

March 24, 2004

MEMORANDUM TO: Michael T. Lesar, Chief
Rules and Directives Branch
Division of Administrative Services
Office of Administration

FROM: William D. Beckner, Chief **/RA/**
Reactor Operations Branch
Division of Inspection Program Management
Office of Nuclear Reactor Regulation

SUBJECT: NOTICE OF AVAILABILITY OF A DRAFT GENERIC COMMUNICATION
THAT IS BEING ISSUED FOR PUBLIC COMMENT (TAC NO. 4864)

Attached is a copy of a Notice of Availability for a draft generic communication for public comment that has been issued for your transmittal to the Office of the Federal Register for publication. An electronic copy of the Notice has been provided to Betty Golden. Five additional copies of the Notice are attached for your use.

Attachment: As stated

CONTACT: Charles D. Petrone, NRR/DIPM
301-415-1027
E-mail: cdp@nrc.gov

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DOCUMENT NAME: C:\MYFILES\Copies\FRN notice for GL Sump Blockage.wpd

ADAMS ACCESSION NUMBER: ML040830518

*See previous concurrence

OFFICE	OES:IROB:DIPM	SPLB:DSSA	OES:IROB:DIPM:SC	IROB:DIPM:BC
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DATE	03/23/2004	03/23/2004	03/24/2004	03/24/2004

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NUCLEAR REGULATORY COMMISSION

Proposed Generic Communication

Potential Impact of Debris Blockage on Emergency Recirculation

During Design Basis Accidents at Pressurized Water Reactors

AGENCY: Nuclear Regulatory Commission.

ACTION: Notice of opportunity for public comment.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is proposing to issue a generic letter (GL) to request that addressees submit information to the NRC concerning the status of their compliance with 10 CFR 50.46(b)(5), which requires long-term reactor core cooling be available following a design basis loss of coolant accident, and with the additional plant-specific licensing basis requirements listed in this generic letter, in accordance with 10 CFR 50.54(f). This request is based on the identified potential susceptibility of pressurized-water reactor (PWR) recirculation sump screens to debris blockage during design basis accidents requiring recirculation operation of the emergency core cooling system (ECCS) or containment spray system (CSS) and the potential for additional adverse effects due to debris blockage of flowpaths necessary for ECCS and CSS recirculation and containment drainage

This *Federal Register* notice is available through the NRC's Agencywide Documents Access and Management System (ADAMS) under accession number **ML040830518**.

DATES: Comment period expires **[60 days after FRN is published]**. Comments submitted after this date will be considered if it is practical to do so, but assurance of consideration cannot be given except for comments received on or before this date.

ADDRESSEES: Submit written comments to the Chief, Rules and Directives Branch, Division of Administrative Services, Office of Administration, U.S. Nuclear Regulatory Commission, Mail Stop T6-D59, Washington, DC 20555-0001, and cite the publication date and page number of this *Federal Register* notice. Written comments may also be delivered to NRC Headquarters, 11545 Rockville Pike (Room T-6D59), Rockville, Maryland, between 7:30 am and 4:15 pm on Federal workdays.

FOR FURTHER INFORMATION, CONTACT: David Cullison at 301-415-1212 or by email at dgc@nrc.gov or Ralph Architzel at 301-415-2804 or by email at rea@nrc.gov .

SUPPLEMENTARY INFORMATION:

DRAFT NRC GENERIC LETTER 2003-XX: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED WATER REACTORS

Addressees

All holders of operating licenses for pressurized-water nuclear power reactors, except those who have ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this generic letter to:

- (1) Request that addressees submit information to the NRC to confirm compliance with 10 CFR 50.46(b)(5), which requires long-term reactor core cooling, and other existing regulatory requirements listed in this generic letter. This request is based on the identified potential susceptibility of pressurized-water reactor (PWR) recirculation sump screens to debris blockage during design basis accidents requiring recirculation operation of the emergency core cooling system (ECCS) or containment spray system (CSS) and the potential for additional adverse effects due to debris blockage of flowpaths necessary for ECCS and CSS recirculation and containment drainage.
- (2) Require addressees to provide the NRC a written response in accordance with 10 CFR 50.54(f).

