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

PI: **Ken Czerwinski** **Proposal No.: 99-0127**

Institution: **Massachusetts Institute of Technology**

Collaborators: **Argonne National Laboratory**

Title: **Chemical Speciation of Neptunium in Spent Fuel**

This project will examine the chemical speciation of neptunium in spent nuclear fuel. The R&D fields covered by the project include waste host materials and actinide chemistry. Examination of neptunium is chosen since it was identified as a radionuclide of concern by the NERI workshop. Additionally, information on the chemical form of neptunium in spent fuel is lacking. The identification of the neptunium species in spent fuel would allow a greater scientific based understanding of its long-term fate and behavior in waste forms.

Research to establish the application and development of X-ray synchrotron radiation (XSR) techniques to determine the structure of aqueous, adsorbed, and solid actinide species of importance to nuclear considerations is being conducted at Argonne. These studies extend current efforts within the Chemical Technology Division at Argonne National Laboratory to investigate actinide speciation with more conventional spectroscopic and solids characterization (e.g. SEM, TEM, and XRD) methods. Our project will utilize all these techniques for determining neptunium speciation in spent fuel.

We intend to determine the chemical species and oxidation state of neptunium in spent fuel and alteration phases. Different types of spent fuel will be examined. Once characterized, the chemical behavior of the identified neptunium species will be evaluated if it is not present in the literature. Special attention will be given to the behavior of the neptunium species under typical repository near-field conditions (elevated temperature, high pH, varying Eli). This will permit a timely inclusion of project results into near-field geochemical models. Additionally, project results and methodologies have applications to neptunium in the environment, or treatment of neptunium containing waste.

Another important aspect of this project is the close cooperation between a university and a national laboratory. The PI has a transuranic laboratory at MIT where students can perform spectroscopic and radiochemical experiments. Through the ANL partner, students will be able to have additional experience research in a DOE setting. This will provide a unique and constructive opportunity for developing quality graduate students with experience and expertise in handling actinides. Our ability to produce experienced actinide scientists is currently restricted by the dearth of radiochemistry and nuclear research at universities, Regardless of all else, future researchers must be trained and educated if the United States is to maintain a leadership role in nuclear technology. This project provides such an opportunity.