Title: ACHIEVING ACCURATE NEUTRON-MULTIPLICITY ANALYSIS OF METALS AND OXIDES WITH WEIGHTED POINT MODEL EQUATIONS

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Submitted to: 45th Annual INMM Meeting
Orlando, FL USA
July 18-22, 2004
(ABSTRACT)
Achieving Accurate Neutron-Multiplicity Analysis of Metals and Oxides with Weighted Point Model Equations

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Abstract

Neutron multiplicity counting is a technique for the rapid, nondestructive measurement of plutonium mass in pure and impure materials. This technique is very powerful because it uses the measured coincidence count rates to determine the sample mass without requiring a set of representative standards for calibration. Interpreting measured singles, doubles, and triples neutron rates using the three-parameter Standard Point Model accurately determines plutonium mass, neutron multiplication, and the ratio of αn to spontaneous-fission neutrons (alpha) for pure oxides of moderate mass. However, underlying Standard Point Model assumptions – including constant neutron energy and constant multiplication throughout the sample – cause significant biases for the mass, multiplication, and alpha in measurements of metal and large, dense oxides.

At Los Alamos National Laboratory a neutron- and photon-transport Monte Carlo code, MCNPX (Monte Carlo Neutron-Photon) uses known physics processes and cross-section data to determine the neutron multiplicity distribution for material with user-specified composition and geometry. We vary material geometries, densities, and impurities in MCNPX and obtain simulated singles, doubles, and triples count rates. Weighting factors in the Standard Point Model equations derived from these simulated count rates account for “non-point” behavior that causes biased measurements for the materials studied. We compare computationally predicted biases of the Standard Point Model (difference between computational results for Standard and Weighted Point Model analyses) with those measured, and show the current status of this weighting technique for reducing bias in neutron multiplicity measurements. Potential safeguards advances are promising for both high-throughput accountability and receipts-verification for large numbers of items.
BIOGRAPHICAL SKETCH

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Jane Burward-Hoy is a Post-Doctoral Research Associate in both P and N Divisions. She holds a Ph.D. in nuclear physics as well as an MA in physics and a BA in both physics and applied mathematics. In N Division, Dr. Burward-Hoy is actively involved in computations related to nondestructive assay of plutonium mass in pure and impure materials for potential nuclear safeguard advances.