U.S. DEPARTMENT OF ENERGY
NUCLEAR ENERGY RESEARCH INITIATIVE
ABSTRACT

PI: **Sean McDeavitt** **Proposal No.: 99-0095**

Institution: **Argonne National Laboratory**

Collaborators: **Purdue University**

Title: **Fuel for a Once-Through Cycle $(Th,U)O_2$ in a Metal Matrix**

This project initiates a new approach to the thorium fuel cycle. The product of this project will be a low-cost dispersion fuel that is proliferation-resistant, is usable to high actinide burnup, and forms a superior waste form without processing.

The key concept in this project is that dispersion fuel comprising low-density $(Th,U)O_2$ microspheres in a zirconium alloy matrix will result in an advanced nuclear fuel that can achieve high burnup and be directly disposed. Our goal is to develop a revolutionary, not evolutionary, fuel form compatible with existing Light Water Reactor technology that may also be easily modified for future advanced reactor designs. The benefits of the proposed fuel concept include 1) high actinide burnup, 2) inherent proliferation resistance, 3) improved irradiation stability due to low internal fuel temperatures, 4) minimal waste treatment, 5) low fabrication cost, and 6) low fuel failure rate.

We propose four tasks to complete this project. The first task is to develop and demonstrate a ceramic processing method for the production of $(Th,U)O_2$ microspheres to be dispersed in the zirconium alloy matrix. The second task is to develop and demonstrate a powder metallurgy method for the fabrication of metal-matrix dispersion fuel rods. The third task is to evaluate and optimize the properties of the fuel through modeling the fuel's nuclear and thermal behavior. Tasks 1 through 3 will proceed in parallel, but they are interdependent; the project investigators have demonstrated expertise in materials processing and nuclear fuel performance modeling. The fourth task is to assess the fuel's performance through modeling, bounding calculations, and critical experiments.