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From the Editor

In this issue of the SSDL Newsletter (No 78), you will read about the changes in the HDR brachytherapy traceability of IAEA standards. The Newsletter is dedicated to the reports of meetings crucial for supporting the international measurement system for ionizing radiation i.e. the BIPM Consultative Committee for Ionizing Radiation (CCRI) and its working groups, the reports of technical meetings within regional metrology organizations and the summary report of the SSDL Technical meeting and the joint workshop with the CCRI(I). Also included are the reports on the joint ICTP-IAEA training courses and other meetings involving the IAEA Dosimetry and Medical Radiation Physics (DMRP) Section.

For the first time, we are introducing a section where medical physicists can ask questions to radiation metrologists on any topic of choice. In this article, a letter is written by a diagnostic radiology medical physicist. Look forward to receiving a response from a radiation metrologist, which will be featured in the next newsletter.

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Services provided by the IAEA in DMRP Section

The IAEA's Dosimetry and Medical Radiation Physics Section focuses on services provided to Member States through the IAEA/WHO SSDL Network and on a system of dosimetry quality audits. The measurement standards of Member States are calibrated, free of charge, at the IAEA's Dosimetry Laboratory. The audits are performed through the IAEA/WHO postal dose audit service for SSDLs and radiotherapy centres by using radiophotoluminescence and optically stimulated luminescence dosimeters (RPLDs and OSLDs).

The Dosimetry Laboratory's Quality Management System has been reviewed and accepted by the Joint Committee of the Regional Metrology Organizations and the BIPM (JCRB). Some of the IAEA Calibration and Measurement Capabilities (CMCs) are published in Appendix C of the BIPM key comparison database (KCDB).

The IAEA CMCs can be found at the following web site: https://www.bipm.org/kcdb/

The range of services offered by the IAEA's DMRP Section are listed below.

Services	*Radiation quality*
**Calibration of ionization chambers (radiation therapy, brachytherapy*, radiation protection, and diagnostic radiology including mammography)	X rays and g rays from ^{137}Cs and ^{60}Co beams ^{137}Cs, ^{60}Co, @linac photon beams* and ^{192}Ir brachytherapy sources
**Comparison of ionization chamber calibrations coefficients (radiation therapy, radiation protection, and diagnostic radiology including mammography) for SSDLs	X rays and g rays from ^{137}Cs and ^{60}Co beams
Dosimetry audits (RPLD) for external radiation therapy beams for SSDLs and hospitals	g rays from ^{60}Co and high energy X ray beams
Dosimetry audits (OSLD) for radiation protection for SSDLs	g rays from ^{137}Cs
Reference irradiations and blind dose checks for dosimetry audit networks (radiotherapy)	^{60}Co and high energy X ray and electron beams
Reference irradiations to dosimeters for radiation protection	X rays and g rays from ^{137}Cs and ^{60}Co beams

* Calibration services are not included in the IAEA CMCs published in the BIPM KCDB.
** Technical procedures and protocols for calibrations and comparisons are available on our website https://ssdl.iaea.org/
@ Service available only for SSDL's that have activities in this area.

Member States interested in these services should contact the IAEA/WHO SSDL Network Secretariat, for further details, at the address provided below. Additional information is also available at the web site: *https://ssdl.iaea.org*

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Note to SSDLs using IAEA calibration and audit services:

1. To ensure continuous improvement in IAEA calibration and audit services, SSDLs are encouraged to submit suggestions for improvements to the Dosimetry Contact Point.

2. Complaints on IAEA services can be addressed to the Dosimetry Contact Point.

3. Feedback can be provided using the form on our website: https://ssdl.iaea.org/

https://iris.iaea.org/public/survey?cdoc=DOL00100

Changes in the Traceability Chain for HDR Brachytherapy Calibrations at the IAEA

The IAEA obtains its traceability, for High Dose Rate (HDR) Brachytherapy using Co-60 and Ir-192, from the Physikalisch-Technische Bundesanstalt (PTB), Germany. Recently the IAEA sent its chambers to the PTB for calibration. Due to an optimization of the calibration method at the PTB the Primary Standard has changed. Users that receive calibration for their standards from the IAEA may therefore notice a difference in the calibration coefficients issued earlier to those issued from September 2023 onwards for the same standard. More information on the improvement of the traceability chain can be obtained from PTB's website: Improved traceability chain for high dose rate (HDR) brachytherapy sources at PTB - PTB.de.

DOL Quality Management System Endorsed by Regional Metrology Organization

G. Azangwe

The IAEA's Dosimetry Laboratory (DOL) is the central laboratory of the IAEA/WHO Secondary Standards Dosimetry Laboratory Network (SSDL Network) and the Dosimetry Audit Network (DAN). To ensure that the performance of the DOL is consistent with the international standards, its quality management system (QMS) is reviewed every five years under the framework of the International Committee on Weights and Measures (CIPM) Mutual recognition Arrangement (CIPM MRA). This is implemented in such a way that one of the Regional Metrology Organisations (RMOs) reviews the DOL QMS. In June 2022, the DOL received a certificate of approval for compliance with the international standard for calibration and testing laboratories (ISO/IEC 17025) from the RMO for the Americas, the Sistema Inter-Americano de Metrología (SIM), which is valid until June 2027.

The five-year peer reviews by RMOs are in addition to regular internal audits of the DOL QMS. These are an integral part of our efforts to continually improve the services we offer to Member States. Previously, the DOL QMS was peer reviewed by the European Association of National Metrology Institutes (EURAMET) for two terms (ten years).

Our partnership with RMOs adds value to our service as we benefit from the information and experience-sharing with the global pool of expertise that is our peers. The DOL is pleased with the confidence given to our QMS by RMOs. With this approval from SIM for the next five years, our team can focus on reviewing old Calibration and Measurement Capabilities (CMC) and submitting new ones for calibration services for ionization chambers for HDR Brachytherapy and high-energy linac photon beams.

