XA0200165 IAEA-SM-367/B/14/09/P

URANIUM ENRICHMENT MEASUREMENTS WITHOUT CALIBRATION USING GAMMA RAYS ABOVE 100 keV*

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The verification of UF6 shipping cylinders is an important activity in routine safeguards inspections. Current measurement methods using either sodium-iodide or high-purity germanium detectors requires calibrations that are not always appropriate for field measurements, because of changes in geometry or container wall thickness. The introduction of the MGAU code demonstrated the usefulness of intrinsically calibrated measurements for inspections. MGAU uses the 100-keV region of the uranium gamma-ray spectrum. The thick walls of UF6 shipping cylinders preclude the routine use of MGAU for these measurements.

We have developed a uranium enrichment measurement method for measurements using high-purity germanium detectors, which do not require calibration and uses uranium gamma rays above 100 keV. The method uses seven gamma rays from U-235 and U-238 to determine their relative detection efficiency intrinsically and with an additional gamma ray from U-234 the relative abundance of these three uranium isotopes. The method uses a function that describes the basic physical processes that predominately determine the relative detection efficiency curve. These are the detector efficiency, the absorption by the cylinder wall, and the self-absorption by the UF6 contents. We will describe this model and its performance on various uranium materials and detector types.

*Work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.