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

PI: **Ken Farrell** **Proposal No.: 99-0072**

Institution: **Oak Ridge National Laboratory**

Collaborators: **None**

Title: **Mapping Flow Localization Processes in Deformation of Irradiated Reactor Structural Alloys**

It is pointed out that localization of plastic strain in the form of dislocation channel deformation (DCD) is involved in the problem areas of radiation embrittlement, plastic instability failure, and radiation-assisted stress corrosion cracking of irradiated metals, and needs to be addressed in depth. It can severely degrade tensile properties and may induce cracking. DCD has been reported in austenitic stainless steel, ferritic pressure vessel steels, and Zircaloy, but the extent of its involvement, and the scope of its effects, are largely unknown. Since these alloys represent the three major groups of reactor structural alloys, and are likely to remain the mainstay materials for near-future reactors, it would be prudent to determine the scope of DCD in the alloys. Experiments are proposed herein to develop initial maps of deformation modes for the three materials, showing the regions of neutron fluence and plastic strain in which DCD prevails, and correlating it with changes we measure in the tensile specimens of the materials. Some effects of irradiation temperature and strain rate will also be explored. In addition to providing specific knowledge of the roles of DCD the maps are expected to form the foundations for broader maps that should become indispensable tools for materials selection, problem reduction, and performance prediction.