Andrée Dutreix (1928–2023)

Andrée Dutreix, the first ever clinical radiotherapy physicist in France, was one of the most prominent medical physicists of her generation. Throughout her long career, she had a major impact on the development of radiotherapy dosimetry and quality assurance since their early years, both in France and internationally.

At the beginning of her career in 1953 for the first betatron installed in France and subsequently for air kerma-based procedures, she contributed substantially to the development of high-energy photon and electron beam dosimetry, particularly with regard to the effective point of measurement of an ionization chamber. Aware of the necessity to harmonize the delivery of patient dosimetry, Andrée Dutreix got involved in the organization of inter-institution comparisons to independently check the local dosimetry of high-energy beams. After a comparison with the IAEA in 1966 using calorimetry, she organized a first multi-centre dose comparison with ferrous sulphate dosimeters in 1970. Since 1991, and under her supervision, TLD audits were offered to European cancer centres. In 1997, with her full support, the European Society for Therapeutic Radiology and Oncology (ESTRO) established its Quality Assurance Network (EQUAL), which operates to this day, albeit in a different format.

As a clinical physicist, Andrée Dutreix was also a renowned expert in brachytherapy dosimetry. In the late 1960s, she contributed to the development of a new method of brachytherapy dose calculations, which was the basis of the so-called 'Paris System'.

During these years, Madame Dutreix – as she was called out of respect – recognized the importance of a formal education for clinically qualified medical physicists. To this end, she co-authored one of the 'classic' textbooks (Bases physiques de la radiothérapie et de la radiobiologie, 1963) and helped developing medical physics education systems in France and in other countries. She also supervised numerous medical physics doctoral students and supported the career development of many young professionals. She served as a lecturer for numerous international training courses, mostly organized by the IAEA and ESTRO.

Andrée Dutreix, 2004. (Photo courtesy: J.-X. Hallet.)

For 44 years (1959–2003), Andrée Dutreix cooperated with the IAEA by advising on various aspects of dosimetry and dose audits. She participated in important expert meetings in 1959–1960 which provided recommendations on the future IAEA's activities in dosimetry and medical radiation physics for many years to come. In the later years of her support to the IAEA, Madame Dutreix helped develop methodologies for national dosimetry audit networks so that radiotherapy centres could benefit from the independent verification of local dose measurements.

The impact of Madame Dutreix's efforts in introducing physicists to the medical field cannot be understated. Her professional achievements led to a progress in early medical physics developments. As well, her dedication inspired countless medical physicists who had the privilege to meet her and collaborate with her. Her mentorship and genuine interest in supporting the development of young medical physicists have undoubtedly left an indelible mark on many. She was truly a celebrity within the medical physics community and will always be remembered as such.

Tribute by Joanna Izewska, Ahmed Meghzifene, Pedro Andreo

Commissioning of Ionization Chambers

Z. Msimang, M. Carrara, J. Cardoso, L. Czap

Ionization chambers are used as reference instruments for dosimetry in several applications, including to transfer traceability from the international measurement system (SI) to the end user. These chambers consist of a cavity filled with gas, in this case atmospheric air, surrounded by a wall of conductive material and a conductive electrode (1, 2). Their type, size and design are mostly based on radiation beam quality and the dose rate to be measured. They can be spherical, cylindrical, plane parallel and well type (3).

Most users buy commercially available chambers instead of building their own. Although there are some users who still build their ionization chambers for measurements where there are gaps and needs for specific type of chambers. When users build their chambers, they commission and test the newly built chamber to determine its characteristics and behaviour in the beam quality for which it is to be used. However, this is not necessarily the case for some users who buy commercially available chambers. These users tend to calibrate the chamber only for the points for which they need to use it and not for the entire range in which it is supposed to measure. Chamber to chamber variation of calibration coefficients has been observed at the IAEA Dosimetry Laboratory (DOL) with some chambers even showing a significant chamber response variation of about 12 % (see Figure.1).

There are several factors that can influence chamber response, such as its production materials which might have impurities, electrical connectors, or polarizing voltage. Commissioning an ionization chamber not only helps the user to know its characteristics and behaviour before the guarantee/warranty period expires but can also equip the user with the information to query any behaviour that is not in line with the chamber specifications. It provides the user with baseline data as part of maintenance of their standards that is included in the quality management system.

As chamber response may change with time, the data collected during commissioning will assist with investigating the causes of any changes, whether it is a fault with the chamber or from other factors during measurements. Figure 2 shows the change of the chamber response for several different calibration dates. In this case, the response should be investigated, and a conclusion should be obtained in order to decide on the detector's future use.

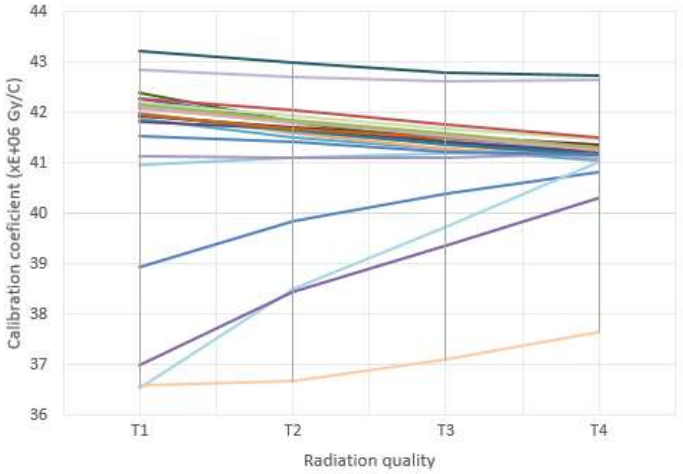

FIG. 1 Chamber to chamber response variation observed at DOL for a specific ionization chamber model

