



BUREAU INTERNATIONAL DES POIDS ET MESURES
Comité Consultatif pour les Rayonnements Ionisants
Section II (Measurement of Radionuclides)
28th Meeting (1-4 June 2021)
Virtual – Global participation
Minutes

Chair Dr Lisa Karam (NIST)
CCRI President Dr Martyn Sené (NPL)
CCRI Executive Secretary Dr Steven Judge (BIPM)

Participants:

First Name	Last Name	Initials used in minutes	Organization	Country
Ameena	AlAbdouli	AA	Federal Authority for Nuclear Regulation	United Arab Emirates
Ilya	Alekseev	IA	VNIM	Russia
Dirk	Arnold	DA	PTB	Germany
Claude	Bailat	CB	IRA, CHUV	Switzerland
Christophe	Bobin		LNE-LNHB	France
François	Bochud		Lausanne University Hospital	Switzerland
Robert	Brettner-Messler	RBM	BEV	Austria
Ryszard	Broda	RB	POLATOM	Poland
Marco	Capogni	MC	ENEA-INMRI	Italy
Seán	Collins	SC	NPL	United Kingdom
Romain	Coulon	RC	BIPM	International

Pierino	De Felice		ENEA-INMRI	Italy
Ryan	Fitzgerald	RF	NIST	United States
Carole	Frechou	CF	LNE-LNHB	France
Raphael	Galea	RG	NRC	Canada
Vaidehi	Garimella		Dubai Central Laboratory, Dubai Municipality	United Arab Emirates
Sanghoon	Hwang		KRISS	Republic of Korea
Volodymyr	Isvsieiev		National Scientific Centre "Institute of Metrology"	Ukraine
Steven	Judge	SJ	BIPM, CCRI Exec Sec	International
Lisa	Karam	LK	NIST, CCRI(II) Chair	United States
Karsten	Kossert	KK	PTB	Germany
Matej	Krivosik		SMI	Slovakia
Devendra	Kulkarni		BARC	India
Kyung-Beom (KB)	Lee		KRISS	Republic of Korea
Sang-Han	Lee		KRISS	Republic of Korea
Anna	Listkowska		POLATOM	Poland
Aurelian	Luca	AL	IFIN-HH	Romania
Justyna	Marganiec-Gałązka		POLATOM	Poland
Carine	Michotte	CM	BIPM	International
Susanne	Picard	SPd	BIPM	International
Stefaan	Pommé	SP	JRC	Belgium
Anuradha	Ravindra	AR	BARC	India
Miguel	Roteta	MR	CIEMAT	Spain
Yasushi	Sato		NMIJ	Japan
Martyn	Sené	MS	NPL, CCRI President	United Kingdom
Sunil	Singh		BARC	India
Jana	Sochorová		CMI	Czech Republic
László	Szűcs	LS	BFKH	Hungary

Zbigniew	Tymiński		POLATOM	Poland
Mark	Tyra	MT	NIST	United States
Milton	van Rooy		NMISA	South Africa
Freda	van Wyngaardt	FvW	ANSTO	Australia
Brian	Zimmerman	BZ	NIST	United States
John	Keightley	JK	NPL	United Kingdom
Ming	Zhang	MZ	NIM	China
Tomasz	Ziemek		POLATOM	Poland
	Zhukov		VNIIM	Russia

First session (1 June): Welcome, organization and comparisons

1. Welcome (CCRI President and Section Chair)

Importance of our work

IR metrology supports many sectors (health, energy, etc.)

Impact of the Pandemic

RI services were not extensively interrupted, showing critical importance of what we do.
No meetings face-to-face (difficult, but increased participation). Catalyst for launching BIPM webinars.

CIPM activities

Strategy – post redefinition of SI.

1. What are evolving needs for Metrology?

Climate, health, manufacturing...how to engage stakeholders.

2. What are key scientific challenges to advance the global measurement system?

Digital Transformation in Metrology...more redefinition (i.e.: the second)

3. How can we deepen engagement with other international organizations on measurement science issues?

95 % of global GDP represented but some smaller countries still missing.

4. What should be our strategy for the future membership of the organization?

5. How can we modernize the operations of the organization?

Evolution of CCRI strategy

CCRI strategy agreed 2019 and updated in 2020. 50+ topics identified. Small changes. Edition 2 circulated for comments in 2021.

Thanks to all and especially to Steven Judge who will be retiring in June 2021. To be replaced by Vincent Gressier (current CCRI(III) chair).

2. Appointment of *Rapporteur*

R. Galea was appointed *Rapporteur*. *Office Metrologist 1st class*. *These minutes have an estimated uncertainty of $\pm 15\%$.*

3. Approval of agenda

Approved.