Background

In 1979, as a result of evolving staff concerns related to the adequacy of PWR recirculation sump designs, the NRC opened Unresolved Safety Issue (USI) A-43, "Containment Emergency Sump Performance." To support the resolution of USI A-43, the NRC undertook an extensive research program, the technical findings of which are summarized in NUREG-0897, "Containment Emergency Sump Performance," dated October 1985. The resolution of USI A-43 was subsequently documented in Generic Letter (GL) 85-22, "Potential for Loss of Post-LOCA Recirculation Capability Due to Insulation Debris Blockage," dated December 3, 1985. Although the staff's regulatory analysis concerning USI A-43 did not support imposing new sump performance requirements upon licensees of operating PWRs or boiling-water reactors (BWRs), the staff recommended in GL 85-22 that all affected reactor licensees replace the 50-percent blockage assumption (under which most nuclear power plants had been licensed) with a comprehensive, mechanistic assessment of plant-specific debris blockage potential for future modifications related to sump performance, such as thermal insulation changeouts. The 50-percent screen blockage assumption does not require a plant-specific evaluation of the debris-blockage potential and may result in a non-conservative analysis for screen blockage effects. The staff also updated the NRC's regulatory guidance, including Section 6.2.2 of the Standard Review Plan (NUREG-0800) and Regulatory Guide 1.82, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," to reflect the USI A-43 technical findings documented in NUREG-0897. Following the resolution of USI A-43 in 1985, several events occurred that challenged the conclusion that no new requirements were necessary to prevent the clogging of ECCS strainers at operating BWRs:

- On July 28, 1992, at Barsebäck Unit 2, a Swedish BWR, the spurious opening of a pilot-operated relief valve led to the plugging of two containment vessel spray system suction strainers with mineral wool and required operators to shut down the spray pumps and backflush the strainers.
- In 1993, at Perry Unit 1, two events occurred during which ECCS strainers became plugged with debris. On January 16, ECCS strainers were plugged with suppression pool particulate matter, and on April 14, an ECCS strainer was plugged with glass fiber from ventilation filters that had fallen into the suppression pool. On both occasions, the affected ECCS strainers were deformed by excessive differential pressure created by the debris plugging.
- On September 11, 1995, at Limerick Unit 1, following a manual scram due to a stuck-open safety/relief valve, operators observed fluctuating flow and pump motor current on the A loop of suppression pool cooling. The licensee later attributed these indications to a thin mat of fiber and sludge which had accumulated on the suction strainer.

In response to these ECCS suction strainer plugging events, the NRC issued several generic communications, including Bulletin 93-02, Supplement 1, "Debris Plugging of Emergency Core Cooling Suction Strainers," dated February 18, 1994, Bulletin 95-02, "Unexpected Clogging of a Residual Heat Removal (RHR) Pump Strainer While Operating in Suppression Pool Cooling Mode," dated October 17, 1995, and Bulletin 96-03, "Potential Plugging of Emergency Core Cooling Suction Strainers by Debris in Boiling-Water Reactors," dated May 6, 1996.

These bulletins requested that BWR licensees implement appropriate procedural measures, maintenance practices, and plant modifications to minimize the potential for the clogging of ECCS suction strainers by debris accumulation following a loss-of-coolant accident (LOCA). The NRC staff has concluded that all BWR licensees have sufficiently addressed these bulletins.

However, findings from research to resolve the BWR strainer clogging issue have raised questions concerning the adequacy of PWR sump designs. In comparison to the technical findings of the USI A-43 research program concerning PWRs, the research findings demonstrate that the amount of debris generated by a high-energy line break (HELB) could be greater, that the debris could be finer (and, thus, more easily transportable), and that certain combinations of debris (e.g., fibrous material plus particulate material) could result in a substantially greater head loss than an equivalent amount of either type of debris alone. These research findings prompted the NRC to open Generic Safety Issue (GSI) 191, "Assessment of Debris Accumulation on PWR Sump Performance." The objective of GSI-191 is to ensure that post-accident debris blockage will not impede or prevent the operation of the ECCS and CSS in recirculation mode at PWRs during LOCAs or other HELB accidents for which sump recirculation is required.

On June 9, 2003, having completed its technical assessment of GSI-191 (summarized below in the Discussion section of this generic letter), the NRC issued Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Recirculation During Design-Basis Accidents at Pressurized-Water Reactors." As a result of the emergent issues discussed therein, the bulletin requested an expedited response from PWR licensees as to the status of their compliance on a mechanistic basis, with regulatory requirements concerning the ECCS and CSS recirculation

functions. Addressees who were unable to assure regulatory compliance pending further analysis were asked to describe any interim compensatory measures that have been implemented or will be implemented to reduce risk until the analysis could be completed. All licensees have since responded to Bulletin 2003-01. In developing Bulletin 2003-01, the NRC staff recognized that it may be necessary for addressees to undertake complex evaluations to determine whether regulatory compliance exists in light of the concerns identified in the bulletin and that the methodology to perform such evaluations was not currently available. As a result, that information was not requested in the bulletin but addressees were informed that the staff was preparing a generic letter that would request this information. This generic letter is the follow-on information request referenced in the bulletin.

