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

PI: **John Marquis** **Proposal No.: 99-0198**

Institution: **Westinghouse**

Collaborators: University of New Mexico

Title: **Novel Integrated Reactor/Power Conversion System**

The objective of the program proposed by University of New Mexico (UNM) and Westinghouse Electric Company is to develop a novel integrated reactor / energy conversion system for addressing needs of developing countries and power supply of remote locations in a proliferation resistant, reliable and economical way. This program undertakes research and development in the following area and categories of science and engineering.

The heart of the proposed concept is the use of a single working fluid (liquid metal) as a heat transfer medium in a fast reactor and as an energy conversion medium in an Alkali Metal Thermal to Electric Converter (AMTEC). Such an integration of the nuclear heat source and energy conversion system will allow the development of small, transportable, disposable power systems with the following characteristics:

- Proliferation resistance: projected core lifetime in excess of 15 years without fuel shuffling or refueling is approximately equal to the life time of static AMTEC devices, resulting in no need for access to both the reactor and energy conversion systems at the plant site. At the end of life, the whole reactor - energy conversion system can be brought back to the country of origin without ever being accessed.

- Enhanced reliability and safety: use of maintenance free, "space qualified" direct energy conversion methods such as AMTEC and possibly a Thermoelectric (TE) bottoming cycle, and absence of steam generators greatly increases the overall plant reliability and safety.

- Simplicity and economic attractiveness: the proposed system utilizes an exceptionally simple and economical cycle layout minimizing manufacturing and operation costs; direct cycle AMTEC uniquely allows for isothermal operation of the energy conversion devices which results in higher efficiency; further savings will be realized through refueling free operation and possibly intact disposal.

This project will assess the technical and economic feasibility issues of such an integrated reactor - direct energy conversion power system, develop corresponding engineering solutions, and determine the concept's range of potential applications and its non-proliferation potential. The specific tasks to be accomplished during the three year program include: design of a long life core; design and optimization of the AMTEC energy conversion system; and overall plant performance

assessment including proliferation resistance and market potential. In order to investigate materials compatibility issues, confirm lifetime, determine life limiting mechanisms and develop solutions to alleviate them, a non-prototypical AMTEC module will be tested. Also, a plan for subsequent development and testing of prototypical system components, and engineering design development will be prepared.

Our team members have the capabilities and experience to successfully contribute not only to the proposed feasibility assessment and preliminary design phase, but also to the full-scale development effort and eventual commercialization of the proposed concept. The University of New Mexico's New Mexico Engineering Research Institute (UNM-NMERI) has world class direct energy conversion and materials testing capabilities, University of New Mexico's Institute for Space Nuclear Power Studies (UNM-ISNPS) is on the forefront of AMTEC technology development, and Westinghouse has unrivaled experience in the design of liquid metal fast reactors, and is well known for development and commercialization of innovative nuclear technologies for a wide range of applications.