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Constellation Energy
Generation Group

September 20, 2006

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
Update of Response to Generic Letter 2004-02, Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors (TAC Nos. MC4672 and MC4673)

REFERENCES:

(a) 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

(b) Letter from Mr. J.A. Spina (CCNPP) to Document Control Desk (NRC), dated June 30, 2006, Update of Response to Generic Letter 2004-02, Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors (TAC Nos. MC4672 and MC4673)

(c) Letter from Mr. G. Vanderheyden (CCNPP) to Document Control Desk (NRC), dated August 30, 2005, Response to NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors"

(d) Letter from Mr. J.A. Spina (CCNPP) to Document Control Desk (NRC), dated February 3, 2006, Supplemental Information Related to Response to NRC Generic Letter 2004-02

(e) Letter from Mr. P.D. Milano (NRC) to Mr. J.A. Spina (CCNPP), dated April 12, 2006, Approval of Extension Request for Completion of Corrective Actions in Response to Generic Letter 2004-02 (TAC No. MC4672)

In Reference (a) the Nuclear Regulatory Commission requested that pressurized water reactor licensees evaluate the Emergency Core Cooling System and Containment Spray System recirculation functions and, if appropriate, take additional actions to ensure system function. In Reference (b), we informed you that we had changed our method of resolving the vulnerabilities identified in Reference (a). We have changed our response from an active strainer technology to a passive strainer technology.

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In References (c) and (d), we provided technical information supporting an extension request for Unit 1 from December 31, 2007 to within 30 days of February 24, 2008. That extension request was approved in Reference (e). The change from an active to a passive strainer technology does not change our need for the extension.

The reason that an extension is still needed is the same as in the original request. Installation of the passive strainer devices for both Units will be completed during the first refueling outage starting after April 1, 2006. However, for Unit 1 the first refueling outage starting after April 1, 2006 is in the spring of 2008. As a result, the corrective actions for Unit 1 will not be completed by December 31, 2007. We could not have installed passive strainers in the 2006 refueling outage because we did not determine that passive strainers were the appropriate solution to the vulnerabilities identified in Reference (a) until June 2006 (after completion of the Unit 1 refueling outage).

We have updated the information we provided in References (c) and (d) to address the change from an active to passive strainer technology and to support our initial extension request. Attachments (1) and (2) provide the updated information. These attachments replace Attachments (1) and (2) of Reference (c), and Reference (d) in its entirety. The attachments contain revision bars to denote changes from the original request. We request the extension granted in Reference (e) be applied to the installation of the passive strainers in Unit 1 required to resolve the vulnerabilities identified in Reference (a).

Should you have questions regarding this matter, please contact Mr. Jay S. Gaines at (410) 495-4922.

Very truly yours,

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

I, James A. Spina, being duly sworn, state that I am Vice President - 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.

Subscribed and sworn before me, a Notary Public in and for the State of Maryland and County of St. Mary's, this 20th day of September, 2006.

WITNESS my Hand and Notarial Seal:

Notary Public

My Commission Expires: March 25 2007

Date

JAS/PSF/bjd

Attachments: (1) Response to NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors"

(2) Justification for Extension Request for Completion Date of the Calvert Cliffs Unit 1 Containment Sump Modification

cc: P. D. Milano, NRC
S. J. Collins, NRC
Resident Inspector, NRC
R. I. McLean, DNR

ATTACHMENT (1)

RESPONSE TO NRC GENERIC LETTER 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS"

ATTACHMENT (1)

RESPONSE TO NRC GENERIC LETTER 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS"

Requested Information (a)

Confirmation that the ECCS [Emergency Core Cooling System] and CSS [Containment Spray System] recirculation functions under debris loading conditions are or will be in compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of this generic letter. This submittal should address the configuration of the plant that will exist once all modifications required for regulatory compliance have been made and this licensing basis has been updated to reflect the results of the analysis described above.

Calvert Cliffs Response

The Calvert Cliffs Units 1 and 2 ECCS and CSS recirculation functions under debris loading conditions will be in compliance with the regulatory requirements listed in the applicable Regulatory Requirements section of Generic Letter 2004-02. This debris load has been identified, and the design of a replacement sump strainer design has been initiated.