In response to Bulletin 2003-01, PWR licensees that were unable to confirm regulatory compliance implemented or plan to implement compensatory measures to reduce risk or otherwise enhance the capability of the ECCS and CSS recirculation functions. During the process of resolving the potential concerns identified in this generic letter, the revised analysis of sump performance may affect addressees' understanding of their facilities' ECCS and CSS recirculation capabilities. In accordance with GL 91-18, Revision 1, "Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Degraded and Nonconforming Conditions," dated October 8, 1997, addressees may find it necessary to reevaluate the adequacy of their compensatory measures in light of the new information and take further action as appropriate and necessary. Upon resolution of the potential concerns identified in this

generic letter and the completion of any corrective actions resulting from that resolution, addresses may consider continuing, revising, or retiring their compensatory measures as appropriate.

The NRC has developed a Web page to keep the public informed of generic activities on PWR sump performance (<http://www.nrc.gov/reactors/operating/ops-experience/pwr-sump-performance.html>). This page provides links to information on PWR sump performance issues, along with documentation of NRC interactions with industry (industry submittals, meeting notices, presentation materials, and meeting summaries). The NRC will continue to update this Web page as new information becomes available.

Discussion

In the event of a HELB inside the containment of a PWR, energetic pressure waves and fluid jets would impinge upon materials in the vicinity of the break, such as thermal insulation, coatings, and concrete, causing them to become damaged and dislodged. Debris could also be generated through secondary mechanisms, such as severe post-accident temperature and humidity conditions, flooding of the lower containment, and the impact of containment spray droplets. In addition to debris generated by jet forces from the pipe rupture, debris can be created by the chemical reaction between the chemically reactive spray solutions used following a LOCA and the materials in containment. These reactions may result in additional debris such as disbonded coatings and chemical precipitants being generated. Through transport methods such as entrainment in the steam/water flows issuing from the break and containment spray washdown, a fraction of the generated debris and foreign material in the containment would be transported to the pool of water formed on the containment floor. Subsequently, if the ECCS or

CSS pumps were to take suction from the recirculation sump, the debris suspended in the containment pool would begin to accumulate on the sump screen or be transported through the associated system. The accumulation of this suspended debris on the sump screen could create a roughly uniform covering on the screen, referred to as a debris bed, which would tend to increase the head loss across the screen through a filtering action. If a sufficient amount of debris were to accumulate, the debris bed would reach a critical thickness at which the head loss across the debris bed would exceed the net positive section head (NPSH) margin required to ensure the successful operation of the ECCS and CSS pumps in recirculation mode. A loss of NPSH margin for the ECCS or CSS pumps as a result of the accumulation of debris on the recirculation sump screen, referred to as sump clogging, could result in degraded pump performance and eventual pump failure. Debris could also plug or wear close tolerance components within the ECCS or CSS systems. The effect of this plugging or wear may cause a component to degrade to the point where it may be unable to perform its designated function (i.e. pump fluid, maintain system pressure, or pass and control system flow.)

Assessing the likelihood of the ECCS and CSS pumps at domestic PWRs experiencing a debris-induced loss of NPSH margin during sump recirculation was the primary objective of the NRC's technical assessment of GSI-191. The NRC's technical assessment culminated in a parametric study that mechanistically treated phenomena associated with debris blockage using analytical models of domestic PWRs generated with a combination of generic and plant-specific data. As documented in Volume 1 of NUREG/CR-6762, "GSI-191 Technical Assessment: Parametric Evaluations for Pressurized Water Reactor Recirculation Sump Performance," dated August 2002, the GSI-191 parametric study concludes that recirculation sump clogging is a credible concern for domestic PWRs. As a result of limitations with respect to plant-specific data and other modeling uncertainties, however, the parametric study does not

definitively identify whether or not particular PWR plants are vulnerable to sump clogging when phenomena associated with debris blockage are modeled mechanistically.

