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

PI: L. M. Hively **Proposal No.: 2000-109**

Institution: Oak Ridge National Laboratory

Collaborators: Duke Engineering & Services

Title: Forewarning of Failure in Critical Equipment at Next-Generation Nuclear Power Plants

---

A deviation from normal operating conditions may indicate performance degradation or the onset of imminent failure in critical equipment. Real-time monitoring can detect a deviation in process-indicative data. Prompt response is needed to avoid failures, maintain optimal performance, and improve performance savings. ORNL has patented technology for assessment of condition change in complex nonlinear systems. The method is data-driven and makes no assumptions about the underlying process dynamics. One- or multichannel time-serial data is converted to geometric (phase space) representation, which in turn is transformed to a distribution function (DF). The dissimilarity between a nominal base case DF and a test case DF is quantified by robust nonlinear metrics. A significant trend in the dissimilarity measures over time indicates a change in the system's condition and provides forewarning for appropriate response. Next-generation nuclear power plants will have many imbedded sensors in critical equipment, such as turbines, pumps, and valves. These sensors will acquire data, such as vibration (acceleration), motor current, electrical power, and acoustic data for both continuous and transient operations. If successful, this technology will reliably detect condition change and/or forewarn of failure in critical next-generation machinery, allowing just-in-time maintenance to improve plant efficiency, to avoid plant down time, and to eliminate safety faults. This project will be conducted jointly with Duke Engineering & Services which will provide operational data and expertise.