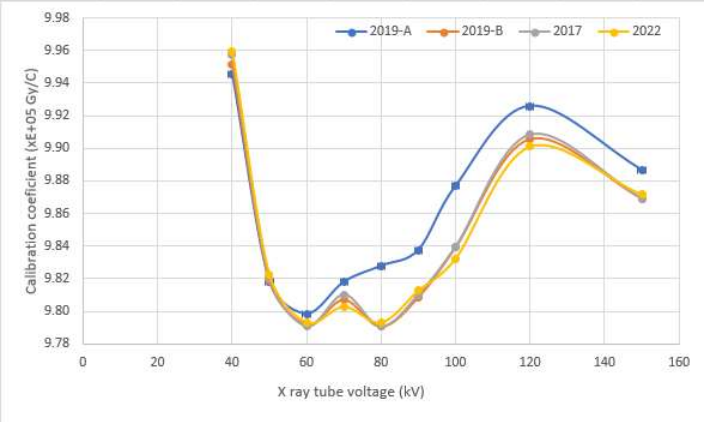

FIG. 2 Variation in the chamber response monitored from 2017 to 2022

The user may use the manufacturer specification to commission the chamber and determine the acceptable limits. Some of the procedures to follow when performing these tests and the acceptable limits can be found in the IAEA TRS 398, 457, 469, 483, 492 (4-8). All but one of the tests will need the ionization chamber to be connected to an electrometer and will be referred to as measurement system henceforth. Care should be taken to ensure that the electrometer and the cable used for commissioning function well. The list below is not exhaustive but rather highlights some of the tests that must be performed.

Mechanical integrity: This test starts with a visual inspection of the ionization chamber, connectors, and electrometer. A radiograph of the chamber, including its stem, may be taken to see the internal chamber wall and the alignment of the electrode. If there are any lose connections, this will also be visible on the radiograph.

Leakage current: Pre and post irradiation leakage are to be checked. Pre irradiation leakage measurements are performed before a chamber is put in any radiation field. Post irradiation leakage measurements are performed after irradiating a chamber for a period. For both tests, readings are taken in the absence of a radiation beam.

Stabilization time: This is the time it takes for the ionization chamber and the electrometer (as a unit) to settle after switching on the beam or changing the beam quality. The user needs to know how long this will take and how it affects the measurement uncertainty. Figure 3 shows data of the stabilisation time for a chamber and electrometer measured at the IAEA dosimetry laboratory (6). The change in the polarising voltage may also affect the stability of the measurement system. This needs to be checked.

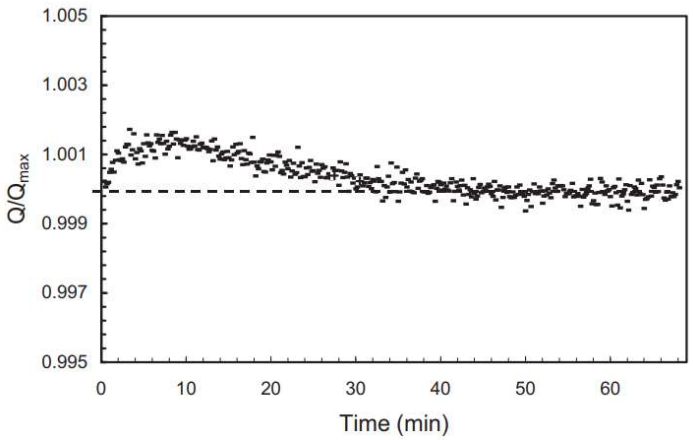

FIG. 3 Stabilization time for a Keithley 6517 electrometer with a PTW 23333 ionization chamber. In this example, acceptable stability is achieved after about 30 min (Extracted from Ref. 6)

Voltage and polarity: The voltage applied to a chamber has to comply with the recommendations of the manufacturer or as stated in a calibration certificate. If the chamber is always going to be used with the same polarizing voltage and voltage gradient, then a correction is not needed. However, care must be taken if the chamber will be used with different electrometers, since the electrometers may apply voltage to different parts of the detector (e.g. chamber wall or central electrode).

Ion recombination: Since chamber response may be affected by the variation in the dose rate and polarising voltage, there is a need to determine the ion recombination factor.

Energy dependence: The chamber response over the energy range of use should be determined for the entire range in which it is to be used.

Stability of the chamber: A check source may be used to determine chamber stability in the short and long term. An irradiator with a source (e.g. Cs-137) or other methods may be used (8). The positioning of the chamber must be consistent during these measurements.

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Report on the SSDL Technical meeting and the workshop with the CCRI(I)

A meeting of metrology minds (29 May to 2 June 2023)

Z. Msimang, M. McEwen

Over the last 50 years, two laboratory networks have established – both with similar goals of co-ordinating and improving ionizing radiation metrology. These are a) the CCRI Section I: X and gamma rays, charged particles (CCRI(I)) and b) the IAEA/WHO SSDL Network. While these two are not independent, share members and have even been linked to each other through the activities of the IAEA's DMRP Section, they have rarely interacted directly. This changed in June 2023, when a joint technical meeting of the CCRI(I) and the SSDL Network was held at IAEA Headquarters in Vienna. Nearly 125 participants from 67 Member States attended and Accredited Dosimetry Calibration Laboratories (ADCLs) from North America were also able to participate.

This joint meeting was a result of the discussions in 2021 on bringing together diverse perspectives on standards, traceability, equivalence, and calibration. Held from 29 May to 2 June 2023, the joint workshop was book-ended by SSDL and CCRI(I) business meetings. "It was impossible to cover everything, but a combination of excellent presentations, animated coffee breaks and technical exhibits meant that many issues were discussed, and new relationships were forged," said Malcolm McEwen, CCRI(I) Chair. "It was amazing to have so many scientists in a room talking about ionizing radiation metrology!" he reflected, adding:"Feedback was very positive, and we hope to repeat this event in the future."

The meeting's first session, presented by the director of the International Bureau of Legal Metrology, focused on the quality infrastructure. The session introduced SSDLs to the concept of legal metrology and helped them understand both type testing and verification of instruments, as opposed to calibration. This addressed a critical need, as SSDLs are now receiving requests to support users on testing some instruments.