Requested Information (b)

A general description of and implementation schedule for all corrective actions, including any plant modifications that you identified while responding to this generic letter. Efforts to implement the identified actions should be initiated no later than the first refueling outage starting after April 1, 2006. All actions should be completed by December 31, 2007. Provide justification for not implementing the identified actions during the first refueling outage starting after April 1, 2006. If all corrective actions will not be completed by December 31, 2007, describe how the regulatory requirements discussed in the Applicable Regulatory Requirements section will be met until the corrective actions are completed.

Calvert Cliffs Response

As we indicated in Reference (1), installation of Control Components Incorporated cassette type suction strainer at both Calvert Cliffs Units 1 and 2 will be completed during the first refueling outage starting after April 1, 2006. However, for Unit 1 the first refueling outage starting after April 1, 2006, is in spring 2008; as a result, Unit 1's corrective action will not be completed by December 31, 2007. In Reference (1), we requested an extension of the completion date for Calvert Cliffs Unit 1 corrective action from December 31, 2007, as required by the Generic Letter, to May 31, 2008. In Reference (2), you noted that additional information was needed to process our request. Accordingly, Attachment (2) provides the additional information you requested that explains how the applicable regulatory requirements will be met until corrective action is completed. Also, please note, after further consideration, we have determined we only need an extension to the beginning of our 2008 Unit 1 refueling outage which is currently scheduled to begin February 24, 2008.

Also note that Calvert Cliffs may take action to reduce flow to the containment sump by securing a redundant containment spray pump after recirculation actuation has occurred [see Response (e)].

Requested Information (c)

A description of the methodology that was used to perform the analysis of the susceptibility of the ECCS and CSS recirculation functions to the adverse effects of post-accident debris blockage and operation with debris-laden fluids. The submittal may reference a guidance document (e.g., Regulatory Guide 1.82, Revision 3, industry guidance) or other methodology previously submitted to the NRC [Nuclear Regulatory Commission]. (The submittal may also reference the response to Item 1 of the Requested Information described above. The documents to be submitted or referenced should include the results of *any supporting containment walkdown surveillance performed to identify potential debris sources and other pertinent containment characteristics.)*

Calvert Cliffs Response

Calvert Cliffs has analyzed the susceptibility of the Unit 1 ECCS and CSS recirculation functions to the adverse effects of post-accident debris blockage and operation with debris-laden fluids identified in Generic Letter 2004-02 using Reference (3). The analysis has also taken into account the exceptions noted in the NRC Safety Evaluation of Nuclear Energy Institute (NEI)-04-07 issued on December 6, 2004. The data used in the analysis was collected by performing a containment walkdown in accordance with Reference (4), with the exception of latent debris sampling. The results of the analysis indicated that the existing sump strainer does not meet the new NRC design guidance and a corrective action is required.

A separate Unit 2 analysis is being performed in accordance with Reference (3). A walkdown on the Unit 2 Containment will be performed in accordance with Reference (4) to validate that the design drawings accurately reflect the field condition of Unit 2.

Requested Information (d)

The submittal should include, at a minimum, the following information:

Requested Information (d)(i)

The minimum available NPSH [net positive suction head] margin for the ECCS and CSS pumps with an unblocked sump screen.

Calvert Cliffs Response

High Pressure Safety Injection (HPSI) Pump margin = 1.90 feet
Containment Spray Pump margin = 2.72 feet

Requested Information (d)(ii)

The submerged area of the sump screen at this time and the percent of submergence of the sump screen (i.e., partial or full) at the time of the switchover to sump recirculation.

Calvert Cliffs Response

The strainer will be 100% submerged during a large break loss-of-coolant accident (LOCA).
(Submerged area = 6000 ft^2)

Requested Information (d)(iii)

The maximum head loss postulated from debris accumulation on the submerged sump screen, and a description of the primary constituents of the debris bed that result in this head loss. In addition to debris generated by jet forces from the pipe rupture, debris created by the resulting containment environment (thermal and chemical) and CSS washdown should be considered in the analyses. Examples of this type of debris are disbonded coatings in the form of chips and particulates and chemical precipitants caused by chemical reactions in the pool.

Calvert Cliffs Response

Maximum sustained headloss = 1.0 feet.

