to the SIR looks like it will be successful.

iv. CCRI(II)-K2.Pa-231: Draft B (2017)
   - There is only one entry in the SIR for Pa-231. Request for other NMIs to submit additional ampoules, preferably from a different solution.

v. CCRI(II)-K2.Fe-55.2019: Approved for Equivalence (2019)
   - Thanks to all participants for their contribution to a great comparison.

vi. CCRI(II)-S15: Cs-137/K-40 in mushrooms; Measurements in Progress (2019)

vii. CCRI(II)-S9: Cs-137/K-40 in rice material; Draft A (2011)

viii. CCRI(II)-S13: Cs-134/Cs-137 in wheat flour; Draft A (2018)

b. RMO Comparisons

i. SIM.RI(II)-K2.Zn-65: Measurements in progress (2021)
   - Appreciation of CCRI(II) to LNMRI/IRD for piloting this comparison during the pandemic. This is an example of an NMI taking on a new responsibility, thank you. The KCWG(II) expressed their willingness to contribute to analysis of results and reporting.
   - 14 participants: 5 SIM, 7 EURAMET, 1 AFRIMETS, 1 APMP

ii. EURAMET.RI(II)-K1.Cr-51: Draft A (2022)

iii. EURAMET.RI(II)-K2.Ho-166: Approved (2017)
   - Only one result for Ho-166 in the SIR at present. There is a need for more submissions to the SIR to achieve DoE linked to the SIR.

iv. APMP.RI(II)-S3.Cs-134.Cs-137: in brown rice: Approved (2013)
   - Status: Approved and published in *Metrologia* 2023.

v. APMP.RI(II)-S4: source emission rate; Measurements in Progress (2020)
   - Measurements completed: NIM, KRISS, NMISA, PTB.
   - Participation delayed: INER and PTKMR-BATAN (authorization for source receipt pending).
   - Next participants: NPL, RC Polatom, NIST (August 2023 – April 2024)
   - Requested to participate last: BARC, ENEA, ANSTO (August 2024 – May 2025)

vi. COOMET.RI(II)-S3: Co-60/Cs-137/Eu-152/Am-241; Planned (2020)
   - No update.

vii. EURAMET.RI(II)-S8.Rn-222: Approved (2019)
   - Comparison complete.
   - Value added to the report with included technical details.

c. BIPM Services (especially SIRTI, RMO SIRTI, ESIR)

i. SIR and SIRTI report (including remote SIRTI)

- New: DAQ and LabView interface and Excel reporting form delivers results much more efficiently
- Since Sept 2022: PDF/A3 format SIR reports that embed machine readable (XML and JSON) versions of the document
- Call for SIR submissions
  - No KCRV defined: Sc-47, Ag-111, Sb-125, Ba-140, Eu-155, **Ho-166**, Au-195, **Pa-231**, Am-243
  - Fewer than 5 primary results to define KCRV: Na-24, Co-56, **Mn-56**, Ge-68, Mo-99, Ru-103, Ru-106, Sn-113, I-123, **Sb-124**, Xe-133, Gd-153, Sm-153, Eu-154, **Tb-161**, Bi-207, Ra-223, Ac-225, Th-228
  - Standard uncertainty associated with KCRV larger than 0.2 %: Co-58, Cu-64, **Ga-67**, Se-75, Tc-99m, Cd-109, In-111, Ce-144, Ho-166m, Yb-169, **Lu-177**, **Tl-201**, Hg-203
- Th-227 in the SIR – planned using solution provided by NPL
- Ra-226 sources replacement by Ho-166m. Five reference sources to produce currents similar to the 5 radium sources planned but may need to reduce activity of Ra-5 (Ho-4 would become the new SIR reference source); BIPM have requested regulatory approval to keep two radium sources.
- The BIPM building a new SIR with two new Centronic IG12 ICs, new electronics, new room, and planned use of an Ultrastable Low-noise Current Amplifier (ULCA)
- KCRV transfer project with NPL underway (two ICs with different wall thicknesses, and transfer KCRV from one to the another)
- Developed remote operation of SIRTI due to Covid travel restrictions; remote protocol tested at LNHB, first remote comparison at PTB (linking measurements for I-123 and Sm-153 to SIR)
- Second SIRTI linking measurements performed at PTB (backup SIRTI at BIPM not yet linked to SIR)
- SIRTI future tours: LNMRI 2023, BEV 2024, NIM 2025, CNEA 2026, NMISA 2027, ININ 2028, CENTIS? 2029 (not currently a member of the BIPM), IRA 2030, NPL? 2031 (request for Tb isotopes)

