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PSEG Nuclear LLC

JUL 11 2013

10 CFR 50.54(f)

LR-N13-0148

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Salem Generating Station, Units 1 and 2
Renewed Facility Operating License Nos. DPR-70 and DPR-75
NRC Docket Nos. 50-272 and 50-311

Subject: **Generic Letter 2004-02 In-Vessel Downstream Effects Resolution**

References:

1. PSEG letter LR-N12-0124, "Final Supplemental Response to Generic Letter 2004-02," dated April 27, 2012, ADAMS Accession No. ML121290536

2. Pressurized Water Reactor Owners Group (PWROG), Topical Report (TR) WCAP-16793-NP, Revision 2, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid," dated October 12, 2011, ADAMS Accession No. ML11292A021

3. Final Safety Evaluation for Pressurized Water Reactor Owners Group Topical Report WCAP-16793-NP, Revision 2, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid," dated April 8, 2013, ADAMS Accession No. ML13084A154

4. NRC Generic Letter 2004-02: "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors," dated September 13, 2004, ADAMS Accession No. ML042360586

Consistent with Reference 1, PSEG Nuclear LLC (PSEG) hereby submits the Generic Letter (GL) 2004-02 plant specific response for WCAP-16793-NP (Reference 2) and the associated NRC Safety Evaluation (SE) (Reference 3), for Salem Generating Station (Salem), Units 1 and 2.

In Reference 1, PSEG stated that a plant specific response to in-vessel downstream effects will be provided within 90 days of the issuance of the final NRC Safety Evaluation on WCAP-16793-NP, Revision 2. The NRC SE on WCAP-16793-NP (Reference 3) was made publicly available on April 16, 2013.

With this submittal, PSEG has concluded that Salem Units 1 and 2 fully meet the requirements of NRC Generic Letter 2004-02. The Salem plant specific response to WCAP-16793-NP, Revision 2 is provided in Attachment 1 to this letter.

There are no new regulatory commitments contained in this submittal.

If you have any questions or require additional information, please do not hesitate to contact Ms. Emily Bauer at 856-339-1023.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on JUL 11 2013
(Date)

Sincerely,

John F. Perry
Site Vice President
Salem Generating Station

Attachment 1: Salem Response to WCAP-16793-NP, Revision 2

cc: Mr. W. Dean, Administrator, Region I, NRC
Mr. J. Hughey, Project Manager, NRC
NRC Senior Resident Inspector, Salem
Mr. P. Mulligan, Manager IV, NJBNE
Mr. L. Marabella, Corporate Commitment Tracking Coordinator
Mr. T. Cachaza, Salem Commitment Tracking Coordinator

Salem Response to WCAP-16793-NP, Revision 2

Introduction

During operation of the Emergency Core Cooling System (ECCS) to recirculate coolant from the containment sump, debris in the recirculating fluid that passes through the sump strainer may collect on the bottom surface of the fuel assembly bottom nozzle, causing resistance to flow through this path.

The collection of sufficient debris on the fuel assembly bottom nozzle is postulated to impede flow into the fuel assembly and core. Another concern is that the debris could bypass the fuel assembly bottom nozzle and either form blockages within the core or adhere to the cladding, thereby reducing the ability of the coolant to remove decay heat from the core.

WCAP-16793-NP, Revision 2 (Reference 2) evaluates the impact of debris that bypasses the containment sump screens on long-term core cooling. The NRC Safety Evaluation (SE) on WCAP-16793-NP (Reference 3) was made publicly available on April 16, 2013.

WCAP-16793-NP requires that all utilities perform a plant specific evaluation to demonstrate that they are bounded by the specified acceptance criteria. The requirements were endorsed by the NRC in the SE.

PSEG has performed a Salem plant specific evaluation (using References 2 and 3), which is documented in PSEG calculation S-C-RHR-MDC-2295 (Reference 4). The following provides the Salem plant specific information.

WCAP-16793-NP Acceptance Criteria

In Section 10 of WCAP-16793-NP, the following acceptance criteria were specified.