Debris bed consists of approximately ~~2000~~1700 ft^3 of fibrous insulation (e.g., NUKON, Temp-Mat) and 450 ft^3 of particulate debris (e.g., coatings, latent debris, labels). Also, chemical precipitation is possible.

Requested Information (d)(iv)

The basis for concluding that the water inventory required to ensure adequate ECCS or CSS recirculation would not be held up or diverted by debris blockage at choke-points in containment recirculation sump return flowpaths.

Calvert Cliffs Response

Adequate NPSH (available) is created for the safety injection and containment spray pumps with the existing Refueling Water Storage Tank inventory; thus no modifications or procedural changes for water inventory will be required. The existing computation of minimum containment flood height assumes drain blockage in the refueling pool cavities, and in the reactor vessel annulus. There are no other choke points for the recirculation flow inside Containment. Thus no modifications are required for the sump flowpaths or choke points.

Requested Information (d)(v)

The basis for concluding that inadequate core or containment cooling would not result due to debris blockage at flow restrictions in the ECCS and CSS flowpaths downstream of the sump screen, (e.g., a HPSI throttle valve, pump bearings and seals, fuel assembly inlet debris screen, or containment spray nozzles). The discussion should consider the adequacy of the sump screen's mesh spacing and state the basis for concluding that adverse gaps or breaches are not present on the screen surface.

Calvert Cliffs Response

See Item (d)(viii) below for a discussion of the effects of debris blockage in the reactor vessel. No flow blockages are anticipated in other parts of the recirculation flow path because the other components (e.g., throttle valves, spray nozzles) have already been found acceptable for a screen opening of 0.244" x 0.244" and the new screen opening will not be greater than 0.0625". While no downstream flow blockage is conceivable, Calvert Cliffs will nonetheless document this conclusion in an evaluation following the guidance contained in the Westinghouse Owners Group report on evaluating downstream effects (Reference 6).

Requested Information (d)(vi)

Verification that close-tolerance subcomponents in pumps, valves, and other ECCS and CSS components are not susceptible to plugging or excessive wear due to extended post-accident operation with debris-laden fluids.

Calvert Cliffs Response

As previously reported to the NRC (Reference 5), Calvert Cliffs has a schedule to address the effects of the debris-laden fluid which passes through the sump strainer. This will consist of following the Westinghouse Owners Group report (Reference 6) for evaluating downstream effects using the strainer bypass flow characterization to be determined through testing (see item viii). Based on preliminary discussions with component vendors no problems are anticipated.

Requested Information (d)(vii)

Verification that the strength of the trash racks is adequate to protect the debris screens from missiles and other large debris. The submittal should also provide verification that the trash racks and sump screens are capable of withstanding the loads imposed by expanding jets, missiles, the accumulation of debris, and pressure differentials caused by post-LOCA blockage under predicted flow conditions.

Calvert Cliffs Response

In accordance with General Design Criterion 4, a plant-specific analysis was performed for Calvert Cliffs to demonstrate that the probability of a pipe rupture is extremely low, and therefore we can apply Leak-Before-Break (LBB) Methodology for the Reactor Coolant System (RCS) cold legs and RCS hot legs (Reference 7). This LBB provision will be invoked for the containment sump modification; therefore, the replacement sump strainers do not need protection from the dynamic effects of a break in this piping. The LBB provision has not been approved for the surge line piping; however, engineering judgment has determined that this piping is sufficiently far from the sump strainer to preclude the need to design for jet impingement loads due to a break in this piping.

The strainer to be installed at Calvert Cliffs is designed for the pressure differential across the sump screen at maximum debris load conditions.

Requested Information (d)(viii)

If an active approach (e.g., backflushing, powered screens) is selected in lieu of or in addition to a passive approach to mitigate the effects of the debris blockage, describe the approach and associated analyses.

Calvert Cliffs Response

Not applicable.

Requested Information (e)

A general description of and planned schedule for any changes to the plant licensing bases resulting from any analysis or plant modifications made to ensure compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of this generic letter. Any licensing actions or exemption requests needed to support changes to the plant licensing basis should be included.