The methodology employed by the GSI-191 parametric study is based upon the substantial body of test data and analyses that are documented in technical reports generated during the NRC's GSI-191 research program and earlier technical reports generated by the NRC and the industry during the resolution of the BWR strainer clogging issue and USI A-43. These pertinent technical reports, which cover debris generation, transport, accumulation, and head loss, are incorporated by reference into the GSI-191 parametric study:

- NUREG/CR-6770, "GSI-191: Thermal-Hydraulic Response of PWR Reactor Coolant System and Containments to Selected Accident Sequences," dated August 2002.
- NUREG/CR-6762, Vol. 3, "GSI-191 Technical Assessment: Development of Debris Generation Quantities in Support of the Parametric Evaluation," dated August 2002.
- NUREG/CR-6762, Vol. 4, "GSI-191 Technical Assessment: Development of Debris Transport Fractions in Support of the Parametric Evaluation," dated August 2002.
- NUREG/CR-6224, "Parametric Study of the Potential for BWR ECCS Strainer Blockage Due to LOCA Generated Debris," dated October 1995.

In light of the credibility of the concerns identified above, the NRC staff has determined that it is appropriate to request that addressees submit information to confirm their plant-specific compliance with NRC regulations and other existing regulatory requirements listed in this generic letter pertaining to post-accident debris blockage. If addressees perform an analysis to confirm compliance, the NRC staff recommends the use of an analysis method that mechanistically accounts for debris generation and transport, post accident equipment and systems operation with debris laden fluid

In addition to demonstrating the potential for debris to clog containment recirculation sumps, operational experience and the NRC's technical assessment of GSI-191 have also identified three integrally related modes by which post-accident debris blockage could adversely affect the sump screen's design function of intercepting debris that could impede or prevent the operation of the ECCS and CSS in recirculation mode.

First, as a result of the 50-percent blockage assumption, most PWR sump screens were designed assuming that relatively small structural loadings would result from the differential pressure associated with debris blockage. Consequently, PWR sump screens may not be capable of accommodating the increased structural loadings that would occur due to mechanistically determined debris beds that cover essentially the entire screen surface.

Inadequate structural reinforcement of a sump screen may result in its deformation, damage, or failure, which could allow large quantities of debris to be ingested into the ECCS and CSS piping, pumps, and other components, potentially leading to their clogging or failure. The ECCS strainer plugging and deformation events that occurred at Perry Unit 1 (further described in Information Notice (IN) 93-34, "Potential for Loss of Emergency Cooling Function Due to a Combination of Operational and Post-LOCA Debris in Containment," dated April 26, 1993, and

LER 50-440/93-011, "Excessive Strainer Differential Pressure Across the RHR Suction Strainer Could Have Compromised Long Term Cooling During Post-LOCA Operation," submitted May 19, 1993), demonstrate the credibility of this concern for screens and strainers that have not been designed with adequate reinforcement.

Second, in some PWR containments, the flowpaths by which containment spray or break flows return to the recirculation sump may include "choke-points," where the flowpath becomes so constricted that it could become blocked with debris following a HELB. Examples of potential choke-points are drains for pools, cavities, isolated containment compartments, and constricted drainage paths between physically separated containment elevations. Debris blockage at certain choke-points could hold up substantial amounts of water required for adequate recirculation or cause the water to be diverted into containment volumes that do not drain to the recirculation sump. The holdup or diversion of water assumed to be available to support sump recirculation could result in an available NPSH for ECCS and CSS pumps that is lower than the analyzed value, thereby reducing assurance that recirculation would successfully function. A reduced available NPSH directly concerns sump screen design because the NPSH margin of the ECCS and CSS pumps must be conservatively calculated to determine correctly the required surface area of passive sump screens when mechanistically determined debris loadings are considered. Although the parametric study (NUREG/CR-6762, Volume 1) did not analyze in detail the potential for the holdup or diversion of recirculation sump inventory, the NRC's GSI-191 research identified this phenomenon as an important and potentially credible concern. A number of LERs associated with this concern have also been generated, which further confirms its credibility and potential significance:

- LER 50-369/90-012, "Loose Material Was Located in Upper Containment During Unit Operation Because of an Inappropriate Action," McGuire Unit 1, submitted August 30, 1990.
- LER 50-266/97-006, "Potential Refueling Cavity Drain Failure Could Affect Accident Mitigation," Point Beach Unit 1, submitted February 19, 1997.
- LER 50-455/97-001, "Unit 2 Containment Drain System Clogged Due to Debris," Byron Unit 2, submitted April 17, 1997.
- LER 50-269/97-010, "Inadequate Analysis of ECCS Sump Inventory Due to Inadequate Design Analysis," Oconee Unit 1, submitted January 8, 1998.
- LER 50-315/98-017, "Debris Recovered from Ice Condenser Represents Unanalyzed Condition," D.C. Cook Unit 1, submitted July 1, 1998.

