

POLICY ISSUE NOTATION VOTE

August 26, 2010

SECY-10-0113

FOR: The Commissioners

FROM: R. W. Borchardt
Executive Director for Operations

SUBJECT: CLOSURE OPTIONS FOR GENERIC SAFETY ISSUE – 191,
ASSESSMENT OF DEBRIS ACCUMULATION ON PRESSURIZED
WATER REACTOR SUMP PERFORMANCE

PURPOSE:

This paper responds to Staff Requirements Memorandum (SRM) M100415, dated May 17, 2010, and requests a decision on policy issues and options that the U.S. Nuclear Regulatory Commission (NRC) staff has considered in bringing Generic Safety Issue (GSI) 191, "Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance," to closure.

SUMMARY:

Long-term cooling following a loss of coolant accident (LOCA) is a basic safety function for nuclear reactors. Failure of long-term cooling results in core damage. The sump recirculation function of the emergency core cooling system (ECCS) is the design feature in a pressurized-water reactor (PWR) that provides this safety function. Success of sump recirculation is therefore necessary for reactor safety and for providing adequate protection of public health and safety following a LOCA. GSI-191 concluded that debris clogging of sump strainers could lead to recirculation system failure as a result of a loss of net positive suction head (NPSH) for the ECCS recirculation pumps. The NRC issued Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors," dated September 13, 2004, to ensure the reliability of the long-term cooling safety function at PWRs.

CONTACTS: Christopher A. Hott, NRR/DSS
301-415-1167

Michael L. Scott, NRR/DSS
301-415-0565

Resolution of GSI-191 involves two distinct but related safety concerns: (1) potential clogging of the sump strainers that results in ECCS pump failure; and (2) potential clogging of flow channels within the reactor vessel because of debris bypass of the sump strainer (in-vessel effects). Clogging at either the strainer or in-vessel channels can result in loss of the long term cooling safety function. Currently, the staff has concluded that the first aspect (sump strainer performance) has been adequately demonstrated for 44 of 69 PWRs. The in-vessel effects issues remain open for nearly all plants.

This paper presents three options for bringing GSI-191 to closure: (1) maintain the current holistic integrated resolution process for remaining plants, including evaluating new licensee methods or testing to justify assumptions that the staff has determined have not been technically justified in the past; (2) develop new risk-informed implementing guidance for GSI-191 using either the existing regulatory framework or the proposed risk-informed rulemaking, "Risk-Informed Redefinition of Large Break LOCA ECCS Requirements" at Title 10 of the *Code of Federal Regulations* (10 CFR) 50.46a, should it be approved, or (3) allow General Design Criterion (GDC) 4, "Environmental and Dynamic Effects Design Bases," leak-before-break (LBB) credit for GSI-191.

The staff recommends a combination of Options 1 and 2 with an implementation schedule that is both risk-informed and takes into account the amount of planning and effort required for licensee implementation. The schedule is risk-informed, in that issues associated with the more likely accident scenarios would be resolved by a near-term schedule, and issues associated with the less likely scenarios may be resolved on a longer schedule consistent with their lower risk significance.

BACKGROUND:

Most of the plants that have not yet achieved closure with regard to strainer performance have large amounts of fibrous insulation. Others have attempted to demonstrate adequate strainer performance using test methods that are unacceptable to the staff. The resolution process is complicated by large uncertainties associated with dynamics of jet impingement, robustness of insulation and coatings, and debris transport in a LOCA environment. These uncertainties are important because testing has demonstrated the significant deleterious effects of debris on strainer performance and in-vessel flow, as well as an unpredictable sensitivity of these effects to differences in debris characteristics. Any option selected in this paper to address the resolution of strainer performance issues for the remaining PWRs will likely have similar impacts on evaluating in-vessel effects because the potential for clogging is dominated by the fibrous debris source term. Even relatively small amounts of the right combination of debris types can lead to significant strainer headloss and in-vessel blockage. For plants with high fiber loading, all of these issues are exacerbated.

