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Development of Non Destructive Assay Approach for Characterization of Spent Fuel Debris at Fukushima-18543

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ABSTRACT

Fukushima is considering options for decommissioning the damaged reactor. One of the technical challenges is the accurate characterization of fissile isotopes in the spent fuel debris. This is due to the fissile content, high gamma and neutron emission and uncertainties regarding the fuel burnup and unknown, heterogeneous mixture of materials that may be present. These requirements lead to significant challenges for potential measurement approaches with regard to the requirements for shielding and remote operation that result from plant and operational constraints.

Mirion Technologies (MTKK) has been working to perform feasibility and concept design studies for a non-destructive assay (NDA) system that could be used to characterize the fissile content of retrieved samples of fuel debris. The main advantage of using an NDA technique is that the entire volume of the sample is interrogated so the method is not reliant upon assumptions of representativeness of samples retrieved and sent for laboratory analysis. The proposed technique comprises a combination of gamma spectroscopy and combined passive / active neutron interrogation with advanced data analysis algorithms in order to determine the maximum available data on the spent fuel properties and obtain a full radionuclide characterization of each sample. This includes quantification of individual fissile nuclides with validated uncertainties.

In this paper we describe the NDA techniques and systems that are proposed, their benefits and limitations, and how they may be implemented into a full-scale system for fuel element debris characterization. We describe the studies that were performed based on experience of real systems and research supplemented with extensive computer modelling work to represent the expected fuel element debris properties. The work benefits from Mirion's extensive global physics and engineering expertise in designing, supplying and operating a wide range of NDA systems for diverse applications and in different challenging physical and operational environments. We describe how the advanced and innovative physics techniques that have resulted from Mirion's collective experience in these areas, can be deployed in an NDA system. The final approach that has been developed provides a means for determining the masses of the individual fissile isotopes with robust uncertainties and capable of implementation into an NDA system that meets the expected requirements for an operational plant. We focus on the techniques that have been developed and describe how they are of wider relevance and interest for projects that include challenges for characterization of fuel residues.

＊ If you are interested in the full paper, please contact to the Marketing specialist, MTKK;

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