4. Status of comparisons

- a. BIPM Services (SIR (report automation), SIRTI, ESIR)
SJ disappointed not to have welcomed us to Paris.

BIPM aims to maintain and develop high-precision instrumentation to compare national standards.

Services were kept running except a brief period when the BIPM facilities in Sevrés were shutdown. Three challenges for the BIPM services were addressed:

- SIR: accelerate completion of reports
 - Automated, using a single database, robust version control, and compatible with FAIR (“Findable Accessible Interoperable Reusable”), even if not particularly user-friendly, concepts.
 - New software, new database, automatic report generation.
 - Recommendations for the SIR. Maybe encourage multiple labs to send sources of the same radionuclide to facilitate full coverage.
- SIRTI: improve accessibility
 - Remote SIRTI. The instrument is sent to you, and you run it with remote support from BIPM.
 - User-friendly software; new packaging for detector tested for air-freight; software controlled remotely; characterized for two new radionuclides (^{123}I and ^{153}Sm)
 - Access for remote-control behind firewalls may be a problem but solutions with hotboxes possible. Good experience from JK (NPL) using a NETGEAR 4G LTE Modem (Model LB2120).
 - Schedule: Mid-June planned test of procedure at LNHB, then full test of system with ^{123}I and ^{153}Sm at the PTB. Longer term has been scheduled by Carine to reflect need, region and multiple radionuclides to compare.

- ESIR: develop and validate methods to expand beyond gamma-ray emitting radionuclides
 - Can be for both pure β and α emitters and low-energy e^- capture. But the measurement of α is more an issue of regulation on using unsealed sources at BIPM (would need to have a glove box for sample preparation).
 - Method using a modified TDCR approach being pursued
 - Instrument redesigned, constructed and commissioned.
 - Two papers published: validation of method and estimation of uncertainties
 - Tested with ^{60}Co . Once complete, ESIR will be available for use.
- BIPM.RI(II).K1-Ac-225 : PTB is the first participant in June 2019-2020. Draft B circulated. Call for other participants to determine KCRV.
- BIPM.RI(II).K1-Tb-161: IRS is the first participant in August 2019-2020. Published 2021. Call for other participants to determine KCRV.
- Recommendations for SIR comparisons
 - No KCRV yet defined: ^{47}Sc , ^{111}Ag , ^{125}Sb , ^{140}Ba , ^{155}Eu , ^{161}Tb , ^{166}Ho , ^{195}Au , ^{225}Ac , ^{231}Pa , ^{243}Am
 - Fewer than five primary results to define the KCRV: ^{24}Na , ^{56}Co , ^{56}Mn , ^{64}Cu , ^{68}Ge , ^{99}Mo , ^{103}Ru , ^{106}Ru , ^{113}Sn , ^{123}I , ^{124}Sb , ^{133}Xe , ^{153}Gd , ^{153}Sm , ^{154}Eu , ^{177}Lu , ^{207}Bi , ^{223}Ra , ^{228}Th
 - Standard uncertainty associated with the KCRV larger than 2×10^{-3} (in relative terms): ^{58}Co , ^{67}Ga , ^{75}Se , ^{109}Cd , ^{111}In , ^{144}Ce , $^{166\text{m}}\text{Ho}$, ^{169}Yb , ^{201}Tl , ^{203}Hg

b. CCRI Comparisons (key and supplementary, including Fe-55)

- **CIPM-MRA-G-11:** *In the case of results that are discrepant with the reference value or are not consistent with their published CMCs, the participants are not allowed to withdraw their results from the report unless a reason not attributable to the performance of the laboratory can be assigned (for example, if an excessive drift or a malfunction is detected in the transfer standard). Individual values and measurement uncertainties may be changed or removed or the complete comparison abandoned only with the agreement of all participants and on the basis of a clear failure of the transfer standard or some other phenomenon that renders the comparison or part of it invalid.*
- CCRI.RI(II).K2-Cd-109 : Pilot (BIPM, LNHB). Ampoule preparation June 2021. 22 participants. Ampoules sent out in July 2022. Exempt package. Submission of results due 31-Jan-2022.
- CCRI.RI(II).S15 mushroom powder. Pilot (KRISS). Samples sent May 2021. Submission results due 15-Sept-2021. Draft B June 2022.
- CCRI(II).S9 rice. Pilot (KRISS). Draft A in preparation June 2021.
- CCRI(II)-S13 wheat flour. Pilot (NMIJ). Draft A in progress.
- CCRI(II)-K2-Tc-99. Pilot (NPL). Draft A in progress.
- CCRI(II)-K2.Pa-231. Pilot (NPL). Draft B. JK (NPL) to take up the completion.
- CCRI(II)-S10 surface contamination. Pilot (ENEA), with handover of report to SC (NPL). Draft B in circulation.
- CCRI(II).K2.Fe-55. Pilot (POLATOM). Draft B published.
 - Noted that all participants used LSC, although some were planning to use additional methods.

