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August 8, 2003

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors"

REFERENCES:

(a) NRC Bulletin 2003-01: Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors, dated June 9, 2003

(b) Draft Regulatory Guide DG-1107 (Proposed Revision 3 to Regulatory Guide 1.82) Water Sources For Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident

The purpose of this letter is to forward Calvert Cliffs Nuclear Power Plant, Inc.'s response to Nuclear Regulatory Commission (NRC) Bulletin 2003-01 (Reference a). The Bulletin was issued to:

(1) Inform addressees of the results of NRC-sponsored research identifying the potential susceptibility of pressurized-water reactor recirculation sump screens to debris blockage in the event of a high-energy line break requiring recirculation operation of the Emergency Core Cooling System or Containment Spray System.

(2) Inform addressees of the potential for additional adverse effects due to debris blockage of flow paths necessary for Emergency Core Cooling System and Containment Spray System recirculation and containment drainage.

(3) Request that, in light of these potentially adverse effects, addressees confirm their compliance with 10 CFR 50.46(b)(5) and other existing applicable regulatory requirements, or describe any compensatory measures implemented to reduce the potential risk due to post-accident debris blockage as evaluations to determine compliance proceed.

(4) Require addressees to provide the NRC a written response in accordance with 10 CFR 50.54(f).

The NRC requests the written response be submitted within 60 days of the date of the Bulletin. Accordingly, Attachment (1) to this letter contains Calvert Cliffs Nuclear Power Plant's response that addresses the requested information under Item 3 above.

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Calvert Cliffs Nuclear Power Plant, Inc. has reviewed the recent research findings pertaining to containment sump strainer blockage as well as the emergent industry issues. While we believe that our existing containment sump strainer design provides a considerable level of safety, we acknowledge that we have not completed all the analyses described in the applicable regulatory guidance document cited by the Bulletin (Reference b). Therefore, we are unable to confirm that we are in compliance with all the regulatory requirements. Attachment (1) provides a description of compensatory measures currently implemented and those that are under review as we continue our evaluations to determine full compliance.

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

Kevin J Nietmann

STATE OF MARYLAND :
: **TO WIT:**
COUNTY OF CALVERT :

I, Kevin J. Nietmann, being duly sworn, state that I am Plant General Manager - Calvert Cliffs Nuclear Power Plant, Inc. (CCNPP), and that I am duly authorized to execute and file this response on behalf of CCNPP. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other CCNPP employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

Kevin J Nietmann

Subscribed and sworn before me, a Notary Public in and for the State of Maryland and County of St. Mary's, this 8th day of August, 2003.

WITNESS my Hand and Notarial Seal:

Notary Public

My Commission Expires:

March 25 2007
Date

KJN/GT/bjd

Attachment: (1) Response to NRC Bulletin 2003-01

cc: J. Petro, Esquire
J. E. Silberg, Esquire
Director, Project Directorate I-1, NRC
G. S. Vissing, NRC
H. J. Miller, NRC
Resident Inspector, NRC
R. I. McLean, DNR

ATTACHMENT (1)

RESPONSE TO NRC BULLETIN 2003-01

Calvert Cliffs Nuclear Power Plant, Inc.
August 8, 2003

Bulletin 2003-01 Requested Information

All addressees are requested to provide a response within 60 days of the date of this bulletin that contains either the information requested in Option 1 or Option 2:

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 this bulletin, taking into account the recent research findings described in the Discussion section, and are in compliance with all existing applicable regulatory requirements.

Option 2: Describe any interim compensatory measures 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 an implementation schedule and provide the basis for concluding that their implementation is not practical until a later date.

CCNPP Response

Calvert Cliffs Nuclear Power Plant, Inc. (CCNPP) has reviewed the recent research findings pertaining to containment sump strainer blockage as well as the emergent industry issues discussed in the Bulletin (Reference 1). While we believe that our existing containment sump strainer design provides a considerable level of safety, we acknowledge that we have not completed all the analyses described in the applicable regulatory guidance document cited by the Bulletin (Reference 2). Therefore, we are unable to confirm that we are in compliance with all the regulatory requirements. Consequently, our 60-day response will consist of information requested in Option 2 above.