The second session focused on ISO 4037 and ISO 8769 standards which are used for the calibration of instruments for radiation protection purposes. The discussions on ISO 8769 brought clarity on what sources are needed for the testing of contamination monitors that help involved SSDLs establish this capability.

The third session focused on codes of practice related to dosimetry in radiation therapy with presentations on those expected to be published in 2023:

- IAEA TRS 398 Rev. 1, Absorbed Dose Determination in External Beam Radiotherapy, An International Code of Practice for Dosimetry Based on Standards of Absorbed Dose to Water (1);
- IAEA TRS 492 Dosimetry in Brachytherapy, An International Code of Practice for Secondary Standards Dosimetry Laboratories and Hospitals (2).

The fourth session covered dosimetry in diagnostic radiology and neutron measurements.

On the meeting's third day, the CCRI(I)/SSDL workshop enlightened participants of the roles of SSDLs, Primary Standards Dosimetry Laboratories (PSDLs), CCRI and the Bureau International des Poids et Mesures (BIPM). PSDLs and SSDLs shared their experiences, activities and engagements within their regional metrology organizations while designated institutes shared how they function within a regulatory body. These institutes also shared their journeys in becoming a designated institute. During the afternoon session, discussions explored how the gap between

PSDLs and SSDLs could be bridge. Discussions also covered training and the introduction of IAEA TCS 76 (3). Subsequent discussions explored the evidence needed by a dosimetry lab to publicise their calibration measurement services in BIPM's key comparison database; the challenges laboratories experience with procuring the required voltage divider for the X-ray beam qualities (ISO 4037); and its associated cost and calibration.

The fourth and fifth days featured parallel sessions that covered quality management systems, (including risk assessments and decision rule), laboratory tours, Half Value Layer Measurements, commissioning, and maintenance of reference standards. SSDLs raised their concerns regarding the accreditation processes, namely instances where the technical assessors sent by accreditation bodies to conduct assessments were not competent in the field. There was also a presentation on the IAEA Human Health Series 44, which provides guidance on establishing an SSDL (4).

The week-long technical meeting provided participants with a great opportunity to not just engage but also discuss possible solutions for the challenges SSDLs experience.

Recommendations

- Consider having this technical meeting again, with CCRI(I), CCRI(II) and CCRI(III) participating since SSDLs are now supporting users in nuclear medicine and users requiring neutron measurements;
- SSDLs that are not part of a national metrology infrastructure should work with their national metrology institutes to become designated, so that they can participate in their respective RMO's activities;
- SSDLs should consider the requirement of their customers on:
  - the capabilities they establish and associated measurement uncertainties;
  - the decision to opt for or against formal accreditation.

Participants of the SSDL Technical meeting and the CCRI(I) workshop ((Photograph: Alwin Paul John)

The CCRI and its associated sections meet every two years. The three sections deal respectively with dosimetry (Section I), radioactivity (Section II) and neutron (Section III) metrology. Summaries of the meeting minutes for 2023 are available on BIPM's website: https://www.bipm.org/en/ccri-blog.

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The Important Role Played by the CCRI RMO WG in Ionizing Radiation Metrology

S. Jozela

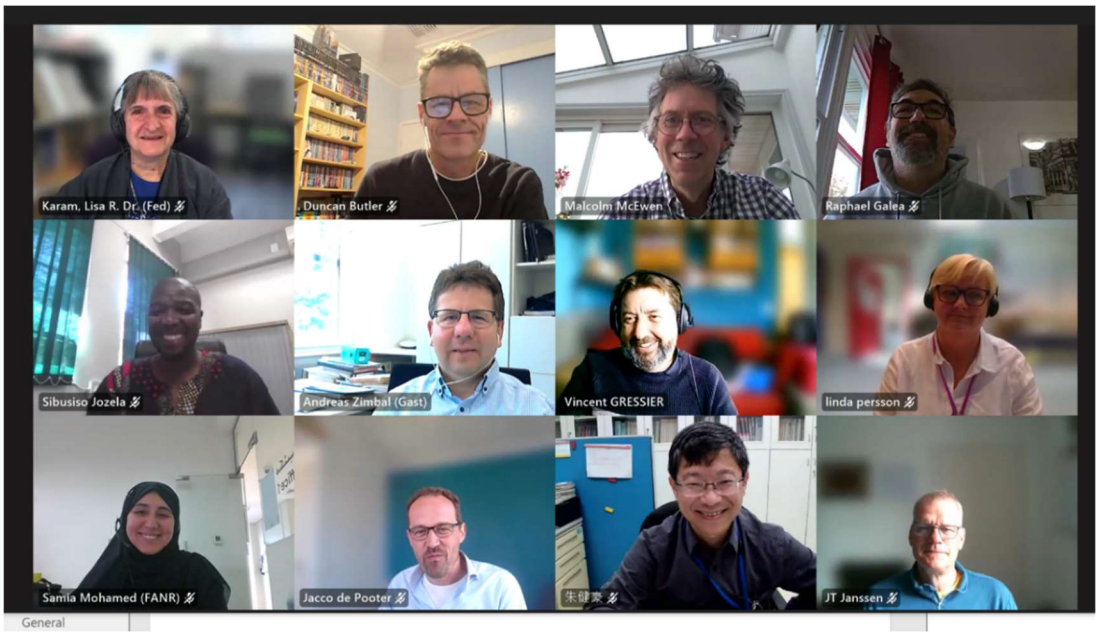
The CCRI's Regional Metrology Organization Working Group (RMO WG) on ionizing radiation calibration and measurement capabilities (CMCs) consists of TCRI chairs from all the RMOs CCRI Section chairs and the BIPM executive secretary. The WG serves as a platform to discuss and provide regular updates to the ionizing radiation metrology community in between CCRI meetings, which take place every two years. (Generally, the WG meets every year and often more frequently). One of the Group's key roles is to provide guidance to the RMOs, who also represent SSDLs, on carrying out CMC declarations, maintenance, and efficient reviews through developing, reviewing, and publishing guidance documents for the national metrology/ designated institutes (NMI/DI) community in ionizing radiation as part of the overall effort to support comparison programs and subsequent CMC claims.

