September 18, 2006

Mr. Dennis Koehl
Site Vice President
Point Beach Nuclear Plant
Nuclear Management Company, LLC
6610 Nuclear Road
Two Rivers, WI 54241-9516

SUBJECT: POINT BEACH NUCLEAR POWER PLANT, UNITS 1 AND 2 - EVALUATION OF EVENT NOTIFICATION 42129 (TAC NOS. MC9035 AND MC9036)

Dear Mr. Koehl:

On November 8, 2005, Nuclear Management Company, LLC (NMC), notified the U.S. Nuclear Regulatory Commission (NRC) in accordance with 10 CFR 50.72, "Immediate notification requirements for operating nuclear power reactors" (Event Notification 42129), that the design basis for long-term cooling at the Point Beach Nuclear Plant, Units 1 and 2 (PBNP), was not correctly modeled. Your notification stated that "[t]hese errors in the modeling fidelity potentially impact the analytical basis for demonstrating compliance with the acceptance criteria of 10 CFR 50.46(b)(5), Long-term cooling." Your notification further stated that operability analyses were performed as immediate actions and that the operability analyses demonstrated that adequate net positive suction head would be available to the emergency core cooling system (ECCS) pumps to ensure long-term cooling.

The NRC staff initially reviewed your operability analyses and determined that there was no immediate safety concern. However, the staff also determined that it required additional information to complete its review of your conclusion. By letter to you dated January 10, 2006, the NRC requested additional information. You responded to the NRC request for additional information (RAI) by letter dated February 16, 2006, as supplemented by letters dated May 12 and May 19, 2006.

Your RAI response identified several nonconformances with your current licensing basis. Your disposition of the nonconformances was in accordance with the NRC guidance contained in NRC Regulatory Information Summary (RIS) 2005-20, "Revision to Guidance Formerly Contained in NRC Generic Letter 91-18, 'Information to Licensees Regarding Two NRC Inspection Manual Sections on Resolution of Degraded and Nonconforming Conditions and on Operability.'" You have committed to resolve these nonconformances consistent with your commitment to resolve Generic Safety Issue (GSI)-191 by December 31, 2007, within the schedule provided in NRC Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors."

The NRC staff's evaluation of your analysis is enclosed. You should consider the NRC staff's comments in your preparation of any supplemental response to GL 2004-02. The NRC staff's expectations are that licensees will ensure an appropriate basis is incorporated into plant-specific evaluations that will be provided in the supplemental responses to GL 2004-02, as noted in the letter from B. Sheron (NRC) to A. Pietrangelo (Nuclear Energy Institute) dated March 3, 2006, and in accordance with the timetable provided by the letter from C. Haney (NRC) to pressurized-water reactor licensees dated March 28, 2006.

Based on its review of the information you provided, the NRC staff has reasonable assurance that the ECCS at PBNP, under the current licensing basis, continues to comply with 10 CFR 50.46(b)(5). The staff's evaluation is valid pending resolution of GSI-191 in accordance with GL 2004-02. If you have any questions regarding this matter, please call me at (301) 415-2296.

Sincerely,

/RA/

Carl F. Lyon, Project Manager
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-266 and 50-301

Enclosure:
As stated

cc w/encl: See next page

noted in the letter from B. Sheron (NRC) to A. Pietrangelo (Nuclear Energy Institute) dated March 3, 2006, and in accordance with the timetable provided by the letter from C. Haney (NRC) to pressurized-water reactor licensees dated March 28, 2006.

Based on its review of the information you provided, the NRC staff has reasonable assurance that the ECCS at PBNP, under the current licensing basis, continues to comply with 10 CFR 50.46(b)(5). The staff's evaluation is valid pending resolution of GSI-191 in accordance with GL 2004-02. If you have any questions regarding this matter, please call me at (301) 415-2296.

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DATE		4/7/06	4/7/06	4/25/06	5/1/06	4/25/06

OFFICE	CPTB/BC	OGC	DSS/D	DCI/D	DORL/D	LPL3-1/BC(A)
NAME	TLiu*	MLemoncelli*	TMartin*	WBateman* for JGrobe	CHaney	MMurphy
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO EVENT NOTIFICATION 42129

NUCLEAR MANAGEMENT COMPANY, LLC

POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-266 AND 50-301

1.0 INTRODUCTION

On November 8, 2005, Nuclear Management Company, LLC (NMC, the licensee), notified the U.S. Nuclear Regulatory Commission (NRC) in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.72, “Immediate notification requirements for operating nuclear power reactors” (Event Notification 42129), that the design basis for long-term cooling at the Point Beach Nuclear Plant, Units 1 and 2 (PBNP), was not correctly modeled. The licensee stated that “[t]hese errors in the modeling fidelity potentially impact the analytical basis for demonstrating compliance with the acceptance criteria of 10 CFR 50.46(b)(5), Long-term cooling.” The licensee further stated that operability analyses were performed as immediate actions and that the operability analyses demonstrated that adequate net positive suction head would be available to the emergency core cooling system (ECCS) pumps to ensure long-term cooling.

On January 10, 2006 (Agencywide Documents Access and Management System (ADAMS) ML060030437), the NRC requested additional information in order to review NMC's actions to establish that the requirements of 10 CFR 50.46(b)(5) continue to be met. By letter dated February 16, 2006 (ADAMS ML060860024), as supplemented by letters dated May 12 (ADAMS ML061420158) and May 19, 2006 (ADAMS ML061420132), NMC responded to the NRC request for additional information (RAI).

1.1 Background

NRC Generic Letter (GL) 2004-02, “Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors [PWRs],” dated September 13, 2004, provides background information regarding NRC staff questions regarding the adequacy of PWR sump designs. These questions derived from research to resolve an earlier boiling-water reactor strainer clogging issue, and prompted the NRC to open Generic Safety Issue (GSI)-191, “Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance.” Based on information identified during efforts to resolve

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GSI-191, the NRC staff determined that the previous guidance used to develop current licensing basis analyses does not adequately and completely model sump screen debris blockage and related effects. As a result, due to the deficiencies in the previous guidance, an analytical error could be introduced that results in ECCS and containment spray system (CSS) performance that does not conform with the existing regulatory requirements (10 CFR 50.46, et al.). Therefore, the NRC staff revised the guidance for determining the susceptibility of PWR recirculation sump screens to the adverse effects of debris blockage during design-basis accidents (DBAs) requiring recirculation operation of the ECCS or CSS. GL 2004-02 requested that licensees perform new, more realistic analyses and submit information to the NRC to confirm the functionality of the ECCS and CSS during DBAs requiring recirculation operations. GL 2004-02 referenced a justification for continued operation for PWRs in accordance with their current licensing basis in light of the targeted resolution date of December 31, 2007.

The NRC staff determined that licensees are not required to be in compliance with the newly issued analysis using an NRC-approved methodology until all plant modifications, as required, are completed in accordance with the resolution schedule provided in GL 2004-02 and until licensees have changed their licensing basis, as appropriate. However, GL 2004-02 states that if a noncompliance with the existing licensing basis that affects the operability of an ECCS or CSS design feature is identified while taking actions in response to GL 2004-02, licensees should comply with established regulatory requirements. As noted in GL 2004-02, these requirements include 10 CFR 50.46, which requires that the ECCS have the capability to provide long-term cooling of the reactor core following a loss-of-coolant accident (LOCA). That is, the ECCS must be able to remove decay heat, so that the core temperature is maintained at an acceptably low value for the extended period of time required by the long-lived radioactivity remaining in the core. NRC guidance regarding the disposition of nonconformances with the existing licensing basis is contained in NRC Regulatory Information Summary (RIS) 2005-20, "Revision to Guidance Formerly Contained in NRC Generic Letter 91-18, 'Information to Licensees Regarding Two NRC Inspection Manual Sections on Resolution of Degraded and Nonconforming Conditions and on Operability.'"

NRC correspondence subsequent to GL 2004-02 provided licensees with additional guidance and staff expectations to licensees on resolving GSI-191. The NRC staff's position regarding containment coatings is described in a letter from B. Sheron (NRC) to M. Coyle (Nuclear Energy Institute, or NEI), dated January 16, 2006 (ADAMS ML053470467). By letters dated February 9, 2006, the NRC requested additional plant-specific information from licensees regarding their responses to GL 2004-02 (see ADAMS ML060370491 for the plant-specific request for additional information (RAI) to NMC for PBNP). By letter dated February 28, 2006 (ADAMS ML060620648) from A. Pietrangelo (NEI) to B. Sheron (NRC), NEI proposed an alternative approach and timetable for licensees to respond to the February 9, 2006, plant-specific RAIs. By letter dated March 3, 2006 (ADAMS ML060650335) from B. Sheron (NRC) to A. Pietrangelo (NEI), the NRC accepted NEI's alternative approach and provided the staff's expectations regarding licensee supplemental responses to GL 2004-02, particularly regarding chemical effects, coatings, and downstream effects. The alternative approach and timetable were provided to pressurized-water reactor licensees by letter from C. Haney (NRC) dated March 28, 2006 (ADAMS ML060870274).

In response to Event Notification 42129, the NRC requested additional information to establish that the requirements of 10 CFR 50.46(b)(5) continued to be met at PBNP. The NRC's request was consistent with the guidance of GL 2004-02 in that, "if a noncompliance with the existing licensing basis that affects the operability of an ECCS or CSS design feature is identified while taking actions in response to GL 2004-02, licensees should comply with established regulatory requirements." By letter dated February 16, 2006, NMC stated that "the ability has been maintained to safely assure long-term core cooling in accordance with the provisions of 10 CFR 50.46." NMC also provided a list of nonconformances with the current licensing basis and a proposed schedule for resolution consistent with the existing NMC commitment to resolve GSI-191 by December 31, 2007.

The NRC staff reviewed the information provided by the licensee to verify that it had reasonable assurance that the licensee, under the current licensing basis, remained in compliance with 10 CFR 50.46(b)(5). In this evaluation, the NRC staff referred to the current licensing basis for PBNP as established in the Final Safety Analysis Report (FSAR, particularly sections 6.2 and 14.3.5), to licensee responses to applicable NRC generic correspondence (GLs 97-04, 98-04, 04-02, Bulletin 03-01, et al.), to applicable licensing actions (i.e., Amendment Nos. 14/18 and 174/178), and to the Final Facility Description and Safety Analysis Report (the predecessor to the FSAR). The NRC staff recognizes that the ongoing resolution of GSI-191, including NMC's proposed sump strainer modifications in the next refueling outages, may impact NMC's current analysis and result in changes to the PBNP licensing basis. Therefore, the staff's evaluation is valid pending resolution of GSI-191 in accordance with GL 2004-02. As noted above, the NRC staff's expectations are that licensees will ensure an appropriate basis is incorporated into plant-specific evaluations that will be provided in the supplemental responses to GL 2004-02, as stated in the letter from B. Sheron (NRC) to A. Pietrangelo (NEI) dated March 3, 2006, and in accordance with the timetable provided by the letter from C. Haney (NRC) to pressurized-water reactor licensees dated March 28, 2006.