- Degrees of equivalence available in publication but not in the KCDB.
- Ready-to-measure sources were a supplementary comparison and not part of the KC (noting the recommendation to use diffusive vials for sources destined for the ESIR).

c. RMO Comparisons (key and supplementary, including APMP comparisons)

- COOMET.RI(II)-S3 point sources. Pilot (VNIIM). Sources prepared and ready to ship.
- EURAMET.RI(II)-K2.Ho-166. Pilot (CMI). Results submitted Feb. 2021. Draft A in circulation. Draft B June 2021.
- APMP.RI(II)-S3 brown rice. Pilot (NMIJ). Draft B in circulation.
- EURAMET.RI(II)-S8. Rn-222. Pilot (LNHB). Draft B in progress.
- APMP.RI(II)-S4 surface contamination monitors. Pilot (NIM). Postponed from 2020 to the beginning of 2022. [NIM](#), [ANSTO](#), [BARC](#), [INER](#), [KRISS](#), [NMISA](#), [PTB](#), [PTKMR-BATAN](#), [NPL](#).

Contact: zhming@nim.ac.cn

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

- SIM.RI(II).K2.Zn-65. Pilot (LMNRI/IRD). Protocol in preparation and should be registered on the KCDB soon. Originally planned for 2020, hope to start in 2021. [CNEA](#), [NPL](#), [CIEMAT](#), [LNMRI/IRD](#), [NIST](#), [BFKH](#), [POLATOM](#), [VINS](#), [SMI](#), [TAEK](#). Note the presence of ⁶⁵Zn in the 10-year plan (Industrial, 2026).
Contact: karla@ird.gov.br
- Proposed comparison Pilot (PTB) on the analysis of TDCR list-mode data. Protocol June 2021. Data for H-3 and Sr-90 will be prepared. High count rates planned (> 10⁷ events per dataset), and participants will use their own software. It was noted that this would be the first comparison specifically focused on digital data.
Contact: ole.j.naehle@ptb.de

Ten-Year Plan for CCRI comparisons (2021)

Sector	Nuclide (Example)	Year	Pilot Lab	Notes
Calibration/Tracers	¹⁰⁹ Cd	2021	BIPM	BARC , BEV , BIPM , BFKH , CIEMAT , CMI-IIR , ENEA-INMRI , IFIN-HH , ININ , KRISS , LNE-LNHB , LNMRI/IRD , NIM , NIST , NMIJ , NMISA , NPL , NRC , NUKEN/TENMAK , PTB , POLATOM , SMU Contact: cmichott@bipm.org
Multiple (ion chamber reference sources)	^{166m} Ho	2022	IRA METAS	Encouraged to send to SIR. Contact : Claude.Bailat@chuv.ch
Medical	²²⁵ Ac	2023	NPL	Encouraged to send to SIR. Contact : sean.collins@npl.co.uk
Gas	⁸⁵ Kr	2024	LNHB	Appropriate container to be decided. Interested labs: LNHB , NRC , NPL , NIM

Sector	Nuclide (Example)	Year	Pilot Lab	Notes
				Contact : carole.frechou@cea.fr
Calibration/Tracers	^{51}Cr (^{152}Eu , ^3H)	2025	TBD	Follow up of Fe-55 also possible (using additional methods).
Industrial	^{241}Am (^{65}Zn)	2026	TBD	ESIR may be available. (Possible supplementary comparison of alpha mix. Sr-90/Y-90 discussed earlier.)
Environmental	(^{40}K , ^{210}Po , ^{235}U)	2027	TBD	U-235 may have limited participation due to international safeguards. Po-210 may have supply issues. K-40 supports many natural matrix comparisons.
Medical	($^{123\text{m}}\text{Te}$, ^{192}Ir , ^{224}Ra , $^*\text{Tb}$)	2028	TBD	Ir-192 used in Section I. At-211 (short half life). Lu-177(SIR). Ru-106 (in equilibrium with Rh-106).
Gas	(^{41}Ar , ^{133}Xe)	2029	TBD	Tritium gas (liquid was done more recently).
Calibration/Tracers	(^{152}Eu , ^3H)	2030	TBD	Liquid tritium.