In addition to discussing the interim compensatory measures that have been implemented or that will be implemented, we will also explain how our current containment sump strainer design incorporates many of the critical features described in Draft Regulatory Guide DG-1107 (Reference 2). Although not explicitly asked for in the Bulletin, we believe this information provides an appropriate background from which to assess the effectiveness of the compensatory measures.

Calvert Cliffs Emergency Containment Sump Strainer Design

Bulletin 2003-01 instructs that licensees may use the guidance in DG-1107 (Reference 2) to assist in determining whether the ECCS and CSS recirculation functions are in compliance with existing applicable regulatory requirements. The following discussion highlights the key features of the Calvert Cliffs strainer design as compared to DG-1107 requirements.

The containment sump strainer employed at Calvert Cliffs consists of two vertical interceptors. The first or outer interceptor is made of 3/16 inch grating which functions to block larger and heavier debris. The second or inner interceptor is made from fine wire mesh screen and functions to filter out smaller debris particles. These interceptors are attached to a frame of heavy structural steel (e.g., W14x26 and W12x14 members) that is braced with structural angle. It is safe to conclude that the containment sump strainer will remain functional during and after a maximum hypothetical earthquake event. Mainly, this is due to the fact that the strainer is located at the lowest level of Containment which is 35 feet below the surface of the ground, and is bolted directly to concrete which forms a portion of the containment basemat. Therefore, for all practical purposes the loads on the strainer will not be subject to seismic amplification.

The sump strainer structure is mounted on a concrete pedestal that is approximately 1 foot high. This concrete pedestal acts as a debris curb which keeps heavier debris from reaching the sump, and ensures that the sump is not drawing water off of the floor of Containment which is where the highest concentrations of particulate matter will be located in the event of a loss-of-coolant accident. The sump strainer is also protected from falling debris by a solid cover. This cover is elevated several inches above the top of the sump strainer to allow water to pass through the top of the sump screen thus maximizing available sump screen surface area. Finally, all sump strainer materials, including the grating, screening, anchor bolts, and structural members are made of stainless steel, and can thus withstand long-term exposure to a boric acid environment without corrosion.

Layout of Calvert Cliffs Emergency Containment Sump Strainer

As mentioned above, the sump strainer is located on the lowest level of Containment. It is more than seven pipe diameters away from any of the Reactor Coolant System (RCS) piping. According to Figure A-2 of Reference 2, high levels of damage are not predicted to occur at distances greater than seven pipe diameters. In addition, concrete supports/flooring separate the sump strainer from the primary coolant piping. Thus, in all probability the sump strainer is protected from jet impingement effects. Even if in the unlikely event that water could ricochet from the concrete flooring and strike the sump strainer, the force of the jet would be greatly weakened and would not be sufficient to damage the strainer. Therefore, it is highly unlikely the sump strainer could be damaged as a result of jet impingement from an RCS piping break. The main steam and feedwater piping inside Containment are located very far from the sump and a break on these lines will not impact the sump strainer. Furthermore, breaks in the main steam and feedwater piping systems would not require ECCS operation for periods long enough where containment sump recirculation might be required.

Finally, the location of all open-air drains relative to the sump strainer were reviewed to determine whether the sump strainer is vulnerable to direct or near-direct debris impingement from these water streams. The termination point of the two drains from the refueling pool were both found to exhaust more than 40 feet away from the containment sump. The only other open drain path is from the reactor cavity, and this drain exhausts at floor level on the lowest level of Containment. Since this exhausts below the height of the debris curb, this drain will also not funnel debris to the sump strainer.

