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Uncertainty Quantification of Fork Detector Measurements from Spent Fuel Loading Campaigns

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With increasing activities at the end of the fuel cycle, the requirements for the verification of spent nuclear fuel for safeguards purposes are continuously growing. In the European Union we are experiencing a dramatic increase in the number of cask loadings for interim dry storage. This is caused by the progressive shut-down of reactors, related to facility ageing but also due to politically motivated phase-out of nuclear power. On the other hand there are advanced plans for the construction of encapsulation plants and geological repositories. The cask loading or the encapsulation process will provide the last occasion to verify the spent fuel assemblies.

In this context, EURATOM and the US DOE have carried out a critical review of the widely used Fork measurements method of irradiated assemblies. The Nuclear Safeguards directorates of the European Commission's Directorate General for Energy and Oak Ridge National Laboratory have collaborated to improve the Fork data evaluation process and simplify its use for inspection applications. Within the Commission's standard data evaluation package CRISP, we included a SCALE/ORIGEN-based irradiation and depletion simulation of the measured assembly and modeled the fork transfer function to calculate expected count rates based on operator's declarations. The complete acquisition and evaluation process has been automated to compare expected (calculated) with measured count rates. This approach allows a physics-based improvement of the data review and evaluation process.
At the same time the new method provides the means for better measurement uncertainty quantification.

The present paper will address the implications of the combined approach involving measured and simulated data to the quantification of measurement uncertainty and the consequences of these uncertainties in the possible use of the Fork detector as a partial defect detection method.

Country or International Organization

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