- SP plans to publish Draft A comparison from 2003 for Am-241 in a paper describing JRC.

6. Group photograph

Official screen shot group photo taken by Carine Michotte.



Second session (2 June): Actions from 2019 Section II meeting, including impacts from the pandemic

1. Welcome back (Section Chair)

Discussions to finalize the points of contact for the previous day's planned comparisons.

2. Approval of minutes of 2019 meeting

CM requested a change in wording to indicate C-11 was measured for 3 half lives not 3 days in section 7.4.2 on page 9.

The minutes from the 2019 meeting were approved once the above correction is made.

3. Actions from previous meeting

#	Person	Action	Status (after discussions)
1	JK	Upload MMM and TYP before the next KCWG(II) meeting.	Done.
2	All	Executive Secretary investigate a better solution for document control and sharing for CCRI(II).	Sharepoint system is available and has been used for KCWG(II). Could use the BIPM e-learning portal to download the MMM together with a presentation. The presentation remains and the MMM must be updated.
3	LK	Talk to SJ to see whether we can put a link to a password-protected document on the CCRI Publications -> Guidance documents page. [complete]	Covered by new BIPM website.
4	All	Policy: If you do publish [Draft B] elsewhere, such as ICRM proceedings, you must send the article to the CCRI(II) Chair, Executive Secretary, and KCWG(II) chair. If OK, that can be posted as the final report	On-going.
5	JK	At next KCWG(II) meeting, choose which medical radionuclide for 2021.	Plans impacted by pandemic.
6	RB	Check with his lab today and let us know tomorrow whether participant list can be increased [for Fe-55 comparison]. If so, POLATOM can decide whether to make this a CCRI(II)-K2 Key comparison. [Complete. The lab is willing. Participants should contact RB by email by 17 June]	Fe-55 comparison completed.
7	LK	Send an email [regarding Mushroom Powder comparison] to CCRI(II) and	Done.

#	Person	Action	Status (after discussions)
		Simon Jerome asking them to contact SHL if interested.	
8	LK	Share the slides regarding Oyster Comparison with everyone and ask them to contact SHL if interested.	Done.
9	CM, MC, KK, SHL	Register your new comparisons and keep BIPM informed of progress (registered, draft A, draft B)	Covered by KCDB2.0 – reminders sent and database maintenance is easier for pilots.
10	SJ	Send Akira further information on ISO1129 and links to the American publications on clearing radioactive waste (completed).	Done.
11	SJ	Talk to CCQM about our needs [for collaborating with mass spectrometry on measuring half-lives etc.], and possibly give a talk	Meeting held with CCQM Chairs, LK, leading to further discussions.
12	RG	In the rule about use of the CIPM MRA logo, change “is” to “must” to read “CMC must be identified on the certificate”	The change to the “Proposed new interpretation of CMCs” dated June 2019 on the BIPM webpage has not been updated. It is hard to find: RMOWG/2019-03.
13	SJ	Promote the achievement of the CCRI that DDEP is now used worldwide: industry, monitoring, etc.	Covered during Metrology Summer School and review paper. Other papers in preparation. CB mentioned that the DDEP is promoted during radiation protection teaching and nuclear MD certification in Switzerland. Also promoted in a CBKT course on piloting international comparisons at NPL. We are all encouraged to promote the use DDEP as the official source of nuclear decay data.
14	LK, SJ	Revise the activities table (roadmap) in the Strategy to include comparison of nuclear data.	Further consultation on strategy in progress – discussion during CCRI plenary.
15	LK, SJ	Revise the text in the Strategy to include importance of nuclear data.	Done.
16	SP	Send proposals for 2 collaborations (energy response of ICs, parent-daughter decay chains) to SJ to send to CCRI(II) members to draw interest	Done but no progress. Will start again in 2022.
17	SJ	Email M Groening and Simon Jerome for a list of reference materials	Not needed at the moment. Covered by ICRM-LLRMT WG. See new action item 2021.
18	FJM (Franz Josef Maringer, retired)	FJM to investigate the possibility of engagement with UN more broadly and identify an arena for engagement, to present at the next KCWG(II) meeting. Send to JK or LK.	Carried over – for broader discussion of stakeholder engagement.
19	DA	Summarize impacts from European project stakeholders by 2021.	Summaries are found on several sites (https://www.euramet.org/research-innovation/research-empir/empir-calls-and-projects/ ;

#	Person	Action	Status (after discussions)
			https://www.euramet.org/research-innovation/search-research-projects/ ; https://www.euramet.org/european-metrology-networks/
20	JK	Invite FJM to the next KCWG	Done.
21	SJ	Draft a letter of condolence from CCRI to ANSTO on the loss of Mark Rheinhardt	Apologies-missed.
22	All	Send updated membership information to SJ	Done.
23	SJ	SJ update CCRI sections text on membership	See new website. SJ noted the new CCRI newsletter for advertising webinars or other news. Contact: SJ or RC or CM if you are interested in posting in this newsletter.