1. The maximum clad temperature shall not exceed 800 °F.

PSEG Response to 1:
The maximum calculated cladding temperature is 384 °F. This is less than the recommended maximum cladding temperature of 800 °F.

2. The thickness of the cladding oxide and the fuel deposits shall not exceed 0.050 inch in any fuel region.

PSEG Response to 2:
The total deposition thickness is 0.0284 inch (28.4 mils). This is less than the recommended total debris deposition thickness of 0.050 inch.

Additional Criteria:
Utilities must evaluate site-specific fiber loading against the debris load acceptance criteria provided in WCAP-16793-NP.

PSEG Response to Additional Criteria:
Based on Salem specific strainer bypass testing, the fiber calculated to bypass the strainers and reach the fuel assembly is 10.6 grams per fuel assembly. This quantity is less than the WCAP-16793-NP acceptance criteria of 15 grams per fuel assembly.

SE Specified Items

On page 70 of the SE, the NRC has specified that Licensee submittals to the NRC regarding in-vessel downstream effects should include the following:

1. The means used to determine the amount of debris that bypasses the ECCS strainer and the fiber loading expected, per fuel assembly, for the cold-leg and hot-leg break scenarios

PSEG Response to 1:
At Salem Units 1 and 2, a pipe break at the hot-leg results in the maximum amount of debris generation. The debris generation due to a cold-leg break is enveloped by the hot-leg break. The bypass testing used a fiber debris load which bounded both the hot-leg and cold-leg breaks.

The fiber bypass testing was done at a vendor (CCI) facility using the Salem prototypical strainer assembly. The bypassed fiber was collected on a fiber bypass capture screen. The fiber bypass capture screen was not removed during the test, thus minimizing the chance for captured fiber to fall off the capture screen. The fiber capture screen was weighed prior to and after completion of the test. The difference between the final and initial bypass capture screen mass is the mass of bypassed fiber. The bypass test is discussed in detail in References 1 and 8.

Based on Salem specific strainer bypass testing, the fiber calculated to bypass the strainers and reach the fuel assembly is 10.6 grams per fuel assembly. This quantity is less than the WCAP-16793-NP acceptance criteria of 15 grams per fuel assembly.

2. The peak clad temperature calculated using LOCADM

PSEG Response to 2:
The unmodified LOCADM spreadsheet (Reference 5), which is based on WCAP-16793-NP, was used to perform the calculation of the thickness of the deposition that is expected to form on the fuel cladding and the calculation of the resulting temperature of the fuel cladding. The maximum calculated cladding temperature is 384 °F. This is less than the recommended maximum cladding temperature of 800 °F.

3. The available driving head used in the hot-leg evaluations

PSEG Response to 3:
The plant specific available hot-leg break driving head is between 12.7 to 13.5 psi for Salem Unit 1, and between 16.1 to 17.2 psi for Salem Unit 2.

4. The licensee's planned and/or completed actions if the acceptance criteria stated herein are exceeded (e.g., plans to reduce fiber loads)

PSEG Response to 4:
The acceptance criteria specified in Reference 3 is not exceeded for Salem Units 1 and 2. Therefore, there are no planned or completed actions.

5. A description and justification for any deviations taken from the topical report as accepted and modified by the Conditions and Limitations in Section 4.0 of this SE

PSEG Response to 5:
The Salem plant specific evaluation did not take any deviations from the topical report, as accepted and modified by the Conditions and Limitations in Section 4.0 of the NRC SE. Please see the "SE Limitations and Conditions" section of this evaluation for a detailed description.

SE Limitations and Conditions

Section 4.0 of the NRC SE lists fourteen limitations and conditions that are to be addressed by licensees as part of their response to in-vessel long term cooling concerns. These limitations and conditions were evaluated in Reference 4. The evaluation concludes that Salem Units 1 and 2 meet each limitation and condition. Following are the PSEG responses to these limitations and conditions.
(Note: The NRC SE limitations and conditions text is not repeated below).

