

November 28, 2005

Mr. William Levis  
Senior Vice President & Chief Nuclear Officer  
PSEG Nuclear LLC - X04  
Post Office Box 236  
Hancocks Bridge, NJ 08038

SUBJECT: SALEM NUCLEAR GENERATING STATION, UNIT NOS. 1 AND 2 -  
RESPONSE TO NRC BULLETIN 2003-01, "POTENTIAL IMPACT OF DEBRIS  
BLOCKAGE ON EMERGENCY SUMP RECIRCULATION AT PRESSURIZED  
WATER REACTORS" (TAC NOS. MB9607 AND MB9608)

Dear Mr. Levis:

The Nuclear Regulatory Commission (NRC) staff has reviewed your letters dated August 6, 2003, October 29, 2004, and September 14, 2005, related to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors." The NRC issued Bulletin 2003-01 on June 9, 2003, to all pressurized-water reactor licensees to: 1) inform them of the results of NRC-sponsored research on debris blockage of recirculation sump screens; 2) inform them of potential additional adverse effects due to debris blockage; 3) request that, in light of these potentially adverse effects, licensees confirm their compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.46(b)(5) and other requirements, or to describe any compensatory measures implemented to reduce the potential risk as evaluations proceed to determine compliance; and 4) require a written response in accordance with 10 CFR 50.54(f). Your letters described compensatory measures to reduce potential risk and, as such, are considered an "Option 2" response to Bulletin 2003-01.

Based on your letters, the NRC staff considers your actions to be responsive to, and meet the intent of, Bulletin 2003-01 for Salem Nuclear Generating Station, Unit Nos. 1 and 2. The staff's evaluation is enclosed. Please retain any records of your actions in response to Bulletin 2003-01, as the NRC staff may conduct subsequent inspection activities regarding this issue.

W. Levis

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Should you have any questions, please contact me at 301-415-1321, or the lead project manager for this issue, Alan Wang, at 301-415-1445.

Sincerely,

**/RA/**

Stewart N. Bailey, Project Manager  
Plant Licensing Branch I-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-272 and 50-311

Enclosure: As stated

cc w/encl: See next page

W. Levis

-2-

Should you have any questions, please contact me at 301-415-1321, or the lead project manager for this issue, Alan Wang, at 301-415-1445.

Sincerely,

*/RA/*

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Docket Nos. 50-272 and 50-311

Enclosure: As stated

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EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RESPONSE TO NRC BULLETIN 2003-01

“POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY SUMP RECIRCULATION  
AT PRESSURIZED WATER REACTORS”

PSEG NUCLEAR LLC

SALEM NUCLEAR GENERATING STATION, UNIT NOS. 1 AND 2

DOCKET NO. 50-272 AND 50-311

By letters dated August 6, 2003, October 29, 2004, and September 14, 2005, PSEG Nuclear LLC (PSEG), the licensee for Salem Nuclear Generating Station, Unit Nos. 1 and 2 (Salem), provided information related to Nuclear Regulatory Commission (NRC) Bulletin 2003-01, “Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors.”

The NRC issued Bulletin 2003-01 on June 9, 2003, to all pressurized-water reactor licensees to: 1) inform them of the results of NRC-sponsored research on debris blockage of recirculation sump screens; 2) inform them of potential additional adverse effects due to debris blockage; 3) request that, in light of these potentially adverse effects, licensees confirm their compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.46(b)(5) and other requirements, or to describe any compensatory measures implemented to reduce the potential risk as evaluations proceed to determine compliance; and 4) require a written response in accordance with 10 CFR 50.54(f). The written response was to contain the information in either of the following options stated in Bulletin 2003-01:

- Option 1: State that the emergency core cooling system (ECCS) and containment spray system (CSS) recirculation functions have been analyzed with respect to the potentially adverse post-accident debris blockage effects identified in the Discussion section, and are in compliance with all existing applicable regulatory requirements.
- Option 2: Describe any interim compensatory measures (ICMs) that have been implemented or that will be implemented to reduce the risk which may be associated with potentially degraded or nonconforming ECCS and CSS recirculation functions until an evaluation to determine compliance is complete. If any of the interim compensatory measures listed in the Discussion section will not be implemented, provide a justification. Additionally, for any planned interim measures that will not be in place prior to your response to this bulletin, submit

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an implementation schedule and provide the basis for concluding that their implementation is not practical until a later date.

Bulletin 2003-01 discussed six categories of ICMs as follows:

(1) operator training on indications of, and responses to, sump clogging; (2) procedural modifications, if appropriate, that would delay the switchover to containment sump recirculation (e.g., shutting down redundant pumps that are not necessary to provide required flows to cool the containment and reactor core, and operating the CSS intermittently); (3) ensuring that alternative water sources are available to refill the refueling water storage tank (RWST) or to otherwise provide inventory to inject into the reactor core and spray into the containment atmosphere; (4) more aggressive containment cleaning and increased foreign material controls; (5) ensuring containment drainage paths are unblocked; and (6) ensuring sump screens are free of adverse gaps and breaches.

