TC Chair Annual Report 2021 - 2022

TC for Ionising Radiation (IR)

TC Chair: Jacco de Pooter

Report to the EURAMET GA on TC-IR activities

Jacco de Pooter (VSL)

TC-IR Chair

1. General Aspects

This report summarizes the activities of the EURAMET Technical Committee for Ionising Radiation (IR) for the period of May 2021 to May 2022. TC-IR currently has contact persons from 29 EURAMET member countries. IAEA as liaison organizations is observer.

The TC-IR annual contact person meeting (2.5 days) was held online with more than 50 registered participants. Topics were CMCs and comparisons (workflow and strategic planning), the new service categories, new structures for CMCs and the KCDB2.0. New upcoming trends in the IR metrology fields, Health, Environment and industrial applications were collected and discussed regarding their future relevance and the resulted metrological questions. PRTs planned for submission for the EMP 2022 Calls were presented. The progress of three European Metrology Networks (EMNs) closely related to the TC-IR was presented and ideas were shared.

TC-IR will put a special focus on activities regarding the revised MRA, EMNs in the IR field as well as the metrological challenges of digitalization for IR.

2. Projects

There are five ongoing EURAMET-TC-IR projects. One project was completed (EUR-1475) in the period from May 2021 to May 2022. Two new projects were started (EUR-1531 and EUR-1541).

ID	Starting Date	Title	Coordinating institute	Collaboration type
1398	2017-01-01	Comparison of personal dose equivalent at 0.07 mm and 3 mm depth, Hp(0.07) and Hp(3), for beta radiation	PTB	Comparison
1435	2017-11-27	Measurement of Ho-166 specific activity under nuclear decay data	CMI	Comparison
1467	2019-02-01	EURAMET DOSEtrace supplementary comparison	VINS	Comparison
1531	2021-06-21	Bilateral comparison of the H*(10) calibration coefficients for photon radiation	IMBiH	Comparison
1541	2021-10-12	Key Comparisons of air kerma and absorbed dose to water standards in ^{60}Co radiation beam for radiation therapy	STUK	Comparison

Projects completed from May 2021 to May 2022

ID	Starting Date	Title	Coordinating institute	Collaboration type
1475	2019-04-08	Rn-222 intercomparison in the frame of MetroRADON	LNE-LNHB	Comparison

3. CMCs of TC-IR

TC-IR prepared the document *TC-IR Proposal for a revised scheme for the CMC categories for the IR fields Radioactivity, Dosimetry and Neutrons* that was first presented at the CCRI meetings at BIPM 2017. One outcome was a revision of the table 'classification of services for IR CMCs' which has significant consequences for the CMCs in the three IR metrology branches: Dosimetry, Radioactivity and Neutrons.

This issue was discussed at the CP annual meeting 2019 and amendments were prepared to improve the consistency in the classification in all three IR metrology branches. The TC-IR comments were discussed at the CCRI 2019 which led to final approval of the new service categories and, related to this, the new document "The interpretation of a CMC" which defines how to make the link between a CMC entry and a service. The first proposal to restructure CMCs following the new broad scope approach following from these developments was discussed at the RMO meeting in 2021 to identify non-technical issues which could prevent the submission. The first Euramet submission of CMC's according to this reduced scheme was done end of 2021.

Status of CMC review:

- Greyed out : ENEA: All (98) claims in dosimetry and radioactivity: reinstatement plan is in preparation
- Greyed out: JRC: All (63) claims in radioactivity: reinstatement plan is being executed

Overview of the ionising radiation CMCs

Country	Dosimetry	Radioactivity	Neutrons	Total
Austria	52	100	0	152
Belgium	2	0	0	2
Bulgaria	7	16	0	23
Croatia	2	0	0	2
Czech Republic	7	104	12	123
Denmark	7	0	0	7
Finland	30	0	0	30
France	82	206	3	291
Germany	93	153	20	266
Greece	35	0	0	35
Hungary	26	78	0	104
IAEA	26	0	0	26
Moldova	2	0	0	0

Netherlands	23	0	0	23
Norway	22	0	0	22
Poland	4	68	0	72
Portugal	42	0	0	42
Romania	0	37	0	37
Serbia	18	0	0	18
Slovakia	30	37	9	76
Slovenia	9	5	0	14
Spain	52	105	0	157
Sweden	23	0	0	23
Switzerland	3	21	0	24
Turkey	0	3	0	3
United Kingdom	22	116	42	180
Total (EURAMET TC-IR)	**619**	**1049**	**86**	**1752**

