

NUCLEAR ENERGY RESEARCH INITIATIVE

Dynamic Simulation and Optimization of Nuclear Hydrogen Production Systems

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Project Number: 06-041

Collaborators: None

Program Area: Nuclear Hydrogen
Initiative

Project Description

An important alternative to producing hydrogen from fossil fuels is producing it via nuclear power. This project is part of a research effort to design a hydrogen plant and its interface with the reactor. The natural interdependence between design and operational decisions for integrated nuclear hydrogen production systems necessitates a modeling and simulation environment that can capture the physical design descriptions and map these to steady-state and dynamic predictions of the hypothesized system behavior. Simulating these systems can provide invaluable information for the next step, whether it be an experiment or design decision. The simulated environment must be adaptable, flexible, and expandable.

This project will develop a dynamic modeling, simulation, and optimization environment for nuclear hydrogen production systems. A hybrid discrete/continuous model design will capture both the continuous dynamics of the nuclear plant, hydrogen plant, and their interface, along with discrete events of the overall system. This will allow researchers to study plant operations and accident scenarios. Researchers can also use it to conduct parameter estimation studies to identify possible improvements in materials, mechanical design, and safety issues. The seamless connection between modeling and simulation can help establish optimal control schemes. These schemes can then be tested in the model.

Workscope

The following activities comprise the scope of work for this project:

- Conduct superstructure analysis to screen and compare hydrogen production alternatives
- Identify key characteristics for subsystems as components of the overall system
- Survey existing reactor and hydrogen production models for suitability
- Integrate new and/or existing models into the overall system
- Validate the models with available data
- Establish scenarios for simulation, including start-up, shutdown, off-normal, and accident
- Perform dynamic simulation studies of alternatives for hydrogen production
- Identify relevant process parameters and conduct dynamic optimization studies
- Compare performance, efficiency, and other factors for hydrogen process alternatives
- Study optimal control policies and streamline model improvement