INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE

Development of Diagnostics and Prognostics Methods for Sustainability of Nuclear Power Plant Safety Critical Functions

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The objective of the project is to develop and demonstrate advanced technologies for condition monitoring, diagnosis, remote sensing, and safety actuation during beyond-design-basis events in operating nuclear plants and next-generation reactors. Design of self-powered sensors that function under loss of power, along with sensor networks that optimize fault monitoring, is key to providing plant information during extreme conditions. Effective mitigation of a beyond-design-basis accident is receiving increased scrutiny in light of the recent accident at the Fukushima Daiichi nuclear power plant. The accident highlighted the need to monitor core and coolant system conditions and communicate sensor measurements and other information during severe accident conditions.

Even though prognosis during accident situations is not always feasible, predicting or estimating impending changes in the performance of safety-related equipment is of high importance. This project will focus on implementing a variety of monitoring methods using low-frequency and wide-band data and developing self-powered sensors, a sensor network strategy, and data communication and control. The U.S. and Korean collaborators will develop and integrate monitoring and diagnostics methods and demonstrate techniques and measurement strategies for selected safety-related equipment. Using dynamic simulation of a typical nuclear plant's operations, the team will generate data needed to validate the proposed technical approach.

The project consists of four key tasks. Technologies and algorithms will be demonstrated throughout by application to selected components.

- Review operability of safety-critical functions and components in light water reactors.
- Develop algorithms for plant monitoring, diagnostics, and prognostics.
- Develop low-energy, self-powered process sensors and networks, and determine optimal placement strategies.
- Develop plant simulation models for data generation.