This evaluation also provides specific NRC staff expectations of the PBNP licensee with regard to resolution of GSI-191 identified during the staff's review of Event Notification 42129. The expectations in this evaluation are provided for the licensee's consideration in developing its supplemental response to GL 2004-02. The expectations in this evaluation are consistent with those provided in GL 2004-02, the letter from B. Sheron (NRC) to A. Pietrangelo (NEI) dated March 3, 2006, and the letter from C. Haney (NRC) to pressurized-water reactor licensees dated March 28, 2006. For reasons stated above, these expectations do not impact consideration of compliance with the existing licensing basis for PBNP.

2.0 <u>EVALUATION</u>

2.1 <u>Containment Coatings</u>

2.1.1 Background

The PBNP reactor containments contain both qualified and unqualified coatings. A qualified coating is one that has been subjected to testing and quality assurance controls to provide reasonable assurance that the coating will remain intact and will not create debris that would impact performance of the emergency sump in event of a DBA. Coatings that are unqualified do not meet the above criteria and are assumed to fail in the event of a DBA. Likewise, qualified coatings that have become degraded are treated in the same manner as unqualified coatings and are assumed to fail during a DBA. The licensee determined the amount of degraded qualified coatings through a visual inspection of the PBNP containments.

The licensee's evaluation assumes that non-degraded qualified coatings remain intact during a DBA, that 100 percent of degraded qualified coatings fail, and that 100 percent of unqualified coatings fail.

The licensee assumed that the failed degraded qualified coatings (epoxy) would form flat circular chips with a diameter of 1/8 inch. This assumption is based on having the smallest possible fragment that could physically lodge in the 1/8 inch screen perforations. The licensee stated that by using the smallest possible size for the coating chips, the transportability of coating chips is maximized. The thickness of the chips was established based on a sampling of containment coatings. For the transport analysis, the minimum thickness was used in order to maximize transport. Also, to maximize transport, the specific gravity of the degraded qualified coatings used in the transport analysis is that of the least dense qualified coating in containment. For the calculations of total coating debris, the maximum thickness was used to maximize the volume of debris.

The licensee assumed that all unqualified coatings would fail as particles equal to or smaller than 1128 microns. The size of the unqualified coating debris was based on Electric Power Research Institute (EPRI) Technical Report 1011753, "Design Basis Accident Testing of Pressurized Water Reactor Unqualified Original Equipment Manufacturer Coatings," dated September 2005. All of the debris from unqualified coatings was assumed to be 100 percent transportable to the sump. The licensee also assumed that 100 percent of the failed unqualified coating particulate would pass through the sump screen openings and would not increase head loss.

2.1.2 NRC Staff Evaluation

The NRC staff agrees with the licensee's conservative assumption that 100 percent of the unqualified coatings and 100 percent of the degraded qualified coatings will fail in the event of a DBA. The NRC staff also believes that it is reasonable to assume that all qualified coatings outside the break zone of influence that have not degraded in some way will remain adhered in a DBA. However, it should be noted that the NRC staff's position is that visual assessment alone may not accurately identify all degraded qualified coatings. This issue is specifically noted by the NRC staff based on the licensee's decision to modify its criteria for assessing coating degradation. The licensee states that for the Unit 1 coatings inspection, only coatings that were delaminating were considered degraded, resulting in a lower inventory of degraded qualified coatings (approximately 3,000 square feet less than Unit 2). The NRC staff expects licensees to show how their coating assessment techniques are correlatable to DBA performance for the resolution of GSI-191. The NRC staff's position is described in a letter from B. Sheron (NRC) to M. Coyle (Nuclear Energy Institute, or NEI), dated January 16, 2006. The NRC staff expects the licensee to follow the guidance provided in the above referenced letter when performing final coating assessments for resolution of GSI-191, or to demonstrate how coatings that only have visual inspection assurance continue to meet qualification standards in light of current industry experience.

The licensee treated the debris created by degraded qualified coatings as round chips with a diameter equivalent to the size of the openings in the screen. For cases in which the debris does not form a fiber bed on the screen, the NRC staff agrees that this is the most conservative treatment for coating debris, in terms of head loss. Treating the debris in this manner gives the most transportable geometry that still has the ability to block the screen openings. However, if the licensee subsequently determines that a fiber bed is formed on the screen, then the NRC staff would expect the licensee to assume that the coating debris forms as particulate that would be filtered out by the fiber bed and result in higher head loss. For the purposes of this evaluation, and based on the licensee's analysis that no fiber bed is formed on the screen, the NRC staff accepts the treatment of degraded qualified coatings debris as 1/8 inch chips.

The licensee assumes that unqualified coating fails as particulate based on the above referenced EPRI Technical Report 1011753. The NRC staff has performed a preliminary review of the referenced report and has the following observations:

- The test subjected actual plant samples with Original Equipment Manufacturers (OEM) unqualified coatings to a modified DBA test (ASTM D3911).
- The main focus of the EPRI report was to provide insight on a percentage of unqualified coatings that may fail during a DBA.
- The test examined a number of coating types.
- Collecting coating debris formed during the test was a test byproduct (not the main intent). Only particulate was observed on the test system filters. Chips were not identified in any portion of the test chamber or on the filters.
- Particulate identified had a size distribution of approximately 10 microns to 1200 microns.

The testing documented in EPRI Technical Report 1011753 is the only coating test of which the NRC staff is aware that provides data on coating debris size resulting from a DBA test. The NRC staff finds that it is reasonable for the purpose of this assessment to assume that the unqualified coatings will fail and form particulate based upon the referenced EPRI test. The licensee's assertion that 100 percent of the unqualified coating debris will pass through the screen and not contribute to head loss is acceptable based on the assumption that a fiber bed is not formed. If GSI-191 analysis shows that a fiber bed can be formed at PBNP, then the licensee would have to evaluate the head loss implications of the coating particulates filtering out on the fiber bed to resolve GSI-191.

The licensee's operability assessment and RAI response do not address why the EPRI test is applicable to its plant or any interactions that may result from the unqualified coating particulate. While the licensee's assessment is acceptable for determining reasonable assurance of operability under the current licensing basis and in accordance with the NRC guidance of RIS 2005-20, if the licensee uses this report in its final analysis for GSI-191, the NRC staff would expect the applicability of the testing to the specific plant conditions to be addressed in detail in any application the licensee may submit to revise its licensing basis in response to GL 2004-02.

2.1.3 Conclusion

The NRC staff finds that the licensee's assumptions regarding coating failure and coating debris generation in a DBA are acceptable for the licensee's assessment that there is reasonable assurance of operability of the ECCS under the current licensing basis. Therefore, the NRC staff concludes that there is reasonable assurance that the requirements of 10 CFR 50.46(b)(5) continue to be met.

2.2 Downstream Effects

2.2.1 Background

The NRC staff reviewed the licensee's response dated February 16, 2006, regarding the effects of debris on downstream components of the ECCS, including the reactor pressure vessel (RPV) internals. The RAI questions concerning effects on downstream components were RAIs E.(1) and E.(2):

E. Effects on Downstream Components

(1) What types, particle sizes and quantities of materials are expected to pass through the sump screens? What is the basis for this answer?

(2) What ECCS equipment/components have tight clearances that could potentially be affected by foreign materials that pass through the sump screens (e.g., pump seals, flow orifices, throttle valve trim, etc.)? What is the basis for this answer?

The licensee's response is summarized below:

E. (1) Prior to resolution of concerns related to GSI-191, the types of debris explicitly evaluated to pass through the sump screens have been limited to fragments of disintegrated coatings. These evaluations are contained in Section 9 of the unit-specific 1989-90 consultant reports, and in Engineering Evaluation 2005-0024, Revision 1. The various evaluations estimated the total quantity of debris fines that pass through the screens and reach the reactor vessel to be from less than 10 cu.ft. to up to 27.5 cu.ft. These particles have been estimated to have sizes ranging from 10 microns to 0.125 inch (the size of the ECCS screen perforations).

(2) There are no ECCS components that have tight clearances and/or materials that could be unacceptably degraded by foreign materials that pass through the sump screens. This conclusion is based on evaluations performed by the consultant in 1989-90 and Engineering Evaluation 2005-0024, Revision 1.

2.2.2 NRC Staff Evaluation

NEI 04-07, “Pressurized Water Reactor Sump Performance Evaluation Methodology,” acknowledges that more engineering evaluation should be performed to address some technical issues in GSI-191, including the issue of potential downstream effects. The NRC staff reviewed the licensee's RAI response and the current licensing basis to evaluate whether there is reasonable assurance that the ability of downstream ECCS components has been maintained to safely ensure long-term cooling in accordance with the provisions of 10 CFR 50.46(b)(5).

The downstream effects evaluation is strongly dependent on the debris source term penetrating the sump screens. In this case, the licensee’s response to RAI E.(1) indicates that the types of debris explicitly evaluated to pass through the sump screens were limited to fragments of disintegrated coatings and that the quantities range from 10 cu.ft. to 27.5 cu.ft. with particle sizes ranging from 10 microns to 0.125 inch. If the debris passing through the screens is limited to only coatings and not other types of debris, then there is a minimal concern for wear to downstream components, particularly if the downstream components have been hard-faced. Coatings are generally considered soft debris (NUREG/CR-2792, “An Assessment of Residual Heat Removal and Containment Spray Pump Performance Under Air and Debris Ingesting Conditions,” September 1982, Table 4-1) and at low concentrations are not capable of damaging hardened or hard-faced materials, unless they contain abrasives. In regard to pump seals, NUREG/CR-2792 states that the effects of soft debris are to cause either seal flush passage clogging or spring hang-up. The licensee’s RAI response stated that it estimated that the concentration of fines within the recirculating water would be less than 0.1 percent. Independent analyses such as those presented in NUREG/CR-2792 state that, in general, the pump specialists agree that soft, fibrous debris at volumetric concentrations less than 1 percent should not impair single-stage pump performance. The effect of coating debris on equipment/components with tight clearances, including consideration of seal blockage, is further evaluated below.

