NUCLEAR ENERGY RESEARCH INITIATIVE

Nuclear Reactor Power Monitoring Using Silicon Carbide Semiconductor Radiation Detectors

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Collaborators: Westinghouse Savannah River Company; General Atomics

This proposal is directed to the design, development, and assessment of a new paradigm in ex-core neutron flux monitoring for nuclear power plants. The proposed system is based on the use of silicon carbide (SiC) neutron sensors configured in arrays, technology that has been under development by Westinghouse since 1994. There are two fundamental characteristics of such arrays that distinguish them from current technology, which employs a variety of gas-filled neutron sensors:

(1) They operate in pulse mode over a wide dynamic range, which permits pulse spectroscopy, and

(2) they are relatively small in physical size, which permits measurements at discrete physical locations.

To access these characteristics, a collaborative program among the Ohio State University (OSU), Westinghouse, and General Atomics (GA) is proposed that will investigate the use of SiC-based sensor arrays as ex-core neutron monitors in the International Reactor Innovative and Secure Reactor (IRIS), which is being developed by Westinghouse Electric Company and in the prismatic-core, gas turbine modular helium-cooled reactor (GT-MHR), which is being developed by General Atomics.

The proposed three year research program will identify advantages and disadvantages associated with the use of SiC neutron sensors, examine solutions for overcoming difficulties associated with their use and will develop and evaluate methods for improving the performance of SiC based neutron sensor channels.

The following deliverables are identified as key products of the proposed research program.

(1) Selection of the optimum locations for SiC-based neutron power monitors in both the IRIS and the GT-MHR. Factors that will be considered include the power monitoring requirements as well as expected detector sensitivity and presence of gamma ray background.

(2) Evaluation of other applications and opportunities offered by SiC-based neutron power monitors that will include but not be limited to prospects for on-line fault identification and diagnosis using pulse height and pulse shape analysis and the use of miniature SiC detectors to define axial, azimuthal, and radial flux profiles.

(3) A prototype SiC-based, neutron-power monitor with high event rate electronics whose performance will be evaluated in the Ohio State University Research Reactor under neutron fluence rate conditions that provide pulse rates that are commensurate with monitoring requirements in both the IRIS and the GT-MHR.