ii. RMO SIRTI: proposal of operational approach

- SIRTI Schedule full through 2029
- SIM and APMP developing "regional" SIRTIs (1 in SIM, 3 in APMP): Proposal for 2-step link to SIR [BIPM SIRTI to SIR (at BIPM) – RMO SIRTI to BIPM SIRTI (at an RMO lab; not necessarily the pilot; each RMO SIRTI has one pilot lab, responsible for running the RMO SIRTI)]
  - Larger uncertainty due to two step link (data show that expected RMO SIRTI uncertainty smaller than typical primary measurement uncertainty despite the 2-step process)
  - Each RMO SIRTI pilot lab must commit to running key comparisons in their region once linked to the SIR through the BIPM SIRTI
  - BIPM support to RMO SIRTI development
- Many different types of comparisons and other validation methods can be used to support CMCs. Only certain comparisons contribute to the SIR KCRV.

iii. Proposed ESIR service (K5)

- Extended International Reference System (ESIR) for measurement of alpha- and beta-particle emitters based on the liquid scintillation (LS) Triple-to-Double Coincidence Ratio (TDCR) method.
- Pilot study with Co-60 gave excellent results; now included in the BIPM quality system
- Need to develop capability to correct for impurities.

iv. Report automation

- Automation in use since the last CCRI(II) meeting (partly due to the Covid pandemic); working well.
- Especially useful for radioactivity with many comparisons for different radionuclides.

6. Future comparisons and strategy (10-year plan, proposed CCRI comparisons)

a. Ten-Year Plan for CCRI Key Comparisons

i. Support CMC claims and support laboratory development

- Rotate among sectors
- Choose radionuclides based on stakeholder (including NMI) needs and availability
- Support smaller labs (including as co-pilots)
- Coordinate with BIPM services (SIR, SIRTI, ESIR)
- Strategically support MMM

Application	Nuclide (Example)	Year	Pilot Lab
Calibration/Tracers	^{109}Cd	2021	BIPM
Industrial	^{65}Zn	2023	LNMRI/IRD
Multiple (ion chamber reference sources)	^{166m}Ho	2024	IRA METAS
Medical	^{225}Ac (^{123m}Te, ^{192}Ir, ^{224}Ra, *Tb)	2024	NPL
Gas	^{85}Kr (^{41}Ar,^{133}Xe)	2025	LNHB?
Calibration/Tracers	^{51}Cr (^{152}Eu ,^{3}H)	2025	TBD?
Industrial	^{241}Am	2026	TBD (consider ESIR)
Environmental	(^{40}K, ^{210}Po, ^{235}U)	2027	TBD
Medical	(^{123m}Te, ^{192}Ir, ^{131}I?, *Tb)	2028	TBD
Gas	(^{41}Ar,^{133}Xe)	2029	TBD
Calibration/Tracers	^{51}Cr (^{152}Eu, ^{3}H)	2030	TBD

ii. Updates

- Calibration/tracer Cd-109: 2021, report in Draft A, success!
- Reference source Ho-166m (IRA-METAS) 2024: Purified solution should be ready by end of September 2023 and ready for distribution in first quarter of 2024 (1 MBq available for up to 30 participants
- Medical Ac-225 (NPL) 2024: Source supply issues; can NMIs source their own material to submit to SIR (400 MBq is absolute minimum activity)? Other medical radionuclides to consider are Tb-161, Sm-153, Ra-223
- Industrial Zn-65 LNMRI 2022: In progress; 10-year plan updated to use for comparison in 2023 rather than originally scheduled industrial in 2026 to give more time to resolve the Ac-225 supply issue (maybe in 2026).
- Gas Kr-85 (LNHB) 2025: No update. Is any other NMI available to pilot the comparison?
- Calibration/tracer Cr-51: Interesting to understand method dependance, no need to plan yet.
- Industrial Am-241 2026: Could combine with ESIR.
- Environmental (K-40, Po-210, U-235) – to be discussed
- Medical: consider I-131

b. Proposed Comparisons

i. Cu-67: Interesting as beta-particle-emitting source with delayed state. Suggestion for coordinated K1 comparison arranged by ANSTO during 2nd half of 2023. Could use this opportunity to calibrate the SIRTI at the same time (would require lower activity source).

