INTERNATIONAL NUCLEAR ENERGY RESEARCH INITIATIVE

Experimental Investigation of Small Break LOCAs in Coupled Vessel/Containment Integral Reactors

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Project Abstract

The purpose of this project is to experimentally verify the behavior of integral reactors during accident conditions. The Global Nuclear Energy Initiative (GNEP) includes international deployment of smaller-scale, grid-appropriate reactors with fully passive safety systems, such as the International Reactor Innovative and Secure (IRIS). IRIS offers advantages over traditional passive safety features with its inherent, design-based approach to coping with small break loss-of-coolant accidents (LOCA) that does not rely on dedicated safety systems for coolant injection. The integral configuration of IRIS (without the primary loop external to reactor vessel) also precludes the possibility of a large break LOCA.

During a small break LOCA the reactor vessel depressurizes due to heat removal and condensation by the integral steam generators, while the pressure in the high design pressure small spherical containment increases from the steam release through the break. The two pressures equalize relatively quickly, nullifying the pressure differential that drives the coolant egress, thus terminating the LOCA without any coolant injection or need for operator intervention. Numerous computer simulations performed under a variety of conditions indicate that the core remains safely covered at all times. However, an accurate and comprehensive experimental investigation is necessary to validate analytic tools and confirm this result.

This work will require extensive modifications and upgrades of SIET's existing AP600 test facility to represent the characteristics of an integral rather than a loop-type reactor and the vessel/containment coupling. Researchers will develop an analytical program to guide testing. The four-year duration supports the IRIS goal of submitting the Design Certification application in 2010.

The project entails the following tasks:

- Design a small break LOCA experimental facility for the coupled vessel/containment configuration that also allows investigation of other accident scenarios
- Review existing QA plans and update as necessary to satisfy IRIS integral testing needs
- Perform pre-test analyses to guide and evaluate the actual tests
- Procure components and assemble the equipment necessary to modify, construct and commission the test facility
- Conduct the test matrix, including shakedown tests
- Evaluate results and prepare a comprehensive report to be incorporated into the safety documentation required by the IRIS application for NRC final design approval.