The licensee’s response to RAI E.(2) indicated that there are no ECCS components that have tight clearances and/or materials that could be unacceptably degraded by foreign materials that pass through the sump screens. The licensee concluded that this is based on engineering evaluations performed in 1989-1990 and in 2005. The licensee’s response suggested that this evaluation considered the blockage of fluid systems and the effect of abrasives in the coatings debris. The licensee’s response also credited an engineering evaluation performed in 2005 that determined that failure is not expected of the mechanical seals on the residual heat removal (RHR) and safety injection pumps from operation with suspended coating decomposition particles. The reason for this, as stated by the licensee, was that the same design seals are used in applications with similar debris-laden fluid, such as pulp and paper, petrochemical, food processing, and waste water treatment processes.

In regard to orifices, the licensee’s evaluation concluded that flow instrumentation and flow limiting orifices are not subject to blockage by fine particles, since flow paths are on the order of inches.

With respect to ECCS valves, the licensee stated that, after sump recirculation is established, valves in the flow path are not relied upon to reposition. Further, valves in these flow paths are 2 inches in diameter or greater and have stainless or harder wearing surfaces. Although the licensee’s evaluation recognized it may be desirable to throttle the RHR heat exchanger outlet butterfly valves, these large-diameter valves are not expected by the licensee to be susceptible to degradation from suspended particulates. The licensee stated that, based on these considerations, wear, erosion, and blockage of valve components are not factors.

The NRC staff reviewed the licensee’s RAI responses and, in general, concurs with the qualitative arguments concerning wear, erosion and blockage of downstream components evaluated for the expected debris source term. The licensee's assessment is acceptable for determining reasonable assurance of operability under the current licensing basis and in accordance with the NRC guidance of RIS 2005-20; therefore, there is reasonable assurance that the requirements of 10 CFR 50.46(b)(5) continue to be met. As stated in its response, the licensee will continue to evaluate issues associated with the plant’s ability to satisfy long-term cooling in an integrated and comprehensive manner.

The recommendations and comments below are provided by the NRC staff for the licensee to consider in addressing the GL 2004-02 request that licensees perform new, more realistic analyses and submit information to confirm the functionality of the ECCS and CSS during DBAs requiring recirculation operations, and in any application that the licensee may submit to revise its licensing basis in response to GL 2004-02. The NRC staff noted that the licensee presented no quantitative analyses or testing results that confirm the debris source term is not detrimental to downstream equipment/components. In addition, the licensee should consider the following in further evaluating downstream equipment and components to resolve GSI-191:

- The downstream effects evaluation is strongly dependent on the debris source term penetrating the sump screens. The licensee should consider validating the downstream debris source term and assumptions used to develop the screen penetration source term.

- The licensee should consider reviewing and identifying any exceptions to industry guidance or regulatory guidance, such as NRC Regulatory Guide 1.82, “Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident.”

- The licensee should consider including additional information on debris concentration (ppm) or reference a plant-specific analysis of wear or wear model for determining wear rate for downstream components.

- The licensee did not support its current evaluation of blockage of downstream components by testing and/or a quantitative analysis. The licensee should consider validating assumptions used in the evaluation of blockage and consider developing a qualification test to demonstrate that, with consideration of chemical effects, a slurry mixture in downstream components cannot result in blockage. Chemical effects testing and valve flow testing by the NRC may be useful as references.

- Heat exchangers are not addressed in the response. The licensee should consider potential tube plugging and fouling due to chemical effects in its analysis. Refer to the NRC safety evaluation report dated December 6, 2004, Section ES.11, “Downstream Effects,” for NEI 04-07.

- The potential blockage of instrument sensing lines and other narrow passages is not addressed in the response. The licensee should consider demonstrating by a quantitative analysis that settlement of debris in these areas is not possible.

2.2.3 Conclusion

The NRC staff recognizes the ongoing evaluation by industry and the licensee of issues associated with potential downstream effects. Based on its review of the licensee's RAI response and the current licensing basis, and notwithstanding the above recommendations and comments, the NRC staff finds that, due to the minimal quantity and type of fines passing through the screens, the licensee's assumptions and conclusions appear reasonable in regard to downstream ECCS components, including the RPV internals. Therefore, the NRC staff concurs with the licensee that, consistent with their current design basis, there is reasonable assurance that the ability of downstream ECCS components has been maintained to safely assure long-term cooling in accordance with the provisions of 10 CFR 50.46(b)(5).

2.3 Sump Screen Performance

2.3.1 Background

As noted in section 1.1 above, the NRC staff does not expect PWR licensees to revise their licensing bases to account for the present state of knowledge regarding GSI-191 post-accident debris effects until December 31, 2007. Accordingly, the NRC staff's evaluation and conclusions pertaining to the licensee's RAI response are based upon the criteria and associated methodologies that support the current PBNP licensing basis. Licensing basis exceptions were reviewed to ensure that they had been appropriately justified.

2.3.2 NRC Staff Evaluation

For this portion of the review, the NRC staff evaluated the licensee's responses, dated February 16, 2006, to the NRC Question 2, Questions 3.A.3 through 3.A.6, and Questions 3.B through 3.D.

2.3.2.a NRC Staff Question 2

The NRC staff requested that the licensee (1) identify the zone of transport (ZOT) for debris in the containment pool, (2) describe how the ZOT was determined, and (3) provide a basis for the ZOT determination.

Licensee Response:

The licensee identified that the ZOT methodology was applied in existing calculations [1, 2, 3, 4] for both the transport of coatings debris that is suspended in the containment pool and for coatings debris that has settled onto the containment floor. The licensee provided the following definition of the ZOT for suspended coatings debris:

> the horizontal distance extending from [the] sump screen projected onto the water surface into which failed coating debris would be transported to the sump screen by the flow of water rather than settling on the containment floor [1, 2].

The licensee's response defined the ZOT for settled coatings debris that may slide or tumble along the containment floor as:

> the area around a screen where coatings debris would settle to the floor, and once on the floor of the containment, could be transported to the screen by sliding along it.

The licensee's response stated that the existing ZOT accounts for all locations where transport by credible mechanisms could result in the deposition of coatings debris at the surface of the containment pool within the ZOT, such as washdown from upper elevations along the containment liner plate in the vicinity of the sump screens.

The licensee’s response stated that the ZOT analysis for PBNP is based upon the methodology established in NUREG/CR-2791, “Methodology for Evaluation of Insulation Debris Effects,” September 1982 [7].

To address issues associated with ECCS functionality in recirculation mode, the licensee has adopted procedures to take suction from the sump with a single train at a reduced flow rate of less than 1582 gallons per minute (gpm). This flow reduction was credited as decreasing the radius of the ZOT for suspended coatings debris from 7.3 feet to 2.4 feet. The licensee further stated that the density of degraded qualified coatings debris is too great to permit sliding along the containment floor (i.e., a ZOT for settled qualified coatings debris does not exist).

As discussed in the RAI response in greater detail, the licensee concluded that unqualified coatings are assumed to degrade into fine particulate that fully transports to (and through) the recirculation sump screens.

NRC Staff Evaluation:

The licensee’s approach in deriving the ZOTs for suspended and settled coatings debris cites the guidance of NUREG/CR-2791. The NRC staff also reviewed and approved a similar ZOT approach used by Comanche Peak Steam Electric Station (CPSES) in that plant’s original safety evaluation report [8]. As a result of its similarity to the NUREG/CR-2791 methodology and the previously approved CPSES ZOT approach, the staff concluded that the overall ZOT approach used by PBNP in its RAI response was generally consistent with the regulatory guidance that supports the current PBNP licensing basis.

In deriving its ZOT (Engineering Evaluation 2005-0024), the licensee scaled down the size of the ZOT to account for the reduced sump flow rate of 1582 gpm. This exception to the licensing basis is documented in Operability Recommendation (OPR) 162 and Engineering Evaluation 2005-0024, which are included in Enclosure 3 to the licensee's February 16, 2006, letter. Via teleconference (ADAMS ML062160328) on March 9, 2006, between T. Kendall (NMC) and J. Lehning (NRC), the licensee clarified its methodology in Engineering Evaluation 2005-0024 for scaling the radius of the ZOT for degraded qualified coatings debris from 7.3 feet to 2.4 feet. The licensee indicated that the scaling approach was based upon the nodal network calculation used in the current licensing basis for computing containment pool velocities. The NRC staff noted that the scaling approach did not address the geometric convergence of flow near the sump screens or uncertainties associated with the perturbations in nodal channel flow resistances that would result from the perturbation in sump flow rate. The licensee responded that no degraded coatings are within 7 feet of the sump screens and further clarified that (1) coating washdown along the liner plate was not predicted to occur and (2) even if coating washdown occurred, these coatings would enter the containment pool over 7 feet away from the sump screens. Based upon the information provided by the licensee in its RAI response, the NRC staff concluded that sufficient margin was available to address the issue of geometric flow convergence and uncertainties regarding the scaling calculation for the ZOT for suspended debris.

Although licensing basis exceptions associated with the licensee's ZOT scaling methodology generally appear to have an adequate technical basis, the staff noted that the potential for degraded qualified coatings debris to settle near the sump and subsequently slide along the containment floor to contribute to the formation of a debris "collar" at the base of the sump screens was not adequately modeled. As a result of this modeling deficiency, the licensee concluded that there was no mechanistic basis for a debris "collar" to form around the sump screens. Despite the licensee's conclusion, as discussed further in Section 2.3.2.e concerning Question 3.D, the licensee assumed the formation of a debris "collar" in its assessment of flashing in the ECCS sump suction line. Therefore, the inadequate modeling of debris "collar" formation did not result in a nonconservative effect on the licensee's overall sump performance analysis. In light of the above discussion, the NRC staff finds that the licensee's assumptions regarding scaling the ZOT for suspended coatings debris are acceptable for the licensee's assessment that there is reasonable assurance of operability of the ECCS under the current licensing basis.

2.3.2.b NRC Staff Questions 3.A.3 - 3.A.6

The NRC staff requested that the licensee identify (1) whether failed coatings would be transported (including during the blowdown phase) to the sump screens, (2) the quantity of coatings determined to transport, (3) the quantity of unqualified and degraded qualified coatings on the containment floor in the ZOT around the sump and the quantity of this debris that will transport to the sump screens, and (4) the percentage of the sump screen surface area that would be blocked by coatings debris. In addition, the NRC staff requested that the licensee provide a basis for each part of the response.