Calvert Cliffs Response

The description of the containment sump strainer in the Updated Safety Analysis Report will be revised to reflect the new strainer design. This change will be evaluated in accordance with the procedural controls for updating the Updated Final Safety Analysis Report. At this time, no license amendment request is anticipated to reflect the new strainer design.

Also, in accordance with the recommendations from the Pressurized Water Reactor Owners Group, Calvert Cliffs is studying the benefit of reducing flow to the containment sump by securing a redundant containment spray pump following recirculation actuation. If this change is pursued, our preliminary review indicated that it will require a license amendment request. This license amendment request will be submitted to the NRC no later than March 1, 2007.

The plant modification to install the new strainers will be reviewed in accordance with 10 CFR 50.59 provisions.

Requested Information (f)

A description of the existing or planned programmatic controls that will ensure that potential sources of debris introduced into Containment (e.g., insulations, signs, coatings, and foreign materials) will be assessed for potential adverse effects on the ECCS and CSS recirculation functions. Addressees may reference their responses to Generic Letter 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System after a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment," to the extent that their responses address these specific foreign material control issues.

Calvert Cliffs Response

Calvert Cliffs currently specifies the amount and types of insulation used in the plant in a controlled document. Any activity which would revise either the type or quantity of insulation installed in the field must be approved in accordance with a plant procedure which specifically identifies thermal insulation as a form of controlled plant equipment which must be evaluated for changes in configuration. The supporting engineering standard will be revised to provide a summary of the results of the LOCA insulation debris impact on the containment sump strainer. While it is believed inconceivable that any proposed plant change in insulation could impact the strainer qualification due to the active nature of the strainer design, this engineering standard will nonetheless be revised to guide engineers on the steps to take if major changes in insulation configuration are proposed.

Our procedures currently require that in preparation for a plant startup, Containment closeout inspections be conducted. This includes explicit instructions for the identification and removal of foreign materials including 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 screening of the emergency sump.

Calvert Cliffs conducts condition assessments of Service Level I coatings inside Containment when a unit is being refueled. Generally, all of the accessible areas within 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 LOCA is minimized. For unqualified coatings a calculation is maintained which quantifies and evaluates the amount of unqualified coatings within 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.

REFERENCES

1. Letter from Mr. G. Vanderheyden (CCNPP) to Document Control Desk (NRC), dated March 3, 2005, Response to NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors"

2. Letter from Mr. R. V. Guzman (NRC) to Mr. G. Vanderheyden (CCNPP), dated June 3, 2005, Calvert Cliffs Nuclear Power Plant, Units 1 and 2 – Request for Additional Information (RAI) Related to Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors" (TAC Nos. MC4672 and MC4673)

3. NEI-04-07, Pressurized-Water Reactor (PWR) Sump Performance Methodology, dated May 28, 2004

4. NEI-02-01, Condition Assessment Guidelines, Debris Sources inside Containment, Revision 1

5. Letter from Mr. G. Vanderheyden (CCNPP) to Document Control Desk (NRC), dated July 15, 2005, Response to NRC Request for Additional Information Re: Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors" (TAC Nos. MC4672 and MC4673)

6. WCAP-16406-P, Evaluation of Downstream Sump Debris Effects in Support of GSI-191

7. Letter from Mr. D. G. McDonald (NRC) to Mr. R. E. Denton (BGE), dated February 3, 1994, Installation of a Neutron Shield/Pool Seal at the Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (TAC Nos. M87176 and M87177)

ATTACHMENT (2)

JUSTIFICATION FOR EXTENSION REQUEST FOR COMPLETION DATE OF THE CALVERT CLIFFS UNIT 1 CONTAINMENT SUMP MODIFICATION

Calvert Cliffs Nuclear Power Plant, Inc.
September 20, 2006

JUSTIFICATION FOR EXTENSION REQUEST COMPLETION DATE OF THE CALVERT CLIFFS UNIT 1 CONTAINMENT SUMP MODIFICATION

Under Calvert Cliffs corrective action program it has been identified that the existing sump strainer does not provide acceptable performance under loss-of-coolant accident conditions when a mechanistic evaluation is performed in accordance with Nuclear Energy Institute (NEI)-04-07 and the accompanying Nuclear Regulatory Commission (NRC) Safety Evaluation. The following is a description of how Calvert Cliffs has established that safety is maintained until all corrective actions can be completed. This is intended to support Calvert Cliffs' request for an extension of the completion date for the Calvert Cliffs Unit 1 corrective action from December 31, 2007 (as required by the Generic Letter 2004-02) to the beginning of our 2008 refueling outage which is currently scheduled to begin February 24, 2008.

