Method/measurement System (including software): PSMC

Application: Measurement of Pu mass in oxide and MOX

Short Description of the method/measurement system and typical measurement conditions (shielding, measurement time etc.)
The methods described under HLNC (q.v.) have limitations for impure and inhomogeneous materials such as scrap and waste. The passive neutron multiplicity counting technique (PNMC) [1] expands the experimental information provided by passive coincidence counting to give three measured quantities: Singles, Doubles and Triples. This allows quantitative information on spontaneous fission rate ($^{240}Pu_{eff}^{*}$), neutron multiplication and (α,n) rate to be extracted from the measurement data. In this way systematic measurement uncertainties can be greatly reduced, thus making the plutonium assay by PNMC much more reliable and accurate, particularly for poorly characterized and impure materials with a large induced fission component. The method does not require reference materials for calibration, but does require high efficiency detectors. Even so, typical measurement times are longer than for passive coincidence counting to obtain good statistics on Triples (~600 s). One detector used for this method is the Plutonium Scrap Multiplicity Counter (PSMC) [2], which has an efficiency of 55% using 80 polyethylene-moderated, 4-atmosphere ^{3}He tubes and 19 preamplifiers. The dieaway time is 47 µs. The data is typically collected and analyzed using the International Neutron Coincidence Counting code [3]. The isotopic composition used in the analysis is obtained from mass spectrometry. * The $^{240}Pu_{eff}$ of an item is the weighted sum of the even Pu isotopes.
Factors affecting the method performance
The data is typically processed with point model equations with a multiplication bias correction for large multiplication items. One assumption is that the (α,n) neutron energy is the same as the spontaneous fission neutron energy. This is a very good approximation for (α,n) neutrons from oxygen, but less good for other potential (α,n) emitters. The counting statistics on the Triples become poor at higher counting rates and for items with high "alpha" values (α>10).
Method References
1. N. Ensslin et al., "Application Guide to Neutron Multiplicity Counting", Los Alamos National Laboratory Report LA-13422-M (1998). 2. H. O. Menlove, J. Baca, M. S. Krick, K. E. Kroncke and D. G. Langner "Plutonium Scrap Multiplicity Counter Operation Manual" Los Alamos National Laboratory Report LA-12479-M (1992) 3. W. Geist, J. Longo, M. Krick and W. Harker "INCC Software Users Manual" Los Alamos Report LA-UR-01-6761 (2009)
Source of bottom-up value (only for prospective ITV not based on historical data)
n/a

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