Contribution ID: **223** Type: **poster**

Gamma-Ray Emission Tomography: Modeling and Evaluation of Partial-Defect Testing Capabilities

Wednesday 22 October 2014 14:50 (40 minutes)

Gamma emission tomography (GET) for spent nuclear fuel verification is the subject for IAEA MSP project JNT1955. In line with IAEA Safeguards R&D plan 2012-2023, the aim of this effort is to "develop more sensitive and less intrusive alternatives to existing NDA instruments to perform partial defect test on spent fuel assembly prior to transfer to difficult to access storage". The current viability study constitutes the first phase of three, with evaluation and decision points between each phase. Two verification objectives have been identified; (1) counting of fuel pins in tomographic images without any àpriori knowledge of the fuel assembly under study, and (2) quantitative measurements of pin-by-pin properties, e.g. burnup, for the detection of anomalies and/or verification of operator-declared data.
Previous measurements performed in Sweden and Finland have proven GET highly promising for detecting removed or substituted fuel rods in BWR and VVER-440 fuel assemblies even down to the individual fuel rod level. The current project adds to previous experiences by pursuing a quantitative assessment of the capabilities of GET for partial defect detection, across a broad range of potential IAEA applications, fuel types and fuel parameters. A modeling and performance-evaluation framework has been developed to provide quantitative GET performance predictions, incorporating burn-up and cooling-time calculations, Monte Carlo radiation-transport and detector-response modeling, GET instrument definitions (existing and notional) and tomographic reconstruction algorithms, which use recorded gamma-ray intensities to produce images of the fuel's internal source distribution or conclusive rod-by-rod data. The framework also comprises image-processing algorithms and performance metrics that recognize the inherent tradeoff between the probability of detecting missing pins and the false-alarm rate. Here, the modeling and analysis framework is described and preliminary results are presented.

Country or International Organization

Sweden

Primary author: JACOBSSON SVÄRD, Staffan (Uppsala University, Uppsala, Sweden)

Co-authors: DAVOUR, Anna (Uppsala University, Uppsala, Sweden); TRELLUE, Holly (Los Alamos National Laboratory, Los Alamos, NM, USA); SMITH, L. Eric (Pacific Northwest National Laboratory, Richland, WA, USA); DESHMUKH, Nikhil (Pacific Northwest National Laboratory, Richland, WA, USA); JANSSON, PETER (UPPSALA UNIVERSITY); WITTMAN, Richard S. (Pacific Northwest National Laboratory, Richland, WA, USA); GRAPE, Sophie (Uppsala University); WHITE, Timothy A. (Pacific Northwest National Laboratory, Richland, WA, USA); MOZIN, Vladimir (Lawrence Livermore National Laboratory, Livermore, CA, USA)

Presenter: JACOBSSON SVÄRD, Staffan (Uppsala University, Uppsala, Sweden)

Session Classification: Challenges in Spent Fuel Verification: E-Posters