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

PI: **Brady Hanson** **Proposal No.: 99-0197**

Institution: **Pacific Northwest National Laboratory**

Collaborators: **University of California-Berkeley**

Title: **Development of a Stabilized Light Water Reactor (LWR) Fuel Matrix for Extended Burnup**

Current Nuclear Regulatory Commission regulations limit the burnup of present Light Water Reactor fuels to about 62 GWd/t. This limit is a regulatory response to evidence that the changes that occur in the fuel and cladding at burnups at about 50 to 60 GWd/t may reduce the capacity of high burnup fuel to survive in-core design-basis accidents. These changes include an increase in fission gas release and the associated increase in fuel rod internal pressure, fuel swelling, and the formation of a High Burnup Structure (HBS) that is characterized by the development of a subgrain microstructure having high porosity and low thermal conductivity. The properties and formation mechanism of the HBS are not well understood. Extensive research efforts on limiting fission gas release and HBS formation have begun. However, most programs tend to examine only one aspect of the problem without examining the possible adverse effects on other fuel properties. This project proposes a comprehensive study and examination to optimize as many fuel properties as possible to increase the reliability of fuels for present operations as well as to design a fuel capable of extended burnup. In particular, we propose designing a stabilized fuel matrix based on the changes in fuel chemistry that result from adding soluble impurities, or dopants, to the UO_2 matrix. The use of dopants and optimum grain sizes should result in an advanced fuel matrix capable of achieving extended burnup while maximizing fission product retention (including fission gas), minimizing matrix restructuring or HBS formation, and minimizing any impact on the neutron economy and thermal conductivity. The results of this project will also directly benefit MOX development and waste programs.