4. Activities of the TC-IR Working Groups

Working group *CMCs and Comparisons* (WG leader: Carole Fréchou, LNE-LNHB, France)

The TC-IR working group (WG) for CMCs and comparisons is split into three teams aligned with the three different branches of IR metrology; Radioactivity, Dosimetry and Neutrons, for the CMC reviews and for monitoring of comparisons. This working group has CMC reviewing as its main task. The work is under the supervision of the CIPM MRA. The technical procedures, set up by the documents CIPM MRA-G-13 and EURAMET Guide No. 3 *EURAMET Procedures and Review Criteria for CMCs*, should be followed. The WG-leader organizes the CMC reviewing, follows the results of comparison projects and coordinates the TC-IR activities in all aspects concerning CIPM MRA.

The membership of the review teams was updated at the last annual meeting; detailed information is given in the annex. Members of this working group are strongly involved in TC-IR activities and many discussions at different meetings regarding the proposed TC-IR approach as answer to the revised MRA. In 2020 and 2021 most of the reviewers attended one or multiple training sessions on the new KCDB 2.0 platform. In 2021, the WG has organized dedicated session for each Ir metrology branche to instruct writers of CMC in IR metrology using the KCDB 2.0 system.

Status CMC review using the new KCDB 2.0 system

NMI/DI	Country	Domain	Number of CMCs	State
IRSN	France	Neutron	3	Submitted
FTMC	Lithania	Radioactivity	17	Submitted

CIEMAT	Spain	Dosimetry	4	Submitted
LNE-LNHB	France	Neutron	1	Under review
BEV	Austria	Radioactivity	1	Revision requested
VSL	Netherlands	Dosimetry	1	Revision requested
PTB	Germany	Dosimetry	6	Revision requested
PTB	Germany	Neutron	2	Revision requested
IRA/METAS	Switzerland	Radioactivity	1	Turned down
LNE-LNHB	France	Radioactivity	1	New submission
CIEMAT	Spain	Dosimetry	4	Published
PTB	Germany	Neutron	5	Published

Working group *Ionising Radiation and Radionuclides in Health* (leader: Ulrike Ankerhold, PTB, Germany)

This working group focuses on important topics concerning the application and use of ionising radiation in the field of Health. The working group establishes connections with stakeholders, standardization bodies and research organizations and institutes to enhance the interdisciplinary work in metrology for Health, making sure to realize important topics in project proposals for EPM calls and other research programs.

The working group drafted two roadmaps for measurements in ionising radiation and radionuclide applications in health in 2012. At the TC-IR meeting in 2022 new topics related to metrology and the use of ionising radiation in health care were discussed. In particular, the topics of artificial intelligence in radiotherapy and medical imaging as well as new advanced radiotherapy modalities seem to have high potential for the future.

In the TC-IR 2022 meeting the WG organized a session on the metrology and nuclear medicine. The purpose of this workshop was to get an overview on the various ways traceability of nuclear medicine is organized throughout Europe. Examples from the UK, Switzerland and France demonstrate that there are considerable differences in approaches how traceability of nuclear medicine is organized, and that more harmonisation is needed.

In preparation of the EPM Health call in 2022 the working group organized a brainstorming session in October 2021 with considerable participation of stakeholders from the health care sector. The brainstorm session resulted in a short list of topics which has been summarized in orientation pages. These orientation pages were jointly prepared with the MIRA JNP. Based on the orientation pages several PRTs have been submitted for the Health call 2022.

Working group *Ionising Radiation and Radionuclides in Environment, Energy and Industry*
(leader: Stefan Neumaier, PTB, Germany/Arunas Gudelis, FTMC, Lithuania)

This working group (WG) aims at the metrological support of research and applications related to radioactivity and ionising radiation in the fields of Environment, Energy and Industry.