Second session (5 June): Actions from 2021 Section II meeting, including impacts from the pandemic

7. Discussion and approval of minutes of 2021 meeting

a. CCRI(II) Membership

i. Official members: ANSTO, BARC, BEV, CIEMAT, CNEA, CMI, VNIIM, ENEA/INMRI, JRC-Geel, BFKH, IRA, KRISS, LNE-LNHB, POLATOM, NIM, IFIN-HH, NIST, NMIJ/AIST, NMISA, NPL, NRC, PTB, SMU, IAEA; IRD/LNMRI and CTBTO not official members. ICRU and ICRM are made up of individual institutes.

ii. An institute can apply for membership if they are: signatory (or Designated Institute) to the CIPM MRA, active in radionuclide metrology (measurement science), primary measurement capable and/or published CMCs, published in the field, and participate in international comparisons.

iii. NMI submit request to join CCRI(II) to chair and executive secretary for CCRI(II). consensus.

iv. Non-member institutes may participate in meetings as an observer or a guest.

b. Minutes of the CCRI(II) 2021 meeting: already issued; further review requested by 1 July 2023.

8. Actions arising [see below]

a. Review of Decisions taken at the 2021 meeting

i. PTB comparison for TDCR list mode data –cancelled; it was never registered on the KCDB.

ii. LNMRI/IRD (Brazil), CCHEN (Chile), ININ (Mexico), and the DI in Colombia encouraged to go through the process and apply for the appropriate level of membership (member, observer).

iii. Following his retirement, all actions on Steven Judge were transferred to VG.

#	Person	Action	Status
1	JK	Will contact Simon Jerome to take over Draft B of CCRI.RI(II).K2.Pa-231 comparison to completion.	Draft B on KCDB
2	R Broda	To send to KCDB (Susanne Picard) Degrees of Equivalence which is in the publication Fe-55.	Done

#	Person	Action	Status
3	S Pommé	Will communicate intention to publish Draft B results from 2003 Am-241 KC with the original participants.	Still to be done
4	C Bailat	Register Ho-166m comparison as planned on the KCDB.	Youcef to follow up
5	RG	To encourage LNMRI/IRD to register Zn-65 SIM comparison on the KCDB.	Done (SIM.RI(II)-K2.Zn-65)
6	LK,CF,RF,JK	Develop a script and slides on the use of the MMM for upload to the BIPM e-learning platform. Contact: Romain Coulon	Not needed; preamble and guidance published
7	VG	Add version number or document number to some interpretation documents for example: Rules documents and other documents such as RI_Service categories.	Still to be done
8	S Pommé	Will revive and redistribute proposals for 2 collaborations to LK to send to CCRI(II) members to draw interest in 2022. Proposals for: Monte Carlo calculations on primary standards, and energy response of ICs for PET and parent-progeny radioisotopes.	Still to be done
9	LK	Contact Begoña Quintana Arnés as chairperson of ICRM-LLRMT WG to help develop catalog of reference materials expected to be needed in the next few years. Everyone one should be prepared to respond to this request.	Done (29 June 2021), LK will follow up
10	LK	In CCRI presentation mention desire to work with the IAEA for help in developing a list of reference materials expected to be needed in the next few years. (IAEA ALMERA network for proficiency tests in the field of environmental activity.)	Done
11	SJ	Work with Manfred to arrange a CCRI webinar by IAEA.	Done
12	All	Send updated membership information (points of contact) to VG.	Ongoing
13	VG	In the "Proposed new interpretation of CMCs" working document of the RMOWG regarding the use of the CIPM MRA logo, change "is" to "must" to read "CMC must be identified on the certificate". Also, it is recommended to put the location of this document in the CCRI section guidance documents at least and otherwise include this document and others without official BIPM document numbering in some version control.	Still to be done (waiting on RMO WG to review)
14	~~CF, SJ~~ VG	Create a document (table of contents) with links to relevant documents to CCRI and CCRI(II) to ease the locating of critical documents. In addition to edit a document from SJ "draftcompendium2019" summarizing important recommendations by the CCRI and sections.	Superseded by SharePoint; action on VG to update table
15	~~SJ~~ VG	Update the contact list for the CCRI(II) to include guest laboratories CCHEN (Chile: Hernan Rodriguez), CTBTO (Arvic Harms), and CENTIS (Cuba: Pilar Oropesa)	Please resolve if CENTIS can be a guest (VG)
16	YS	Provide status and update on CCRI(II).S13 to KCWG(II).	Done (June 2023)