Your letter dated August 6, 2003, provided an Option 2 response and stated that the following ICMs had already been implemented at Salem:

- (1) Emergency operating procedures (EOPs) which address transfer to cold-leg recirculation and the loss of recirculation capability, and which are exercised by operators during simulator training scenarios (ICM category 1);
- (2) EOPs which direct operators to monitor 12 plant-specific instruments for indication of proper ECCS operation (ICM category 1);
- (3) Loss-of-coolant accident (LOCA) procedures which direct the stoppage of one containment spray pump early in recirculation alignment to prolong the time available for the operators to establish cold-leg recirculation prior to RWST depletion (ICM category 2);
- (4) EOP guidance for other than large-break LOCAs to delay depletion of the RWST before switchover to sump recirculation, including steps to cooldown and depressurize the reactor coolant system (RCS) to reduce break flow, thereby reducing the injection flow necessary to maintain RCS subcooling and inventory, with safety injection pumps sequentially stopped to reduce injection flow and, therefore, RWST outflow (ICM category 2);
- (5) for smaller LOCAs, RCS pressure remains greater than residual heat removal (RHR) pump discharge pressure and containment spray actuation does not occur, resulting in a significant reduction of RWST draindown and making it possible to depressurize the RCS to cold shutdown conditions before the RWST is drained to the sump recirculation switchover level, making sump blockage a non-issue (ICM category 2);
- (6) capability to quickly inject borated water to the affected unit RWST from the opposite unit RWST (ICM category 3);
- (7) procedures for positive control of materials taken into the containment, with controls on plastic placement, paper tags and tool loss, and with containment inspection criteria to

verify that no loose debris is present at containment closeout which could cause restriction at the containment sump suction during a LOCA event (ICM category 4);

- (8) containment sump visual inspections every outage, and procedures to review the storage of "transient loads" (i.e., temporary equipment) in containment during power operation (ICM category 4);
- (9) planned outage cleanup activities to assure that containment housekeeping standards are met (ICM category 4);
- (10) an end-of-outage walkdown inspection to verify that no loose debris is present in accessible places, with independent senior manager inspection tours of the containment assessing cleanliness and loose debris status (ICM category 4);
- (11) routine vacuum cleaning and visual inspection of both the inner- and outer-annulus drain trenches (ICM category 4); and
- (12) visual operability verification of the containment sump and its subsystem suction piping for loose debris and evidence of structural distress or corrosion, and verification that the sump components (trash racks and screens) show no evidence of structural distress or corrosion, with acceptance criteria for the interior mesh screens that they be intact and free of defects (ICM category 6).

Your August 6, 2003, letter also stated that you would be implementing the following ICMs at Salem:

- (1) additional training on the containment sump blockage issues of Bulletin 2003-01 by April 30, 2003 (ICM category 1);
- (2) enhancements to the Technical Support Center (TSC) integrated engineering response procedure to provide additional guidance on mitigating the effects of degraded ECCS pump performance due to sump blockage, with tabletop training sessions by October 2004 (ICM category 1);
- (3) updates to the Salem containment walkdown procedures to add emphasis based on the issues raised in Bulletin 2003-01 by spring 2004 (ICM category 4); and
- (4) operability verifications ensuring that the containment drain annulus within and outside the bio-shield are free of debris, with plates (baskets) in place, by spring 2004 (ICM category 5).

Your August 6, 2003, letter further stated that you would not be implementing the ICM to make procedural modifications that would delay the switchover to containment pump recirculation. Instead, you followed the industry recommendation to only consider these procedure changes after the owners groups had completed an evaluation of their generic impact. The Westinghouse Owners Group (WOG) was scheduled to evaluate these actions and provide generic recommendations by March 31, 2004.

The WOG's ICM recommendations were documented in WCAP-16204, "Evaluation of Potential ERG [emergency response guidelines] and EPG [emergency procedure guidelines] Changes to Address NRC Bulletin 2003-01 Recommendations (PA-SEE-0085)." By letter dated September 10, 2004, the NRC requested additional information, in part, about PSEG's evaluation and implementation of the WOG recommendations. In your response dated October 29, 2004, you discussed the WOG ICM recommendations as they pertain to the design and operation of Salem, as follows:

