NUCLEAR ENERGY RESEARCH INITIATIVE

Near-Core and In-Core Neutron Radiation Monitors for Real Time Neutron Flux Monitoring and Reactor Power Level Measurements

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Proposal Number: 2002-174

There is a need for neutron radiation detectors capable of withstanding intense radiation fields, of performing "near-core" reactor measurements, of pulse mode and current mode operation, and of discriminating neutron signals from background gamma ray signals. The detectors should also be tiny enough to be inserted directly into a nuclear reactor without significantly reducing or altering the neutron flux. Such devices can be used to monitor nuclear reactor power levels in "real-time."

A method is proposed here to accomplish these requirements with a new type of compact neutron detector fabricated through the utilization of present day micro-machining technology. The basic device consists of a miniaturized gas-filled chamber with either ^{10}B or ^{235}U inside coatings. The device width can be reduced to 1 mm or less while retaining up to 7 percent thermal neutron detection efficiency. The device is extremely radiation-hard and should continue to operate after exposure to neutron fluences exceeding 10^{16} n/cm^2. Furthermore, the compact design reduces background gamma ray interference. The device can be manufactured from a variety of materials, including common semiconductor and insulating materials. Overall, the device will be inexpensive to reproduce and operate.

The compact devices will be deployed in and around the KSU TRIGA reactor and tested as real-time neutron flux and power monitors. Inversion models will be developed to correlate the detector measurements with reactor power levels and performance.