Programmatic Controls Supporting the Emergency Containment Sump Design

Containment Cleanliness Controls

Calvert Cliffs procedures require that in preparation for a plant startup, containment closeout inspections be conducted. This includes explicit instructions for the identification and removal of trash and debris inside all areas of Containment. Included in these procedures are particular instructions for inspecting and cleaning the lowest level of Containment to ensure no debris exists inside the emergency sump and on the screen/grating of the emergency sump. Furthermore, as a result of Nuclear Regulatory Commission Bulletin 93-02, "Debris Plugging of Emergency Core Cooling Suction Strainers," these procedures contain specific requirements to inspect the containment sump for evidence of structural distress or abnormal corrosion.

Existing procedures also provide guidance for containment cleanliness during shutdown conditions. In particular, ensuring that the Containment is kept free of debris that could clog the containment sump is specifically identified as a required responsibility. A procedure devoted exclusively for the control of foreign material contains a section that is dedicated to the lowest level of Containment. This procedure requires verification that a cover is installed over the emergency containment sump to provide protection to the sump structure and to prevent entrance of foreign material on and inside of the sump. For defense-

in-depth, at the end of each refueling outage, there is a requirement for system engineers to perform a walkdown of their systems. Walkdown of the containment sump strainer is performed by the ECCS System Engineer.

As the above discussion clearly indicates, CCNPP has a containment cleanliness program with explicit emphasis on keeping the containment sump free from debris that could clog the flow passageway. In addition, requirements exist to verify the sump strainer and the recirculation header inside the strainer are not damaged in any way. Based on this, CCNPP believes that the applicable containment cleanliness requirements of DG-1107 are met, as well as two of the six compensatory measures cited by the Bulletin -- aggressive containment cleaning and foreign materials control, and ensuring sump screens are free of adverse gaps and breaches.

Containment Coatings Controls

Calvert Cliffs conducts condition assessments of Service Level I coatings inside the Containment when a unit is being refueled. Generally, all of the accessible areas within the Containment are visually inspected. As localized areas of degraded coatings are identified, those areas are evaluated and scheduled for repair or replacement, as necessary. The periodic condition assessments and the resulting repair/replacement activities assure that the amount of Service Level I coatings outside of the Zone of Influence that may be susceptible to detachment from the substrate during a loss-of-coolant accident is minimized.

In regards to unqualified coating, Calvert Cliffs maintains a calculation that quantifies and evaluates the amount of unqualified coating within each Containment. The amount of unqualified coating generally remains relatively constant over time. Any new amount of unqualified coating added to the Containment is evaluated to ensure that it produces no adverse effect.

Operating Procedural Controls Supporting the Emergency Containment Sump Design

Calvert Cliffs has operational procedures to verify that the low-head safety injection pumps have been turned off upon the start of containment recirculation, and to monitor the high-head safety injection pump flow, discharge pressure, and amperage. By monitoring the high-head safety injection pump flow, discharge pressure, and amperage, Control Room personnel could properly diagnose the occurrence of cavitation, which would be an indication of sump clogging. Control Room personnel have been trained to evaluate this type of indication and take appropriate action such as reducing pump flow rates. We are currently evaluating various enhancements to our training program to improve the capabilities of the Control Room personnel to handle such symptoms. Turning off the high-flow, low-head injection pumps greatly reduces the suction velocity to the sump, and in fact the suction velocity at the sump screen is computed to be below 0.1 ft/sec for large and medium break loss-of-coolant accidents. This is less than the 0.2 ft/sec minimum velocity needed to initiate motion of sunken insulation according to NUREG/CR-6808, Section 5.2.1 (Reference 3).

Also, per NUREG/CR-6808, Figure 5–2, the settling velocity of insulation fibers occurs at a minimum rate of 1 mm/sec. Based on the post-recirculation actuation signal (RAS) sump levels at Calvert Cliffs, all of the insulation would have settled to the floor in less than 27 minutes. The minimum time to RAS at Calvert Cliffs is 32 minutes, which is more than adequate time for all of the insulation and coatings debris to settle onto the floor after the initial washdown phase is complete. The turbulence created by water falling from the break location may suspend debris in that immediate area, which would only result in a small amount of debris that might transport to the sump. Calvert Cliffs currently employs a large sump strainer that would even under minimum water level conditions still provide over 100 ft^2 of gross surface area, thus providing sufficient flow area to accommodate incidental sump screen blockage.

