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► To cite this version:

Benoit Sabot, Florestan Ogheard, Matthieu Hamel, Philippe Cassette, Philippe Gervais, et al.. Development of a portable device for primary measurement of radiopharmaceuticals volume activity. ICRM 2023 - 23rd International Conference on Radionuclide Metrology and its Applications, Mar 2023, Bucarest, Romania. cea-04799423

HAL Id: cea-04799423

<https://cea.hal.science/cea-04799423v1>

Submitted on 22 Nov 2024

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Title: Development of a portable device for primary measurement of radiopharmaceuticals volume activity

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Text:

Radiopharmaceuticals (RPMs) used for diagnostic or therapeutic purposes are produced most often in the form of colloidal radioactive solutions. On-site measurement of their activity is mainly carried out using dose calibrator. This type of device requires prior calibration for each measured sample geometry (vials, syringes, etc.). In practice, these dose calibrators are first calibrated on-site by a secondary laboratory equipped with a transfer instrument that has been previously calibrated.

In the latter case, performing these experiments for very short-lived radionuclides is more than complicated for various reasons on the top of which radioprotection and transportation from the manufacturer to the NMI. The subject of this development is therefore to propose an alternative solution where the primary calibration is performed at the RPM production site. Such a solution is intended to meet a direct need for the calibration of measuring devices for short-lived RPMs, but will also limit the transport of sources that becomes more and more complicated due to regulation rules.

A transportable instrument has thus been developed allowing both the precise measurement of a volume of solution sampled in the order of μL and the measurement of the activity of this same drop of solution. A device using a quartz capillary with a diameter of 1 mm was developed. This system allows the sampling of a drop of radiopharmaceutical solution directly from penicillin type vial. The volume of this drop is of about 1 μL and is measured by image processing with a relative standard uncertainty of less than 1%. This capillary was coupled to a compact TDCR measuring device using a plastic scintillator specifically designed and shaped to optimise the measurement geometry.

We will present the design of this new device and the methods used for the measurement and calculations. The first measurement results, performed in Orsay Hospital, on the two RPMs [¹¹C]PIB (10 MBq/mL) and [¹⁸F]FDG (80 MBq/mL) in solutions ready for injection, will be presented. We measured the volume activity on a single drop of solution with a relative standard uncertainty of 2% within only 5 min of experimentation. On top of that, these measurements can be controlled remotely and limit the dose received by the user. To validate these first measurements, we performed a transfer of the drop in the capillary to a liquid scintillation vial for standard TDCR. The

results are consistent within their standard uncertainties. The possibilities offered by this new device are important for the metrological traceability of RPM as it allows the standardization of the volume activity directly on a very small sample of a high-activity vial of RPM. This vial can then be used to create all the geometries necessary for the calibration of the dose calibrator in the RPM producer laboratory. However, this type of measurement is not applicable in every case and the current limitations will be discussed.

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Proposed session: Radionuclide metrology in life sciences

Presentation type: ORAL/INVITE