Licensee Response:

The licensee stated that unqualified coatings would be assumed to degrade into fine particulate of approximately 0.04 inch or less in characteristic dimension. As such, the licensee indicated that 100 percent of the fine unqualified coatings debris would transport to the recirculation sump screens. These fine particles, however, would be assumed to pass through the sump screen openings of 1/8 inch (0.125 inch), rather than accumulating upon the screen surface.

The licensee identified that qualified (i.e., acceptable) coatings are considered to be degraded only if they are de-bonding or delaminating. Based upon the discussion of ZOT provided in response to Question 2, the licensee indicated that degraded qualified coatings debris would only be transported to the sump screens if it is deposited on the containment pool surface within the ZOT around the screens (approximately 2.4 feet in radius). The licensee further indicated that containment pool flow velocities are too low to transport along the containment floor any coatings debris large enough to accumulate on the sump screens (i.e., a ZOT for settled 1/8-inch chips of degraded qualified coatings debris does not exist). With these ZOTs, the licensee determined that no degraded qualified coatings debris is capable of transporting to the sump screens.

The licensee's RAI response indicated that assuming transport of coatings debris during the blowdown phase of a loss-of-coolant accident (LOCA) is generally nonconservative for degraded qualified coatings debris. For degraded qualified coatings debris that fails into chips large enough to become lodged upon the sump screens, transport into the pool during the blowdown phase would allow the chips significant opportunity to sink to the containment pool floor. Based upon the coating densities and predicted fluid flow velocities, transport along the containment floor would not be expected for degraded qualified coating chips for the reduced recirculation sump flow rate of 1582 gpm. Therefore, the licensee stated that the transport of coatings chips is not considered during the blowdown phase of an accident.

The licensee stated that walkdowns of the containment sump elevation have been conducted and that no pre-existing debris from degraded qualified coatings is anticipated on the containment floor in the immediate vicinity of the sump screens. The licensee indicated that large areas of mechanical damage existed, such as abrasions or “dings,” but that coating delamination was not observed in this area. The licensee further indicated that the containment pool flow velocities outside the trash rack enclosure would be too low (i.e., less than 0.2 ft/sec) to enable 1/8-inch chips of qualified coatings debris to slide or tumble along the floor. Therefore, the licensee concluded that no degraded qualified coatings debris on the floor in the vicinity of the sump is expected to reach the containment recirculation sump screens.

Based upon the discussion above, the licensee concluded that no coatings debris is capable of blocking the sump screens.

NRC Staff Evaluation:

The NRC staff’s review determined the licensee’s response regarding coatings transport to be generally consistent with the current licensing basis with the exception of two input assumptions: (1) unqualified coatings debris failing as fine particulate and (2) the ZOT for degraded qualified coatings being scaled down based upon the reduced sump flow rate.

The licensing basis exception concerning the size of failed unqualified coatings led to the apparently conservative result of 100 percent debris transport to the sump screens (during recirculation). The licensee justified this exception based upon a recent EPRI study of unqualified coating failures [13]. Although the transport results based upon the new information appear conservative, the subsequent conclusion that 100 percent of this debris passes through the sump screens negates any conservatism with regard to clogging the sump screen. In its evaluation of the licensee's response to Question 3.D, the NRC staff will discuss residual concerns associated with the licensee’s treatment of unqualified coatings.

In its evaluation of the licensee's response to Question 2, the NRC staff found that the scaled-down ZOT for suspended degraded qualified coatings debris was appropriately justified. The licensee’s response indicated that no degraded qualified coatings can enter the containment sump pool within the scaled-down ZOT for suspended debris and that there are no degraded qualified coatings on the floor in the vicinity of the sump screens. Based upon this information, the NRC staff considers the licensee’s treatment of degraded qualified coatings transport to be appropriate in consideration of the current licensing basis.

Although licensing basis exceptions associated with the licensee's coatings debris transport methodology generally appear to have an adequate technical basis, the staff noted that the potential for degraded qualified coatings debris to settle near the sump and subsequently slide along the containment floor to contribute to the formation of a debris "collar" at the base of the sump screens was not adequately modeled. As a result of this modeling deficiency, the licensee concluded that there was no mechanistic basis for a debris "collar" to form around the sump screens. Despite the licensee's conclusion, as discussed further in Section 2.3.2.e concerning Question 3.D, the licensee assumed the formation of a debris "collar" in its assessment of flashing in the ECCS sump suction line. Therefore, the inadequate modeling of debris "collar" formation did not result in a nonconservative effect on the licensee's overall sump performance analysis. In light of the above discussion, the NRC staff finds that the licensee's assumptions regarding coatings debris transport are acceptable for the licensee's assessment that there is reasonable assurance of operability of the ECCS under the current licensing basis.

2.3.2.c NRC Staff Question 3.B

The NRC staff requested that the licensee identify (1) the amount of insulation debris that could be generated by a pipe rupture, (2) the physical characteristics of the insulation debris, (3) whether the insulation debris will transport to the sump screens, (4) the amount of insulation that will transport to the sump screens, and (5) the fraction of the sump screen that will become blocked by insulation debris. In addition, the NRC staff requested that the licensee provide a basis for each part of the response.

Licensee Response:

The licensee stated that several types of debris would be generated as the result of the most limiting pipe rupture, including reflective metallic foils, asbestos and calcium silicate, encapsulated fiberglass, temp-mat blankets, and encapsulated mineral wool. The licensee's response cites existing calculations [3, 4] in providing quantities and describing the physical characteristics of the various insulation debris types.

The licensee's response stated that the quantities of debris were derived according to methodology adapted from NUREG/CR-2791 [7], NUREG/CR-3616 [11], and NUREG-0897, Revision 1 [12]. The evaluated mechanisms for debris generation were jet impingement within a 7-pipe-diameter spherical zone of influence, pipe whip, and pipe impact.

The licensee's response further concluded that no significant quantity of insulation debris is expected to transport to the sump screens. The licensee stated that blowdown from the pipe rupture would tend to disperse debris throughout containment, but that there would be no preferential transport toward the sump screens via this mechanism based upon the containment geometry. The licensee further stated that part of the dispersed insulation debris would be sequestered in upper containment elevations (although this phenomenon is not currently credited) and that insulation debris that did enter the pool during the blowdown phase would tend to settle onto the containment floor, from where it could not transport once sump recirculation was initiated. In support of this position, the licensee stated that NUREG-0897, Revision 1, established the minimum velocity necessary to transport submerged debris as 0.2 ft/sec. The licensee stated that transport will not occur at PBNP because the calculated containment pool fluid velocities are less than 0.1 ft/sec. The low containment pool velocities cited by the licensee resulted from a reduced sump flow rate and the assumption of an increased containment pool height as compared to previous calculations [1, 2]. Consequently, the licensee concluded that no blockage of the sump screens by insulation debris would occur.

NRC Staff Evaluation:

The NRC staff's limited-scope review determined that the licensee's approach generally followed regulatory guidance (e.g., NUREG/CR-2791, NUREG/CR-3616, and NUREG-0897, Revision 1) effective at the time the existing calculations [3, 4] were performed. Although several data limitations and differing methodologies existed in the guidance for debris transport, this guidance generally indicated that post-accident debris will consist of fragments that are not very susceptible to transport at low containment pool flow velocities, such as those calculated by the licensee for PBNP. As a result, the NRC staff finds that the licensee appropriately used the applicable regulatory guidance in assessing the operability of the ECCS under the current licensing basis.

Although licensing basis exceptions associated with the licensee's insulation debris methodology generally appear to have an adequate technical basis, the staff noted that the potential for insulation debris to settle near the sump and subsequently slide along the containment floor to contribute to the formation of a debris "collar" at the base of the sump screens was not adequately modeled. As a result of this modeling deficiency, the licensee concluded that there was no mechanistic basis for a debris "collar" to form around the sump screens. Despite the licensee's conclusion, as discussed further in Section 2.3.2.e concerning Question 3.D, the licensee assumed the formation of a debris "collar" in its assessment of flashing in the ECCS sump suction line. Therefore, the inadequate modeling of debris "collar" formation did not result in a nonconservative effect on the licensee's overall sump performance analysis. In light of the above discussion, the NRC staff finds that the licensee's assumptions regarding insulation debris are acceptable for the licensee's assessment that there is reasonable assurance of operability of the ECCS under the current licensing basis.

2.3.2.d NRC Staff Question 3.C

The NRC staff requested that the licensee identify (1) the amount of containment debris transported to the sump screens (including during blowdown), (2) the physical characteristics of the containment debris, and (3) the fraction of the sump screen that will become blocked by containment debris. In addition, the NRC staff requested that the licensee provide a basis for each part of the response.

Licensee Response:

The licensee stated that no containment debris is expected to be transported to the sump, including during the blowdown phase of a postulated accident. The licensee used the same general approach for analyzing the transport of containment debris as was discussed above for coatings and insulation debris.

The licensee stated that the types of containment debris specifically evaluated are tape and adhesive labels that are known or suspected to reside in containment in small quantities. Tape and labels are generally expected to delaminate under accident conditions. The licensee stated that the specific gravity of this type of debris ranges from 1.1 to 1.3.

During blowdown, the licensee stated that a chaotic redistribution of debris would occur. Debris would tend to be dispersed away from the break location, but there would be no trapping or preferential accumulation of debris upon the trash rack or fine inner sump screens. The licensee indicated that containment debris would have an opportunity to sink to the bottom of the containment pool prior to the initiation of sump recirculation.

The licensee determined that containment debris would be incapable of transporting to the sump screens. In support of this determination, the licensee cited guidance in Regulatory Guide 1.82, Revision 1, which indicates that a velocity of approximately 0.2 ft/sec will tend to allow debris with a specific gravity of 1.05 or greater to settle prior to reaching the sump screens.

The licensee noted that analyzed containment pool flow velocities for PBNP are less than 0.1 ft/sec. The containment pool velocities cited by the licensee resulted from a reduced sump flow rate and the assumption of an increased containment pool height as compared to previous calculations [1, 2].

The licensee's response indicated that consideration of latent dirt and dust debris is not required under the current licensing basis. However, the licensee indicated that the density of these materials is too great to permit them to transport to the sump screens. The licensee also mentioned published studies indicating that fine particulate transportable at fluid velocities of approximately 0.2 ft/sec would generally tend to be on the order of 0.04 inch or less in size and would pass unimpeded through the 1/8-inch perforations in the existing sump screens. The licensee further stated that containment closeout inspections increase assurance that any tools, equipment, dirt accumulation, or other debris that could inhibit sump screen performance will be identified and remediated prior to plant operation.

Therefore, the licensee's response indicated that no containment debris is expected to transport to the sump screens.