During the WG's 2023 meeting, the CCRI President – Dr J.T. Janssen, who recently assumed the role – introduced himself and emphasised the Group's important role towards realizing CCRI's strategy to expand CMC-supported service coverage. On the IAEA's bilateral comparison report, the WG decided to accept the revised format as part of the supporting documents for CMC claims. This will benefit SSDLs and NMIs/DIs that are part of the IAEA/WHO SSDL Network and wish to publish CMCs. The WG also reviewed and published:

- Rules for Ionizing Radiation CMCs;
- An Interpretation of the CIPM MRA-G-11: Implications and Impacts for CCRI;
- CMC Review Checklist;
- CCRI Service categories.

These documents can be accessed at CCRI - BIPM under "Publications: Guidance documents on the CIPM MRA."

In 2023, RMO WG's leadership changed with Dr Chien-Hau Chu and Dr Duncan Butler, both from the Asia Pacific Metrology Programme (APMP), serving as Chair and Vice Chair respectively. APMP will chair the RMO WG over the next 4 years. The previous chair was Sibusiso Jozela from AFRIMETS (Intra-Africa Metrology System).



Participants of the CCRI RMO WG (Photograph: Malcolm McEwen)

GULFMET TCRI Meetings

S. Mohamed

Established in February 2021, the GULFMET Technical Committee of Ionizing Radiation (TCIR) is concerned with the metrology of ionizing radiation related to various applications e.g. radiation protection, medicine, industry and environment. The TCIR is responsible for carrying out the activities required by GULFMET as an RMO to fulfil the Mutual Recognition Arrangement (CIPM-MRA), namely:

- Intra-RMO review of the Calibration and Measurement Capabilities (CMCs) of GULFMET Members and Associates;
- Inter-RMO review of CMCs of Members and Associates of other RMOs;
- Review of proposed RMO Key and Supplementary Comparisons;
- Review of comparison reports submitted by other RMOs.

The Committee currently conducts its meetings twice a year and participates in other RMOs' activities and CCRI events. Consisting of five members (Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates) and five associate members (Bosnia and Herzegovina, Egypt, Iraq, South Korea and Turkey), the Committee is also open to observers such as Jordan, Uzbekistan and Yemen.

The GCC Standardization Organization (GSO) has provided a platform to its members and their associates to exchange knowledge and experience. Two TCIR members (FANR SSDL in the United Arab Emirates and KACST SSDL in Saudi Arabia) were designated for Ionizing Radiation by their respective metrology institutes. The Committee has three ongoing regional comparisons for Radiation Protection and Diagnostic Radiology, which are also registered in the BIPM KCDB.

To become qualified peer reviewers and technical assessors in line with CIPM MRA and ISO/IEC 17025, Committee members have undergone training with multiple online and physical training courses conducted with GULFMET's expertise. These courses can be found in the GSO platform as well as BIPM e-learning.

*TCIR members participated in the peer review training programme hosted by GULFMET (*Photograph: Eng. Abdulelah)

SIM TCRI Meetings

L. Laureano-Perez

Hosted by the St. Kitts and Nevis Bureau of Standards (SKNBS) and held in the NEMA (National Emergency Management Agency) building in St. Kitts, the SIM-MWG6 2023 meeting took place from 13 to 14 November 2023. It covered reports on comparisons, facilities, technical highlights, and updates in visitors and/or personnel from all of the members in attendance: NIST (USA), NRC (Canada), LMNRI/IRD (Brazil), ININ (Mexico) and the IAEA. In addition, there were scientific and technical talks on: gas counting in the Americas, the development of the SIM-SIRTI and the activities of the IAEA supporting SSDLs. Meeting minutes will be available on the SIM-MWG6 member website.

The SIM-MWG6 meeting also welcomed the IAEA which joins SIM for the next 8 years, following its term in EURAMET, for the purpose of CMC declaration and QMS review. The meeting notably represented the end of Raphael Galea's (NRC) term as Chair. Lizbeth Laureano-Perez (NIST) serves as the current Chair, with Raphael expected to serve as Vice-Chair and support Lizbeth for a term of 3 years ending in 2026.

A symposium for countries in the region that are interested in developing ionizing radiation standards was held on the 15th of November 2023. It covered:

- CCRI strategy;
- Establishing an SSDL;
- You don't know what you got, till you lose it, the story of reviving radionuclide metrology at NRC;
- Brazilian Laboratory for Ionizing Radiation metrology;
- The challenge of geography: metrology at high altitude;
- NIST: Changes and Challenges (challenges don't end when you are well established).

These talks were followed by a panel discussion led by Raphael Galea (NRC). Representatives from Trinidad and Tobago, the Bahamas, St. Vincent and the Grenadines and St. Lucia attended the symposium, which was also held as a hybrid meeting.

SIM-MWG6 Participants at the 2023 meeting hosted by the St. Kitts and Nevis Bureau of Standards (SKNBS), held in the NEMA (Photograph: Raphael Galea)

The IAEA Hosts the BIPM

The cooperation between the IAEA and the *Bureau International des Poids et Mesures* (BIPM) has a very long history that began as far back as 1961 through the exchange of letters between Sterling Cole, the IAEA's first Director General, and Charles Volet, the seventh Director of BIPM. This enduring collaboration was then expanded over a decade ago through a joint Memorandum of Understanding that was signed in 2012.

Since then, the organizations have continued to work together to advance metrology in ionizing radiation by working on joint activities aimed at:

- developing measurement standards and reference materials;
- preparing standardized procedures;
- supporting the delivery of reference products and services to countries around the globe;
- providing the world with nuclear data;
- linking ionizing radiation measurements in members states to the international measurement system;
- and raising awareness of metrology, its importance and necessity.