Defining primary standards in radionuclide metrology and the need for comparisons among ionization chambers (“radionuclide” or “dose” calibrators) were discussed, with specific impact regarding action item #16. Regarding action item #17 (on a catalog of needed reference materials), the importance of the IAEA’s ALMERA network (Iolanda Osvath and Alexander Muring) and its proficiency test materials was recognized and a potential source of additional information, along with the ICRM LLRMT working group (Begoña Quintana). The potential interest of having a point of contact increase involvement of the UN (action item #18) was briefly addressed. The CCRI pages on the new BIPM website are up and available; for any issues, email WebMaster@bipm.org.

4. Reports from NMIs & the BIPM

See reports and presentations from the working documents on the BIPM website.

<https://www.bipm.org/en/committees/cc/ccri/wg/ccri-ii-/2021-06-01>

Brief presentations made by the following labs: ENEA-INMRI, NMISA, BARC, NRC, PTB

5. Impact of the pandemic (access to laboratory facilities / training etc.)

NIST(LK) – occupancy restrictions and lab moves were the main causes for delays due to the pandemic, but they have been catching up and should be back to normal in the 3rd quarter of 2021. Pre-book time to gain access. New staff have suffered in not being able to mingle with colleagues.

SMI(LS) – not a strong effect due to the pandemic but staff restricted to half time.

LNHB(CF) – Actually closed for 2 months. Only a slow progression of allowing more people into the laboratory. Back in the lab in mid-June. Encouraged to work remotely. Delay impacts have not been that bad.

NPL(JK) – Shutdown labs for a long period. Some support continued for isotope manufacturers. Took time to write software and catch up on delayed projects. IT support has been an issue. Back in 2-3 days a week. Book time 1-week in advance.

NRC(RG) – Personally missed the hallway or coffee time conversations with colleagues. This is hard to gauge what we lose in new ideas, help or research possibilities.

CIEMAT(MR) – closed for a few months. Personal losses in Spain were difficult. Activities are moving back to normal. Vaccinations are well underway, and things should be back to normal perhaps in August.

ANSTO(FvW) – Working from home and home schooling were really difficult at first. Missed the interaction with colleagues.

NIM(MZ) – Mainly effected 1st half of 2020. 2nd half of 2020 things improved. 2021 is back to normal. There are more virtual meetings than in the past, but work has returned to normal.

VNIIM(IA) – lockdown in 2020 for 2 months. All returned to lab except those above 60 years of age. Travel within Russia was restricted and income from calibration of radionuclide sources was hindered. Lost an important staff member to COVID-19. Virtual meetings have permitted more frequent and smaller meetings.

POLATOM(RB) – Stay at home an option. However, radiopharmaceutical production did not stop. These technical staff members continued their activities.

BARC(AR) – 5-6 months' work from home in 2020. Only 25 % staff remained for radiopharmaceutical production. Currently 2021 things are worse. Since April 2021 all to work from home. A lot of personal losses. Vaccinations are slow due to supply shortage. There were large problems in bringing things back up after a shutdown.

ICRM conference (AL) – postponed till 2023. Staff working normally in lab and things in Romania are good. Hotels and restaurants are open but can only organize smaller events (<100) at the moment. They encourage vaccinations as there will be less restrictions. The ICRM conference has had to be restarted but hotels and partners have been understanding. Changes in the local organizing material and new management at the Institute. Aim for the conference around April 2023 and Aurelian is optimistic.

Third session (3 June): CCRI strategy

1. Welcome back remarks (Section Chair)

JK taking notes due to RG's absence in the morning session.

LK showed the strategy document.

