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Nuclear Safeguards verification of modelled spent BWR fuel using a multivariate analysis approach

In the field of nuclear safeguards, analysis of data using multivariate analysis (MVA) techniques are being researched lately. Earlier work have analyzed passive gamma spectroscopy signatures from PWR fuels using MVA techniques, to e.g. evaluate the capability of determining initial enrichment, burnup, and cooling time, to classify fuels as UOX or MOX, and to identify partial defects on the level of 30% .

In this work, we will analyze passive gamma spectroscopy signatures from spent BWR assemblies using MVA techniques, in order to assess the verification capability with respect to these fuels. First, MVA is used to analyze modelled data from intact spent nuclear fuel, in order to determine initial enrichment, burnup and cooling time of the fuels. Then, the isotopic contributions from gamma-emitting isotopes in BWR fuels are compared for those previously calculated for PWR fuels to identify possible differences. Finally, MVA techniques are used to investigate verification of "atypical"fuel assemblies, such as sparsely populated reassembled nuclear fuel assemblies, since these are very challenging fuels to verify using conventional instruments and methods.

The spent fuel inventory of 8x8 BWR-type fuels are computed for various initial enrichments, burnups, and cooling times using Serpent2. The response from a passive gamma spectroscopy detector is modelled in two steps: the geometrical efficiency is computed with an in-house point kernel gamma attenuation analysis program, and the intrinsic efficiency is computed with MCNPX. The simulated dataset is used for the training of a custom-made partial least squares (PLS) regression model in order to make predictions of the burnup and cooling time for unknown test fuel samples.

Which "Key Question" does your Abstract address?

NEW1.2

Topics

NEW1

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