#	Person	Action	Status
17	All	Respond to CF, RF, SJ, LK on which upcoming comparisons in which they would like to participate.	Ongoing
18	LK	Prepare summary report for the CCRI.	Done
19	All	Provide nominations to LK for a deputy-chair of CCRI(II) by end of 2021.	Done
20	*LK (not initially captured)*	*Propose a method-based approach option for radionuclide CMCs (near future)*	Draft to be done by 1 Oct 23

Third session (6 June): CCRI strategy

1. Welcome back remarks (Section Chair)

2. Progress on radionuclide metrology and advancing the state of the art
   a. BIPM Activities
      i. BIPM is at the limit of the service quantities that it can provide (2 scientists, 1.5 technician, with 2 renewals in next 10 years)
      ii. Service expansion: K5 ESIR, expected to expand in terms of radionuclides covered; K4 with SIRTI, more radionuclides, difficult to be on site for more than one set of K4 comparisons in a year
      iii. Call for secondments:
         - Monte-Carlo (Penelope) evaluation of SIRTI uncertainty budget for high-energy gamma-ray emitters
         - Measurement of links to the SIR of the backup SIRTI detector
         - Development and tests of ionization current measurement using ULCA for SIR2.0
         - 30 months secondment included in WP for 2024-2027
   b. Activities at the NMIs
      i. NIST (US): cryogenic decay energy spectrometry (DES) using transition edge sensors (TES) in collaboration with Los Alamos National Lab; initial test of DES using Am-241
      ii. NIM (China): current job positions and near future plans on Radionuclide Metrology; recent improvement in primary methods; work on a portable TDCR; plans to implement mass spectrometry for radionuclide metrology; plans for a new building
      iii. LNMRI/IRD (Brazil): recent activities including national traceability programs and outreach to students
      iv. ENEA (Italy): report on the ENEA INMRI radioactivity section, followed by a report on the status of CMCs (all three Sections), which were all greyed out pending peer-review of QMS in 2023.
      v. KRISS (Republic of Korea): response to high levels of radon in mattresses; TDCR and development of a miniature 4πβ coincidence system (possible development to portable system); proficiency tests.
      vi. RC POLATOM (Poland): recommendation to use diffusive vials in the ESIR, especially for Fe-55.

c. Other Activities from Stakeholders

i. ICRM: A Luca presented a report on the recent ICRM conference in Bucharest [Elsevier ARI awards to Alan Nichols (JARI Medal), Xavier Mougeot (Hubbell award); Leon Grigorescu awards to Maria Sahagia, Octavian Sima, Philippe Cassette, Uwe Wätjen. Best poster award to Yoonhee Jung (KRISS, development of reference material for quality control of uranium analysis in marine sediments)].

d. Written reports from the NMIs/members for the record

3. Discussion and suggested modifications on the revised CCRI strategy (2nd September 2021 Edition) [V. Gressier with NMIs, stakeholders and guests]

i. JTJ: presented the CCRI strategy, providing context and a view from the CIPM
- 150-year anniversary on 20 May 2025 – CCRI(II) strategy to be ready for this
- CIPM Strategy 2030+
  - Drivers of change (Well-being, Sustainability, Enterprise)
- Metrology grand challenges
- 3 Priorities for metrology in the future
  - Digitally enabled global measurement system
  - Measurements to support a systems-understanding of the world
  - Enabling confidence in decision making
- CCRI strategy 2018-2028, 2nd edition, September 2021
  - To be reorganized to better fit the CIPM strategy

ii. Latest revision (from last CCRI(II) meeting) and implemented changes

iii. Important challenges for radionuclide metrology still remain:
- Reliance on sealed radium sources for SIR
- Staff travel for SIRTI comparisons
- Shipping of sources for comparisons (including delays at customs)
- Expanding use of mass spec needs expertise, instrumentation
- Changes in the metrology community – 29 member states with RM capability, also medical imaging or Mass Spec, excludes IAEA ALMERA network labs – "New" metrology
- Across sections – Digital transformation