Yellow highlights indicate significant changes to previous versions

LK showed a summary/overview of the 2nd edition of the CCRI Strategy “Metrology to meet Scientific, Economic, Social Challenges”

New (or newly phrased) in this strategy:

- Improve global comparability
- Build capabilities at smaller NMIs/Dis
- Progress state of the art
- Expand the coverage of services by CMCs

2. Progress on implementation of the strategic plan

RG resumed his minute taking responsibilities. Apologized to the group for being late.

a. BIPM activities

ESIR status: RC (see presentation in the working documents for details)

- 4 labs have submitted results (^{60}Co) to the BIPM, although the LNMRI is still waiting for the source (issues with shipment).
- One significant outlier (lab #2).
- No significant impact when changing the scintillator cocktail (though changing scintillant from lab #1 to the others seems to have affected the efficiency).
- No significant bias when using different extendable dead times.
 - “self-compensation” overcomes most issues.
- The results from SIR and ESIR are in good agreement for $\frac{3}{4}$ labs.
- The problem encountered with lab #2 is probably related to issues in the building at the same time.
- The QC using toluene sources demonstrates the stability of the ESIR on the order of 1 year (13 months).
- To do: more pilot studies to cover
 - Extension ESIR to alpha emitters. Requires glove box.
 - How to address low energy beta, EC decay radionuclides (scintillant development)?
 - Develop transportable TDCR (micro-TDCR like LNHB)
- JK (NPL) urged BIPM to get facilities to handle open alpha emitters
- PTB (KK) issue with ^{60}Co . Had great agreement with multiple primary methods. Measurements of the samples to be submitted to the BIPM found a discrepancy between coincidence counting and the LS-based counting methods. Perhaps a beta-emitting impurity could be a problem. ANSTO potentially has observed a similar problem with a PTB-traceable source. PTB tried to dry the source and then put it in an LSC cocktail to potentially remove an ^3H impurity but this was not reproducible. Increasing the beta threshold above the ^3H increases the uncertainty due to the extrapolation but restores agreement, which supports the hypothesis that ^3H might be the impurity. The difficulty in confirming the impurity hypothesis is that the deviation is only 0.5 % but significant compared to the uncertainty of the multiple methods used in the standardization of ^{60}Co .

b. Activities at the NMIs

POLATOM: RB

- Main work: A lot of measurements for the production department. ICs, gamma-ray spec and LSC methods.
- Also participated in international comparisons ^{55}Fe -, ^3H , ^{222}Rn , and others.
- Validation measurements for their equipment e.g., Wallac LSC.
- ESIR pilot study.
- The lab worked all the time during the pandemic with 50 % staff.

LNE-LNHB: CF. The following is not a comprehensive list of work and projects in which the lab is involved.

- Source preparation for decommissioning
 - Surface emission source mixed emission type, variable roughness and shape to mimic real samples such as contaminated pipes.
 - Seeking to improve the adsorption/physorption for improved stability.
- Tools for Decay data
 - Maintain DDEP. All the DDEP evaluated data on the LNHB website. Two new staff to help in this task. Remember to cite *Monographie BIPM-5*, 2016.
 - Nucleide-Lara web application very useful to acquire decay data and other tools to filter and interrogate the decay data.
- Beta-spectra studies
 - Acquire experimental and theoretical metrological tools specific to beta transitions.
 - Beta sources are measured in a 4π geometry.
 - MMC detectors compared with other beta spectra.
 - Development of a new type of thick mylar source.
 - All contained in PhD thesis of A. Singh (2020), "Metrological study of the shape of beta spectra and experimental validation of theoretical models," CEA-R-6551, ISSN 0429-3460.
- Portable μ -TDCR
 - Reduced 1.7 m tall RCTD1 to μ TDCR that fits in a 25 cm case.
 - Used for ^{18}F , ^{11}C , ^{15}O and ^{222}Rn .
 - 2 portable devices created mini-, μ -TDCR and both had good agreement with previous devices.
 - To overcome need for on-site weighing systems: Use camera to quantify the volume in LSC vial. Uncertainty on volume sample is 1 %. Tested in a hospital on ^{18}F and ^{11}C . Good agreement on activity measurements between this system and classical TDCR.

BEV: RBM

- RBM is the new head of ionizing radiation group.
- Main thrust is legal metrology.
- IC traceable to NPL.
- Large area sources and other facilities to support PT testing and other customer requirements.
- Pandemic experience
 - Partial lockdown in March/April 2020. Restart in May 2020.

c. Other activities from stakeholders

3. Feedback on the revised CCRI strategy (2nd Edition) (NMIs, stakeholders and guests)
 - Progressing Metrology Science
 - Reducing need to distribute sources
 - Reducing need for sources to check stability

- Measuring and evaluating NDD as a component of comparisons
- Improving Stakeholder Involvement
 - Increasing involvement of smaller NMIs/DIs
 - Optimizing visiting scientist possibilities
 - Leveraging BIPM CBKT opportunities
- Promoting Global Comparability
 - Harmonizing and optimizing interlaboratory comparisons and their publication
 - Expanding the use of the Digital Framework in ionizing radiation metrology
 - Supporting and enhancing the work program of the BIPM laboratories

Open discussion: Only altered phrasing for CCRI slides on the strategy will be highlighted in green below.

