Abstract

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Identifying Source Attributes of Spoofed Plutonium Samples using Isotopic Ratios

Attributing the source of separated plutonium poses a challenge, but is a capability that can enhance global security by acting as a deterrent to the smuggling of potential weapons materials. Research efforts previously conducted at Texas A&M University yielded a validated nuclear forensics methodology to discriminate a separated plutonium sample's reactor of origin, burnup, and time since irradiation. This methodology utilized up to ten isotope ratios found within separated plutonium samples to compare against a library of isotope ratio values produced using MCNP burnup simulations. A maximum likelihood analysis can be performed to find the sample's most probable combination of reactor of origin, burnup, and time since irradiation. Now, the focus is on how to improve the methodology to account for more complicated plutonium samples. One case that is of particular interest is a spoofed sample in which plutonium from multiple reactor sources are mixed. Preliminary efforts indicate that a case of this nature is difficult to accurately attribute. One potential way to improve the methodology's ability to attribute these samples is to introduce a more sophisticated maximum likelihood calculation scheme. The first step is to identify how each attribute is sensitive to each of the isotope ratios. With a greater understanding of how each isotope ratio contributes to the maximum likelihood, the calculation method can be adjusted, either by weighting the isotope ratios differently or by compartmentalizing into three maximum likelihood calculations for the three different sample attributes of interest.