NRC Staff Evaluation:

The NRC staff's limited-scope review determined that the licensee's approach generally followed regulatory guidance (e.g., NUREG/CR-2791, NUREG/CR-3616, and NUREG-0897, Revision 1) effective at the time the existing calculations [3, 4] were performed. Although several data limitations and differing methodologies existed in the guidance for debris transport, this guidance generally indicated that post-accident debris will consist of fragments that are not very susceptible to transport at low containment pool flow velocities, such as those calculated by the licensee for PBNP. As a result, the NRC staff finds that the licensee appropriately used the applicable regulatory guidance in assessing the operability of the ECCS under the current licensing basis.

Although licensing basis exceptions associated with the licensee's containment debris methodology generally appear to have an adequate technical basis, the staff noted that the potential for containment debris to settle near the sump and subsequently slide along the containment floor to contribute to the formation of a debris "collar" at the base of the sump screens was not adequately modeled. As a result of this modeling deficiency, the licensee concluded that there was no mechanistic basis for a debris "collar" to form around the sump screens. Despite the licensee's conclusion, as discussed further in Section 2.3.2.e concerning Question 3.D, the licensee assumed the formation of a debris "collar" in its assessment of flashing in the ECCS sump suction line. Therefore, the inadequate modeling of debris "collar" formation did not result in a nonconservative effect on the licensee's overall sump performance analysis. In light of the above discussion, the NRC staff finds that the licensee's assumptions regarding containment debris are acceptable for the licensee's assessment that there is reasonable assurance of operability of the ECCS under the current licensing basis.

2.3.2.e NRC Staff Question 3.D

The NRC staff requested that the licensee identify (1) the safety functions of the ECCS recirculation sump, (2) the percentage of the sump screens that would become blocked by debris during an accident, (3) the percentage of the screens that is required to remain unblocked during an accident (or, alternately, the limiting allowable head loss across the sump screens), and (4) whether a reasonable expectation exists that the sump will fulfill its safety functions in light of any associated uncertainties. In addition, the NRC staff requested that the licensee provide a basis for each part of the response.

Licensee Response:

The licensee identified two safety functions for the ECCS recirculation sump. First, the sump serves as the suction source for the RHR pumps during the recirculation phase of a LOCA. As such, the sump collects water at the lowest elevation of the containment building and supplies it at an acceptable head loss and without excessive air entrainment. Second, the sump is screened to preclude the passage of particulate debris greater than 1/8-inch in diameter from reaching downstream components.

In conjunction with the responses to Questions 3.A through 3.C above, the licensee indicated that blockage of the sump screens with debris is not anticipated. The licensee's response reiterated that fluid velocities in the containment pool are too low to transport most types of debris. The licensee indicated that, although degraded qualified coatings have a limited potential for transport, they do not currently exist inside and could not enter the scaled-down ZOT around the sump screens. Thus, the licensee concluded that degraded coatings debris will not transport to the screens.

For the sump to fulfill its safety function, the licensee indicated that the maximum sustainable screen head loss is 1.6 feet. The licensee's response indicated that this limit is based upon the potential for air ingestion and can be derived as one half the minimum submerged height of the sump screens. The licensee further stated that the containment sump level will rise, increasing the head loss limit to 2.5 feet, once containment sprays have completed draining the refueling water storage tank.

The licensee's response further discussed the potential for debris to accumulate in a "collar" at the base of the fine inner sump screens, which could channel all sump flow through an annulus around the sump suction valve disc approximately 3/4 inch in width and 12 inches in diameter. The effect of channeling the entire flow through this relatively small opening would be to substantially increase the hydraulic friction losses in the sump suction piping, possibly resulting in flashing. Although this condition was analyzed [6], the licensee indicated that it is not expected to occur because the modified analysis in the RAI response does not predict that debris will transport to form a collar the base of the sump screens.

Based upon the discussion above and the previous responses to Questions 3.A, 3.B, and 3.C, the licensee concluded that there is reasonable expectation that the containment recirculation sump will fulfill its safety functions. The licensee's response stated that this conclusion is based upon regulatory guidance that supports the incapability of low velocity fluid fields to transport negatively buoyant (i.e., denser than water) debris. The licensee also noted that the quiescent period between the blowdown transient and the initiation of sump recirculation would provide time for initially suspended debris to settle onto the floor of the containment pool, whereupon it would subsequently be incapable of transporting to the sump screens.

The licensee's response indicated that uncertainties in the specific quantities and mixes of debris that could be generated by LOCAs of various sizes and locations are not significant because the debris from all LOCAs would be negatively buoyant. As such, this debris would not be expected to transport, regardless of the pertinent uncertainties. The licensee further indicated that low containment pool flow velocities and the high specific gravity of debris provide approximately a factor of 4 as margin to account for uncertainties. The licensee concluded that the available margin envelops an estimated uncertainty of 10 percent associated with the containment pool flow velocities.

NRC Staff Evaluation:

The licensee's determination that the containment recirculation function would not be adversely affected by blockage is largely based upon the assumption that post-accident debris would not be transportable. Based upon the previous discussion concerning Questions 3.A, 3.B, and 3.C, the NRC staff generally considers the licensee's determination to be consistent with the current licensing basis for determining sump screen blockage, with the exception of the licensee's conclusion that there is no mechanistic basis to postulate the formation of a debris "collar" at the base of sump screens. The staff considered this issue to be noteworthy because the formation of a debris "collar" could substantially decrease the available margin to ECCS sump suction line flashing, as discussed in further detail below.

Current licensing basis calculations [1, 2] predict that a "collar" of unqualified coatings debris higher than 1 foot will form around the sump screens for each unit, thereby resulting in the potential for flashing in the sump suction piping. However, assuming that unqualified coatings debris will pass through the sump screens and that the sump flow rate is reduced, thereby lowering containment fluid flow velocities, the licensee determined that debris collars cannot form because any debris capable of reaching the sump screens will pass through (and none will settle in the area directly at the base of the screens).

The NRC staff is concerned that there is very little margin associated with the licensee's determination that debris collars cannot form. Although calculations supporting the existing licensing basis predict collars of higher than 1 foot around the sump screens for each unit, based upon drawings provided by the licensee, these collars would actually only need to be approximately 4 to 6 inches high to channel recirculation sump flow through the restrictive annulus around the sump suction valve disc. The NRC staff estimates the quantity of debris needed to form this size collar to be on the order of only a fraction of a cubic foot (e.g., 0.2 cu.ft. to 0.6 cu.ft.).

As discussed in more detail below, in the NRC staff's judgment, uncertainties associated with the two assumptions noted above are too great to reasonably preclude the transport of such a small quantity of debris to the base of the sump screens.

First, significant uncertainty is associated with the methodology used by the licensee to scale down the containment fluid flow velocities in the vicinity of the sump screens based upon the reduced sump flow rate of 1582 gpm. The NRC staff noted concerns in a March 9, 2006, teleconference that the velocity scaling approach did not address the geometric convergence of flow near the sump screens or uncertainties associated with the perturbations in nodal channel flow resistances that would result from the reduced sump flow rate. Further, the licensee's approach did not address the potential for a vertical profile to develop in the fluid velocity field near the sump screens. The NRC staff is concerned that horizontal flow velocities could be significantly increased near the containment floor (where tumbling debris transport would occur) as a result of the restrictive opening in the sump suction line. Without assuming any blockage, the NRC staff estimates that horizontal velocities in excess of 5 ft/sec would be expected to pass through the suction line opening. Large horizontal flow velocities along the containment floor could extend well beyond the sump screens and outside the trash rack enclosure under this condition. The licensee's conclusion of no transport for insulation and containment debris was based upon flow velocities in containment being less than 0.2 ft/sec. As flow velocities along the containment floor in the vicinity of the sump screens may well exceed 0.2 ft/sec, the NRC staff would consider it inappropriate not to consider the potential for debris deposited in such high-velocity areas to be transported to the base of the screens to form a debris collar. Similar conclusions apply to degraded qualified coatings debris and other types of debris according to their respective transport velocities.

Second, significant uncertainty is also associated with the licensee's treatment of unqualified coatings. The licensee used data from an EPRI report to characterize the failure of unqualified coatings as small fines; however, a degree of uncertainty exists in correlating the EPRI results to the specific unqualified coatings at PBNP. Although the NRC staff considers the licensee's approach to be generally reasonable for the purpose of this evaluation, a sufficiently detailed analysis was not presented to provide a high degree of confidence that other sizes of unqualified coatings debris could not be generated as well. Aside from this, the NRC staff also identifies uncertainty with the assumption that 100 percent of the unqualified coatings debris will pass through the screen. Although this assumption also appears generally reasonable for the present evaluation, the NRC staff notes that some of the small particles may be capable of piling up at the screen openings. The licensee's response indicates that at least 3.5 cu.ft. of unqualified coatings debris will be available for transport at both PBNP units. Considering that this volume is based upon the assumption of no internal void space (i.e., perfect compression), and that realistic debris formations could include considerable internal void space, it is clear that only a small fraction of the total volume of unqualified coatings is necessary to create a collar around the sump screens.

Moreover, the NRC staff notes the selective application of new information regarding GSI-191 debris effects (e.g., the EPRI coatings report [13]) to address current licensing basis concerns, such as ECCS sump suction line flashing. The framework established by GL 2004-02 intended that the new criteria and methodology associated with GSI-191 would be implemented holistically once modifications to address this issue had been completed (i.e., December 31, 2007). Partial implementation of new methodologies and assumptions could lead to contradictory or unreasonable analytical results, and may not ensure that existing design issues are appropriately addressed.

On the basis of the concerns discussed above, the NRC staff considers the licensee's conclusion that a debris collar would not form under the expected post-LOCA conditions to be nonconservative. However, as discussed in section 2.5 below, the licensee appropriately addressed this nonconservatism by assuming the formation of a debris "collar" in its analysis of ECCS sump suction line flashing. As a result, the inadequate technical modeling of debris "collar" formation did not result in a nonconservative effect on the licensee's overall sump performance analysis. Therefore, based upon this finding and the staff's evaluations presented in Sections 2.3.2.a through 2.3.2.e above, the NRC staff has reasonable assurance under the current licensing basis that the ECCS sump is capable of fulfilling its safety functions.

2.3.3 Conclusion

As outlined in GL 2004-02, the NRC staff does not expect PWR licensees to revise their current licensing bases to account for the present state of knowledge regarding post-accident debris effects until December 31, 2007. As such, the NRC staff evaluated the licensee’s RAI response according to the criteria and associated methodologies that were used to develop the PBNP current licensing basis.

