On Using Code Emulators and Monte Carlo Estimation to Predict Assembly Attributes of Spent Fuel Assemblies for Safeguards Applications

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Abstract —*The quantification of the plutonium mass in spent nuclear fuel assemblies is an important measurement for nuclear safeguards practitioners. A program is well underway to develop nondestructive assay instruments which, when combined, will be able to quantify the plutonium content of a spent nuclear fuel assembly. Each instrument will quantify a specific attribute of the spent fuel assembly e.g., the fissile content. In this paper, we present a Monte Carlo-based method of estimating the mean and distribution of some assembly attributes. An MCNPX model of each instrument has been created and the response of the instrument was simulated for a range of spent fuel assemblies with discrete parameters (e.g., burnup, initial enrichment, and cooling time). The Monte Carlo-based method interpolates between the modeled results for an instrument to emulate a response for parameters not explicitly modeled. We demonstrate the usefulness of this technique in applying the technique to six different instruments under investigation. The results show that this Monte Carlo-based method can be used to estimate the assembly attributes of a spent fuel assembly based upon the measured response from the instrument.*

keywords: Monte Carlo, emulation, safeguards.

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