Guidance on Applying the Measurement Methods Matrix (MMM) in Using Comparison Results to Support CMCs

In the interest of supporting the calibration and measurement capabilities (CMCs) published by National Measurement and Designated Institutes (NMIs and DIs) on the Key Comparison Database (KCDB), the Consultative Committee on Ionizing Radiation Section II [CCRI(II)] developed a generic groupings table of radionuclides called the MMM. Using these groupings, CCRI(II) and corresponding technical committees in the Regional Metrology Organizations (RMOs) might leverage a select set of comparisons to support a wider range of CMCs for the measurement of radionuclides. The MMM has been designed for used by the NMIs and DIs¹.

For the official rules to CMC claims, refer to the latest "Rules for entering CMC Claims in Ionizing Radiation Metrology" located on the BIPM website: https://www.bipm.org/en/committees/cc/ccri/publications

This document is meant to be used as a tool for evaluating CMCs but should not be construed to imply traceability of radionuclides, which still requires an unbroken chain of comparisons or calibrations against an appropriate standard.

- Radionuclides have been categorized by a <u>primary</u> measurement method (column in the MMM) as appropriate for a specific nuclide.
- Each method is described by the geometry, detector type, radiation, and detection mode. The expected, relative, minimum, expanded (k = 2) uncertainty is given in percent. The relative difficulty of measuring a specific nuclide by the indicated method (without consideration of source preparation issues) is denoted by a color-coded system: "red" for the most difficult, "yellow" for the moderately difficult, and "green" for the least difficult. It should be noted that a "red" nuclide by one method may be indicated as "green" by another.
- Several primary methods may be used for a given radionuclide; the application of more than one method for verification and confidence in results, as appropriate, is encouraged.
- In general, results from a comparison of a radionuclide indicated as red for a given primary measurement method may be used to support the calibration and measurement capability (CMC) claims for other nuclides of the same type (presuming similar decay complexities and measurement challenges) by that measurement method (i.e., other red, yellow and green-indicated nuclides for that method). Results from a comparison of a nuclide indicated as yellow will support claims for the yellow and green-indicated nuclides, and that of a green-indicated nuclide will support CMCs of only green-indicated nuclides by the same method. CMCs should, in all cases, be claimed only for those radionuclides measured by the submitting laboratory.

¹ See L. Karam, "Application of the CIPM MRA to radionuclide metrology", Metrologia **44** S1 (2007), https://doi.org/10.1088/0026-1394/44/4/S01

- A comparison result of a radionuclide measured by a specific primary method generally
 will <u>not</u> be supportive of claims for that radionuclide measured by other primary
 methods.
- As comparisons are generally not undertaken for secondary methods specifically, a similar matrix for those methods is not practical. Extension of primary comparison results to support CMCs of secondary methods may be possible with demonstration of traceability of those methods to the primary method used in the comparison; the uncertainties would be expected to be greater than those achieved in the initial, primary-method comparison.
- When a secondary method is used in the context of a comparison, the results for that comparison can support the CMCs of only that nuclide as measured by that method.

4P.APIBPIPHAEVR.CD-00-00-C/PP/LS/SP-GR-NA/GH-CO/AC 4P-BP-CD-00-00-TD***
(***Cere nkov Counting in LS channe!) • AP/BP/PH/AE/XR-LS-00-00-TD**
(****all not pure-beta emitting nuclides) NAE-PC/PP/LS/SP-GR-NA/G Nuclide App. β-particle (pure)
TDCR with
Cerenkov
counting in the
LS channel
α or (mixed) β
or photon or
Auger or x-ray
TDCR or (mixed) p
or photon or
Auger or x-ray
TDCR with
Čerenkov
counting in the x-ray or Auger α-particle high efficiency liquid or α or β or x-ray photons Nal(TI) efficiency anticoincidence scintillation or Csl x-ray or Auger proportional counter high efficiency Defined solid angle α-partic with PIPs detector proportional counter or liquid scintillation wit y-ray efficiency β-particle internal gas counting MET/NIST 5 ENV, RES 1 2 0.6 0.7 1.5 ENV,MDD,FOF CI-36 Co-56 1 1.2 Ru-103 Pd-103 Ce-139 Ba-140/La-140 Pm-147 Gd-148 Gd-153 Ho-166m 1.5 1.5 Yb-169 Lu-176 Ta-182 0.6 2 2 2 Au-195 Hg-197 Po-208 TI-208 Po-209 1.5 Pb-210 Po-210 Ac-228 Ra-228/Ac-228 Th-228+d Th-229 2 2 3 2 4 2 U-232 Pa-233 U-233 Th-234(/Pa-234) 2 U-235 Np-237 Pu-238 U-238/(Th,Pa) Pu-240 Pu-241 0.5 0.8