It was under this auspice that the BIPM met with the IAEA on 9 November 2023 to further broaden and deepen this collaboration across a wider range of fields and techniques. The persons representing the BIPM were the CIPM Member Prof Jan-Theodoor Janssen (T.J.B.M.) who is also the CCRI president and the Director of BIPM's Ionizing Radiation Department, Dr Vincent Gressier. The meeting consisted of a half-day discussion at IAEA Headquarters in Vienna and an afternoon visit to the IAEA's laboratories in Seibersdorf.

Participants of the BIPM- IAEA meeting held at IAEA (Photograph: Peter Lee)

Standardizing Dosimetry in Radiopharmaceutical Therapy: Insights and Challenges from the IAEA's CRP E2.30.05 Study

P. Knoll

In 2017, the International Atomic Energy Agency launched the Coordinated Research Project (CRP) E2.30.05 to standardize dosimetric procedures in radiopharmaceutical therapy (RPT) and train medical physicists. The project, focusing on precision and variability, used SPECT/CT images from a patient treated with ^{177}Lu -DOTATATE. Despite using consistent protocols and software (PLANETDose), initial results showed significant variability among operators. The study highlighted the importance of intensive training, quality assurance and error analysis to reduce human errors and increase the reliability of dosimetry in RPT. This approach emphasizes developing robust clinical dosimetry practices, underscoring the need for comprehensive training and cross-validation methods.

The results of CRP E2.30.05 were published (open access) in the *Journal of Nuclear Medicine* Quality Assurance Considerations in Radiopharmaceutical Therapy Dosimetry Using PLANETDose: An International Atomic Energy Agency Study | Journal of Nuclear Medicine (snmjournals.org).

Joint ICTP-IAEA Workshop on Artificial Intelligence in Ionizing Radiation for Medical Physicists

Trieste, Italy, 20–24 November 2023

There has been a rapidly growing interest in the use of Artificial Intelligence (AI) in healthcare in recent years, as it is commonly perceived that AI will transform healthcare processes in the near future. There are, however, diverse challenges associated with AI implementation and potential risks of unintended consequences of a diverse nature (clinical, technical, safety, ethical, privacy and regulatory). The safety, effectiveness, appropriateness, and efficiency of any AI-based tool must be ensured prior to its clinical use.

According to the recent IAEA Publication, Artificial Intelligence in Medical Physics: Roles, Responsibilities, Education and Training of Clinically Qualified Medical Physicists, TCS 83 (1), medical physics is considered to be a key profession involved in the selection and safe integration of AI tools into clinical practice. In considering the roles and responsibilities of medical physicists in the technical supervision of the equipment used in radiation medicine, it is imperative to contextualize and extend these responsibilities to the implementation, risk mitigation and quality assurance of AI-based tools in radiation medicine.

Following this new publication's recommendations on competences in AI, the Joint ICTP-IAEA Workshop on Artificial Intelligence in Ionizing Radiation for Medical Physicists held in Trieste, Italy, from 20 to 24 November 2023 (2) expanded the knowledge and skills of participating medical physicists for implementing AI-based tools. In doing so, it provided them with a contemporary overview of the field and the theoretical principles relevant to support radiotherapy and medical imaging departments on the deployment and use of AI-based tools. Some of the workshop's topics included: an overview of AI-based tools currently used in radiation medicine, the roles and responsibilities of clinically qualified medical physicists within AI-based clinical applications, advanced statistical methods, data management, machine learning, deep learning, regulatory and ethical considerations, the clinical implementation of AI tools and relevant challenges and pitfalls. These were also complemented by demonstrations and hands-on practical sessions in ICTP's Informatics Laboratories. Endorsed by the European Federation of Organisations for Medical Physics (EFOMP), the workshop was co-sponsored by the International Organization for Medical Physics (IOMP) and the American Association of Physicists (AAPM). It provided an excellent opportunity for its 58 participants from 50 Members States to learn from distinguished experts – Mr Ander Dekker of Maastricht University Medical Center and Maastro Clinic, The Netherlands; Ms Jackie Wu of Duke University Medical Center, USA; Mr John Damilakis of the University of Crete and University Hospital of Heraklion, Greece; and Ms Serafina di Gioia of ICTP, Italy – and interact with experts as well as their medical physics colleagues on topics relevant for the clinical implementation of AI-based tools in radiotherapy and medical imaging.

References

1. INTERNATIONAL ATOMIC ENERGY AGENCY, Artificial Intelligence in Medical Physics: Roles, Responsibilities, Education and Training of Clinically Qualified Medical Physicists, Training Course Series No. 83, IAEA, Vienna (2023).
2. https://indico.ictp.it/event/10229

Participants of the Joint ICTP-IAEA Workshop on Artificial Intelligence in Ionizing Radiation for Medical Physicists (Photograph: ICTP)

Joint ICTP-IAEA Training Course on Quality Assurance, Quality Control and Optimization of Equipment and Procedures Used in Fluoroscopically Guided Interventional Radiology | (SMR 3884)

Trieste, Italy, 9-13 Ocotber 2023

Medical imaging plays a pivotal role in accurate diagnosis and improved treatment of diseases. Specifically, fluoroscopically-guided interventional procedures are increasingly used as an alternative to conventional surgical procedures, while modern X ray angiography systems utilize numerous protocols for clinical management of many diseases. Unfortunately, the education and training of medical physicists on quality assurance, dosimetry and particularly on the optimization of procedures with the use of modern angiography systems are limited.

From the 9 to 13 October 2023, a Joint ICTP-IAEA Training Course entitled "Quality Assurance, Quality Control and Optimization of Equipment and Procedures Used in Fluoroscopically-Guided Interventional Radiology" was hosted in the Trieste, Italy, and focused on addressing these challenges.

The topics of the course included but were not limited to: 1) Quality assurance and dosimetry, 2) Performance testing and its added value in the clinical everyday practice, 3) Various software tools for dosimetry, patient data collection and data analysis, 4) Image quality evaluation, 5) Optimization of clinical procedures and 6) Artificial Intelligence applications. The training course was notably live streamed. For the 48 participants attending in person and 867 registered online, the interactive course featured lectures and practical sessions on optimization in interventional cardiology and vascular procedures. The course also provided participants with hands-on experiences through hospital practicals, infoLab analyses of QC/dosimetry measurements as well as an exercise on the use of artificial intelligence algorithms. Towards the end of the course, interested participants also had the opportunity to present their work.