The NRC staff evaluated Question 2, Questions 3.A.3 through 3.A.6, and Questions 3.B through 3.D of the licensee’s response. As described above, the NRC staff found the licensee’s responses in these areas to be largely consistent with the plant’s current licensing basis. Several licensing basis exceptions were identified and reviewed by the NRC staff. In general, the NRC staff concluded that the licensee had appropriately justified these exceptions within the framework established by GL 2004-02. However, the NRC staff determined that the licensee had not appropriately justified its conclusion that a debris collar will not form around the sump screens. If the licensee had used this conclusion as a basis for neglecting debris "collar" formation in its ECCS sump suction line flashing assessment, the staff would have considered the assessment nonconservative. However, as discussed in section 2.5 below, since the licensee's analyses did assume the formation of a debris collar, the inadequate modeling of debris "collar" formation did not result in a nonconservative effect on the licensee's overall sump performance analysis. Therefore, the NRC staff concurs with the licensee that, consistent with their current design basis, there is reasonable assurance of continued sump operability.

Accordingly, based upon the information provided in the RAI response, the NRC staff has concluded that reasonable assurance exists that the PBNP ECCS is capable of performing its safety function in accordance with the current licensing basis criteria with respect to sump screen performance, and that the requirements of 10 CFR 50.46(b)(5) continue to be met.

The licensee has committed to updating its licensing basis assumptions and methodologies for analyzing containment recirculation sump performance to address the present state of knowledge associated with NRC staff and industry efforts on GSI-191 [10]. The NRC staff expects the updated licensing basis to be implemented by December 31, 2007.

2.3.4 References for Section 2.3

1. Sargent and Lundy Calculation M-09334-345-RH-1, Containment Sump Blockage Due to Failure of Unqualified/Undocumented Coatings, (Unit 1), Revision 0 approved June 4, 1998, Revision 1 issued January 21, 1999.

2. Sargent and Lundy Calculation M-09334-431-RH-1, Containment Sump Blockage Due to Failure of Unqualified/Undocumented Coatings, (Unit 2), Revision 0 issued January 1, 1999.

3. Gibbs & Hill (G&H), Inc., “Evaluation of Paint and Insulation Debris Effects on Containment Emergency Sump Performance,” for Unit 1, forwarded by letter to WEPC dated May 18, 1989.

4. Gibbs & Hill (G&H), Inc., “Evaluation of Paint and Insulation Debris Effects on

Containment Emergency Sump Performance," for Unit 2, forwarded by letter to WEPC dated August 1, 1990.

5. Operability Recommendation OPR 161, Revision 1, "Containment Coatings Not Maintained Within Analyzed Limits," November 9, 2005.

6. Operability Recommendation OPR 162, Revision 2, "Question with the Ability of ECCS Sump Screens to Pass Required Flow," January 26, 2006.

7. NUREG/CR-2791, Methodology for Evaluation of Insulation Debris Effects, Containment Emergency Sump Performance USI A-43, September 1982.

8. NUREG-0797, Supplement 9, Safety Evaluation Report Related to the Operation of Comanche Peak Steam Electric Station, Units 1 and 2, March 1985.

9. Point Beach Engineering Evaluation 2005-0024, Evaluation of Containment Sump Screen Debris Buildup Based on EPRI Technical Report and Current Degraded Epoxy Inventories, Revision 1, November 9, 2005.

10. Point Beach Nuclear Plant, Response to Generic Letter 2004-02, September 1, 2005 (ML052500302).

11. NUREG/CR-3616, Transport and Screen Blockage Characteristics of Reflective Metallic Insulation Materials, December 1983.

12. NUREG-0897, Revision 1, Containment Emergency Sump Performance: Technical Findings Related to Unresolved Safety Issue A-43, October 1985.

13. EPRI Technical Report 1011753, "Design Basis Accident Testing of Pressurized Water Reactor Unqualified Original Equipment Manufacturer Coatings," September 2005.

2.4 Radiological Consequences

2.4.1 Background

The NRC staff evaluated the licensee's responses to NRC RAI Questions 5.A, 5.D-5.F, and 5.J regarding the radiological consequences of a DBA.

2.4.2 NRC Staff Evaluation

In its responses to RAI Questions 5.A, 5.D-5.F, and 5.J, the licensee stated that the PBNP current licensing basis does not include passive failure of ECCS components that are not outside containment in the DBA dose analyses. Based upon its review of the licensing basis, the NRC staff agrees that this is the case. The current licensing basis limit for leakage from the ECCS during normal operation is 400 cubic centimeters per minute (cc/min), and is included as an input to the DBA dose analyses.

The licensee did not provide a credible ECCS leak rate attributable to passive failure of the

recirculation containment sump suction line outside the containment based on testing of the ECCS or on some other method. Instead, the licensee stated that the flow rate would be less than 50 gpm and would occur 200 days after the LOCA values taken from the basis for the original Technical Specification (TS) 15.4.4. The requirement to analyze for a passive failure of the sump suction line derives from the licensee's answers to questions from the Atomic Energy Commission dated November 7, 1969, as noted in Chapter 14 of the PBNP Final Facility Description and Safety Analysis Report. The passive failure is presumed to be excessive packing or weld leakage. The licensee considers a limiting ECCS leakage rate from passive failure to be 50 gpm from a RHR pump mechanical seal, as stated in the PBNP Final Safety Analysis Report, Section 6.2. The licensee then quotes from the basis for the original TS 15.4.4 (April 1970), which stated that, "The limiting leakage rates from the [RHR] system are a judgment value primarily based on assuring that the components could operate without mechanical failure for a period on the order of 200 days after a [DBA]." The licensee did not justify the use of these values in its consideration of packing or weld leakage from the recirculation line. While 50 gpm appears to be conservative for calculating packing or weld leakage, a 200-day delay does not appear reasonable for packing or weld leakage.
The licensee's other assumptions in its dose analyses are acceptable, either because the licensee followed the appropriate regulatory guidance, or because the assumptions are within the current licensing basis for PBNP.

The licensee stated that leakage past the shut containment sump recirculation isolation valve (SI-850) was not considered in the dose analyses because of the conservative passive failure leakage rate and duration used to estimate the dose consequences. However, leakage past the shut SI-850 valve would be part of the release from the ECCS containment sump recirculation line and is not a separate leakage pathway. The licensee states that shutting the SI-850 valve on a failed line would serve to reduce the leakage below the assumed 50 gpm. The NRC staff considers the licensee's assumptions reasonable for the DBA dose analyses.

However, if the time to passive failure in the ECCS containment sump recirculation line is less than 200 days, the dose analyses provided in and supporting the EN 42129 RAI responses would be non-conservative, assuming that the 50 gpm leak rate is a reasonable value. In addition, the current licensing basis DBA dose analyses would be non-conservative. The NRC staff recognizes that the current licensing basis DBA dose analyses ECCS leakage assumptions (i.e., 400 cc/min for the control room dose analysis and 800 cc/min for the offsite dose analysis) do not bound the dose associated with a 50-gpm leak from the ECCS containment suction line if the leakage occurred immediately upon start of ECCS recirculation.

To maintain the leakage limit of 400 cc/min or less for the dose analyses, the licensee performs a series of Leakage Reduction and Preventive Maintenance tests each refueling outage. These tests measure and quantify the leakage from the system to atmosphere by looking at leakage from individual components outside containment (i.e., valves, body-to-bonnet joints, packing) and portions of trains or systems. Seat leakage at boundary valves is included in the total leakage value. The licensee states that the packing glands are inspected for leakage during these tests. The most recent licensee tests (IT-531 and IT-536 for Units 1 and 2, respectively) for the 2005 refueling outages indicated no leakage from the SI-850 valves or valve actuators. The licensee states that the valves are infrequently stroked and are not expected to be repeatedly stroked after initiation of sump recirculation, so early or significant degradation of the packing is not expected. Nevertheless, the NRC staff concludes that if leakage from the valves or valve actuators is detected, then the licensee must either isolate the leakage or demonstrate that it is within the leakage limits of the DBA dose analyses.

2.4.3 Conclusion

Since there is currently no leakage from the SI-850 valves or valve actuators, and the licensee states that early or significant degradation of the packing is not expected since the valves are infrequently stroked and are not expected to be repeatedly stroked after initiation of sump recirculation, the NRC staff considers that the licensee's RAI responses with respect to the radiological consequences of a DBA provide reasonable assurance that 10 CFR Part 100 and General Design Criterion 19 continue to be met.

2.5 Containment Sump Recirculation Isolation Valves (SI-850A/B)

2.5.1 Background

On November 8, 2005, NMC submitted a 10 CFR 50.72 notification that stated that the design basis for long-term cooling at PBNP was not correctly modeled and that the modeling errors could potentially impact the analytical basis for demonstrating compliance with the acceptance criteria of 10 CFR 50.46(b)(5), Long-term cooling (Event Number 42129).

In its February 16, 2006, response to the NRC's RAI, NMC indicated that the principal modeling error was failure to address the effects of potential debris accumulation on the ECCS suction strainers and the pressure drop past the containment emergency sump exit valves. NMC concluded that, to achieve adequate net positive suction head (NPSH), (1) the RHR flow had to be restricted during post-accident alignment to address boron precipitation, and (2) a 1.45 psig containment pressure had to be credited to prevent flashing at the sump exit valves. In its February 16, 2006, response, NMC described how it had previously addressed the following deficiencies in ECCS design and operation:

(1) There was insufficient NPSH margin to the operating RHR pump to support operation of containment spray in the piggyback mode. This option was removed from emergency operating procedures (EOPs).

(2) Simultaneous operation of both ECCS trains throughout the injection phase would deplete the refueling water storage tank (RWST) too rapidly to assure successful transition to sump recirculation prior to losing the RWST water source. EOPs were revised to secure one ECCS train to provide more time for transition from the injection to the recirculation phase.

(3) Implemented candidate operator actions to provide more aggressive cooldown and depressurization following a small break LOCA.

