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Identification of High Confidence Nuclear Forensic Signatures by Analysis of Spent Fuel Samples and Other Nuclear Materials

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Nowadays, nuclear forensics has an increasing role worldwide. Several informative parameters have been already found for full characterization of nuclear materials with unknown origin for nuclear forensic purposes. However, international Round Robin exercises in the field resulted in that it is difficult to find exact and responsible parameters (signatures) for indisputable identification. For determination of such reliable signatures, analysis of numerous samples from the same and also different confiscations and batches with different origin would be necessary. Another thing is that although fresh and reprocessed fuel have been mainly in the focus of nuclear forensics, analysis of spent fuel seems also interesting recently. In this work analytical and statistical results are shown for finding high confidence nuclear forensic signatures for origin assessment of spent fuel samples and other nuclear materials. In the case of spent fuel three different methods were found useful for identification: correlation of fission products (e.g. Cs-137), transuranium elements (e.g. total Pu) and the fissile content (U-235, 239,241Pu) versus burn-up (BU). These correlations were obtained by depletion calculation for VVER-440 assemblies. These parameters are specific for reactor types, therefore they are considered as a basis for finding relevant signatures and establish a database (library). Methods were tested during a Round Robin exercise in 2013 for origin assessment of spent fuel statistically. In the case of fresh and reprocessed fuel other analytical data (obtained by NDA and DA techniques) will be shown.

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