ACTIONS IN SUPPORT OF THE STRATEGY SLIDE 1:

- LK: Need to distribute the capability to act as a backup in case staff or services become unavailable at the BIPM.
- CF: Rephrase: Coordinate use of the BIPM comparison and calibration services to OPTIMIZE (not reduce) the need for large-scale comparison exercises.
- CM, RG, LK, SJ: RMO-SIRTIs do not remove the need for the labs to perform their own measurements and develop their own capabilities. RMO-SIRTIs still need to be compared and linked to the BIPM SIRTI and SIR but having RMO-SIRTIs would be inclusive by extending the reach of the SIRTI to more laboratories.
- RF: include digital data in comparison reports as supplements.
- BZ: governments are also moving to open data that result from public funding.
- CM: Clarify raw data, maybe interpreted data or standardized data for this to be useful or could be misinterpreted. E.g., list-mode standard.
- SJ: when the BIPM strategy comes around this summer for review, we are encouraged to add and comment.
- LK: add statement to encourage the addition of supplementary data to the actions in support of the strategy.
- CF: Digitization has been underway in our field for years. Our field has been preparing for this digital transformation.
- SJ: Perhaps ionizing radiation needs to show case our experiences and work.
- LK, All: Define SI digital Framework as shifting from physical to digital, we can expand what we do beyond MC, digital phantoms etc., and share datasets for comparison or education.
- NEW PHRASE FOR ACTIONS IN SUPPORT OF THE STRATEGY: Expand the use of the Digital Framework in Ionizing Radiation Metrology such as making data sets used in the final analysis of comparison results available to facilitate data exchange.
- RC: Digitalization = exchange of data through API. Digitization = use of a digitizer with your measurement system.
- CF: We are hoping for simplified reports and now we are talking about complicating things by adding data? Having a database like the KCDB is the heart of what we are talking about.
- CM: In order to provide this data, it has to be automated so it will still not be available to those labs who do not have the time or capacity to implement automation.

- JK: This is about the more developed NMI/DIs helping the developing NMI/DIs.

SLIDE 2:

- To build capabilities.
 - Expand the use of teleconferencing technology to fully support face-to-face meetings to increase accessibility to the wider community.
 - Expand training and mentoring support for new comparison pilots and for CMC reviewers.
 - Maintain the database of major facilities and establish a process to enable access.

SLIDE 3:

- To progress the state of the art.
 - Establish a joint group with the CCQM on the use of mass spectrometry in radionuclide metrology.
 - Where appropriate, encourage the measurement and evaluation of nuclear decay data to be included in protocols for comparison exercises, to add value to the exercises.

SLIDE 4:

- To expand the coverage of services by CMCs.
 - Already doing everything on this slide.
 - SP happy with the direction of a method-based approach option for CMC declarations that CF worked on and presented to the RMO WG. LK will produce a guidance document in the near future.

LK closed the session by asking all the consider nominating someone from their institute to act as Vice-Chair for the CCRI(II) to permit the individual time to possibly transition to the Chair position upon the end of the current term (2023).

Fourth session (4 June): Working Group reports & CMCs

1. Welcome back remarks (Section Chair)

2. Report from Radiopharmaceutical Therapy and Quantitative Imaging Working Group
BZ – presentation available in the CCRI(II) meeting working documents.

- Radioactivity involved in the calibration scheme of radiation therapy.
- Treatment can last for a long period of time and not always at the same hospital or using the same scanner. Calibration will provide “ground” truth.

- This group brings together CCRI(I, II) and outside experts (medical physicists) involved in actual treatments.
- While CCRI(I) is involved, the dosimetry is quite mature at the moment and there is so much activity in the radioactivity side of things that the first ~5 years will concentrate on that aspect.
- Plans for calibrated phantom comparisons and develop best practice guides.
- Webinar (first in a planned series) held (June 2021) bringing together the clinical and metrology communities with 90 participants and 7 panelists.
- Best practice guides:
 - Uncertainties in activity measurement and QI for dosimetry.
 - Guidance to NMI/DIs not currently involved in nuclear medicine to assist in developing programs.
CF: at the last EURAMET TC-IR meeting they received inquiries from small dosimetry labs with no radionuclide metrology, so these guides would be of interest. BZ: IAEA has a large secondary dosimetry network have also received inquiries. Stakeholder laboratories (such as the SSDLs) that also have radionuclide metrology capabilities are few.
 - Fill gaps in existing best practice guides for improving measurements associated with RT and QI.
- Next Webinar September 2021. Bringing clinical and metrology communities together.
- CCRI(I) assistance is needed, in particular, for help in understanding/evaluating uncertainties in MC codes.
- RG: NRC is attempting to present a set of ion chamber models to be available to end users, perhaps this can be done with IC.
- JK: leverage work already done others (ex: ICRM-LS WG) with sharing dial factors for their radionuclide calibrators.
- SJ: BIPM looking at all historical medical radionuclides calibrations and see if they are fit for purpose. Classified SPECT, PET, therapy and *in-vitro* research. Are they fit for purpose $\pm 1\%$? Have something available in the next couple of weeks.