The course was endorsed and supported by the International Organization for Medical Physics (IOMP), the European Federation of Organizations for Medical Physics (EFOMP) and the American Association of Physicists (AAPM). Speakers included: Dr Paddy Gilligan, who was supported by EFOMP; Prof. Chai Hong Yeong, who was supported by IOMP; Prof B.A. Schueler, who was supported by AAPM; Dr Annalisa Trianni, EFOMP Working Group Angiography QC Chair; Dr Francoise Malchair; Dr Carlo Maccia; Dr David Caldwell; and Dr Manuel Belgrano. Nine in-person participants delivered presentations. Mrs Al Maymani Naema Ali Mohammed of the Sultan Qaboos Comprehensive Cancer Care and Research Centre in Oman received the best presentation award for her work. The participants were very active and engaged throughout the course.

Participants of the Joint ICTP-IAEA Workshop on Quality Assurance, Quality Control and Optimization of Equipment and Procedures Used in Fluoroscopically-Guided Interventional Radiology (Photograph: ICTP)

Letter to a radiation metrologist

From the Desk of a Clinical Medical Physicist: Seeking SSDL's Dosimetry Expertise in Radiology

As a radiology clinical medical physicist, I am deeply involved in the realm of all radiology imaging services in our hospital, whether these are in the radiology department, the catheterization laboratory, the surgery theater or the emergency unit and I constantly strive to ensure the highest standards of dosimetry for the well-being of our patients. While the IAEA Dosimetry Code of Practice 457 provides valuable guidelines and insights, I think that practical collaboration with the SSDL would be indispensable in truly realizing this objective.

To that end, I am reaching out with some questions from my side looking for your feedback on certain challenges I have and hope for your expertise and support.

- **Calibration Services**: Maintaining the precision and accuracy of our dosimetry equipment is foundational to our commitment to patient safety and care quality. While we endeavour to uphold the highest standards, the absence of a dedicated SSDL calibration facility in our vicinity presents a significant challenge. We keenly feel this gap, as it hinders our ability to regularly ascertain and validate the precision of our dosimetry instruments. Collaborating with the SSDL for calibration services would not only address this challenge but also reinforce our confidence in the data we rely on daily. My hospital as well as other hospitals have tens or hundreds of radiology equipment, so the challenge of multiple radiology modalities and a limited number of SSDLs available for consultation and calibration services needs to be addressed through some strategies. Do you have any suggestions on this?
- **Dosimetry Audits**: Continuous improvement remains central to the mission in providing exceptional patient care. Periodic audits by an SSDL can significantly elevate our practices. While we are keenly aware of the geographical challenge, owing to the absence of an SSDL facility nearby, we believe in seeking a solution. With this in mind, would the SSDL consider a collaboration that allows for remote audits or perhaps periodic visits, ensuring we align our practices with global standards?
- **Consultation**: The evolving landscape of radiology continually presents us with opportunities to integrate new technologies and methodologies. Navigating these changes while ensuring adherence to international standards can be daunting. Given the lack of an SSDL facility in close proximity, the expertise of SSDL specialists becomes even more crucial for us. What are your thoughts on this?

In closing, I am confident that a collaboration between our institution and the SSDL can lead to meaningful advancements in radiological dosimetry. Despite the challenges, our collective commitment to ensuring patient safety and adhering to the highest standards offers a solid foundation for a fruitful partnership. I am hopeful that together we can chart a path that serves both our immediate needs and sets the tone for future collaborations. Let's pave the way for a safer and more accurate medical radiology service future.

I am looking forward to receiving your response in the next SSDL Newsletter.

A Farewell to Our Marie Curie Interns

In 2022/2023 the Dosimetry and Medical Radiation Physics Section hosted interns, within the scope of the IAEA's Marie Sklodowska-Curie Fellowship Programme. They share their journey below.

Elene Lortkipanidze (Georgia): Pursuing an internship at the IAEA gave me a unique experience as a young professional after completing a master's degree in medical physics at Georgian Technical University.

In addition to my core responsibilities as an intern, I was given the opportunity to participate in the workshops and conferences relevant to medical physics, organized by the DMRP Section. It has been valuable experience in terms of gaining knowledge and networking. In conclusion, being able to work with the leading experts of the medical physics field has been transformative for my career and further development. The IAEA and especially DMRP provide a friendly and supportive work environment, which makes the whole experience very special.

Andrea Nathalia Vargas-Castillo (Colombia): Before I came to the IAEA, I was sure that this opportunity would be very important for me and the women of my region since it would be a further motivation to keep breaking stereotypes and prejudices because there are women who have achieved the goal to contribute in science – those women who inspire others, like Marie Curie, that everything is possible if we work for it.

I was studying in Colombia developing a lead-free shielding material to be used by patients undergoing diagnostic radiology examinations as part of my master's degree in medical physics. Looking back and thinking how far I have come; I can only feel happiness.

I was so scared to face this challenge of going to a new country far from my family, new language, different environment, and more uncertainties that came to my mind. But, once I landed in Vienna, good things started to happen. I met friends and people who became my family and provided me with the support I required. If I did not know how to do a task, I always found a clear explanation with patience and a big smile.

Working with the IAEA taught me not only about metrology and dosimetry but also how to work in an international setting and the value of collaboration. I am grateful for this opportunity.

Josephine Nkhula (Malawi): Following the completion of my Master's Degree in Nuclear Science and Technology at the University of Manchester, I had the privilege to undertake an internship within the DMRP Section.

During my internship, I contributed to the management of data for the IAEA's Directory of Radiotherapy Centres (DIRAC). My primary responsibilities revolved around the meticulous updating and validation of global radiotherapy resources data. This effort contributed to the overall completeness and accuracy of DIRAC, while concurrently honing my data management skills.