The roadmap of this WG presently covers the following four triggers (targets): Radioactivity in industrial processes (control of NORM materials), nuclear industry (decommissioning and waste management), homeland security (emergency preparedness) and climate change (monitoring of greenhouse gases). These targets are addressed by the activities of the WG, especially by participating in related EMPIR and EPM projects, e.g. 16ENV10 “MetroRADON”, 16ENV09 “MetroDecom II”, 16ENV04 “Preparedness”, and 19ENV01 “TraceRadon”. Metrology for the monitoring of radon and its progeny at low activity concentrations is a challenging issue for both, the EMPIR project “MetroRADON”, dealing with the radiation protection against risks arising from indoor natural radon and its progeny in Europe and “TraceRadon”, where the role of radon as a proxy (tracer) for the dispersion of greenhouse gases in the earth’s atmosphere is studied. The Green deal call 2021 resulted in three EPM projects related to IR metrology (BIOSPHERE, MetroSoilMoist and MetEnvPol).

Members of the WG are also strongly involved (as coordinator, Work Package leaders etc.) in some of the forthcoming EMPIR network projects. The successful project 19NET03 “supportBSS” is in progress and the network proposal SNT-w03 “Support for a European Metrology Network on pollution monitoring” was granted in the EMPIR call 2020.

Novel challenges for the WG are radioactivity and building materials in NORM and TNORM applications and related radiation protection tasks arising from EU directives. The roadmap of the WG will be regularly checked and appropriately updated, to include new trends (e.g., the metrology of radon, thoron and its progeny) in the fields Environment, Energy and Industry. Based on the work of EMPIR projects input to several standardisation bodies and working groups (ISO TC-147 Water quality, IEC TC-45 Nuclear instrumentation, CENELEC TC-45B Radiation protection instrumentation, ISO TC-85 Nuclear energy, nuclear technologies, and radiological protection) was delivered.

5. TC-IR participation in EPM and EMPIR research projects

I. EPM JRPs with start in 2022:

Green deal Call 2021:

BIOSPHERE Metrology for Earth Biosphere: Cosmic rays, ultraviolet radiation and fragility of ozone shield, Faton Krasniqi (PTB), 2021-2024

MetroSoilMoist Metrology for multi-scale monitoring of soil moisture, Miroslav Zboril (PTB), 2021-2024

MetEnvPol Metrology for the harmonisation of measurements of environmental pollutants in Europe, Dirk Arnold (PTB), 2021-2024

II. EMPIR JRPs with start in 2021:

Fundamental Call 2020:
PrimA-LTD Towards new primary activity standardisation methods based on low-temperature detectors, Philipp Ranitzsch (PTB), 2021-2024

III. EMPIR JRPs with start in 2020:

Normative Call 2019:
MRgRT-DOS Traceable dosimetry for small fields in MR-guided radiotherapy, Jacco de Pooter (VSL), 2020-2023
Environment Call 2019:
traceRADON Radon metrology for use in climate change observation and radiation protection at the environmental level, Annette Röttger (PTB), 2020-2023
RemoteAlpha Remote and real-time optical detection of alpha-emitting radionuclides in the environment, Faton Krasniqi (PTB), 2020-2023

IV. EMPIR JRPs with start in 2019:

Health Call 2018:
UHDpulse Metrology for advanced radiotherapy using particle beams with ultra-high pulse dose rates, Andreas Schüller (PTB), 2019-2022
Normative Call 2018:
PRISM-eBT Primary standards and traceable measurement methods for X-ray emitting electronic brachytherapy devices, Thorsten Schneider (PTB), 2019-2022

V. EMPIR JRPs with start in 2018:

Fundamental Call 2017:
MetroMMC Measurement of fundamental nuclear decay data using metallic magnetic calorimeters, Dirk Arnold (PTB), 2018-2021
Research Potential Call 2017:
DOSEtrace Research capabilities for radiation protection dosimeters, Amra Sabeta (IMBiH), 2018-2021

6. Capacity Building: Activities of the last year and future needs

Capacity Building (CB) (contact person capacity building: Denis Glavič-Cindro, MIRS/IJS, Slovenia)

TC-IR currently has 29 registered contact persons, 10 from NMIs and 19 from Dis or international organisation. 10 contact persons come from EU member states with an emerging metrological infrastructure in IR, 3 institutes do not have any CMC claims. The TC-IR activities for capacity building are coordinated by TC-IR contact person *Capacity Building* in close collaboration with the EURAMET officer for capacity building.

Capacity building needs and activities in the field of ionising radiation are covering researcher mobility grants (RMG), RPT projects and practical training courses in coordination of projects, in preparation of documentation for submitting CMCs in KCDB and in organization and coordination of comparisons.

