The role of the CIPM Consultative Committee on Ionising Radiation (CCRI)

Malcolm McEwen, Chair, CCRI(I)
Overview

1. Where did it come from?
2. What does it do?
3. Where is it going?
The Metre Convention: May 20, 1875

- International Treaty that creates the Bureau International des Poids et Mesures (BIPM) and launches the idea of a unified system of units for measurement across the globe

- As of November 30, 2018, there are 60 Member States and 42 Associate States and Economies
Consultative Committees (the CCs)

➢ Aim “to contribute to the establishment of a globally recognized system of national measurement standards, methods and facilities”

➢ Each Consultative Committee provides a forum where metrology issues can be discussed

➢ Probably the only meeting you will attend where metrology is primary focus!

➢ Not just for the 7 base units!

1927 – CCEM
1937 – CCT
1952 – CCL
1956 – CCTF
1958 – CCEMRI
1964 – CCU
1980 – CCM
1993 – CCQM

Only 5 years after the first clinical linac!
The role of the Consultative Committees

Over the years, the CIPM has set up a number of Consultative Committees, which bring together the world's experts in their specified fields as advisors on scientific and technical matters. Among the tasks of these Consultative Committees are the detailed consideration of advances in physics that directly influence metrology, the preparation of Recommendations for discussion at the CIPM, the identification, planning and execution of key comparisons of national measurement standards, and the provision of advice to the CIPM on the scientific work in the laboratories of the BIPM.

The CCs have the responsibility:

- to advise the CIPM on all scientific matters that influence metrology, including any BIPM scientific programme activities in the field covered by the CC;
- to establish global compatibility of measurements through promoting traceability to the SI, and where traceability to the SI is not yet feasible, to other internationally agreed references (for example, hardness scales and reference standards established by the WHO);
- to contribute to the establishment of a globally recognized system of national measurement standards, methods and facilities;
- to contribute to the implementation and maintenance of the CIPM MRA;
- to review and advise the CIPM on the uncertainties of the BIPM's calibration and measurements services as published on the BIPM website;
- to act as a forum for the exchange of information about the activities of the CC members and observers; and
- to create opportunities for collaboration.
CCRI

CCRI(I)  “Dosimetry”
Chair
Malcolm McEwen
NMIs involved
~ 25
Stakeholders
ICRU
IAEA
IOMP
IRPA
AAPM
ASTM

CCRI(II)  “Radioactivity”
Chair
Lisa Karam (NIST)
NMIs involved
~ 25
Stakeholders
ICRU
IAEA
IOMP
IRPA

CCRI(III)  “Neutrons”
Chair
Vincent Gressier (LNE)
NMIs involved
~ 15
Stakeholders
ICRU
IAEA
CCRI(III) – neutron metrology

1) Radiation protection
   ✓ power plants, radiation therapy clinics

2) Fundamental research
   ✓ material science with neutron scattering

3) Future: Fusion reactors, space dosimetry
1) Medical Isotopes (diagnostic/therapeutic)
   ✓ Provision of standards and services for the calibration of radionuclide calibrators in nuclear medicine departments and radioisotope producers.

2) Nuclear Security
   ✓ Provision of standards and services for nuclear forensic analysis development/testing. (ex: CTBTO)

3) Environmental Monitoring
   ✓ Provision of standards and services for low level activity monitoring of air/ground/water for human health.
1) Radiation therapy

1/2) Diagnostic radiology

2) Radiation protection

3) Radiation processing

3 very different measurement challenges!
CCRI(I) – co-ordination activities

CCRI(I) has a close relationship with ICRU (as you might expect)

Most recent example was ICRU90 – the report was commissioned at the request of CCRI to provide updates on key dosimetric data

The result?

The biggest change in dosimetry standards in two decades, with impact across many modalities (kV x-rays to heavy ions)

Implementation through CCRI(I), not ICRU
1) Recommend the adoption of the ICRU recommendations regarding $W_{\text{air}}$ as follows:

1.i No change in $W_{\text{air}}$ or $g_{\text{air}}$ for energies above 10 keV

1.ii An increase in the uncertainty for $W_{\text{air}}$ from 0.15% to 0.35%

1.iii Application of an energy-dependent $W_{\text{air}}$ value for electron energies below 10 keV.

2) Recommend the adoption of the ICRU recommendations regarding I-values and stopping powers as follows:

2.i The density of graphite to be used when evaluating the graphite density effect is $\rho_g = 2.265\ \text{g cm}^{-3}$.

2.ii A change in the I-value for graphite from 78 eV to 81 eV, standard uncertainty = 1.8 eV.

2.iii A change in the I-value for water from 75 eV to 78 eV, standard uncertainty = 2.0 eV.

2.iv No change in the I-value for air (85.7 eV), standard uncertainty = 1.2 eV. This value applies to all beam modalities discussed in ICRU Report 90.
3) Recommend, based on a review of the ICRU Report 90 discussions:

3.i Renormalized photoeffect cross-sections should be used.

4) Recommend the following changes be applied to NMI/DI primary standards:

4.i New corrections for $k_{ii}$ and $k_w$ to be included in air-kerma determinations using free-air chambers.

4.ii Revised value for $W_{air,s_{g,air}} = 33.72 \text{ eV}$ (relative standard uncertainty = 0.08%) to be used for $^{60}$Co air kerma and absorbed dose standards based on a cavity ionization chamber.

4.iii No change in the heat defect of graphite or water.
CCRI(I) – possible co-ordination activity

- CCRI is truly international, and, by definition, impartial
- Dealing with different/inconsistent protocols and recommendations
  Presently there are standards and procedures from a variety of organizations:
  National professional bodies (e.g., AAPM, IPEM, JSMP)
  National standards bodies (e.g. DIN)
  International organizations (e.g. IAEA)
  International standards bodies (e.g., ISO, IEC)

- CCRI(I) can provide independent guidance or support on what recommendations to adopt
But that needs stakeholder engagement

CCRI(I) aiming to increase input and/or involvement from stakeholders:

- ICRU (Technical Experts)
- IAEA (SSDL network, collaborator, standards development)
- AAPM (standards development, medical physics)
- ASTM (standards development, radiation processing)
- IRPA (radiation protection implementation)

This provides a user perspective independent of NMIs
CCRI(I) – developmental areas

1) Dosimetry for proton and ion beams
2) Molecular radiotherapy and quantitative imaging
3) Dosimetry for radiobiology
4) Low-energy beams for radiation processing (e.g. 150 keV)
5) Other modalities – electronic brachytherapy, synchrotron beams
6) Need for key data, impact of miniaturization of accelerators
CCRI(I) – identified challenges

1) Radiation facilities are expensive and replacement (due to rust-out, source decay) is not always supported.

2) Long-term access to radioactive sources is not guaranteed due to increasing security procedures.

3) Having control of facilities provides improved performance

*CCRI(I) can act both as a lobbying organization to provide support to NMIIs in regard to facilities, and look into sharing models to improve access*
Not many people outside of NMIs have heard of the CCRI!

Fewer understand its role!

It is a unique forum and resource

It is not a closed community
THANK YOU

Malcolm McEwen  malcolm.mcewen@nrc-cnrc.gc.ca