Fourth session (6 June): Working Group reports

1. Report from Radiopharmaceutical Therapy and Quantitative Imaging Working Group [B. Zimmerman, NIST]

- Aim of CCRI RTQI WG
  - Enable the CCRI and its sections to identify where radionuclide (and dosimetry) metrology can improve the effectiveness of radiopharmaceutical therapy (RT)
  - Coordinate activities to address this, particularly in the fields of quantitative imaging and patient dosimetry.
- Radionuclides of interest (based on a quick literature scan and participation in other working groups)
  - Imaging PET: F-18, Ga-68, Zr-89, I-124
  - Imaging SPECT: Ga-67, Tc-99m, In-111, Pb-203
  - Beta-emitters for therapy: Cu-64, Y-90, I-131, Lu-177
  - Alpha-emitters for therapy (hot topic): At-211, Pb-212, Ra-223, Ra-224, Th-227, Ac-225

- Participants: from Radionuclide Metrology, Nuclear Medicine and Malcolm McEwan (Dosimetry)
- Recent activities
    - Virtual meetings (4) and webinars
    - Interactions with professional societies (SNMMI, AAPM, EANM, ASTRO)
    - Advice to other CCRI WGs on measurement needs, comparisons
    - Developing Good Practice Guides where metrology community can provide impact
    - Planning Workshop on radionuclide metrology for alpha-emitter therapy (late 2023/early 2024)

2. Report from CCEM-CCRI Task Group – low electrical current measurement [S. Giblin, NPL]

- Need for improvements:
    - Pull from radioactivity community: Ageing current measurement systems in need of replacement; drive to phase out long-lived sealed check sources
    - Push from electrical community: Major advances in state-of-the-art in last 20 years [(e.g., ultrastable low-noise current amplifier (ULCA)]
- Emerging collaborations between electrical and radiation metrology
    - Giblin, et al., *Review of Scientific Instruments* 90, 014705 (2019)
    - Fitzgerald et al., *Applied Radiation and Isotopes* 163, 109216 (2020)
- Guidelines paper for best practice in small current measurement, in progress.
    - 3 conference presentations to radionuclide community
    - Guidelines document exists in (very rough) draft form
    - EPM project "small current metrology for industrial and scientific applications" not funded; new EPM proposal "small current metrology for industrial applications" progressed to Selected Research Topic stage in 2023 industry call

3. Report from Communications WG [F. van Wyngaardt, ANSTO]

- Created in February 2022
    - To help Executive Secretary to plan and shape communication activities
    - 12 members, from each RMO, each Section of CCRI, and three BIPM
- Webinars
    - 19 webinars to date, 7300 YouTube views
    - 1370 unique participants (2800 attendees); 40 % from stakeholders (i.e., not NMI/DI)
- Meetings, workshops, and E-learning
    - In-person and virtual
    - High energy accelerator facilities, CCRI(III) or CCRI(I)/(III) – in discussion
    - BIPM dedicated webpage can accept any e-learning presentation/videos from CCRI (BIPM) and from the RMOs
    - Issue with inaccessibility of YouTube in China and Cuba, BIPM working on a solution

4. Report from CCU-CCQM workshop on Counting (28-30 Mar 2023) [R. Fitzgerald, NIST]

- "The metrology of quantities which can be counted", 28-30 March 2023. Presentations are available online: https://www.bipm.org/en/committees/cc/ccu/wg/ccu-ccqm-ws/2023-03-28
- Included three sessions:
    - Concepts and theoretical aspects of counting and the unit one
    - Counting entities (case studies from electricity, mass, chemistry and biology)
    - Counting processes & other phenomena (case studies from radioactivity to light)
    - RF presented "Counting in radionuclide metrology"

- Next steps:
  - The text of the SI Brochure related to counting and number quantities needs improvement.
  - The CCU Task Group on Angles and Dimensionless Quantities in the SI Brochure, TG-ADQSIB, will create a Focus Group to deal with this topic.
  - The objective of the Focus Group will be to suggest clarifications of the text of the SI Brochure related to counting and number quantities.