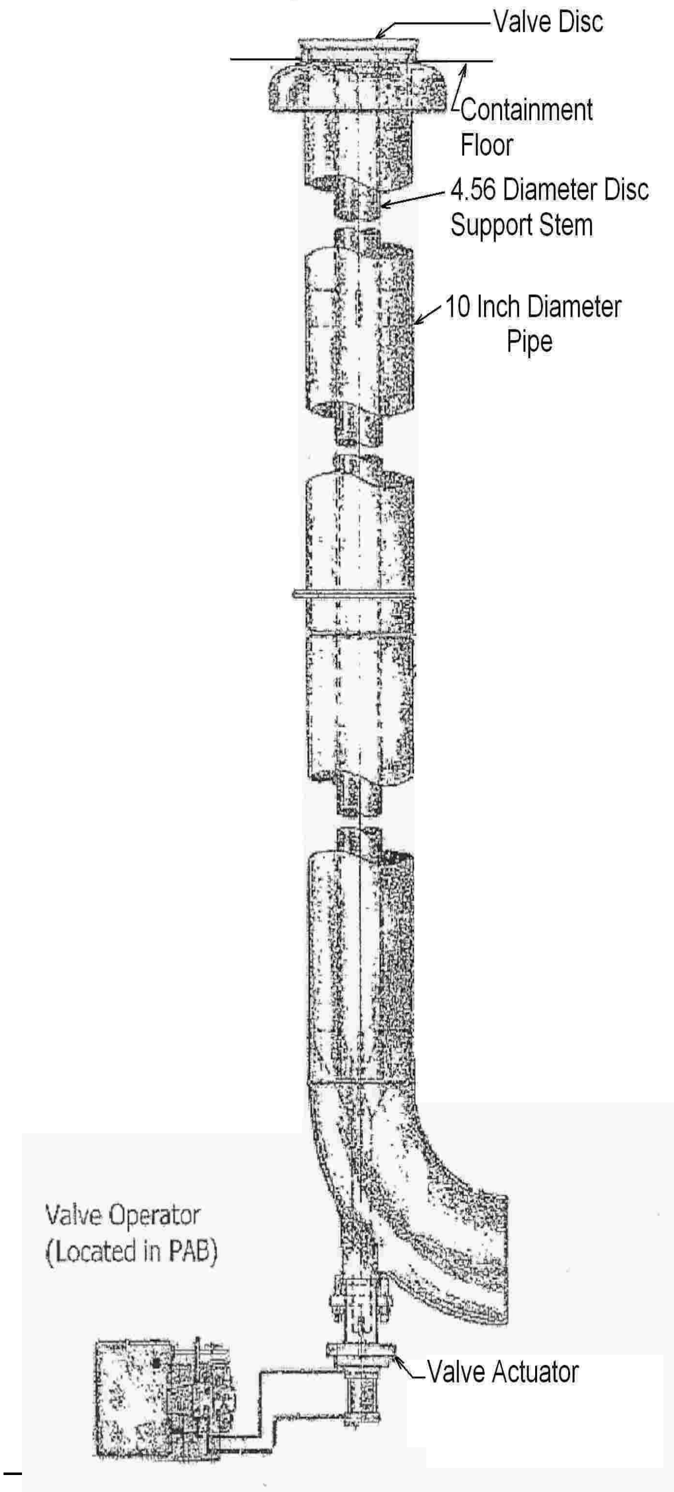
(4) Implemented candidate operator actions to provide guidance to refill the RWST.

(5) Implemented candidate operator actions to provide guidance regarding identification of sump blockage and provided contingency plans for response to sump blockage, loss of pump suction, and cavitation.

(6) Initiated a corrective action program to address discovery of higher than previously analyzed pressure drops across sump exit valves, the nonconservative methodology

used to calculate the pressure drop across sump screens,[1] and determination that air entrainment rather than NPSH was the limiting factor for RHR pump operation during recirculation operation with partially submerged sump screens.

Figure 1. Valve Closed



2.5.2 NRC Staff Evaluation

The NRC staff evaluated the licensee's RAI response to verify that adequate NPSH was available for the ECCS pumps to perform their safety function.

2.5.2.a SI-850A/B Valve Configuration

The containment sump recirculation isolation valve (SI-850) is illustrated in the closed position in Figure 1. It consists of a vertical 10-inch diameter pipe with an upper end that terminates at the containment floor. This end is closed by a 12.065-inch diameter disc so that, when closed, the plate is essentially flush with the containment floor. The disc is connected to a 4.56-inch outer diameter valve stem that is, in turn, connected to an actuator located about 18 feet below the disc. The valve will provide a full open stroke of at least 2 inches and the maximum possible stroke is 2.5 inches. The upper end of the valve is covered by a 36-inch high, 13.5-inch diameter screen that is closed by a flat plate at the top.

Figure 2 illustrates the postulated buildup of a debris collar around the base of the screen that blocks direct flow along the bottom of containment into the valve. In this configuration, water must pass through the screen above the valve, flow downward through the annulus defined by the valve disc and the screen, and then turn to flow horizontally toward the vertical portion of the valve. The additional turns and the annulus cause a static pressure drop that does not exist if the screen is fully unblocked. Further, the increased velocity in the annulus results in a dynamic

[1]The pressure drop across the sump screens was considered in order to assess the available NPSH.

pressure change that, when combined with the decreased static pressure, may cause flashing. Flashing, in turn, would cause a further decrease in static pressure and may result in loss of adequate NPSH at the ECCS pumps.

2.5.2.b Technical Evaluation

NMC calculated that formation of a debris collar would increase differential pressure by 4.8 ft of water so that the total pressure drop through the valve would be 7.7 ft. NMC stated that previous calculations showed the NPSH margin was 10.64 ft. It added a previously neglected 3.22 ft of submergence and concluded that there was in excess of 9 ft of NPSH margin at the RHR pumps when operated at a maximum permissible flow rate of 1582 gpm. It further concluded that flashing in the annular gap would be prevented if containment pressure was greater than about 1.5 psig.

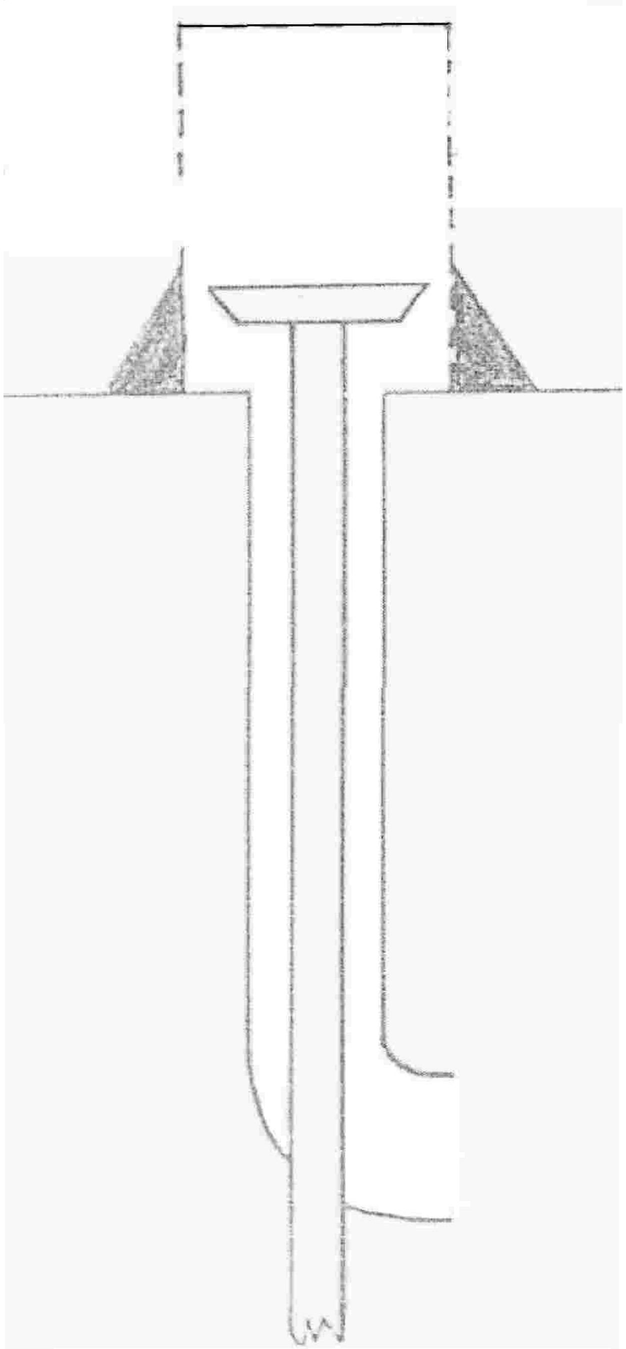


Figure 2. Valve Open with Debris

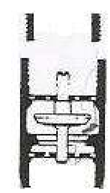
Velocity in the annulus is significantly greater than at any other location. This causes the most significant dynamic pressure decrease associated with any location in the valve and, in combination with the static pressure, results in the lowest pressure being located in or immediately following the annulus. Thus, it is particularly important to understand the prediction of annulus pressure.

NMC found no references that directly addressed pressure drop for its valve configuration and no test data were available. Consequently, it postulated that the pressure drop consisted of combinations of expansions, contractions, and turns. It then used information provided by Crane Technical Paper No. 410, “Flow of Fluids Through Valves, Fittings, and Pipe,” to calculate the pressure drops. It further stated that its selections were generally conservative so that the pressure drops would be over-predicted, thus providing a margin to account for uncertainty in the calculations.

The NRC staff reviewed the NMC calculations and agreed with the predictions, with one exception. NMC assumed contraction and expansion in the flow area between the 13.5-inch diameter screen and the 0.75-inch annular flow passage between the blocked screen and the outer diameter of the valve disc could be represented by contraction and expansion in a pipe where the constriction was a circular opening with a flow area identical to the annular flow area. This assumption maximized the ratio of flow area to wetted perimeter. The NRC staff judged the assumption to be nonconservative because flow resistance increases as the ratio of flow area to wetted perimeter decreases. The licensee provided no justification for its assumption.

To evaluate this issue, the NRC staff observed that the Figure 3 poppet valve provided by Crane on pages A-28 and A-32 has annular flow features similar to those in the NMC valve. Consequently, the NRC staff expanded the Crane illustration, measured the dimensions, and calculated the flow resistances using the same methodology as previously applied to the NMC valve with one exception. The NRC staff omitted the contraction from the full diameter to the annulus and then back-calculated that effect from the following overall pressure drop correlation that was provided by Crane for the poppet valve:

Figure 3. Poppet Valve



$K = 420 f_T$

$$h_L = K\, v^2 / (2\, g)$$

where:	h_L	= head loss
	K	= resistance coefficient, given by Crane as K = 400 f_T
	v	= inlet velocity
	g	= acceleration of gravity
	f_T	= friction factor in zone of complete turbulence

The NRC staff’s calculations are summarized in the following table:

Item	Head loss / v^2	Comments
Sudden enlargement at top of valve body	0.00129	
Upper valve support	0.00754	Assuming the Crane p. A-28 ball valve configuration, formula 7 (p. A-26), with f_T = 0.014 (p. A-26)
Turns from vertical flow above valve to vertical flow at entry into disc annulus	k_{disc} / (2 g)	See discussion following table.
Contraction into disc annulus	0.016	
Expansion from disc annulus	0.018	
Turn from vertical to horizontal flow below disc	0.020	Same general analysis as used by NMC - sharp angle turn without reduction due to interaction with adjacent flow perturbations
Turn from horizontal to vertical downward below disc	0.0194	Same as above
Valve seat	0.00689	Treated as an orifice
Lower valve support	0.00754	
Total minus k_{disc} / (2 g)	0.0963	

For the poppet valve, K = 420 X 0.014 = 5.88 and h_L = 5.88 / 64.4 X v^2 = 0.0913 v^2. Thus, the contribution associated with flow above the valve, k_{disc} / (2 g), is essentially zero, considering the conservatisms associated with flow below the valve disc, which include neglecting interactions between closely-coupled adjacent flow perturbations. These interactions are known to reduce calculated total pressure drop.