1. <u>Debris Quantity/Size/Transportability</u>

The majority of the debris predicted to accumulate on the sump screen is fibrous insulation. As described in Section 3.1.2.1 of NUREG/CR-6808 (Knowledge Base for the Effects of Debris on PWR Emergency Core Cooling Sump Performance, February 2003), the results of debris generation experiments of fibrous materials demonstrate that impingement of a high-pressure jet onto fibrous insulation (jacketed or not) will generate debris which spans a wide range of sizes ranging from individual fibers, to interwoven strands, to fiber clusters, to clumps of insulation, to nearly intact pillows.

Each of these different debris sizes has different transport velocities. From Section 5.1.3 of NUREG/CR-6808, fine debris such as individual fibers would remain suspended in the sump pool, and ultimately most of the fine insulation debris, referred to as small fines, would be transported to the sump screen. From Section 5.2.1, test data is given which shows that water velocities of 0.2 ft/s are needed to move sunken individual shreds of insulation (i.e., small fines), 0.5 ft/s is needed to move small pieces, and 0.9-1.5 ft/s is needed to move large pieces. For our partially submerged containment sump screen having an initial gross surface area of 102.9 ft^2 at a total sump flow of 5000 gpm [2 x Containment Spray + 2 x High Pressure Safety Injection (HPSI) + margin] the approach velocity would be 0.11 ft/sec. This would indicate that only small fines of suspended fibrous insulation would be transported to our sump.

Furthermore, per Figure 5-2 of NUREG/CR-6808 small fines of fiber insulation have a settling velocity of 1 mm/sec. Taking a conservatively high sump level after the blowdown phase of 62 inches at a settling velocity of 1 mm/sec means that all the insulation would be settled to the floor within 26.25 minutes. The earliest a recirculation actuation signal could be received is 32 minutes. Therefore, there is ample time for the insulation to settle to the floor prior to the onset of containment sump recirculation. At Calvert Cliffs, the sump strainer is currently mounted on a concrete curb approximately 1 foot high. Thus, the suction flow stream to the sump will be off of the floor where the insulation debris will have settled.

Section 3.4.3.6 of NEI-04-07 states that the debris sizes assumed are the most conservative for purposes of debris transport and headloss. In accordance with Section 3.4.3.3.1 of NEI-04-07, it is required that 60% of the generated debris is assumed to be small fines and that 100% of these small fines are assumed to transport to the sump.

Given the low transport velocities and debris curb which exist at Calvert Cliffs, for all practical purposes, only small fines will be transported to the sump screen. Furthermore, it is the larger pieces of fiber which after being caught on the sump screen would trap the small fines and thus build up the debris bed. With flow velocities low enough to only move these small fines of insulation much of this insulation will pass through the sump screen.

Finally, the quantity of insulation generated assumes a zone of influence (ZOI) of 17 D (diameters). This ZOI is actually applicable to unjacketed insulation. Insulation jacketed by standard banding was not tested, and therefore it is conservatively assumed that the ZOI for insulation jacketed by standard banding is also 17 D. Testing done for NUKON jacketed with Sure-Hold bands shows a ZOI of 1.6 D. Thus, it can be inferred, that if testing were done on insulation jacketed with standard bands the ZOI would be significantly less than 17 D.

2. Leak-Before-Break

Calvert Cliffs currently has NRC-approval to invoke the leak-before-break principle to address the dynamic effects of a cold leg, or hot leg break in the Reactor Coolant System. This approval was based on a plant specific evaluation (CEN-367-A) of the inherent toughness of the cold leg and hot leg piping at Calvert Cliffs which concluded that the probability of a pipe failure before noticeable leakage could be detected and the plant brought into a safe-shutdown condition was negligibly small. While leak-before-break can not be used to establish the design basis debris load on the sump strainer, it does provide a basis for safe continued operation until the beginning of our 2008 Unit 1 refueling outage which is currently scheduled to begin February 24, 2008.

