

NE-21-25133, Advanced Nuclear Fuel Pellet Designs

Exelon Nuclear, a division of Exelon Generation, operates the largest U.S. fleet of carbon-free nuclear plants consisting of 21 reactors spread across 12 facilities in Illinois, Maryland, New York, and Pennsylvania. Exelon's mission is "to be the leading diversified energy company - by providing reliable, clean, affordable and innovative energy products."

Due to the current manufacturing process requirements, UO₂ fuel is limited to homogeneous sintered fuel pellets. Homogenous fuels have several disadvantages including low thermal conductivity and the reduction of neutron flux within the pellet interior. In the pursuit of improving the operational, safety, and economic performance of existing power plants, a number of advanced heterogeneous fuel design concepts will be explored. Detailed modeling and simulation (M&S) analysis of complex designs requires access to advanced M&S environments, which are lacking in current industry tools.

In 2010, the Virtual Environment for Reactor Applications (VERA) was developed by the Consortium for Advanced Simulation of Light Water Reactors (CASL). VERA can simulate the operation of an entire reactor down to the characteristics of a single fuel rod. Housed at Oakridge National Laboratory (ORNL), this state-of-the-art simulation environment will accommodate the required analysis for heterogeneous fuel pellet designs, aiding in the optimization of fuel cycle economics.