International Rules for Filling in the CMC Tables for Ionizing Radiation

Agreed at the RMO Working Group meeting 18/9/00 and updated on 26/09/03, 24/09/04 and 21/11/06. Reviewed on 29/11/07 and no further changes made.

This document should be read together with the BIPM instructions for drawing up CMC EXCEL files dated March 2001 contained within the JCRB Document "CMCs INSTRUCTIONS FEB 2002". Each submission of an EXCEL file should include a row, between the headings and the first CMC (row 3), to include the column letter A, B, etc., associated with each heading, to facilitate CMC review.

The field of ionizing radiation is divided into three groups corresponding to the three sections of the CCRI: Dosimetry, Radioactivity and Neutron measurements. In order to harmonize the Appendix C data format internationally, the rules for filling in the ionizing radiation CMC tables are as follows.

COLUMN A: Quantity

Dosimetry:

The following quantities are the agreed service categories (see also "classification of services"):

- Absorbed dose/rate specified separately to air, water, graphite, tissue or other material
- Air kerma/rate (Note: Exposure should not be used)
- Reference air kerma rate
- Ambient dose equivalent/rate
- Directional dose equivalent/rate
- Personal dose equivalent/rate penetrating (in 10 mm depth) and superficial (in 0.07 mm depth) specified separately
- Air Kerma Length product
- Air Kerma Area product
- X-ray tube voltage

Note: Dose and dose rate are independent entries in the CMC tables, as are air kerma and air kerma rate.

Radioactivity:

The word radioactivity should not be used. This column should use the agreed terms (see also "classification of services"):

- Activity
- Activity per unit mass
- Activity per unit area
- Activity per unit volume
- Surface emission rate
- Surface emission rate per unit area
- Emission rate per unit solid angle
- Emission rate
- Efficiency of γ-ray spectrometers (versus energy)
- Efficiency of ionization chambers
- Efficiency of contamination monitors

Neutron Measurements:

This column should use the agreed terms (see also "classification of services"):

- Emission rate
- Emission anisotropy
- Fluence (and rate)
- Ambient dose equivalent (and rate)
- Personal dose equivalent (and rate) at 10 mm depth
- Absorbed dose to water, graphite, tissue or other material (and rates)

Note: Dose and dose rate are independent entries in the CMC tables, with different service category classification.

COLUMN B: Instrument or Artifact

Column 2 should describe the instrument or artifact (source) which is calibrated:

Dosimetry:

- In the description the term "dosemeter" should be used e.g. for an area meter and “dosimeter” for a personal monitor

- The term “doseratemeter” is not used
- The NMI should specify the instrument or artifact as closely as possible e.g. ionization chamber, personal dosimeter, survey meter, chemical dosimeter.

Radioactivity:

The item to be measured could be

- a single or multiple nuclide, solid, gas or solution or extended area source, then the use of the source in some cases may be added in brackets (e.g. surface contamination or medical or gamma-ray detectors) or
- a reference material or
- an instrument e.g. spectrometer, ionization chamber etc.

Note: When the service provided is the certification of a reference material or of a multiple nuclide source, the lines (rows) between columns 4 and 14 are completed for each radionuclide in the material.

Neutron measurement:

The item to be measured could be

- (sealed) neutron source
- neutron sensitive device
- dosemeter (neutron survey meter) or
- neutron personal dosimeter

COLUMN C: Instrument type or method

Dosimetry:

A brief description of the calibration with reference to the transfer instrument (if applicable) and phantom material should be given in this column. Two examples are given:

1. Calibration against a transfer standard in a water phantom (for an instrument)
2. Irradiation in a calibrated field in air (for a personal dosimeter)

Radioactivity:

The method by which the service is performed should be given e.g. $4\pi\beta$-γ absolute

measurement, high pressure well type ionization chamber, HPGe spectrometer, liquid scintillation counter, 2π proportional counter.
Where the unit (column 6) is given in Bq g^{-1} then the instrument type should include "balance" or "set of standard weights" and the source of traceability for mass measurements should be included in column 14.

Neutron measurement:

A brief description of the calibration with reference to the transfer instrument (if applicable) and phantom material should be given in this column, e.g.:

- calibration in a manganese bath or
- calibration relative to (or with) a national standard source
- calibration relative to a calibrated monitor or a primary standard instrument.

COLUMN D: Measurand level or range: minimum value

Dosimetry, Radioactivity and Neutron Measurements:

Information should be entered in text format and not standard scientific format (e.g. 1.0E+02); only significant digits should be specified.

COLUMN E: Measurand level or range: maximum value

Dosimetry, Radioactivity and Neutron Measurements:

Information should be entered in text format and not standard scientific format (e.g. 1.0E+02); only significant digits should be specified.