3. Additional NPSH Available

Calculations are performed in accordance with NRC Safety Guide 1 ("Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal System Pumps, November 2, 1970") to determine the adequacy of the net positive suction head (NPSH) available to the Emergency Core Cooling System (ECCS) pumps. These calculations do not credit containment backpressure or the vapor pressure of the sump water in calculating the NPSH. These analyses show that the margin between the available NPSH and that required to prevent pump cavitation is less than 2 feet. This calculation also assumes that the sump screen remains clear.

For purposes of evaluating the Generic Letter 2004-02 extension request, a best estimate evaluation was done. Two cases are presented, the start of containment sump recirculation and a later case. These cases look at the more realistic NPSH available to the ECCS pumps based on containment pressure and the vapor pressure of the sump water.

At the start of containment sump recirculation, the containment pressure will be at least 5 psi above atmospheric pressure and the sump temperature will be approximately 190°F (assumes all required ECCS pumps running for maximum debris transport). When the containment backpressure and the difference between atmospheric pressure and the vapor pressure of the sump water (at 190°F) are converted to feet of head using Bernoulli's theorem, an additional 24 feet of available NPSH results. The total NPSH under these conditions is 26 (24+2) feet.

As the event progresses, containment pressure will gradually lower. At some time prior to the containment pressure reaching atmospheric pressure, the containment sump temperature will be less than 170°F. When the difference between atmospheric pressure and the vapor pressure of the sump water (at 170°F) is converted to feet of head using Bernoulli's theorem, 20 feet of additional available NPSH results. The total NPSH under these conditions is 22 (20+2) feet. At atmospheric pressure the containment backpressure does not contribute to the NPSH.

The evaluations above assume that the sump screen is either submerged, or if not completely submerged, that the debris accumulation on the screen is not sufficient to cause the flow through the screen to be less than the flow requirements of the ECCS pumps. Additionally, if realistic assumptions are used in the evaluation, it can be shown that the sump screen would be completely submerged. Item 1 addresses insulation debris accumulation and shows that it is not sufficient to affect the ECCS pumps. Also, note that without insulation buildup on the sump screen, any chemical precipitants which might form will not have a fiber bed to get caught in. Therefore, we believe that any chemical precipitant present will also pass through the sump screen.

3. Containment Cleanliness

Procedures direct a containment closeout inspection with explicit instructions for removing trash and debris from all areas of Containment. In particular, instructions are provided to ensure no debris is lodged on the sump strainer, or is located inside the sump strainer. The sump strainer itself is to be inspected for structural distress, and is also to be inspected separately by the responsible System Engineer. By maintaining high standards of containment cleanliness and inspection, Calvert Cliffs is able to minimize debris loads, and ensure the sump strainer is in optimal condition should a loss-of-coolant accident occur.

4. Operator Training and Actions

The above discussion points out that because of the low suction velocity to the sump, and the long available debris settling time prior to recirculation mode, the sump strainer at Calvert Cliffs is not susceptible to rapid accumulation of debris. If debris were to somehow accumulate on the screen to the point that cavitation resulted, this process would only occur very gradually. As part of the defense-in-depth strategy, procedural guidance exists which identifies actions to be taken to mitigate this condition.

Pump cavitation would be detected by the Operators who have procedural guidance to monitor the pumps for evidence of pump cavitation. The training the Operators received in response to Bulletin 2003-01 instructed them to consider reducing the total sump flow when pump cavitation was detected. This would be achieved by first throttling HPSI flow, and then if necessary turning off the containment spray pumps and relying on the containment air coolers for atmosphere control. Only one HPSI pump at throttled flow would be needed to keep the core covered. Even assuming a HPSI flow of 620 gpm (600 gpm is maximum post-recirculation actuation signal flow) the velocity of the flow through the net sump strainer flow area (39.386 ft^2) would only be 0.0351 ft/sec. This velocity is less than the minimum screen retention velocity of 0.04 ft/sec listed in Table 5-1 of NUREG/CR-6808. Therefore, if only one HPSI pump were to be operating, sufficient amounts of debris would be expected to fall off the screen thus freeing up screen flow area to supply flow to the one operating HPSI pump.