5. Progress on discussions with CCQM – mass spectrometry for radionuclide metrology [L. Karam, NIST]

- Joint effort between CCRI(II) and two CCQM working groups
- MS is not intended to replace decay counting methods.
  - CCRI(II) members with MS capability for RM (CMI, IFIN-HH, KRISS, LNE-LNHB, NIST, PTB, NPL, CNEA); developing capabilities (NIM, ENEA)
  - Members potentially interested to develop capabilities (ANSTO, NRC)
  - Webinar in February 2022 (https://www.youtube.com/watch?v=B_5QvV69cIA&t=8s) on use of Mass Spec in RM
  - CCRI/CCQM Joint Workshop
    - Scope: Current activities; enabling mass spec for radionuclide metrology and future; stakeholder needs and gaps
    - Tutorials with background information prepared to support discussion: https://www.bipm.org/fr/committees/cc/ccri/wg/ccri-ccqm-ws/2023-02-14
    - Recording of workshop now available: https://www.youtube.com/playlist?list=PL-vj-3_a7wTAwR2DmyGhwwlDU3EQr99Ts
  - Task Group established under CCRI(II), Membership from IR (Dirk Arnold, Richard Essex), Chemistry (Janine Eberhardt, Jackie Mann), and MS intersection (Ben Russell, Chair)
    - Terms of Reference to September 2025
    - Will report at 2025 meeting and periodically on potential CCRI(II) activities

Update on CCRI(II) vice chair position

The incumbent for vice chair should be willing to take over Chairmanship after 2025 meeting. Should be from outside SIM, and ideally from APMP. Previous chair was Bruce Simpson (1997-2010) from NMISA (AFRIMETS) who took over from Klaus Debertin (PTB, EURAMET).

Roundtable discussion on comparisons NMIs want to pilot, or are interested in participating

Radionuclide	Alphas	Other medical	Gases	Other
NIST	Ac-225 Ra-223 Ra-224 Pb-212			
ANSTO	Ac-225 Pb-212	Cu-67 Ga-67 Lu-177		
NIM	Ac-225	Lu-177	Kr-85 Xe-133	
CTBTO			Xe-133 Xe-131m	
CMI	AlphaMET			Radionuclide calibrators
JSI		medical		Pure betas

Radionuclide	Alphas	Other medical	Gases	Other
ENEA	AlphaMET			Surface emission rate for gamma emitters (contamination monitors)
LNHB	AlphaMET Ac-225 At-211 Pb-212	Cu-67 Ga-67		Including decay data measurement
IRA	AlphaMET			Ho-166m, needs another accurate half-life measurement
LNMRI	Ac-225			
CIEMAT	AlphaMET		Rn-222	
IFIN-HH	Alpha emitters	Cu-67		
NRC	Ac-225 (supply?)	Cu-67 (supply?) Zr-89		
NMIJ	At-211			
KRISS		Lu-177		I-129 Ni-59 Ni-63 decommissioning
BARC	Ac-225			
PTB	Ac-225			MetroPOEM Mass spec
BEV				Co-57 SIR, SIRTI next year, radionuclide calibrator comparison
NPL	AlphaMET			DCC software data analysis comparison; TDCR digital data analysis comparison, use IEC 63047 data format for list mode data
Polatom	AlphaMET			
IAEA				SSDLs requesting setup of Secondary Standard ionization chambers
NMISA	Ac-225			

Fifth session (7 June): CMCs and Summaries

1. CMCs and KCDB2.0 status [S. Maniguet, BIPM]]

- Platform used daily, 1635 individual user accounts, 25 863 published CMCs, 1825 comparisons available
- Key statistics for CCRI
    - 3 738 CMCs in RI published (as of 2023-06-06): of these, 166 CMCs published on the KCDB platform; 61 were drafted, reviewed and approved by JCRB
    - 184 Key Comparisons in RI published: 51 Final reports published and 9 KCs registered
    - 70 Supplementary Comparisons in RI published: 5 Final reports published and 3 SCs registered
- Continuous improvement of web platform based on users' feedback
- Digitalization – API (Application Programming Interface) for machine readable data, BIPM server can query data from KCDB to get statistics, etc.
- KCDB 2.0 API status: Presently possible to carry out menu based or keyword-based search for CMCs on the KCDB using the API. Targeting to fulfill the FAIR principles (findable, accessible, interoperable, reusable)

2. Report from the CCRI RMO WG on CMCs [L. Karam]

- Consists of the Chairs of TCIR from each region and Chairs of Sections (*ex officio*).
- Discusses variety of documents that we rely on to do our work.
    - Revised rules for filling out CMCs (to allow bundling of radionuclides per CMC)
    - KCDB does not search from Table attachment
    - CMC writers need to supply a narrative with a CMC, to guide the reviewer

