
Innovative Use of Accident Tolerant Fuels (ATF) with the RCIC System to Enhance Passive Safety of Commercial BWRs

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ABSTRACT:

The overarching objectives of this proposal are to:

- Demonstrate new operational strategies with the combined use of Accident Tolerant Fuels (ATF) and the Reactor Core Isolation Cooling (RCIC) System to increase the passive safety capabilities of current Boiling Water Reactors (BWRs) in delaying or preventing core damage.
- Pursue the delay of containment venting until after a 72-hour coping period through new BWR Suppression Pool mixing procedures.

This proposed project will directly address the objectives described in Technical Work Scope Identifier RC-7 by using both simulation and experimental data to validate the proposed strategies. Analytical models for the RCIC System and an experimental facility capable of integral RCIC System testing, including Suppression Pool mixing, are available to the proposing team. Original contributions of the proposed work will be new ATF models, new passive strategies for combined use of ATF and the RCIC System, new procedures for increasing the thermal utilization of the Suppression Pool and validation of these strategies and approaches.

The motivation for this project stems from the potential to increase the ability of existing nuclear power plants to passively respond to beyond design basis events using existing equipment and without changes to the plants. ATF lead assemblies are scheduled to be introduced into reactor cores in the near future for the purpose of improved fuel performance. However, ATF has several features that may also provide greater thermal margin and thereby enhance reactor safety. Similarly, the capabilities of the RCIC System might not be fully utilized for providing cooling water to the reactor core.

Regarding the potential for coupled ATF-RCIC System operational strategies, current RCIC System operations assume a core with traditional fuel designs, and possibly with partial MOX loading. However, the more-resilient nature of ATF permits new upset recovery techniques or greater recovery abilities at high temperature. For instance, high temperature core reflood can be permitted to occur more slowly if the fuel design is more tolerant of very high temperature conditions, reducing the thermal shock applied to the fuel; this could make the RCIC System preferable to High Pressure Core Injection (HPCI) or Low Pressure Core Injection (LPCI) in some scenarios for ATF. This is an extreme condition, but highlights the fact that additional margin in ATF can have a significant role in systems operations in BDBE-space.