NEUP Nuclear Energy University Program
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Advanced Instrumentation for In-Situ Diagnostics in Reactor Conditions

PI: Michael Corradini, University of Wisconsin
Program: FC-2.4: Maintaining and Building upon the Halden Legacy of In-situ Diagnostics

Collaborators: Mark Anderson, University of Wisconsin (UW); Wade Marcum, Oregon State University (OSU); International Collaborator - HangJin Jo, Pohang Institute of Science and Technology, South Korea

ABSTRACT:
The Halden boiling water reactor (HBWR) had been used for research into fuel, cladding and materials for the last sixty years, but it is now in a shutdown state and at present is transitioning toward a decommissioning effort. With the expanding missions of test reactors for accident tolerant fuels and advanced fuels, it is crucial to maintain and improve upon Halden reactor's legacy of in-situ instrumentation and sensor capabilities. In particular, the Halden reactor has been a significant and high-impact source of experimental data to support the nuclear industry's better understanding of fuel-cladding response during light water reactor (LWR) transients and accidents; e.g., Loss-of-Coolant-Accident (LOCA). Therefore, it is important not to lose this capability and to be able to have consistent and hi-quality data. Specifically, this type of LOCA testing has become particularly important given the interest in advanced LWR fuels that seek to extend burnup beyond current regulatory limits; i.e., using chromium-doped fuel or coated claddings that can minimize operational corrosion and oxidation under accident conditions.

Our proposed research addresses the overall objective of FC-2.4 that seeks to maintain the Halden legacy of in-situ test diagnostics, and to expand and to improve upon the ability to provide real-time in-situ measurements during testing. Specifically, our research proposal is focused on developing in-situ measurements of distributed temperatures and local strain for a test rod in out-of-pile test loops at University of Wisconsin, UW (steady-state) and at Oregon State, OSU (LOCA transient). Our proposal has the following objectives:

[1] Review of the various types of fiber optic sensors that are suitable for the nuclear environment (i.e., radiation, pressure, temperatures) and identify the fiber optic sensor system to be installed in test rods;

[2] Develop the optimized fiber optic sensor systems for use in distributed temperature measurements as well as local strain measurements and test (initially under steady-state PWR conditions at UW);

3] Design and modify the current OSU transient LOCA test facility to allow for transient LOCA testing that is prototypic of planned TREAT experiments;

[4] Perform the LOCA tests in OSU transient LOCA facility with fiber optic sensors installed;

[5] Analysis of the LOCA test results using state-of-the-art safety analysis computer codes

(Analyses efforts will be a team effort between University of Wisconsin and POSTECH)