- REQUEST: Enable comments in CMCs to specify radionuclides in searchable form

3. Machine-readable key comparison reports update [R. Coulon, BIPM]

- CCRI Task Group on Digital Transformation.
  - In response to CGPM resolution on global digital transformation and the SI
  - Advice to the CCRI on the SI Digital Framework for ionizing radiation metrology
  - SI Digital framework described by 3 layers: application layer is composed of all end-user applications that will use digital services for traceability chain.
  - Forum to exchange information on progress
  - https://thebipm.sharepoint.com/sites/CCRI-TGDT
- CCRI(II) issues: (For discussion in the TG, Contact Ryan, Haoran or Romain with ideas)
  - Deal with time dependance (radioactive decay) in Digital Calibration Certificates
  - Monte-Carlo simulation seen as « digital twin »
  - How to digitally identify radionuclides?
  - BIPM prototype using PDF/A-3 embedding xml and json versions of K1 reports
  - How can DDEP evolve to meet M2M needs?
  - Interest for sharing digital metadata (e.g., raw data of measurements)?
- Case Study demonstrating discussion. machine readable data and metadata and the SIR

4. Membership Changes [All]

- Membership is by institution, not person (but need details of a contact person)
- One vote per institute (one representative accompanied by one technical expert support)
- ENEA: contact person to be updated (from P de Felice to either M Capogni or P Carconi)
- LNMRI/IRD: to request membership
- SIM: TC chair to encourage other institutions to join
- EURAMET: already well represented
- APMP: already well represented
- GULFMET: not yet deeply involved in radioactivity
- COOMET: need increased representation

5. Summary of Actions [All]

#	Person(s)	Action	Status
CCRI(II)-23(01) KCWG(II)-23 1	RF	include Lu-177 comparison on KCWG(II) agenda to discuss scientific updates	
CCRI(II)-23(02) KCWG(II)-23 2	Andrew Pearce	Contact KCDB to update status OF ccii(ii)-K2.Tc-99 to Draft A in progress.	
CCRI(II)-23(03) KCWG(II)-23 3	SC	Arrange meeting among RF, SC, LK and Andy Pearce to discuss completion of Tc-99 report	
CCRI(II)-23(04) KCWG(II)-23 4	RF	Decide by the end of the year whether to remove this comparison from the KCDB	
CCRI(II)-23(05) KCWG(II)-23 5	Robert Sherman	Contact participants of CCRI(II)-K2.Pa-231 for Draft B approval	
CCRI(II)-23(06) KCWG(II)-23 6	NPL [JK(?)]	Submit reporting form for CCRI(II)-K1.Pa-231 to BIPM	

#	Person(s)	Action	Status
CCRI(II)-23(07) KCWG(II)-23 7	Sang Han Lee	Contact KCDB to update CCRI(II)-S15: Cs-137/K-40 in mushrooms status to Draft A in progress, and complete draft A	
CCRI(II)-23(08) KCWG(II)-23 8	Sang Han Lee	Complete CCRI(II)-S9: Cs-137/K-40 in rice material Draft A	
CCRI(II)-23(09) KCWG(II)-23 9	YS	Complete CCRI(II)-S13: Cs-134/Cs-137 in wheat flour Draft A and notify KCDB	DONE
CCRI(II)-23(10) KCWG(II)-23 10	RB	Contact KCDB to update EURAMET.RI(II)-K1.Cr-51 status to Draft B	DONE? (shown "submitted to the KCDB office")
CCRI(II)-23(11) KCWG(II)-23 11	LK	Add a discussion topic on acceptance and validation of RMO SIRTIs to agenda for 2025 CCRI(II) meeting	
CCRI(II)-23(12) KCWG(II)-23 12	KCWG(II)	Contribute to review of ESIR protocol; establish subcommittee to contribute to developing the capability to correct for impurities	
CCRI(II)-23(13) KCWG(II)-23 13	VG	Contact CCRI(II) members to confirm interest in Ac-225 comparison and amount of activity	
CCRI(II)-23(14) KCWG(II)-23 14	SC	Confirm Ac-255 supply from CERN-MEDICIS and impurity levels	
CCRI(II)-23(15) KCWG(II)-23 15	CB	Confirm LNHB availability to pilot Kr-85 gas key comparison in 2025	
CCRI(II)-23(16) KCWG(II)-23 16	KCWG(II)	Consider Zn-65 (started 2022) as a replacement industrial radionuclide for Am-241 (planned 2026) in the 10-year plan.	
CCRI(II)-23(17)	LK	Send instructions defining the different membership categories (Official Member, Observer) and how to apply for membership to TCIR chairs	Done (26 June)
CCRI(II)-23(18)	SP	Communicate intention to publish Draft B results from 2003 Am-241 KC with the original participants.	
CCRI(II)-23(19)	YN	Register Ho-166m comparison as planned on the KCDB	Done
CCRI(II)-23(20)	VG	Add version number or document number to some interpretation documents for example: Rules documents and other documents such as RI_Service categories.	
CCRI(II)-23(21)	SP	Will revive and redistribute proposals for 2 collaborations to LK to send to CCRI(II) members to draw interest in 2022. Proposals for: Monte Carlo calculations on primary standards, and energy response of ICs for PET and parent-progeny radioisotopes.	

