Cost-Benefit Analyses through Integrated Online Monitoring and Diagnostics

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ABSTRACT:

The objective of the project is to improve the economic competitiveness of advanced reactors through the optimization of cost and plant performance, which can be achieved by coupling intelligent online monitoring with asset management decision-making. As advanced reactors are early in the development life-cycle, online monitoring systems and associated sensor networks can be incorporated directly into the design without the constraints related to retrofitting and system upgrades. However, due to their innovative designs and lack of operating experience, advanced reactors have large uncertainties regarding component reliability, potential failure modes, and long-term maintenance needs. Therefore, it is necessary to develop a system that is capable of multifaceted plant performance cost-benefit analyses but which is both flexible and robust to tolerate operational uncertainties.

There are two development steps to the optimization of advanced reactor operation and asset management through the use of online monitoring and diagnostics. First, during the reactor design phase, it is necessary to develop a sensor network that can properly monitor and diagnose important faults and component degradation throughout the lifetime of the plant. This is a difficult task as there are many unknowns regarding long-term operational reliability and the associated costs of additional sensors and system penetrations can be prohibitive. Second, once reactor operation begins, the asset management approach must seamlessly integrate online monitoring information and the plant's risk profile to develop an optimized plant operation and maintenance plan. The challenges of this task include cost-benefit decision-making in multivariate space while ensuring the plant does not approach risk or safety limits.

The research addresses both of the development steps. A methodology is developed to design a sensor network which optimizes the number of sensors, their placement, and requirements grading, while maximizing the number of potential faults that could be identified. Subsequently during reactor operation, a system is created to utilize the sensor network for online monitoring and diagnosis of component degradation. This information is then transmitted to the plant's risk model and asset management software, which determines the optimal operational approach.

The project is divided into four tasks, as outlined below. The first three tasks center on the development of necessary methodologies, including the optimized design of a sensor network, integration with online diagnostics and plant risk, and finally incorporation into operational decision-making. The final task is a case study for an advanced reactor design utilizing the newly developed methods.

Task 1: Development of a methodology for the design and optimization of a sensor network
Task 2: Methodology for the integration of online monitoring, diagnostics, and plant risk profile
Task 3: Methodology for intelligent operational supply chain and asset management decision-making
Task 4: Case study of an advanced reactor design

The assembled team brings together expertise and leading capabilities in sensor network design, online monitoring and diagnostics, advanced reactor risk assessment, and supply chain and asset management decision-making.