**NUCLEAR ENERGY UNIVERSITY PROGRAMS**

**Improvements to Nuclear Data and Its Uncertainties by Theoretical Modeling**

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**Abstract**

This project addresses three important gaps in existing evaluated nuclear data libraries that represent a significant hindrance against highly advanced modeling and simulation capabilities for the Advanced Fuel Cycle Initiative (AFCI). This project will:

- Develop advanced theoretical tools to compute prompt fission neutrons and gamma-ray characteristics well beyond average spectra and multiplicity, and produce new evaluated files of U and Pu isotopes, along with some minor actinides
- Perform state-of-the-art fission cross-section modeling and calculations using global and microscopic model input parameters, leading to truly predictive fission cross-sections capabilities. Consistent calculations for a suite of Pu isotopes will be performed.
- Implement innovative data assimilation tools, which will reflect the nuclear data evaluation process much more accurately, and lead to a new generation of uncertainty quantification files. New covariance matrices will be obtained for Pu isotopes and compared to existing ones.

The deployment of a fleet of safe and efficient advanced reactors that minimize radiotoxic waste and are proliferation-resistant is a clear and ambitious goal of AFCI. While in the past the design, construction and operation of a reactor were supported through empirical trials, this new phase in nuclear energy production is expected to rely heavily on advanced modeling and simulation capabilities. To be truly successful, a program for advanced simulations of innovative reactors will have to develop advanced multi-physics capabilities, to be run on massively parallel supercomputers, and to incorporate adequate and precise underlying physics. And all these areas have to be developed simultaneously to achieve those ambitious goals. Of particular interest are reliable fission cross-section uncertainty estimates (including important correlations) and evaluations of prompt fission neutrons and gamma-ray spectra and uncertainties.