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Uranium enrichment measurement in UF₆ cylinders by HRGS : an evaluation of the measurement uncertainty

The paper presents the work performed at IRSN to optimise the traditional enrichment meter method applied to uranium enrichment measurement in 30B and 48Y UF₆ cylinders by high resolution gamma spectrometry, to evaluate the parameters influencing the measurement result and the associated uncertainties.

The calibration between the uranium enrichment and the net count rate of the 185.7 keV gamma-ray in collimated geometry is performed in IRSN using four U₃O₈ standards (235U% from 0,7 to 89%) and a weighted least squares linear regression. In order to reduce the container inspection time on site, the net count rate of the 185.7 keV gamma-ray of UF₆ container is measured in a no-collimated geometry. Therefore, several corrections need to be done.

These corrections are due to differences in the attenuation of the gamma-rays between the U₃O₈ reference material container wall and the 30B or 48Y container wall, in the measurement geometry (with collimation for the U₃O₈ standards and without collimation for the UF₆ containers), in the physicochemical nature between the standards and the items to measure, and eventually in the detection efficiency of the gamma spectrometry system after its transport from IRSN and relocation on site for inspection purposes.

Some assays performed on site using 30B and 48Y UF₆ containers (235U% from 0,3 to 5,5%) showed (1) the necessity to perform a container thickness measurement (ultra sonic gauge) on each item to correct the measurement from container wall attenuation effects, and (2) the no significant influence of the measurement position on the enrichment measured (a specific spectrometer support was manufactured to allow measurements on the top, side or front of a container). These tests were used to evaluate a calibration transfer factor, estimate the measurement time, evaluate the uncertainty component of each parameter of influence, and finally the measured uranium enrichment uncertainty.

Which "Key Question" does your Abstract address?

SGI1.1

Topics

SGI4

Which alternative "Key Question" does your Abstract address? (if any)

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