In the event that more significant amounts of debris were to transport to the sump, blockage would occur very slowly. By the time significant blockage would occur, the Technical Support Center would be staffed to provide additional guidance to the Operators in accordance with the Severe Accident Management Guidelines. Guidance already exists in these Guidelines to recover an alternate source of water for the RCS to prevent or mitigate core damage which is one of the six interim compensatory measures listed in Bulletin 2003-01. More importantly, the Technical Support Center could assess plant conditions and make educated decisions concerning what pumps could be turned-off to reduce transport velocities to the sump. It is important to note that if the containment air coolers are used to cool containment atmosphere and only one high pressure head pump is operating, the velocity of flow at the sump screen would be less than the minimum screen retention velocity (0.04 ft/sec) listed in NUREG/CR-6808, Table 5-1 (Reference 3). This would enable sufficient sump screen flow area to be restored, thus allowing long-term core cooling to continue.

The low suction velocity in the recirculation headers also reduces the Froude numbers to less than 0.25 thus ensuring 0% air ingestion into the recirculation headers. This would allow the existing pump net positive suction head (NPSH) required curves to be used. While the above discussion may not address all the analytical concerns raised by DG-1107, we believe it provides relevant information to support our interim conclusion that the risk of sump screen blockage is acceptably low.

Analytical Approach Supporting the Emergency Containment Sump Performance

Adequate NPSH available for the ECCS and containment spray pumps is demonstrated by calculation which considers the hydraulic friction losses across the sump screen and through the recirculation header piping. Adequate NPSH is shown to exist without crediting containment overpressure. Although, Calvert Cliffs inspects the drains for debris at the end of each refueling outage, the computation of the minimum water height in the containment sump conservatively assumes that the refueling pool drains and the drain in the reactor pedestal annular area are clogged. These assumptions provide a conservative prediction of available NPSH. Therefore, we have addressed one of the interim compensatory actions cited in the Bulletin -- ensuring containment drainage paths are unblocked.

Compensatory Measures Currently Being Evaluated

Of the six interim compensatory measures listed on page 7 of Bulletin 2003-01, five of them have been addressed as described above. However, as discussed below, one of the measures requires further review.

One of the interim compensatory measures involves procedural modifications to delay switch-over to sump recirculation operation by shutting off unnecessary pumps while in injection mode. We agree that shutting off an unnecessary train of pumps could provide a positive benefit by halving the transport velocity to the sump strainer thereby reducing debris transport to the sump. However, we are concerned about shutting off a train of pumps during what may be considered a critical phase of the accident response. If conditions require these pumps be turned back on, or a malfunction occurs with the operating train of pumps, requiring these pumps to start a second time could create a new challenge. Therefore, in collaboration with the Westinghouse Owners Group (WOG), Calvert Cliffs is evaluating the benefit of the following procedural actions:

i. Terminate one train of high pressure safety injection (HPSI) following a RAS.

ii. Review safety injection stop/throttle criteria to terminate unneeded safety injection pumps prior to RAS.

iii. Review stop and reset criteria to enable early termination and subsequent cycling of containment spray pumps as needed.

Furthermore, as mentioned previously, at Calvert Cliffs the Severe Accident Management Guidelines identify flowpath alignments to provide alternative water sources. While this provides the immediate benefit of continuing core and containment atmosphere cooling in the event that the sump is blocked, our containment structural analysis will not permit indefinite filling of the Containment with water. Since our recirculation lines have check valves we are not able to backflush the sump strainer, thus, short-term injection from other water sources can not be used to buy time to backflush the sump strainer. Therefore, actions to provide alternative water sources have not been included in the plant Emergency Operating Procedures. However, Calvert Cliffs will be participating with the WOG in evaluating the benefit of adding alternative water source guidance to the Long-Term Actions of the Emergency Operating Procedures. This action is not an interim measure for the response to this Bulletin, but rather a potential permanent enhancement to the Emergency Operating Procedures.