PSEG Response to Limitation 1:
The plant specific available hot-leg break driving head is between 12.7 to 13.5 psi for Salem Unit 1, and between 16.1 to 17.2 psi for Salem Unit 2. This is greater than the debris head loss measured during the proprietary fuel assembly tests (Reference 7).

The maximum flow rate per fuel assembly at Salem is 44.6 gpm. This flow rate is bounded by the flow rate of 44.7 gpm per fuel assembly used in the Westinghouse and AREVA testing.

Salem utilizes Westinghouse fuel assemblies with the P-grid design. This design is evaluated in WCAP-16793-NP.

In addition, Section 10.2 of Reference 2 states the following:
"The AREVA testing conducted in support of this program demonstrated that 15 g of fiber/FA does not cause a blockage that will challenge LTCC, the maximum dP due to debris (dP_{debris}) was very small and all plants have an available driving head (dP_{avail}) that is considerably greater. Therefore, all PWROG plants can demonstrate LTCC is not impeded if the plant-specific fibrous debris load is less than or equal to 15 g of fiber/FA."

Based on Salem specific strainer bypass testing, the fiber calculated to bypass the strainers and reach the fuel assembly is 10.6 grams per fuel assembly. This quantity is less than the WCAP-16793-NP acceptance criteria of 15 grams per fuel assembly.

Salem Units 1 and 2 did not perform any plant specific testing and/or evaluations to increase the debris limits on a site-specific basis.

PSEG Response to Limitation 2:
The calculated available hot-leg driving head is between 12.7 to 13.5 psi for Unit 1 and between 16.1 to 17.2 psi for Unit 2. The maximum flow rate per fuel assembly at Salem is 44.6 gpm. In addition, Salem utilizes Westinghouse fuel assemblies with the P-grid design. This design is evaluated in WCAP-16793-NP.

Based on the LOCADM calculation, the maximum calculated cladding temperature is 384 °F. This is less than the recommended maximum cladding temperature of 800 °F. The total deposition thickness is 0.0284 inch. This is less than the recommended total deposition thickness of 0.050 inch.

Based on Salem specific strainer bypass testing, the fiber calculated to bypass the strainers and reach the fuel assembly is 10.6 grams per fuel assembly. This quantity is less than the WCAP-16793-NP acceptance criteria of 15 grams per fuel assembly.

PSEG Response to Limitation 3:
Salem Units 1 and 2 did not credit any alternate flow paths in the RPV.

PSEG Response to Limitation 4:
At Salem Units 1 and 2, the quantity of fibrous debris that could bypass the ECCS screens and reach the core is less than 15 grams per fuel assembly. In addition, the evaluations provided in Sections 3.2 and 3.3 of WCAP-16793-NP are not used.

PSEG Response to Limitation 5:
At Salem Units 1 and 2, the quantity of fibrous debris that could bypass the ECCS screens and reach the core is less than 15 grams per fuel assembly.

PSEG Response to Limitation 6:
Salem utilizes Westinghouse fuel assemblies with the P-grid design. This design is evaluated in WCAP-16793-NP. Any future design changes will be evaluated in accordance with 10 CFR 50.59 to ensure that new designs do not impact adequate long term core cooling following a LOCA.

PSEG Response to Limitation 7:
The maximum calculated cladding temperature is 384 °F. This is less than the recommended maximum cladding temperature of 800 °F. The unmodified LOCADM spreadsheet (Reference 5), which is based on WCAP-16793-NP, was used to show that the maximum fuel cladding temperature does not exceed 800°F.

PSEG Response to Limitation 8:
A procedure consistent with the one described in Limitation 8 is used in the Salem analysis (Reference 4) to account for the increased corrosion rate of aluminum metal. In order to account for the increased corrosion rate of aluminum metal during the initial days following a LOCA, the aluminum surface area was increased by a factor of two while limiting the aluminum mass to the 30 day dissolved amount with the original aluminum area.

PSEG Response to Limitation 9:
At Salem Units 1 and 2, the unmodified version of the LOCADM spreadsheet was used.