The in-vessel effects issue remains open for nearly all plants and is the last aspect of GSI-191 for which the staff has not yet issued guidance regarding acceptable generic models and methods. At the time of this writing, the staff is reviewing an industry topical report on plant-specific methods to demonstrate that a core will not clog. These methods will rely on a plant's conservatively determined debris loading, strainer bypass flow, and fuel testing that was performed under various combinations of debris. The staff plans to issue a safety evaluation (SE) for in-vessel effects in 2010, although unexpected differences in the apparent behavior of

the two fuel vendors' fuels may necessitate additional testing to support the staff's issuance of this SE.

Prior to the Commission meeting on April 15, 2010, the staff had concluded that industry attempts to refine test and evaluation methods to reduce perceived conservatisms would not likely be successful in the near term. As such, the staff had developed a format for draft letters under 10 CFR 50.54(f) to the affected licensees, that would ask them to provide information on how they would show adequate strainer performance by a date certain using methods consistent with the 2004 SE for NEI-04-07, "Pressurized Water Reactor Sump Performance Methodology" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML043280007).

In response to SRM M100415, issuance of these letters is in abeyance pending additional Commission direction. Enclosure 1 provides further discussion regarding the history and complexities of the issue, as well as the basis for why the staff has not accepted the proposed refinements to test and evaluation methods.

During the April 15, 2010, Commission meeting, licensee speakers expressed concern that the NRC staff's approach to issue resolution (issuing 10 CFR 50.54(f) letters to licensees expecting issue resolution in the near-term using staff-accepted methods) would lead to large radiation exposures to plant staff without significant safety benefit. The Nuclear Energy Institute and the Union of Concerned Scientists (UCS) each submitted two letters in conjunction with the April Commission meeting, detailing their respective views on whether GDC 4 credit should be allowed for GSI-191. In developing its recommendations on a path forward for GSI-191, the staff has carefully evaluated these stakeholder views, which are discussed elsewhere in this document and its enclosures, and/or in correspondence to the stakeholders.

DISCUSSION:

The staff recognizes the significant costs associated with replacing or reinforcing insulation materials and acknowledges that compensatory actions and modifications made to date have reduced the risk of strainer clogging. All PWR licensees have implemented interim compensatory measures and have made their sump strainers substantially larger. Some licensees also removed fibrous and/or particulate insulation, while others changed their sump pH buffers or installed debris interceptors. In addition, while smaller LOCAs are more probable than larger LOCAs, the probability of all LOCAs is low, and smaller LOCAs proceed more slowly allowing time for additional mitigation and operator intervention that may not be credited in design basis analyses. For these reasons, and additional reasons documented in GL 2004-02 that are still applicable today, the staff has determined that continued operation is justified, consistent with the time frame of the recommended options in this paper, to allow additional time to fully address the issue.

However, given the clogging potential of fibrous insulation, the NRC staff does not think it is prudent to allow these materials to remain within containment, or that continued operation is justified indefinitely, without an analysis of adequate sump performance that demonstrates compliance with the regulations and provides reasonable assurance that long-term cooling will be maintained. Therefore, assuming Commission approval of the staff recommended options, the staff intends to use additional regulatory measures, as appropriate, for those licensees that

do not provide information that demonstrates adequate sump performance within the implementation schedule set forth in this paper. Licensees have been cooperative on addressing these issues, so any measures beyond information requests under 10 CFR 50.54(f) should not be needed.

Lastly, given that relatively small amounts of the right combination of debris types can lead to significant headloss, none of the options below provide an “analysis-only” option to resolving GSI-191. Each would rely either on past strainer test results, if determined to be bounding, or on new strainer testing.

Options To Bring GSI-191 To Closure

Enclosure 2 describes the options presented below in more detail, including pros and cons, as well as some options the staff considered but determined were not viable.

- *Option 1: Maintain the current holistic integrated resolution process for remaining plants including evaluating new refinement methods.*

This option continues to make use of the current holistic integrated review process until closure is reached for all plants. It includes a three-member team of senior staff with the requisite technical expertise (not part of the GSI-191 review team), which evaluates the staff review packages for each PWR to determine whether, given the conservatisms, nonconservatisms, and/or uncertainties in the various review areas, the licensee has demonstrated adequate strainer performance and therefore compliance with the regulations. Additionally, this option includes evaluation of new proposed approaches by licensees and industry to justify some GSI-191 analysis assumptions that the NRC staff has not previously accepted. For example, industry currently plans to perform new testing to justify reduced zones of influence (ZOIs) and credit for debris settling.