A decision as to whether any of these actions is beneficial will be made, and if any changes are determined to be beneficial they will be implemented and the appropriate staff will receive the relevant training.

Debris Impact on HPSI Pump Operability (Davis-Besse LER 50-346/03-002-00)

Bulletin 2003-01 includes a description of the Licensee Event Report written by Davis-Besse wherein they discovered that debris which could pass through the sump strainer may not be able to pass internal clearances on their high pressure injection pumps. The limiting location was found to be the pump internal openings which provide lubricating flow to the hydrostatic bearings. Should this opening be blocked by debris, damage to the hydrostatic bearings could result. Also, debris in this passageway could potentially damage the bearing shaft sleeve.

At CCNPP, the Component Cooling Water System is used to provide direct cooling flow to the stuffing box jackets and the two bearing housings on each pump; therefore, the impact of debris does not need to be considered on these sub-components. A mechanical seal is installed at each end of the pump shaft. To cool these seals a portion of the water from the first stage of the pump is circulated through a centrifugal separator and cooler. The cooled water is then flushed into the cavity of the mechanical seal. The separator prevents damage to the seals due to debris. This device, known as the Doxie Impurity Eliminator, only permits cleaned water to reach the mechanical seal. The portion of the liquid containing solids is returned back to the main flow of the pump. Therefore, the HPSI pumps at Calvert Cliffs are not vulnerable to the Davis-Besse type event.

Summary of Interim Compensatory Actions

Calvert Cliffs has implemented or is evaluating the usefulness of the following compensatory measures:

1. Operator training on indications of and responses to sump clogging.

   - Current Operator training and procedures provide guidance on symptoms and appropriate actions to take in the event of HPSI pump cavitation. Complete

   - Enhancements to this training are being assessed.

     Evaluation Completion Date: 9/15/2003

     Implementation Date (if applicable): 1/31/2004

2. Procedure actions to delay switchover to containment sump recirculation.
   - Potential actions to delay onset of RAS being evaluated in conjunction with the WOG.

     Evaluation Completion Date: 3/31/2004

     Implementation Schedule to be determined following completion of evaluation.

3. Ensuring alternative water sources are available. Complete
   - Guidance to use alternate water sources exists in accident management guidelines.

4. Aggressive containment cleaning and foreign materials control. Complete
   - Strong procedural requirements to keep containment clean and keep debris from the sump already exist.

5. Ensure Containment drainage paths are unblocked. Complete
   - Procedure requires open-air drains be verified clean.
   - Containment sump water level computation conservatively assumes these drains are blocked.

6. Ensure Sump Screens are free of adverse gaps and breaches. Complete
   - Procedure already exists that requires inspection of the sump for damage and for lodged debris.

Conclusion

We believe the combination of our containment sump design features and procedural controls that are in place ensure that the risk associated with potentially degraded containment sump recirculation functions has been acceptably reduced for the immediate future. During this interim period, we will be performing analyses and/or modifications to ensure that our containment sump strainer system is in compliance with all of the regulatory requirements. The schedule for completion of these activities will be in accordance with the requirements to be specified in the upcoming Generic Letter on this issue.

REFERENCES

1. NRC Bulletin 2003-01: Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors, dated June 9, 2003
2. Draft Regulatory Guide DG-1107, "(Proposed Revision 3 to Regulatory Guide 1.82) Water Sources For Long-Term Recirculation Cooling Following Loss-of-Coolant-Accident"
3. NUREG/CR-6808, "Knowledge Base for the Effect of Debris on Pressurized Water Reactor Emergency Core Cooling Sump Performance"