#	Person(s)	Action	Status
CCRI(II)-23(22)	VG	"Proposed new interpretation of CMCs" working document of the RMOWG regarding the use of the CIPM MRA logo, change "is" to "must" to read "CMC must be identified on the certificate".	
CCRI(II)-23(23)	VG	Update document (table of contents) with links to relevant documents to CCRI and CCRI(II) to ease the locating of critical documents	
CCRI(II)-23(24)	VG	Please resolve if CENTIS can be an observer (VG)	
CCRI(II)-23(25)	LK	Propose a method-based approach option for radionuclide CMCs (near future)	Draft to be done by 1 Oct 23
CCRI(II)-23(26)	All	Send secondments to BIPM	
CCRI(II)-23(27)	JR	Request membership for LNMRI/IRD in CCRI(II)	Done (input ends 17 July)
CCRI(II)-23(28)	All	Review the CCRI strategy and share ideas with LK on how the document can better reflect CIPM expectations	
CCRI(II)-23(29)	LK, VG, JTJ	Realign CCRI strategy to better reflect structure of CIPM 2030 strategy	
CCRI(II)-23(30)	JK, SP	Speak to Richard Brown (NPL, TG ADQSIB Chair) and confirm if someone from Radionuclide Metrology needs to be involved	
CCRI(II)-23(31)	LK	Update table to include NIM and ENEA as interested to develop MS for RM capabilities	
CCRI(II)-23(32)	All	Volunteer (or recommend someone) to take on the position of vice chair, noting the vice chair will become chair after the 2025 meeting. Candidates from APMP and EURAMET particularly encouraged	
CCRI(II)-23(33)	All	Provide extensive list of who are contact persons for each institute to VG	

6. Any other business [All]

Pierino de Felice will be retiring soon. LK acknowledged Pierino's long history with CCRI.

Decisions and Recommendations

Item	Status
Plan for linking RMO SIRTI to SIR via BIPM SIRTI	Approved
Include (4) Cu-64 SIRTI results in K1 KCRV	Approved

Item	Status
Open BIPM(II)-K5 ESIR comparison in March 2024 for 11 radionuclides (C-14, S-35, Ca-45, Fe-55, Ni-63, Sr-89, Sr-90, Pm-147, Tc-99, Am-241, Pu-241)	Approved
Keep Lu-177 KCRV unchanged for now, calculate degrees of equivalence for all participants	Approved
RMO SIRTI instrumentation must match the BIPM SIRTI as it is at present to within specified criteria (to be provided)	Approved
RMO SIRTI protocols for operation (validation, measurement, data handling) must be close to that of the BIPM SIRTI (to be provided)	Approved
Inclusion of RMO SIRTI results in the SIR K1 KCRV can be allowed (when appropriate, approved individually)	Approved
Request (to CCRI) quick completion and distribution of rules for IR CMCs. Enable comments in CMCs to specify radionuclides in searchable form, and comments for reviewers in private but easily accessible format.	Approved

7. Date of next meeting (2025)

- CCRI meeting could be 1st two weeks of June (might be affected by CIPM meeting and have to move)
- Section I, II, III and CCRI in these two weeks
- 150-year anniversary of the Metre convention just before proposed CCRI dates.
- ICRM dates 15-20 June 2025 (tentative)