Note: Columns 4 and 5 must both be filled in, even if the number in each is the same.

COLUMN F: Measurand level or range: Units

- SI units must be used and should be that of the quantity given in column 1.
- Superscripts should be used. Slashes, prefixes and decimal points should be avoided.

Dosimetry:

- In the fields of radiotherapy and industrial processing units may be expressed in Gy and Gy s^{-1}.
- In the field of radiation protection units may be expressed in Gy or Sv and mGy h^{-1} or Sv h^{-1}.
- Other examples:
  - Air kerma length product — mGy cm
  - Air kerma area product — mGy cm^2
  - Tube voltage — kV

Radioactivity:

- Activity — Bq
- Activity per unit mass — Bq g^{-1}
- Activity per unit area — Bq cm^{-2}
- Activity per unit volume — Bq cm^{-3}
- Surface emission rate — s^{-1}
- Surface emission rate per unit area — s^{-1} cm^{-2}
- Emission rate per unit solid angle — s^{-1} sr^{-1}

For efficiency measurements, calibration factor units such as s^{-1} Bq^{-1} or "indicated Bq Bq^{-1}" should be used.

Neutron Measurements:

- In the field of radiation protection, units may be expressed in mGy h^{-1} or in Sv h^{-1}.
- In the field of radiotherapy, units may be expressed in Gy s^{-1}.
- Other examples:
  - Fluence — cm^{-2}
  - Fluence rate — $cm^{-2}s^{-1}$
  - Emission rate — s^{-1}

COLUMN G: Parameter

The contents of columns G: Parameter and H: Specifications, separated by a colon, appear on the same line in Appendix C.
For example, Co-60: rectangular, planar sources.

Dosimetry:

The radiation type is specified as indicated in the "classification of services" level 3.

Radioactivity:

The radionuclide in question is specified. The format "Co-60" is to be used (see classification of services level 4); one line being used per radionuclide, even for multi-nuclide sources and for reference materials containing more than one radionuclide.
Note: Multi-radionuclide sources and reference materials will be grouped together in the database according to their NMI service identification (column 16).

Neutron measurement:

The neutron radiation type is specified, as indicated in the "classification of services" level 3.
Note: When specifying the fluence or the dose rate the distance from the (point) source may be added here, e.g. [at 1 m from the source]

COLUMN H: Specifications

Column H must not be left blank.

Dosimetry:

- The radiation quality may be specified in more detail, e.g. refer to a specific publication e.g. ISO-4037-1 or give values for beam quality specifiers.
- If no specification is necessary, the words "no further specifications" should be entered.

Radioactivity:

More details on the type of source may be given, e.g.

- in the case of ^{3}H, "Tritiated water"
- the chemical form
- in the case of a reference material, the matrix must be given (e.g. "bone ash")
- if no specification is necessary, the words "no further specifications" should be entered.

Neutron Measurements:

The neutron quality is specified in more detail, e.g.:

- Neutron spectrum according to standard ISO 8529-1 (e.g. for radionuclide sources, e.g. Cf-252, Am-241-Be-9, etc)
- Neutron producing reaction, neutron energy and occasionally, standard ISO 8529-1 in the case of accelerator based neutron sources
- Neutron dose equivalent quantities must be specified, e.g. with ref. to ICRP 21 or ICRP 74 for definition and conversion functions

COLUMN I: Expanded uncertainty: value

Dosimetry, Radioactivity and Neutron Measurements:

The uncertainty quoted should be the lowest that can realistically be achieved with the types of instruments or artifacts for which the service is intended. A range of uncertainties can only be given if the uncertainty varies linearly within the range given. E.g. for activity range 100 Bq to 1000 Bq the uncertainty range 10 % to 1 % is only valid if the uncertainty at 500 Bq is 6 % and inversely proportional to the activity range. Otherwise, the range must be split into bands for which the uncertainties are the same with the consequent additional lines for the radionuclide.

Note: The expanded uncertainty relating to a CMC for an NMI should not normally be smaller that the uncertainty given in the supporting comparison (column 15) unless the circumstances in the RMO warrant this.

COLUMN J: Expanded uncertainty: units

Dosimetry, Radioactivity and Neutron Measurements:

The uncertainties should be stated as relative uncertainties in %.

COLUMN K: Expanded uncertainty: coverage factor

Dosimetry, Radioactivity and Neutron Measurements:

The coverage factor must be stated. In the absence of knowledge of the distribution function, a value of $k = 2$ should be applied.

COLUMN L: Expanded uncertainty: level of confidence

Dosimetry, Radioactivity and Neutron Measurements:

This column should be left blank unless the distribution function is known. A confidence level of 95% is recommended.

