September 28, 2011

MEMORANDUM TO: Stewart N. Bailey
Safety Issues Resolution Branch
Division of Safety Systems

FROM: Ervin L. Geiger ***/RA/***
Safety Issues Resolution Branch
Division of Safety Systems
Office of Nuclear Reactor Regulation

SUBJECT: TRIP REPORT ON STAFF OBSERVATIONS OF GENERIC SAFETY ISSUE-191-RELATED WESTINGHOUSE FUEL ASSEMBLY TESTING AT CONTINUUM DYNAMICS INC.

On August 3 of 2011, The Nuclear Regulatory Commission (NRC) staff observed GSI-191-related downstream effects fuel blockage testing conducted on Westinghouse fuel assemblies by Continuum Dynamics Inc. in Ewing New Jersey. Enclosed is the trip report describing the staff observations.

Enclosure:
As noted

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301-415-5680

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<u>DISTRIBUTION</u>: WRuland PKlein SSmith

ADAMS ACCESSION NO.: ML112430115 NRR-106

Office	NRR/DSS/SSIB	NRR/DSS/SSIB/BC
Name	EGeiger:	SBailey:
Date	9/06/ 11	9/28/ 11

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Trip Report
Westinghouse Fuel Assembly Testing at
Continuum Dynamics Inc. Located in Ewing New Jersey
August 3, 2011

Background

In response to NRC staff's request for additional information related to topical report WCAP-16793-NP, "*Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid",* the Pressurized Water Reactor Owners Group (PWROG) is performing additional testing to evaluate in-vessel effects of particulate, fibrous, and chemical debris that pass through the sump strainer following a loss-of-coolant-accident (LOCA). These tests are being conducted by Westinghouse and AREVA on their respective fuel designs using various fiber, particulate, and chemical precipitate debris loads to examine the pressure drop across a single fuel assembly. The tests also examine the effect of the various fuel inlet nozzle designs on debris capture and flow blockage. Because the combinations of fuel designs and debris quantities was too great to permit testing of every combination, the PWROG proposed to conduct extended testing on whichever fuel design was shown, through initial testing, to yield the most conservative results. Earlier testing had shown that the Westinghouse and AREVA fuel designs produced similar results with high particulate-to-fiber ratio debris mixes. However, when tests using debris mixes having lower particulate-to-fiber ratios resulted in higher pressure drops, the need for additional testing for each fuel design was identified. Therefore, the PWROG sponsored additional testing using lower particulate-to-fiber ratio debris mixes, including tests intended to demonstrate that the two fuel vendor designs exhibit similar results with lower particulate debris. The goal of these tests is to determine the maximum sump strainer debris bypass loads that will not result in unacceptable pressure drops across the mock-up fuel assembly. The purpose of the test observed on August 3, 2011 was to demonstrate that the Westinghouse fuel assembly would yield tests result similar to that obtained for the Westinghouse fuel tested at the Westinghouse test facility under similar conditions (test number CIB 54), thereby proving that the difference in the fiber acceptance limits between the Westinghouse and AREVA fuel designs was due to the difference in fuel design and not the differences between the test loops used by the two fuel suppliers. This trip report summarizes the NRC staff's observations of the fuel blockage test performed on the Westinghouse fuel assembly.

Discussion

Test Parameters

The test was designed to simulate the flow rate and debris load associated with a hot-leg break (44.7 gpm flow rate per fuel assembly (FA)). The maximum debris load in the test was 25 grams fiber, 25 grams silicon carbide particulate, and 20 gallons of AlOOH precipitate.
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ENCLOSURE

The test followed the procedure used in previous tests except that the water temperature was raised from 70 °F to 130 °F. The sequence of debris addition was also the same except that the precipitate was added in small quantities in rapid succession to simulate precipitation in the containment pool.

The fuel assembly test using scaled flow rate, scaled debris load, scaled height mock-up fuel assembly, and simulated gap between fuel assemblies is considered representative for the specific type of Westinghouse fuel assembly and debris load being tested.

Test Sequence

Flow through the test loop was initiated and the water temperature was raised to 130 °F. Next, 25 grams of particulate (silicon carbide) was added. After the particulate addition, the pressure drop across the FA was allowed to stabilize for 30 minutes. After the pressure drop stabilized, 10 grams of fiber was added, followed by two more additions of fiber (10 grams and 5 grams, respectively) in approximately 10 minute intervals. After 30 minutes, small batches of chemical precipitate were added in rapid succession, as described above.

Staff Observations

The addition of particulate produced negligible pressure drop across the FA. The addition of fiber caused the pressure drop to rise steadily. The addition of chemical precipitate caused the differential pressure across the FA to approach the design pressure of the test tank and, therefore, the flow was throttled back slightly to prevent the maximum allowable test tank pressure from being exceeded.

Westinghouse personnel stated that the results of the test did not match the results obtained in the reference test (CIB 54) within the 25 per cent acceptance criterion set by the PWROG.

Comments

The conclusion that can be drawn from the test observed during this visit, and a similar test of AREVA fuel observed at the Westinghouse test facility (ML102720058), is that subtle difference in the test loop (i.e., test tank inlet geometry, mixing, loop components, air entrainment, etc.) can significantly influence test results.