In addition, I served as a DIRAC Contact Point which enhanced my communication skills and the ability to collaborate effectively with professionals from diverse backgrounds. Finally, participating in the Section's webinars and workshops enriched my medical physics knowledge and facilitated meaningful networking with experts in the field.

Interns of the NAHU-DMRP Section in 2022/2023 (Photograph: Alwin Paul John)

IAEA Publications in the Field of Dosimetry and Medical Physics (2022–2023)

IAEA Technical Report Series

Absorbed Dose Determination in External Beam Radiotherapy (IAEA Technical Reports Series No. 398 (Rev. 1)), expected publication in December 2023 or January 2024

Dosimetry in Brachytherapy - An international code of practice for Secondary Standards Dosimetry Laboratories and Hospitals (IAEA Technical Reports Series No. 492), expected publication in December 2023 or January 2024

IAEA Human Health Series

Establishing a Secondary Standards Dosimetry Laboratory, (IAEA Human Health Series No. 44), March 2023

Worldwide Implementation of Digital Mammography Imaging (Human Health Series No. 46), October 2023

Handbook of Basic Quality Control Tests for Diagnostic Radiology, (IAEA Human Health Series No. 47), February 2023

IAEA Human Health Reports

Selecting Megavoltage Treatment Technologies in External Beam Radiotherapy (IAEA Human Health Reports No. 17), January 2022

National Networks for Radiotherapy Dosimetry Audits IAEA (Human Health Reports No. 18), July 2023

IAEA Training Course Series

Audit Methodology for Medical Physics Clinical Training Programmes (Training Course Series No. 74), July 2022

Education of Radiation Metrologists for Secondary Standards Dosimetry Laboratories (Training Course Series No. 76), February 2023

Guidelines on Professional Ethics for Medical Physicists, (Training Course Series No. 78), June 2023

Artificial Intelligence in Medical Physics: Roles, Responsibilities, Education and Training of Clinically Qualified Medical Physicists (Training Course Series No. 83), November 2023

Non-serial and other publications

Comprehensive Audits of Radiotherapy Practices: A Tool for Quality Improvement, September 2022

Sustainable management of radiotherapy facilities and equipment, WHO and IAEA, October 2023

SSDL Newsletters

SSDL Newsletter Issue No. 75, August 2022
SSDL Newsletter Issue No. 76, December 2022
SSDL Newsletter Issue No. 77, May 2023

Courses, Meetings and Consultancies in 2023/2024

TC Courses and Workshops related to DMRP activities

- RER6040: Virtual Event - Inholland Academy's VMAT Treatment Planning, Haarlem, Netherlands, 1 September 2023 – 2 February 2024
- RER6036: Virtual Event – Regional Training Course on Physics for Conformal Radiotherapy: Advanced Technologies, Moscow, Russian Federation, 4 – 15 December 2023
- RER6042: Regional Training Course on Basic Quality Control in Diagnostic Radiology (in Russian), Tashkent, Uzbekistan, 22 – 26 January 2024 (postponed from 2023)
- RAS6101: Regional Training Course on Medical Physics Academic Programmes, Beijing, People's Republic of China, 11 – 15 March 2024
- RAS6112: Regional Training Course on Diagnostic Radiology Calibration, dates and venue to be confirmed
- RLA 9093: Regional Training Course on Calibration with X ray Beams (in Spanish), dates and venue to be confirmed

Training courses and ESTRO Courses

- ESTRO Course on Multidisciplinary Management of Brain Tumours, Brussels, Belgium, 3 – 5 December 2023
- Joint ICTP–IAEA Workshop on Quantitative Imaging and Analysis Methods in Modern Nuclear Medicine, Trieste, Italy, 29 April – 3 May 2024

DMRP Meetings and Consultancies

- Consultancy Meeting on Developing Guidelines on Clinical Implementation of Medical Imaging-based Artificial Intelligence Tools – Guidelines for Medical Physicists, Vienna, Austria, 4 – 8 December 2023
- Consultancy Meeting on Calibration of Contamination Monitors by SSDL's, Vienna, Austria, 5 – 8 December 2023
- Consultancy Meeting for a Draft Framework for IAEA Human Health Report on Staffing and Training Requirements for Proton Facilities, Vienna, Austria, 16 – 18 January 2024
- Consultancy Meeting on New Audit Tool for Advanced Radiotherapy Techniques, Vienna, Austria, 5 – 9 February 2024
- 21st Biennial Meeting of the Scientific Committee of the IAEA/WHO Network of Secondary Standards Dosimetry Laboratories for the Evaluation of and Recommendations on the IAEA's Dosimetry Programme and the IAEA/WHO SSDL Network, Vienna, Austria, 11 –15 March 2024
- Consultancy Meeting on Establishing a Framework for Global Database in Radiation Medicine for Cancer Patients, 2 – 5 April 2024, Vienna, Austria
- Consultancy Meeting on "Medical Imaging Repositories", Vienna, Austria, 27 – 31 May 2024
- Consultancy Meeting on Update of Human Health Series 19 on "Quality Assurance Programme for Computed Tomography: Diagnostic and Therapy Applications", Vienna, Austria, 10 – 14 June 2024
- Second Biennial Meeting of Dosimetry Audit Networks, Vienna, Austria, 12 – 16 August 2024
- First Research Coordination Meeting on Doctoral CRP in Advanced Dosimetry and Radiation Metrology, Vienna, Austria, 14 – 18 October 2024
- Third Research Coordination Meeting on Development of Methodology for Dosimetry Audits in Brachytherapy, Vienna, Austria, 25 – 29 November 2024
- Third Research Coordination Meeting on Advanced Tools for Quality and Dosimetry of Digital Imaging in Radiology, Vienna, Austria, 2 – 6 December 2024

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Bureau International des Poids et Mesures (BIPM)

International Commission on Radiation Units and Measurements (ICRU)

International Electrotechnical Commission (IEC)

Organisation Internationale de Métrologie Légale (OIML)

International Organization of Medical Physics (IOMP)

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