COLUMN M: Expanded uncertainty: is the expanded uncertainty a relative one?

This column should be completed with the word "Yes", for all ionizing radiation CMCs.

COLUMN N: Reference standard used in calibration: Standard

Dosimetry, Radioactivity and Neutron Measurements:

The relevant national reference standard(s) of the calibrating laboratory should be stated. Examples are: free air chamber, graphite calorimeter, 4πβ-γ absolute measurement, hydrogen gas proportional counter, or secondary standard ionization chamber.
If another method is used in the calibration then this should be stated in column 3. All

standards used to provide the calibration traceable to the SI should be indicated.

COLUMN O: Reference standard used in calibration: source of traceability

Dosimetry, Radioactivity and Neutron Measurements:

If the NMI national standard (column 13) is a primary standard, this column 14 should state the NMI itself; if the NMI does not hold the appropriate primary standard, the laboratory from which its traceability was obtained should be indicated in this column. The CMC should show each source of traceability for the different standards used in the particular calibration.

COLUMN P: List of comparisons supporting this measurement / calibration service

Note: This column will not be available to viewers of the database. It is part of the verification process for the RMO and the JCRB. Each CMC should have in general a corresponding supporting comparison or other method of validation, for example if the type of calibration is only available from one NMI. Other blank entries are only acceptable on a short-term basis, the deadline for completion being determined as 2010.

Dosimetry, Radioactivity and Neutron Measurements:

Supporting comparisons can be BIPM, CCRI, RMO or IAEA comparisons. Bi-lateral comparisons may be used if no other comparison exists for the NMI, as long as the partner NMI has taken part in a BIPM, CCRI, RMO or IAEA comparison.

If no directly related comparison exists, a similar type of comparison can be used to support the CMC but the reference should be preceded by the words "similar to" or some other indication as to the indirect nature of the comparison.

- If an NMI holds primary standards, supporting comparisons will include key comparisons. There should be a supporting comparison for the CMC unless the type of calibration is unique to that NMI.
- If an NMI receives its traceability from another laboratory, supporting comparisons

referring to this other laboratory should not be listed here. The regional comparison supporting the NMI's own calibration capability should be cited.

- Any comparison supporting the measurement capability of the NMI with secondary standards should be given in this column
- If an NMI has more than one comparison supporting its capability, only one of these should be quoted and the expanded uncertainty of the calibration (column 9) should reflect that used in the comparison chosen.

For key and supplementary comparisons, such as BIPM, CCRI, RMO or IAEA, only the reference is required. For multilateral comparisons, the reference of the publication (or internal report) plus between brackets the participating laboratories and the year should be indicated (for RMO, CCRI- and BIPM comparisons, see BIPM web site).

COLUMN Q: Comments to be published via the KCDB

Any comments in this column will appear in the KCDB for the customer to see. To add a further comment within the cell use "Alt:enter" to introduce a carriage return.

COLUMN R: Services Administration: service ID

Dosimetry, Radioactivity and Neutron Measurements:

The NMI service identification must be unique for each CMC entry. This will enable its fast location by the service administration. The system will use the following components:

- EUR-RAD for EUROMET Ionizing Radiation subject field,
- APM-RAD for APMP Ionizing Radiation subject field,
- SIM-RAD for SIM Ionizing Radiation subject field,
- COO-RAD for COOMET Ionizing Radiation subject field,
- SAD-RAD for SADCMET Ionizing Radiation subject field,

Followed by the name of the NMI then a four digit number stating with

- 1xxx for dosimetry,
- 2xxx for measurement of radionuclides,
- 3xxx for neutron measurements

e.g. COO-RAD-VNIIM-2001

Note: Numbering should be sequential without omissions for each NMI. This will not affect the order of display when the database is interrogated.
Note: A single identifier **must be used** for a multi-nuclide source and a single identifier **must be used** for a reference material containing more than one radionuclide (see example excel file).

COLUMN S: Services Administration: service category

Dosimetry, Radioactivity and Neutron Measurements:

The service category "classification scheme" is given in the excel table with the same name. For dosimetry and for neutron measurements, the number takes the form 1.2.7 or 3.3.2 for the three level classification while for activity measurements a fourth level is needed to indicate the radionuclide e.g. 2.1.3.Mn-54. (see "RI example" in excel format)

COLUMN T: Services Administration: NMI

Dosimetry, Radioactivity and Neutron Measurements:

This column contains the name of the NMI, as listed in the CCRI directory.

COLUMN U: Services Administration: comments

Dosimetry, Radioactivity and Neutron Measurements:

To be used by the RMO review panel for review status or comments, or by the submitter to communicate comments to the reviewers, or to keep track of changes.