- (1) Candidate Operator Action (COA) A1a, "Operator Action to Secure One Spray Pump" (prior to initiating containment sump recirculation), concluding that PSEG will complete, by February 11, 2005, an evaluation of actions to stop one of two operating containment spray pumps earlier in a LOCA recovery, considering a complete interruption of spray flow due to a failure of the remaining active pump, and (if acceptable) will implement the appropriate EOP changes by July 31, 2005;
- (2) COA A1b, "Operator Action to Secure Both Spray Pumps," concluding that the Salem EOPs currently provide direction to stop two containment spray pumps if containment pressure has been reduced below the spray signal reset pressure (ICM category 1);
- (3) COA A2, "Manually Establish One Train of Containment Sump Recirculation Prior to Automatic Actuation," concluding that it is not feasible to establish a train of sump recirculation based on the small margin between the water volume available in the containment sump when the RWST low level is reached, and the water volume required in the containment sump to support operation of an RHR pump on recirculation;
- (4) COA A3-W, "Terminate One Train of Safety Injection After Recirculation Alignment," concluding that both the necessary analyses and single failure-related license amendment effort, and the potential for clad surface temperatures to reach unacceptable values, outweigh the sump-blockage-related benefit of this COA;
- (5) COA A4, "Early Termination of One LPSI [low-pressure safety injection]/RHR Pump Prior to Recirculation Alignment," concluding that risk to core cooling and potential fuel damage would result from this COA;
- (6) COA A5, "Refill of Refueling Water Storage Tank," concluding that Salem will modify its transfer to cold-leg recirculation procedure to establish makeup to the RWST after the last operating containment spray pump is stopped (with actual injection of this water into the RCS or into containment not being directed until after sump recirculation is lost), and will modify its containment sump blockage contingency actions procedure to provide additional makeup flow to the RCS from borated water sources by February 11, 2005 (ICM category 3);
- (7) COA A6, "Inject More Than One RWST Volume From a Refilled RWST or by Bypassing the RWST," concluding that Salem will include actions to provide additional makeup flow to the RCS from a borated water source, after loss of recirculation capability due to sump blockage, in a new procedure based on the generic Westinghouse guideline "Sump Blockage Control Room Guideline" or "SBCRG" (ICM category 1);



- (8) COA A7, "Provide More Aggressive Cooldown and Depressurization Following a Small Break LOCA," concluding that, with the Salem EOPs based on Westinghouse ERGs, the cooldown rate was already maximized at the technical specification limit (ICM category 2);
- (9) COA A8-W, "Provide Guidance on Symptoms and Identification of Containment Sump Blockage," concluding that PSEG will make monitoring of indications of sump blockage integral (rather than referenced) parts of Salem's procedures for transfer to cold-leg recirculation and loss of emergency recirculation (ICM category 1);
- (10) COA A9, "Develop Contingency Actions in Response to: Containment Sump Blockage, Loss of Suction, and Cavitation," concluding that, along with developing a new procedure based on the Westinghouse SBCRG discussed above, procedures were enhanced to provide additional guidance to the TSC staff to mitigate the effects of degraded ECCS pump performance if containment sump blockage is indicated or occurs. This included additional guidance for determining whether one train of ECCS pumps should be shut down, whether one train of CSS should be shut down, whether RHR flow should be throttled/reduced, whether the Salem loss-of-emergency recirculation procedure should be entered, and whether the chemical volume control system positive displacement pump cross connection should be used to support the affected unit (ICM category 1);
- (11) COA A10, "Early Termination of One Train of HPSI [high-pressure safety injection]/High-Head Injection Prior to Recirculation Alignment (RAS)," concluding that this ICM is not considered risk-beneficial due to the risk of core damage upon single failure loss of the one operating HPSI pump during a small-break LOCA; and
- (12) COA A11, "Prevent or Delay Containment Spray for Small Break LOCAs (<1.0 Inch Diameter) in Ice Condenser Plants," concluding that this COA does not apply to Salem.

As a follow-up to your letter dated October 29, 2004, in a conference call on August 18, 2005, the NRC staff asked whether you had completed your evaluation and implemented procedure changes for COA A1a. By letter dated September 14, 2005, you responded to the NRC staff's question as follows:

- (1) COA A1a, "Operator Action to Secure One Spray Pump," (prior to initiating containment sump recirculation), would not be implemented at Salem because the continuous operation of the CSS is credited in the current licensing basis. The analysis for the design basis LOCA assumes that at least one containment spray pump is running. A single failure of the remaining pump would result in a loss of iodine removal capability.

The NRC staff has considered your responses and the compensatory measures that have been implemented to reduce the interim risk associated with potentially degraded or nonconforming ECCS and CSS recirculation functions. Based on your letters, the NRC staff considers your actions to be responsive to, and meet the intent of, Bulletin 2003-01. Please retain any records of your actions in response to Bulletin 2003-01, as the NRC staff may conduct subsequent inspection activities regarding this issue.

Principal Contributors: M. Kowal  
A. Wang