Third, debris blockage at flow restrictions within the ECCS recirculation flowpath downstream of the sump screen is a potential concern for PWRs. Debris that is capable of passing through the recirculation sump screen may have the potential to become lodged at a downstream flow restriction, such as a high-pressure safety injection (HPSI) throttle valve or fuel assembly inlet debris screen. Debris blockage at such flow restrictions in the ECCS flowpath could impede or prevent the recirculation of coolant to the reactor core, thereby leading to inadequate core cooling. Similarly, debris blockage at flow restrictions in the CSS flowpath, such as a containment spray nozzle, could impede or prevent CSS recirculation, thereby leading to inadequate containment heat removal. Debris may also accumulate in close tolerance sub-

components of pumps and valves. The effect may either be to plug the sub-component thereby rendering the component unable to perform its function or to wear critical close tolerance sub-components to the point at which component or system operation is degraded and unable to fully perform its function. Considering the recirculation sump screen's design function of intercepting potentially harmful debris, it is essential that the screen openings are adequately sized and that the sump screen's current configuration is free of gaps or breaches which could compromise the ECCS and CSS recirculation functions. It is also essential that system components are designed and evaluated to be able to operate with debris laden fluid as necessary post-LOCA.

To assist in determining on a plant-specific basis whether compliance exists with 10 CFR 50.46(b)(5), addressees may use the guidance contained in Regulatory Guide 1.82 (RG 1.82), Revision 3, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," dated November 2003. Revision 3 enhanced the debris blockage evaluation guidance for pressurized water reactors provided in Revision 1 of the regulatory guide. The NRC staff determined after the issuance of Revision 2 that research for PWRs indicated that the guidance in that revision was not comprehensive enough to ensure adequate evaluation of a PWR plant's susceptibility to the detrimental effects caused by debris accumulation on debris interceptors (e.g., trash racks and sump screens). Revision 2 altered the debris blockage evaluation guidance found in Revision 1 following the evaluation of blockage events, such as the Barsebäck Unit 2 event mentioned above, but for BWRs only. Revision 1 replaced the 50-percent blockage assumption in Revision 0 with a comprehensive, mechanistic assessment of plant-specific debris blockage potential for future modifications related to sump performance, such as thermal insulation changeouts. This was in response to the findings of USI A-43. In addition, the NRC staff is reviewing generic industry guidance and

will issue a safety evaluation report endorsing portions or all of the generic industry guidance, if found acceptable. Once approved, this guidance may also be used to assist in determining the status of regulatory compliance. Individual addressees may also develop alternative approaches to those named in this paragraph for determining the status of their regulatory compliance; however, additional staff review may be required to assess the adequacy of such approaches. If the industry guidance will not be available when the generic letter is issued, the NRC will provide additional guidance for determining on a plant-specific basis whether compliance exists with 10 CFR 50.46(b)(5).

The time frames for addressee responses in this generic letter were selected to 1) allow adequate time for addressees to perform an analysis, if they opt to do so, 2) allow addressees to properly design and install any identified modifications, 3) allow addressees adequate time to obtain NRC approval, as necessary, for any licensing basis changes, and 4) allow for the closure of the generic issue in accordance with the published schedule. These time frames are appropriate since all addressees have responded to Bulletin 2003-01 and will, if necessary, implement compensatory measures until the issues identified in this generic letter are resolved.

Applicable Regulatory Requirements

NRC regulations in Title 10, of the *Code of Federal Regulations* Section 50.46,(10 CFR 50.46), require that the ECCS must satisfy five criteria, one of which is to provide the capability for long-term cooling of the reactor core following a LOCA. The ECCS must have the capability to provide decay heat removal, such 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. For PWRs licensed to the General Design Criteria (GDCs) in Appendix A to 10 CFR Part 50, GDC 35 specifies additional ECCS requirements.

Similarly, for PWRs licensed to the GDCs in Appendix A to 10 CFR Part 50, GDC 38 provides requirements for containment heat removal systems, and GDC 41 provides requirements for containment atmosphere cleanup. Many PWR licensees credit a CSS, at least in part, with performing the safety functions to satisfy these requirements, and PWRs that are not licensed to the GDCs may similarly credit a CSS to satisfy licensing basis requirements. In addition, PWR licensees may credit a CSS with reducing the accident source term to meet the limits of 10 CFR Part 100 or 10 CFR 50.67.