The staff identified the following three suboptions to Option 1:

- (a) Set a near-term schedule for licensees to address the full spectrum of LOCAs.
- (b) Set a near-term schedule for smaller LOCAs, and set a longer term schedule for the less likely larger LOCAs.
- (c) Do not set a schedule for licensees to address remaining issues.

The staff proposed Suboption 1.a during the Commission meeting held on April 15, 2010. Suboption 1.b is, in part, a risk-informed alternative that would require near-term resolution of the more likely, and thus more risk-significant, accident scenarios while allowing modifications needed to resolve the less risk-significant scenarios to be completed within a longer timeframe commensurate with their lower risk-significance. Schedules could be established using 10 CFR 50.54(f) letters (and additional regulatory measures if appropriate) and would, for the near-term schedule, call for an affected licensee to complete testing and evaluation using staff-accepted methods and to complete all needed modifications within two refueling outages. Suboption 1.c is the continuation of the current process, which has no resolution schedule.

- *Option 2: Develop additional risk-informed implementing guidance for GSI-191.*

Risk-informed implementing guidance would be developed based on a risk-informed approach described in SECY-04-0150, "Alternate Approaches for Resolving the Pressurized Water Reactor Sump Blockage Issue (GSI-191), Including Realistic and Risk-Informed Considerations," dated August 16, 2004, which resulted in Section 6 of the SE for NEI 04-07, or based on the proposed 10 CFR 50.46a rule, if the rule is promulgated. This guidance would provide analysis relaxations for larger LOCAs (14-inches in diameter and above at most PWRs), based on their low likelihood. Thus, there are two suboptions for developing risk-informed implementing guidance for GSI-191 as follows:

- (a) Expand limited risk-informed guidance in Section 6 of the SE for NEI 04-07.
 - (b) Generate new guidance assuming that the proposed 10 CFR 50.46a is approved.
- *Option 3: Allow application of the GDC 4 exclusion of jet effects to debris generation for GSI-191.*

This option would require a Commission policy decision as discussed in the policy section of this paper and would allow licensees to exclude from sump performance analyses the effects of debris that could be generated from LOCAs in piping that is LBB qualified. A policy decision to expand GDC 4 to allow credit for GSI-191 would require an initial Commission decision that expanding GDC 4 does not result in an unacceptable reduction in defense-in-depth, is appropriate given that there is no perceived safety benefit, and that it would not result in unintended consequences (e.g., unacceptable precedent for the use of LBB). This would be followed by a staff evaluation of how primary water stress corrosion cracking (PWSCC) should be addressed for LBB piping under an expanded GDC 4, and subsequently, a final Commission policy decision. Implementation of this final policy decision would require exemptions to GDC 4, rulemaking to revise GDC 4, or rulemaking to issue a new Statement of Considerations (SOC) for the rule. A detailed discussion of GDC 4 and industry views is provided in Enclosure 3.

Option 1 would continue the current review process until closure is reached at all plants. However, until resolution is achieved, the reliability of sump recirculation at affected plants remains in question. Option 1.a would likely require significant insulation removal at plants with large fiber loads, but would bring the issue to final closure and completion of all needed modifications in the shortest time (e.g. two operating cycles). The staff has determined that two operating cycles is the minimum reasonable amount of time necessary to plan, design, and install insulation modifications using "as low as is reasonably achievable" (ALARA) methods. The near-term schedule would also be consistent with the time needed to issue an SE for in-vessel effects and for licensees to evaluate in-vessel effects using the guidance. Additionally, based on current industry timelines for proposed new testing, setting a near-term schedule would allow sufficient time for the staff to evaluate the results of currently planned industry ZOI and settling tests before the schedule is exceeded. Thus, if the staff were to accept these new industry methods, licensees could decide not to make modifications potentially called for by the current staff-accepted approaches.