With the influence of flow through the disc annulus addressed, the NRC staff summarized the differential pressure through the NMC valve as follows for an assumed valve opening height of 2.5 inches:

Item	K	ΔP, feet
Flow through full height (36 inches) of screen	3	0.005
Contraction loss following flow through screen	51.55	0.09
Turning loss from horizontal flow through screen to downward within screen	-	0.08*
Turning losses due to flow direction changes as valve disc is approached	-	0
Contraction loss at entrance to disc annulus between valve disc and screen	0.40	1.93
Expansion loss at exit from disc annulus to region under valve	0.49	2.36
Turning loss from above toward inward flow under valve disc	1.08	0.48
Contraction from edge of valve to concentric pipe annulus between 10 inch pipe and 4.56 inch diameter disc support stem	0.24	0.17
Turning loss when entering concentric pipe annulus	1.08	1.08
Flow down concentric pipe annulus	-	0.71
Elbow from above vertical line to horizontal line	0.196	0.12
Expansion when leaving concentric pipe annulus to full pipe within elbow	0.069	0.04
Pressure drop due to flow around disc support stem within elbow		0.59
Total		7.6
*Calculated value assuming the turn occurs at maximum velocity is 0.16.		

This process effectively removed the conservatism from the pressure loss calculations upstream of the floor elevation, since those calculations were used to obtain the 0 value associated with the change from the full 13.5-inch diameter to the disc annulus. It also meant that the pressure at and immediately following the annulus will be less than calculated, a nonconservatism with respect to assessing initiation of flashing. To assess this nonconservatism, the NRC staff noted that the calculated head losses that would apply are 1.93 + 2.36 + 0.48 = 4.77 ft. Based on engineering judgment, the NRC staff judged the nonconservatism to be on of the order of half of 4.77 ft, or 2.4 ft. Further, since the disc annulus pressure no longer reflects a conservatism, the NRC staff used a safety factor to account for uncertainty in the calculation. Based on engineering judgment, the NRC staff used a factor of 30 percent, or about 1.5 ft, for a total of 2.4 + 1.5 or approximately 4 ft. This is equivalent to an additional 2 psi of containment pressure above the value of about 1.5 psig predicted by NMC to reasonably ensure flashing will not occur. However, as described below, the NRC staff estimated that there is significantly more than 3.5 psig available and therefore concludes that flashing is not a concern.

2.5.2.c Containment Overpressure

The licensee states that equilibrium containment conditions between the sump temperature and the containment pressure are limiting for the flashing calculation. It is not clear that this is the case, and so the NRC staff did not make use of this argument. Instead, the NRC staff used very approximate sensitivities in PWR containment calculations in considering the licensee's evaluation.

The licensee states that the containment integrity calculation predicts a sump temperature of 215 °F and containment pressure of 31 psig at the time of switchover from injection to recirculation. This is typically the time of maximum sump temperature. Containment integrity calculations typically assume one train of sump water cooling (single failure assumption). This is a conservative assumption for estimating sump temperature.

However, containment integrity calculations maximize energy input to the containment atmosphere, to increase the containment pressure, rather than to the sump, which would increase sump temperature. This is not a conservative assumption for sump temperature. However, based on engineering judgment, the NRC staff estimates the difference is probably only several degrees. Thus, maximizing the sump temperature, the temperature may be several degrees above 215 °F for a conservative sump temperature calculation.

Since a containment integrity calculation maximizes containment pressure, it is not conservative for the flashing calculation. Doing a minimum pressure calculation could yield a containment pressure much lower than 31 psig (taking more credit for heat sinks, with all active containment cooling in operation, and no uncertainty for decay heat and reactor power). However, realistic calculations of sump temperature give temperatures much less than the temperatures predicted by design basis containment integrity calculations, by as much as 20 °F to 50 °F or more.

Because of the non-linearity of the vapor pressure (a small decrease in temperature can produce a relatively large decrease in vapor pressure), the conservatism in the temperature will have a much bigger effect than the difference in pressure between a design basis maximum and minimum pressure calculation. That is, even though the calculated minimum containment pressure could be lower than 31 psig, there is reasonable assurance that a more realistic sump temperature would demonstrate that the required containment pressure to prevent flashing would be even lower than the minimum containment pressure.

Therefore, there is reasonable assurance that sufficient containment pressure should be present to prevent flashing.

2.5.3 Conclusion

NMC’s analysis does not contain a margin for calculation uncertainty. To reasonably assure there is no flashing in the ECCS valve, the containment pressure should be 2 psi higher than

NMC predicts is necessary to prevent flashing. The NRC staff estimates that there is significantly more than 2 psi available. Therefore, based on information provided by the licensee and the NRC staff's independent analyses and assessments, the NRC staff concludes that there is reasonable assurance that, with regard to the potential effect of suction line flashing, the ECCS continues to meet the requirements of 10 CFR 50.46(b)(5).

3.0 LICENSEE COMMITMENTS

The licensee's RAI response identified several nonconformances with its licensing basis, which it has committed to resolve consistent with its commitment to resolve GSI-191 by December 31, 2007, within the schedule provided in NRC GL 2004-02. The licensee stated that the actions and schedule are being tracked to completion in the PBNP corrective action program. The licensee's disposition of the nonconformances is consistent with the NRC guidance contained in RIS 2005-20. The commitments are noted below.

Specific Items to be Resolved External to GSI-191

Refueling Frequency Testing of SI-850 Valves: The procedures to stroke test the valves on a refueling frequency will be revised with appropriate acceptance criteria prior to the next performance of each test during each unit's upcoming refueling outage.

Sump Outlet Valve Position Indication Qualification: The position indication limit switches for the SI-850 valves will be dedicated or upgraded to be able to withstand an anticipated harsh environment due to integrated gamma dose prior to the end of the next refueling outage on each unit.

Sump Outlet Valve Motive Power: The hydraulic power packages and positioning solenoid valves for the SI-850 valves will be dedicated or upgraded to be able to withstand an anticipated harsh environment due to integrated gamma dose prior to the end of the next refueling outage on each unit.

Detection of SI System Leakage into the Tendon Gallery: Alternatives to the grouting that currently exists in the tendon gallery are being evaluated. Resolution of tendon gallery grouting issues will be consistent with resolution of GSI-191 and will be completed by the end of the next refueling outage of each unit (fall 2006 for Unit 2 and spring 2007 for Unit 1).

Programmatic Guidance for Monitoring Containment Sump Level: Post-accident, long-term programmatic guidance will be implemented by June 2006 to include explicit direction for monitoring the containment accident sump level for adverse trends that may indicate a leak of service water into containment (uncontrolled rise in sump level), or a leak of sump inventory out of containment (uncontrolled drop in containment sump level), and to investigate the condition accordingly.

Remediation of the Unit 2 CRDM Fan Coatings: The non-conforming coatings on the Unit 2 CRDM fans will be removed or the fans replaced with ones that are either uncoated or coated with qualified coatings prior to the end of the fall 2006 refueling outage.

Sump Outlet Valve Solenoid Operating Valves (SOVs): An "Operable But Degraded/Nonconforming Corrective Action Plan" has been developed. Per the current plan, SOVs within the control circuits for 1&2SI-850A&B will be replaced. Engineering of the design and installation of the new SOVs will be performed on a schedule commensurate with the safety significance of the change and in consideration of the plant conditions required to implement the change. At the latest, these actions will be completed consistent with the existing NMC commitment to resolve GSI-191 by December 31, 2007.

Specific Items of Concern to be Resolved Under GSI-191

NMC continues to pursue resolution of GSI-191 issues in accordance with GL 2004-02 requirements and will provide status updates to the Commission in accordance with the provisions of the GL.

Control of Containment Coatings: The design basis for the replacement sump screens defines the limits of unqualified and degraded coatings that may exist in containment and the location of those coatings. Prior to the end of the next refueling outage on each unit, containment coatings will be removed, repaired, or restored to the extent necessary to be enveloped by this design basis. Subsequent refueling frequency coatings inspections will ensure the total inventory of coatings and other sources of particulate debris will remain bounded.

Sump Screen Replacement: Replacement of the existing sump screens with the GSI-191 replacement screens will eliminate the potential for a “debris collar” flow restriction. Replacement of the sump screens will occur consistent with NMC’s commitment to GL 2004-02, no later than December 2007.

Crediting of Containment Overpressure: Assuming no containment overpressure, there may be a potential for fluid flashing under the sump outlet valve discs, even after installation of the new strainers. However, a minor “overpressure” would suppress such flashing. Substantial overpressure would be available due to trapped air and non-condensibles inside the containment building. Resolution of this issue will occur concurrent with resolution of GSI-191.

4.0 CONCLUSION

Based on its review of the information provided by the licensee, the NRC staff has reasonable assurance that the ECCS at PBNP, under the current licensing basis, continues to meet the requirements of 10 CFR 50.46(b)(5). The staff's evaluation is valid pending resolution of GSI-191 in accordance with GL 2004-02. NMC's RAI response identified several nonconformances with its licensing basis, which it has committed to resolve consistent with its commitment to resolve GSI-191 by December 31, 2007, within the schedule provided in GL 2004-02. The licensee's disposition of the nonconformances is consistent with the NRC guidance contained in RIS 2005-20. The expectations in this evaluation are provided for the licensee's consideration in developing its supplemental response to GL 2004-02. The expectations in this evaluation are consistent with those provided in GL 2004-02, the letter from B. Sheron (NRC) to A. Pietrangelo (NEI) dated March 3, 2006, and the letter from C. Haney (NRC) to pressurized-water reactor licensees dated March 28, 2006.

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