3. Report from CCEM-CCRI Task Group – low electrical current measurement

SJ: On behalf of Stephen Giblin: Chair of the CCEM-CCRI task group. 1st cross-CC group.

- Efforts of the group will initially focus on the development of a best practice guide. Section dedicated to ionization chambers of interest to this community.

4. Progress on discussions with CCQM – mass spectrometry for radionuclide metrology

MT: Gave an introduction to the mass counting and decay counting complementarity.

KK: Atom counting and decay counting are complimentary only if the half life is known. We need excellent radio-chemistry and need to be included even if they are not exactly in the metrology world.

RF: Impurities are something we still need to evaluate better. It would be great if the radioactivity physicists can routinely measure our samples to chemically evaluate the impurity profile.

- Initial Encounter: 17 March 2021
 - Radionuclide metrologists “meet and greet” Chemical metrologists
 - Related activities in CCQM
 - Mass & mole fraction and isotopic ratio focus
 - Use of MS in comparisons
 - Related radioactivity measurement activities at NMIs (NIST, NPL) using MS capabilities
 - Relevant measurement needs for both communities
 - May lead to a joint task group
- Next Steps
 - Socialization at this meeting
 - CCRI Webinar (“Potential of Mass Spec in Radionuclide Metrology”) in September?
 - Workshop?
 - Summary document on the major challenges in the mass-to-activity traceability chain and possible approaches to resolve?
 - Other ideas?
 - Zoltan Mester (NRC) and LK (NIST) to nurture this along

5. CMCs and KCDB2.0 status. Presentation by SPd

- KCDB2.0 launched October 2019.
- CBKT sessions available for RMOs, Writers, TC Chairs...
- Presently larger reviews carried out for CCQM and EM.
- RI 3849 CMCs.
- 860 new CMCs drafted, reviewed and approved on the new KCDB platform. 0 CMCs in RI.
- RI has not used uncertainty equations but is available and should be aligned with ILAC format.
- Comparisons are registered by pilots. Encouraged to supply data to be in line with OpenData concept. Can search KCDB using software.
- In the effort to make things even more machine readable, there is a need to harmonize certain fields. E.g., multiple ways to declare the same thing: multi nuclide vs. multiple nuclide, etc.
- JK: possible to take method approach.

6. Membership changes

- BEV and BARC both have been members
- RG: In favour of being inclusive and not exclusive and would prefer inviting any interested country to join our Section. CCHEN (Hernan Rodriguez) has established capabilities in

radionuclide metrology and should be encouraged to request to join CCRI(II). Colombia is developing radionuclide metrology and is close to designating an institute for such measurements. They are participating in SIM-MWG6.

- JK: CTBTO as invited guests. SJ: BIPM and CTBTO have an MOU so they can come to any event. CTBTO contact identified (Arvic Harms).
- BZ: CENTIS in Cuba should be encouraged to request to join.

7. Summary of actions

See [2021 Action items from CCRI.docx](#) in the meeting working group documents.

8. Any other business

RMO Supplementary comparison reports are not required to be reviewed by CCRI anymore. Sometimes, RMO reviewers are also participants or pilot of the comparison. In such cases, outside advice is welcomed. Moreover, KCWG(II) expert review is always considered as a precious step in the review process.

- Recommendation to CCRI(II) to continue to treat RMO supplementary comparisons in the same way as before to support and help. This will be recommended to CCRI so as to allow CCRI(I, III) to potentially do the same.
- Recommendation to look at the strategy to ensure that the SIR, ESIR, SIRTl are adequately captured.
- Recommendation: CCRI(II) should elect a vice-chair to serve as backup to the chair and to learn in order to possibly apply for the chairmanship in the future.

9. Date of next meeting

Q1/Q2 in 2023. Possibly try to arrange close to the ICRM2023 (perhaps end of April 2023). CCRI(II) can be held anywhere and need not be BIPM. May consider alternatives such as before/after the ICRM2023.