Several webinars have been organized in a collaboration between EURAMET and the BIPM:

- CCRI Webinar on 'Metrology for brachytherapy' – 23 June 2021
- CCRI Webinar on 'ICRU report 95: new operational quantities for radiation protection' – 12 October 2021
- CCRI Webinar on 'Dosimetry of cosmic radiation: a challenge for metrology' – 17 November 2021

At the TC-IR 2022 meeting the development of the BIPM e-learning platform was presented. This platform offers great opportunities to share knowledge and to enhance CB activities.

Currently one RPT project in the field of ionising radiation is running: 17RPT01 DOSEtrace (2018 – 2021): "Research capabilities for radiation protection dosimeters" (coordinator: Amra Šabeta, IMBiH). Funded by RMGs two researchers have caried out a short research project at a hosting institute. One more has been granted in 2021. This project will take place in 2022. One mentoring scheme award (a new CB instrument) will take place in 2022.

7. Meetings

TC-IR Contact Person meeting in 2021:

The TC-IR Contact Person annual meeting was organized online, from 24-28 January. The advantage of the online meeting was that more people could attend than in physical TC-IR meetings (>65 instead of ~35). Topics were EURAMET IR projects (running and proposed comparisons), present status of TC-IR CMCs, news from the working group "Capacity Building", presentations of highlights from single institutes and the 2022 Calls. A special focus was laid on the brainstorming of upcoming trends in the IR fields and the discussion of the resulted future challenges for metrology. In addition, the development on and the use of the new KCDB2.0 within TC-IR was discussed and follow-up steps were defined. In a dedicated networking session, the two running JNPs and one recently granted JNP to establish European Metrology Networks (EMNs) closely related to the IR-field were presented and discussed. Furthermore, the TC-IR discussed the format of the annual meeting in a post-COVID-19 setting.

8. Issues

None

9. Strategic Planning

As in many other fields, also in IR, digitalization plays a big role and will cause fundamental changes with completely new challenges for metrology. One example is: the new trend in medicine to improve diagnosis and therapy is the combination of different techniques to create new multi-modal methodologies (examples are MR guided radiotherapy, PET/MR or PET/CT). To have the full benefit of those new units a proper handling of big data sets is required where the reliability, comparability and uncertainties of the data play a central role.

The techniques 'artificial intelligence' or 'machine learning' and 'deep learning' offer new possibilities in data analysis. These techniques affect the work of IR metrology in two ways. The first one is the application to IR metrology to further improve metrological capabilities. The second way is that IR metrology can contribute to the application and development of these advanced techniques for

example in their validation, uncertainty assessment and monitoring their reliability over time. evaluation and can make for assisting doctors and medical physicists in a completely new way. Examples are the determination of image quality for the optimization of applied doses in mammography, CT and other diagnosis using IR, deep learning in treatment planning and the field of computer-aided diagnosis (CAD). Several ideas on this have presented at the TC-IR meeting in the working group Health and in the session on ideas for future EMP calls.

The metrological questions in this new field 'digitalization' need completely new approaches than the conventional metrology provides. Interdisciplinary research work is indispensable to find answers. TC-IR will broaden its scope to this field, will initiate projects and will push this theme in the IR community.

10. Outlook for 2022/2023

1. Next TC-IR CP meeting:
    - Spring 2023 physical meeting.
    - days meeting with special focus on activities regarding CMC review capacity building, the development of EMNs in the IR field as well as to discuss project proposals for the EMP calls 2023.
2. CMC review is ongoing.
3. Comparisons: strategic planning of multiple partners comparison to avoid bilateral comparisons. The scopes of the comparisons to be able to underpin with one comparison a couple of CMCs shall be identified and shall be as broad as possible. The requests for new comparisons shall be discussed on a regular basis at the annual meetings. Comparisons as an activity in an EMPIR project shall be presented at the next possible opportunity, generally at the next annual meeting.
4. TC-IR will put a special focus on activities regarding the revised MRA, and the submission of CMCs according to the revised scheme
5. TC-IR will closely collaborate with recently established EMN Radiation Protection and the EMN's in preparation (on the medical use of ionising radiation, MIRA and pollution monitoring, POLMON), with the aim to promote the further development of the EMNs and to further identify their respective roles in the IR metrology field
6. TC-IR will develop knowledge sharing activities on digitalization for IR metrology.
7. Possible collaborations with other European projects / programs in the field of ionising radiation shall be identified and intensified.

