



Contribution ID: 304

Type: oral

## Characterization of Spent Nuclear Fuel with a Differential Die-Away Instrument

Wednesday 22 October 2014 16:00 (20 minutes)

The Differential die-away technique (DDA) is currently being investigated within the Next Generation Safeguards Initiative Spent Fuel project as one of the non-destructive assay techniques for spent nuclear fuel characterization and verification. This technique is based on active interrogation of the spent fuel assembly (SFA) by neutrons from an external, off-the-shelf, neutron generator. As the interrogating neutrons penetrate the SFA that is submerged in water, they thermalize and induce fission preferentially on the fissile content of the SFA, typically  $^{235}\text{U}$ ,  $^{239}\text{Pu}$  and  $^{241}\text{Pu}$ . The strength and dynamic properties of the signal from the induced fission reflect the isotopic content of the SFA and makes it possible to determine various general characteristics of the SFA such as its total Pu content, initial enrichment, burn-up and possible existence of partial defects.

Following promising results of initial simulations, our research currently focuses on the design of a prototype instrument capable of characterization of the SFAs in Sweden, which consist of Boiling Water and Pressurized Water Reactor fuel assemblies. According to the requirements of the Swedish Nuclear Fuel and Waste Management Company, the instrument is being customized to perform test measurements of 50 different SFAs in the Swedish central interim storage facility (CLAB). At the future encapsulation facility (CLINK), an instrument is required to reliably characterize more than 50 000 SFAs with wide range of characteristic parameters.

In addition, within the scope of the IAEA objective of “development of more sensitive and less intrusive alternatives to existing non-destructive assay instruments,” we will present our reasoning that this instrument, developed for a specific purpose (CLAB+CLINK), has the potential to become a more universally applicable tool installable or deployable to other sites as a standardized safeguards tool.

### Country or International Organization

Sweden

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**Session Classification:** Technology Foresight and Emerging Technologies I