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

PI: **M. Ishii** **Proposal No.: 99-0097**

Institution: **Purdue University**

Collaborators: **Brookhaven National Laboratory, Toshiba Corporation**

Title: **Modular and Full Size Simplified Boiling Water Reactor Design with Fully Passive Safety Systems**

The proposed research focuses on two new conceptual designs of next generation simplified boiling water reactors (SBWRs) namely 1) compact modular 200 MWe SBWR and 2) full size 1200 MWe SBWR. These SBWRs with fully passive safety systems have several advantages relative to the existing LWR systems. The major objectives of this research are: (1) perform generic design studies of the core physics and core thermal-hydraulics for both a small capacity and full size simplified boiling water reactor, (2) perform integral testing in a well-scaled test facility and experimentally evaluate passive safety systems of the prototype designs, (3) develop analytical tools based on improved best estimate reactor systems analysis code and evaluate the passive safety systems of the simplified boiling water reactor, and (4) develop the final conceptual design of both 200 MWe and 1200 MWe SBWR systems.

The core neutron physics studies are performed with current standard technology for both size reactors. The core thermal-hydraulics studies are specifically focused on the natural circulation cooling mechanism. Detailed stability analysis of the SBWR core is considered for both size reactors by BNL. Complete safety analysis of the reactor design including neutronic analysis, and integral testing and thermal hydraulics analysis is carried out at the Purdue University. Experiments are performed on the scaled integral test facility PUMA. PUMA is the only facility in the world that is well scaled and has all safety related components of the SBWR. This facility is well suited for the proposed research.

The data from the integral tests are used to improve safety code models and benchmark the code prediction. The evaluations of the safety systems for the prototype are then carried out. Based on the experimental data, thermalhydraulic study, safety study and neutronic study, the preliminary scientific design for the small size and full size SBWR reactors is developed.