

Proliferation Deterrence by Spent Fuel Monitoring

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Success of global utilization of nuclear energy is highly dependent on the ability to deter any risk of nuclear proliferation. This is particularly important as we developed advanced Mixed Oxide (MOX) fuels using weapons-grade and/or recycled Plutonium. Therefore, it is exceedingly important to develop and deploy sound spent fuel monitoring technologies for Special Nuclear Material (SNM) accountancy. Nondestructive Burnup Analysis (NBA) using fission product gamma spectroscopy is a well documented process for UO₂. Currently ¹³⁴Cs, ¹³⁷Cs, and ¹⁵⁴Eu are being used either separately or in combination for estimating total burnup of UO₂. Our research is an extension of gamma spectroscopy based monitoring system for Plutonium. Given the performance similarities between UO₂ fuel and MOX fuel, investigations are underway to develop similar correlation for MOX. MOX fuel burnup and decay simulations were performed using ORIGEN-ARP (Oak Ridge Isotope Generation and Depletion Code – Automatic Rapid Processing). Several important gamma energy peaks were identified from these preliminary simulation results capable of discrimination between Uranium and Plutonium fission products. These peaks were experimentally confirmed using the Missouri S&T research reactor. Simulation results as well as experimental data are being analyzed to determine performance specifications of a detection system for field applications. Analysis of isotopic activity from irradiated fuel will be used to develop correlations to determine fuel burn-up as well as well as for estimating isotopic composition of the spent fuel.