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Project Number 694

August 24, 2015

OG-15-336

US Nuclear Regulatory Commission
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Subject: PWR Owners Group
Notification of Intent to Submit Additional Information in Support of WCAP-17788-P Regarding Brine Testing Report

Dear Mr. Cusumano,

In response to your discussions with the PWR Owners Group (PWROG) on August 17, 2015, the PWROG intends to submit additional information in support of the determination of the cold leg break (CLB) fiber limit documented in WCAP-17788-P, Volume 1, Revision 0, contingent on approval of funding by PWROG membership. This report is expected to be completed by November 30, 2015 and will be submitted to the Staff at that time. In the interim, the following has been prepared in order to clarify how the brine testing information has been used, in addition to other data and rationale, to establish the CLB fiber limit.

The objective of the subscale brine test program is to evaluate the influence of debris-induced core inlet blockage on the density-driven transport of high concentration boric acid from the core to the lower plenum and to determine a fiber debris load for which communication continues such that current boric acid precipitation (BAP) analysis methods that credit the lower plenum remain valid.

Typical BAP analyses performed for Westinghouse, CE, and some B&W NSSS designs credit some fraction of the lower plenum volume when calculating the buildup of boric acid in the reactor vessel. Crediting lower plenum volume reduces the buildup rate of boric acid and extends the time until BAP is predicted to occur. The closure of GSI-191 has brought crediting lower plenum volume into question due to concerns related to the influence of a debris bed following a large CLB loss-of-coolant accident (LOCA). The concern is that if a debris bed forms at the core inlet, it will prevent communication between the core and lower plenum by eliminating the mechanisms that transport high concentration boric acid from the core to the lower plenum.

Verification of continued communication between the core and lower plenum is accomplished by demonstrating, through testing, that the presence of fibrous debris at the core inlet does not prevent mass transport between these regions following a large CLB LOCA. Results from the

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brine testing are used to support the core inlet fibrous debris limit for the large CLB scenario in the GSI-191 closure program (WCAP-17788).

To accomplish this objective, an adiabatic separate effects test was designed that takes advantage of the existing subscale test apparatus constructed for GSI-191 head loss testing (see Volume 6 of WCAP-17788-P). The subscale facility was designed to conduct systematic, separate effects tests under well-controlled laboratory conditions in order to generate debris bed resistance data as a function of debris mass. The facility is capable of operating over a wide range of conditions representative of those expected in a PWR during the post-LOCA phase of a postulated accident and was easily modified to accommodate the brine testing.

The brine test conditions are defined to simulate the post-LOCA density gradient that exists between the core and lower plenum by using a high density brine solution that is injected downstream from the core inlet geometry. The injected brine creates the necessary density gradient to transport mass through the core inlet geometry. A total of 44 brine tests were completed under the program. Debris load (fiber and particulate), flow rate, brine injection concentration, and the timing of brine injection were varied as part of the test matrix.

Two core inlet geometries were utilized in the testing: one representative of Westinghouse fuel, and one representative of AREVA fuel. These are the same core inlet geometries that were used in the GSI-191 head loss testing documented in Volume 6 of WCAP-17788-P. The debris addition protocol was also the same as was used in the head loss testing program and the resulting debris bed formation and structure was comparable in both programs.

The existing subscale instrumentation used to measure pressure drop across the debris bed and bulk flow rate through the test column was also utilized in the brine test program. The resulting pressure drops recorded during the brine testing were small because of the low fiber loads and low flow rates tested. The low pressure drops measured in the brine testing were comparable to measurements from the subscale head loss program under similar debris loadings and flow conditions. Additional instrumentation to measure the brine solution concentration at multiple axial locations across the test column was added for the brine testing. These concentration measurements, as well as visual observations, are used to confirm the transport of solute mass through the core inlet geometry over a broad range of fibrous and particulate debris loads.

The brine test results, in conjunction with other testing observations and rationale, collectively support the core inlet fibrous debris limit for CLB conditions. Volume 1, Section 7.1 of WCAP-17788-P presents qualitative arguments to support the PWROG position that contiguous and continuous beds will not form across the core inlet. Further, the WCAP-17360 tests, which were run with a fiber load much higher than the brine testing, showed that a debris bed could not form at the core inlet under boiling conditions. This adds further justification that the WCAP-17788 CLB fiber limit is conservative and will not result in conditions that significantly affect mixing between the core and lower plenum.

Irrespective of the testing observations described above, the quantification of conservatisms contained in the BAP calculations described in OG-13-205 demonstrate that even if a uniform debris bed did form across the entire core inlet under large CLB conditions, BAP control is maintained. The conservatisms inherent to current BAP calculations are sufficient to off-set the

loss of the lower plenum volume. The major conservatisms identified in OG-13-205 include: use of Appendix K decay heat, limiting the two-phase mixture level to the bottom of the hot leg, not crediting additional vessel volumes (e.g., barrel/baffle volume), using maximum boron source concentrations, using minimum solubility limit, and not crediting system effects (e.g., liquid entrainment into hot legs and steam generators. Additional third party large scale BAP experiments, although conducted without debris, support these conservatisms and demonstrate that the buildup rates of boric acid concentration in a reactor vessel are much slower than those predicated by current BAP calculations).

The collective testing information and arguments provided above demonstrate that there is assurance of protection of the public health and safety, and that the fibrous debris limit documented in WCAP-17788 for the large CLB scenario is conservative. The brine and WCAP-17360 testing provide evidence that supports the assertion that a uniform debris bed will not form at the core inlet under CLB conditions. The evaluation performed in OG-13-205 provides defense-in-depth by demonstrating that if a uniform debris bed does form at the core inlet following a large CLB such that communication between the core and lower plenum is lost, sufficient margin exists in the methodology and assumptions to prevent the boron concentration in the reactor vessel from exceeding the solubility limit prior to currently licensed HLSO times.

The PWROG requests a follow-up discussion with the Staff to address any additional questions regarding the PWROG plans to complete and submit the brine test report, or the technical content contained herein. Please advise as to your earliest availability.

If you have any questions, please do not hesitate to contact me at (205) 992-7037 or Mr. W. Anthony Nowinowski, Program Manager of the PWR Owners Group, Program Management Office at (412) 374-6855.

Sincerely,

Norman J. Stringfellow

Jack Stringfellow, Chairman
PWR Owners Group

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