PSEG Response to Limitation 10:
At Salem Units 1 and 2, the unmodified version of the LOCADM spreadsheet was used with the default thermal conductivity of 0.11 BTU / (h-ft-°F).

PSEG Response to Limitation 11:
At Salem Units 1 and 2, a pipe break at the hot-leg results in the maximum amount of debris generation. The debris generation due to a cold-leg break is enveloped by the hot-leg break. The bypass testing used a fiber debris load which bounded both the hot-leg and cold-leg breaks.

At Salem Units 1 and 2, the fiber calculated to bypass the strainers and reach the fuel assembly is 10.6 grams per fuel assembly. This quantity was determined by performing strainer bypass testing using the plant strainer design, plant-specific debris loads, and plant-specific flow

velocities. This quantity is less than the WCAP-16793-NP acceptance criteria of 15 grams per fuel assembly.

PSEG Response to Limitation 12:
At Salem Units 1 and 2, the quantity of fibrous debris that could bypass the ECCS screens and reach the core is less than 15 grams per fuel assembly.

PSEG Response to Limitation 13:
The bypass fiber size distribution at Salem was compared to the fiber size distribution in Reference 2. The PWROG fuel assembly testing used a blender to produce fibers with lengths representative of bypassed fibers. The Salem plant specific testing at the vendor facility (CCI) used a high pressure washer to produce fibers with lengths representative of fibers upstream of the strainer.

The blender method is known to result in larger amounts of smaller fibers. However, the methodology used to prepare the fiber insulation at Salem is consistent with NEI's recommended procedure (Reference 9) and is expected to produce a representative fiber bypass size distribution. Based on the comparison between the Salem and PWROG testing, the bypass fiber sizes for Salem are slightly larger than those tested by the PWROG but are comparable. Therefore, the size of fibrous debris which bypasses the strainer is comparable to the fiber sizes used in the fuel assembly testing in Reference 2.

PSEG Response to Limitation 14:
Salem Units 1 and 2 did not use the "Margin Calculator" methodology.

Conclusion

Based on the above information, PSEG concludes that Salem Units 1 and 2 meet the requirements specified in WCAP-16793-NP, Revision 2, and the specifications, limitations, and conditions listed in the associated NRC Safety Evaluation. Therefore, PSEG is in compliance with the requirements of Generic Letter 2004-02.

References

1. PSEG letter LR-N12-0124, "Final Supplemental Response to Generic Letter 2004-02," dated April 27, 2012, ADAMS Accession No. ML121290536

2. Pressurized Water Reactor Owners Group (PWROG), Topical Report (TR) WCAP-16793-NP, Revision 2, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid," dated October 12, 2011, ADAMS Accession No. ML11292A021

3. Final Safety Evaluation for Pressurized Water Reactor Owners Group Topical Report WCAP-16793-NP, Revision 2, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid," dated April 8, 2013, ADAMS Accession No. ML13084A154

4. PSEG Calculation S-C-RHR-MDC-2295, Revision 1, "Post LOCA Fuel Deposition Analysis in Support of GSI-191"

5. OG-07-534, “Transmittal of Additional Guidance for Modeling Post-LOCA Core Deposition with LOCADM Document for WCAP-16793-NP (PA-SEE-0312),” dated December 14, 2007

6. NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors," dated September 13, 2004, ADAMS Accession No. ML042360586

7. WCAP-17057-P (Proprietary), Revision 1, “GSI-191 Fuel Assembly Test Report for PWROG,” dated September 2011

8 PSEG letter LR-N13-0091, "Final Responses to NRC Questions Regarding Salem Bypass Testing," April 22, 2013, ADAMS Accession No. ML13114A048

9. Letter from J. Butler (NEI) to S. Bailey (NRC), Subject: Fibrous Debris Preparation Procedure for ECCS Recirculation Sump Strainer Testing, Revision 1, dated January 30, 2012, ADAMS Accession No. ML120481052; including Attachment entitled, “ZOI Fibrous Debris Preparation: Processing, Storage and Handling,” Revision 1, dated January 2012, ADAMS Accession No. ML120481057