Criterion XVI (Corrective Action) of Appendix B to 10 CFR Part 50 states that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected. For significant conditions adverse to quality, the measures taken shall include root cause determination and corrective action to preclude repetition of the adverse conditions.

If, in the course of preparing a response to the requested information, an addressee determines that its facility is not in compliance with the Commission's requirements, the addressee is expected to take appropriate action in accordance with requirements of Appendix B to 10CFR Part 50 and the plant technical specifications to restore the facility to compliance.

Applicable Regulatory Guidance¹

Regulatory Guide 1.82, Revision 3, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," November 2003.

Requested Information

All addressees are requested to provide the following information:

1. Within 60 days of the date of this generic letter, addressees provide information regarding their planned actions and schedule to confirm their compliance with 10 CFR 50.46(b)(5) and other existing regulatory requirements listed in this generic letter. The provided information should include the following:
 - (a) A description of the methodology used or that will be used to analyze the susceptibility of the ECCS and CSS recirculation functions for your reactor to adverse effects of post-accident debris blockage and operation with debris laden fluids identified in this generic letter. Provide the completion date of any analysis that will be performed.
 - (b) If a mechanistic analysis was or will be performed to confirm compliance, provide a statement of whether or not you plan to perform a containment walkdown surveillance in support of the analysis of the susceptibility of the ECCS and CSS

¹ The NRC staff is currently reviewing evaluation guidance developed by the industry. The NRC staff will document its review in a safety evaluation which licensees can reference as regulatory guidance.

recirculation functions to the adverse effects of debris blockage identified in this generic letter. Provide justification if no containment walkdown surveillance will be performed. If a containment walkdown surveillance will be performed, state the planned methodology to be used and the planned completion date. If a containment walkdown surveillance has already been performed, state the methodology used, the completion date, and the results of the surveillance.

2. Addressees are requested to provide no later than April 1, 2005, information that confirms their compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of this generic letter.
 - (a) Provide confirmation that the ECCS and CSS recirculation functions under debris loading conditions are or will be in compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of this generic letter. This submittal should also address the configuration of the plant that will exist once all modifications required for regulatory compliance have been made.
 - (b) A general description of and implementation schedule for all corrective actions, including any plant modifications that may be necessary to ensure compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of this generic letter. Provide justification for any corrective action that will not be completed by the end of the first refueling outage after April 1, 2005.
 - (c) A submittal that describes the methodology that was used to perform an analysis of the susceptibility of the ECCS and CSS recirculation functions to the adverse

effects of post-accident debris blockage and operation with debris laden fluids.

The submittal may reference a guidance document (e.g. Regulatory Guide 1.82, industry guidance) or other methodology previously submitted to the NRC. If a mechanistic analysis was performed to confirm compliance, the documents to be submitted or referenced should include the methodology for conducting a supporting containment walkdown surveillance used to identify potential debris sources and other pertinent containment characteristics.

- (d) If a mechanistic analysis was performed to confirm compliance, the submittal should include, at a minimum, the following information:
 - (I) The minimum available NPSH margin for the ECCS and CSS pumps with an unblocked sump screen.
 - (ii) The extent of submergence of the sump screen (i.e., partial or full) at the time of the switchover to sump recirculation, and the submerged area of the sump screen at this time.
 - (iii) The maximum head loss postulated from debris accumulation on the submerged sump screen, and a description of the primary constituents of the debris bed that result in this head loss. In addition to debris generated by jet forces from the pipe rupture, debris created by the resulting containment environment (thermal and chemical) and CSS washdown should be considered in the analyses. Examples of this type

of debris are disbonded coatings in the form of chips and particulates or chemical precipitants caused by chemical reactions in the pool.

- (iv) The basis for concluding that water inventory required to ensure adequate ECCS or CSS recirculation would not be held up or diverted by debris blockage at choke-points in containment recirculation sump return flowpaths.
- (v) The basis for concluding that inadequate core or containment cooling would not result due to debris blockage at flow restrictions in the ECCS and CSS flowpaths downstream of the sump screen, such as a HPSI throttle valve, pump bearings and seals, fuel assembly inlet debris screen, or containment spray nozzles. The discussion should consider the adequacy of the sump screen's mesh spacing and state the basis for concluding that adverse gaps or breaches are not present on the screen surface.
- (vi) Verification that close tolerance sub-components in pumps, valves and other ECCS and CSS components are not susceptible to plugging or excessive wear due to extended post accident operation with debris laden fluids.
- (vii) If an active approach (e.g. back flushing, powered screens, etc.) is selected in lieu of or in addition to a passive approach to mitigate the

effects of the debris blockage, describe the approach and associated analyses.