ANNEX

Internal organization of the TC-IR

(status: May 2022)

1. **TC Chair:** Jacco de Pooter (VSL, The Netherlands), elected: 2019, for the term 05/2020 – 05/2022

2. **Management Board**

Members**:** Jacco de Pooter (VSL, The Netherlands), Carole Fréchou (LNE-LNHB, France), Ulrike Ankerhold (PTB, Germany), Arunas Gudelis (FTMC, Lithuania), Denis Glavič-Cindro (MIRS, Slovenia)

3. **Working group *CMCs and Comparisons***

Group leader: Carole Fréchou (LNE-LNHB, France), re-elected: 2021

Review team *Radioactivity*:

Team leader: Carole Fréchou (LNE-LNHB, France), nominated in 2018

Members: László Szücs (BKMH, Hungary), Marco Capogni (ENEA, Italy), John Keightley (NPL, UK), Dirk Arnold (PTB, Germany)

Review team *Dosimetry*:

Team leader: Linda Persson (SSM, Sweden), nominated in 2017

Members: Jean-Marc Bordy (LNE-LNHB, France), Jacco de Pooter (VSL, The Netherlands), Argiro Boziari (EXHM/GSCL-EIM, Greece), Massimo Pinto (ENEA, Italy), Reetta Nylund (STUK, Finland), Ulrike Ankerhold (PTB, Germany)

Review team *Neutron radiation*:

Team leader: Andreas Zimbal (PTB, Germany), nominated in 2017

Members: Neil Roberts (NPL, UK)

4. **Working group *Ionising Radiation and Radionuclides in Health***

Group leader: Ulrike Ankerhold (PTB, Germany), elected: 2021

Members: Jean-Marc Bordy (LNE-LNHB, France), Andrew Robinson (NPL, UK), Linda Persson (SSM, Sweden), Teemu Siiskonen (STUK, Finland), João Henrique Garcia Alves (IST/ITN, Portugal), Jacco de Pooter (VSL, The Netherlands), Jaroslav Solč (CMI, Czech Republic), Carole Frechou (LNE-LNHB, France), Andrew Fenwick (NPL, UK), Miguel Embid (CIEMAT, Spain)

5. Working group *Ionizing Radiation and Radionuclides in Environment, Energy and Industry*

Group leader: Arūnas Gudelis (FTMC, Lithuania), elected: 2022

Members: Franz-Josef Maringer (BEV, Austria), Carole Fréchou (LNE-LNHB, France), Jiří Šuráň (CMI, Czech Republic), Nuria Navarro, (CIEMAT, Spain), Petr Kovář (CMI, Czech Republic), Jan Rusnak (CMI, Czech Republic), Jiří Suráň (CMI, Czech Republic), Martina Rozmaric (EPA, Ireland), Arūnas Gudelis (FTMC, Lithuania) Mihail Razvan(IFIN, Romania), Denis Glavič Cindro (IJS, Slovenia), Siarhei Saroka (INM-MD, Moldova), Mikael Hult (JRC-GEEL, EC), Valentin Blideanu (LNE-LNHB, France), Valérie Lourenco (LNHB, France), Steven Bell (NPL, UK), Ben Russell (NPL, UK), Vladimir Skliarov (NSC-IM, Ukraine), Dirk Arnold (PTB, Germany), Faton Krasniqi (PTB, Germany), Annette Röttger (PTB, Germany), Miroslav Zboril (PTB, Germany), Andreas Zimbal (PTB, Germany), Matej Krivošík (SMU, Slovakia), Stanislav Sandtner (SMU, Slovakia), Jens Jensen (SSM, Sweden), Cathrin Tolinsson (SSM, Sweden), Teemu Siiskonen (STUK, Finland), Namık Kemal (ŞAHİN TENMAK-NÜKEN, Turkey), Miloš Živanović (VINS, Serbia)

6. Contact person for *Capacity Building*

Contact person: Denis Glavič-Cindro (MIRS, Slovenia), elected: 2017

7. Contact person for *COOMET TC 1.9*

Contact person: Efimia Luchian (INM-MD, Republic of Moldova), nominated: 2019