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# ACTIVE INTERROGATION FOR SPENT FUEL

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## Benefit

This research project showed the feasibility of operating a Differential Dieaway Assay (DDA) instrument for nuclear safeguards applications. We used a full-scale neutron generator with fresh fuel and tested data acquisition and electronics capable of operating at extremely high count rates. Experimental results agreed with simulations. We have designed a facility independent and less massive DDA instrument.

## Applications

The fields the DDA technique applies to include:

- Spent fuel safeguards
  - Input accountancy for reprocessing
  - Shipper receiver differences
- Plutonium inventory verification
- Material control and accountability

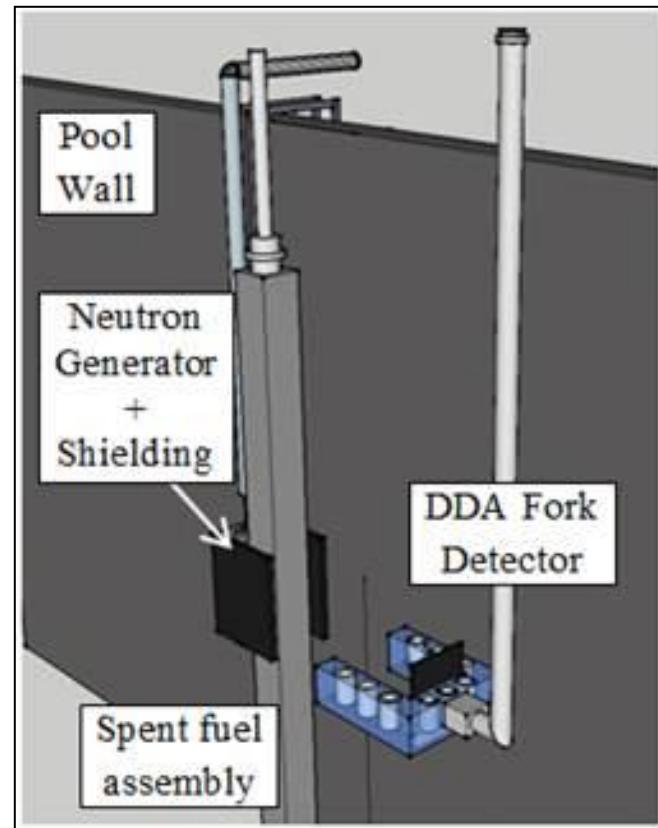
## Current Capabilities

- High sensitivity to small changes in the amount of fissile material in the fuel assembly
  - Removal/replacement of 10 pins can be detected
- New front-end electronics for thermal neutron detectors capable of handling extremely high count rates ( $>1\text{Mcps}$ )
- Updated general-use design is facility independent and much less massive compared to previous design iterations

## Anticipated Final Capabilities

The final prototype will have the following:

- Multiple  $^3\text{He}$  detectors paired with fast post-burst front-end electronics to acquire list-mode data from positions around the spent fuel assembly
- Small mass such that safeguards inspectors can position the instrument and perform measurements



The general-use, facility independent DDA instrument for underwater spent fuel assay (inspired by the Fork Detector)

## Project Description

The DDA instrument for nuclear safeguards is a fast, non-destructive assay, active neutron interrogation technique using an external 14 MeV DT neutron generator for characterization and verification of spent nuclear fuel assemblies.

## Further Reading

1. V. Henzl, M. Swinhoe, S. Tobin, H. Menlove, J. Galloway and D. Won Lee, "Direct Measurement of Initial Enrichment, Burn-up and Cooling Time of Spent Fuel Assembly with a Differential Die-Away Technique Based Instrument," in *Institute of Nuclear Materials Management*, Orlando, 2012.
2. A. Goodsell, V. Henzl, M. Swinhoe, C. Rael, D. Desimone and W. Charlton, "Comparison of fresh fuel experimental measurements to MCNPX results using the differential die-away instrument for nuclear safeguards applications," *ESARDA Symposium 2015*, LA-UR-15-23252, 2015.
3. A. V. Goodsell, V. Henzl, M. T. Swinhoe, W. S. Charlton "Simulation Study for Detection of Pin Diversion with the Differential Die-Away Instrument Using Fresh Fuel" *Institute of Nuclear Materials Management*, 56<sup>th</sup> Annual Meeting Palm Desert 2015