- (e) A general description of and planned schedule for any changes to the plant licensing bases resulting from any analysis or plant modification done to ensure compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of this generic letter.
- (f) A description of any existing or planned programmatic controls that will ensure that, in the future, potential sources of debris introduced into containment (e.g., insulations, signs, coatings, and foreign materials) will be assessed for potential adverse effects on the ECCS and CSS recirculation functions.

Addressees may reference their responses to GL 98-04 to the extent that their responses address these specific foreign material control issues.

Required Response

In accordance with 10 CFR 50.54(f), the subject PWR addressees are required to submit written responses to this generic letter. This information is sought to verify licensees' compliance with current licensing basis for the subject PWR addressees. The addressees have two options:

- (1) addressees may choose to submit written responses providing the information requested above within the requested time periods, or

- (2) addressees who choose not to provide information requested or cannot meet the requested completion dates are required to submit written responses within 15 days of the date of this generic letter. The responses must address any alternative course of action proposed, including the basis for the acceptability of the proposed alternative course of action.

The required written responses should be addressed to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, 11555 Rockville Pike, Rockville, Maryland 20852, under oath or affirmation under the provisions of Section 182a of the Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f). In addition, a copy of a response should be submitted to the appropriate regional administrator.

The NRC staff will review the responses to this generic letter and will notify affected addressees if concerns are identified regarding compliance with NRC regulations and their current licensing bases. The staff may also conduct inspections to determine addressees' effectiveness in addressing the generic letter.

Reasons for Information Request

As discussed above, research and analysis suggests that (1) the potential for the failure of the ECCS and CSS recirculation functions as a result of debris blockage is not adequately addressed in most PWR licensees' current safety analyses, and (2) the ECCS and CSS recirculation functions at a significant number of operating PWRs could become degraded as a result of the potential effects of debris blockage or extended operation with debris laden fluids identified in this generic letter. An ECCS that is incapable of providing long-term reactor core

cooling through recirculation operation would be in violation of 10 CFR 50.46. A CSS that is incapable of functioning in recirculation mode may not comply with GDCs 38 and 41 or other plant-specific licensing requirements or safety analyses. Bulletin 2003-01 requested information to verify addressees' compliance with NRC regulations and to ensure that any interim risks associated with post-accident debris blockage are minimized while evaluations to determine compliance proceed. This generic letter is the follow-on generic communication to Bulletin 2003-01 which is requesting information on the results of the evaluations referenced in the bulletin. Therefore, the information requested in this generic letter is necessary to confirm plant-specific compliance with 10 CFR 50.46 and other existing regulations.

The NRC staff will also use the requested information to (1) determine whether a sample auditing approach is acceptable for verifying that addressees have resolved the concerns identified in this generic letter, (2) assist in determining which addressees would be subject to the proposed sample audits, (3) provide confidence that any nonaudited addressees have addressed the concerns identified in this generic letter, and (4) assess the need for and guide the development of any additional regulatory actions that may be necessary to address the adequacy of the ECCS and CSS recirculation functions.

Related Generic Communications

- Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Recirculation During Design-Basis Accidents at Pressurized-Water Reactors," June 9, 2003.
- Bulletin 96-03, "Potential Plugging of Emergency Core Cooling Suction Strainers by Debris in Boiling-Water Reactors," May 6, 1996.
- Bulletin 95-02, "Unexpected Clogging of a Residual Heat Removal (RHR) Pump Strainer While Operating in the Suppression Pool Cooling Mode," October 17, 1995.
- Bulletin 93-02, "Debris Plugging of Emergency Core Cooling Suction Strainers," May 11, 1993.
- Bulletin 93-02, Supplement 1, "Debris Plugging of Emergency Core Cooling Suction Strainers," February 18, 1994.
- Generic Letter 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System After a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment," July 14, 1998.
- Generic Letter 97-04, "Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps," October 7, 1997.

- Generic Letter 85-22, "Potential For Loss of Post-LOCA Recirculation Capability Due to Insulation Debris Blockage," December 3, 1985.
- Information Notice 97-13, "Deficient Conditions Associated With Protective Coatings at Nuclear Power Plants," March 24, 1997.
- Information Notice 96-59, "Potential Degradation of Post Loss-of-Coolant Recirculation Capability as a Result of Debris," October 30, 1996.
- Information Notice 96-55, "Inadequate Net Positive Suction Head of Emergency Core Cooling and Containment Heat Removal Pumps Under Design Basis Accident Conditions," October 22, 1996.
- Information Notice 96-27, "Potential Clogging of High Pressure Safety Injection Throttle Valves During Recirculation," May 1, 1996.
- Information Notice 96-10, "Potential Blockage by Debris of Safety System Piping Which Is Not Used During Normal Operation or Tested During Surveillances," February 13, 1996.
- Information Notice 95-47, "Unexpected Opening of a Safety/Relief Valve and Complications Involving Suppression Pool Cooling Strainer Blockage," October 4, 1995.

- Information Notice 95-47, Revision 1, "Unexpected Opening of a Safety/Relief Valve and Complications Involving Suppression Pool Cooling Strainer Blockage," November 30, 1995.
- Information Notice 95-06, "Potential Blockage of Safety-Related Strainers by Material Brought Inside Containment," January 25, 1995.
- Information Notice 94-57, "Debris in Containment and the Residual Heat Removal System," August 12, 1994.
- Information Notice 93-34, "Potential for Loss of Emergency Cooling Function Due to a Combination of Operational and Post-LOCA Debris in Containment," April 26, 1993.
- Information Notice 93-34, Supplement 1, "Potential for Loss of Emergency Cooling Function Due to a Combination of Operational and Post-LOCA Debris in Containment," May 6, 1993.
- Information Notice 92-85, "Potential Failures of Emergency Core Cooling Systems Caused by Foreign Material Blockage," December 23, 1992.
- Information Notice 92-71, "Partial Plugging of Suppression Pool Strainers at a Foreign BWR," September 30, 1992.
- Information Notice 89-79, "Degraded Coatings and Corrosion of Steel Containment Vessels," December 1, 1989.

- Information Notice 89-79, Supplement 1, "Degraded Coatings and Corrosion of Steel Containment Vessels," June 29, 1990.
- Information Notice 89-77, "Debris in Containment Emergency Sumps and Incorrect Screen Configurations," November 21, 1989.
- Information Notice 88-28, "Potential for Loss of Post-LOCA Recirculation Capability Due to Insulation Debris Blockage," May 19, 1988.

Backfit Discussion

Under the provisions of Section 182a of the Atomic Energy Act of 1954, as amended, and 10CFR 50.54(f), this generic letter transmits an information request for the purpose of verifying compliance with existing applicable regulatory requirements (see the Applicable Regulatory Requirements section of this generic letter). Specifically, the required information will enable the NRC staff to determine whether the emergency core cooling system (ECCS) and containment spray system (CSS) at reactor facilities are able to perform their safety functions following all postulated accidents for which ECCS or CSS recirculation is required while taking into account the adverse effects of post-accident debris blockage and operation with debris laden fluids. No backfit is either intended or approved by the issuance of this generic letter, and the staff has not performed a backfit analysis.

Small Business Regulatory Enforcement Fairness Act

The NRC has determined that this generic letter is not subject to the Small Business Regulatory Enforcement Fairness Act of 1996.

Federal Register Notification

The NRC published a notice of opportunity for public comment on this generic letter in the *Federal Register* on In addition, the NRC has provided opportunities for public comment at several public meetings. As the resolution of this matter progresses, the NRC will continue to provide opportunities for further public involvement.

Paperwork Reduction Act Statement

This generic letter contains information collections that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These information collections were approved by the Office of Management and Budget (OMB) under approval number XXXX-XXXX which expires on XXX XX, XXXX.

The burden to the public for these mandatory information collections is estimated to average 1000 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the necessary data, and completing and reviewing the information collections. Send comments regarding this burden estimate or any other aspect of these information collections, including suggestions for reducing the burden, to the Records Management Branch, Mail Stop T-6 E6, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet electronic mail to INFOCOLLECTS@NRC.GOV; and to the Desk

Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0011), Office of Management and Budget, Washington, DC 20503.

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END OF DRAFT GENERIC LETTER

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if you have problems in accessing the documents in ADAMS, contact the NRC Public Document Room (PDR) reference staff at 1-800-397-4209 or 301-415-4737 or by e-mail to pdr@nrc.gov.

Dated at Rockville, Maryland, this 24th day of March 2004.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

William D. Beckner, Chief
Reactor Operations Branch
Division of Inspection Program Management
Office of Nuclear Reactor Regulation