Option 1.b would address any outstanding issues associated with more likely and risk-significant smaller LOCAs (14 inches and below) in the short term, but would allow more time to address issues associated with the low-likelihood larger break LOCAs (above 14 inches). In this way, the more risk-significant issues would be closed quickly, and licensees would have the flexibility to reduce the impact (cost and dose) of addressing the less risk-significant LOCAs through

planning, testing, or refined analyses. However, a deadline would still be defined for final resolution. The longer schedule for larger breaks (if directed by the Commission) could be set to allow the time needed to implement Option 2, followed by sufficient additional time to perform ALARA planning of any needed modifications. It is expected that the longer schedule would delay additional modifications, if needed, for larger LOCAs by approximately 2 years beyond the near-term schedule (e.g., about one additional operating cycle).

Option 1.c (wherein no schedule is specified) has the potential for long-term vulnerability, particularly for plants with the highest fiber loads. Without a schedule, the industry is likely to continue to pursue further refinements to evaluation methodologies to avoid making additional modifications. Experience with the sump issue suggests that the reviews of such refinements are often complex, span several years, and may not result in staff approval of the refinements.

Option 2 would provide more flexibility to licensees for addressing larger LOCAs than is currently permitted under Section 6 of the SE for NEI 04-07, which no licensee has credited. While Section 6 was intended to be consistent with the proposed 10 CFR 50.46a rule at the time NEI 04-07 was issued, there are important differences between using Section 6 (e.g., exemptions required) and the proposed 10 CFR 50.46a that are discussed in Enclosure 4. The staff expects that the non-design basis analyses possible if proposed 10 CFR 50.46a is promulgated would result in more analysis flexibility than an expanded Section 6, but the degree of difference has not yet been established. Despite these differences, given the current improved state of knowledge as compared to 2004, the NRC staff believes that some additional relaxations may be possible to the existing Section 6 approach. However, the extent of the benefit under either approach may be limited unless proposed industry testing of ZOI and settling yield more favorable results than the staff expects. For plants with high fiber loads, it is likely that significant testing, system modifications or insulation removal may still be necessary. Option 2 would, however, provide more flexibility for achieving resolution and could potentially be used to reduce the cost and dose impacts of issue closeout. One drawback of this approach is the potential need for separate small-break and large-break demonstration tests of adequate strainer performance. Preparation of risk-informed guidance could be completed about 12 months after a Commission decision to expand Section 6, or 12 months after a Commission decision on the proposed 10 CFR 50.46a rule. The proposed 10 CFR 50.46a rule is due to the Commission in December 2010. The implementation of Option 2 would be expected to delay any needed modifications to address larger LOCAs by about 2 years as compared to sub-option 1.a.

The proposed 10 CFR 50.46a reflects rigorous development of the basis for an alternate ECCS rule. If the 10 CFR 50.46a rule is not issued, the staff would need to consider the implications of the Commission's decision on the existing Section 6 approach. It might be appropriate to eliminate the approach entirely, depending on the Commission's views on the subject.

Option 3 would exclude consideration of debris generated from LOCAs in LBB-qualified piping. Since all PWR licensees have LBB qualifications in place for the largest reactor coolant system piping, this option would provide significant relaxation for licensees in their analyses of debris generation for GSI-191. This option might eliminate the need for additional modifications at some or all remaining high-fiber plants. However, breaks in piping outside the scope of LBB credit would likely generate enough debris to still require a demonstration test of adequate strainer performance. Additionally, other potential breaks could occur where LBB credit is not

applicable, including failed pump seals; leaking valve packing; blow-out of valve bonnets, flange connections, bellows, manways and rupture discs; and actuation of valves that discharge directly into the containment atmosphere (e.g., safety/relief valves and squib valves). Therefore, additional modifications at some high-fiber plants might still be required.

Feasibility of Alternate Regulatory Treatment for In-Vessel Effects

As noted above, the in-vessel effects issue remains unresolved for nearly all plants. As such, the staff considered separating in-vessel effects from GSI-191 into a new generic issue. While this approach is possible, the staff believes that this action would not significantly speed up closure of GSI-191, because sump strainer performance and in-vessel effects are closely linked. Given the apparent susceptibility of reactor fuel to debris-induced clogging, separate regulatory treatment for in-vessel effects is not recommended because it may simply delay additional needed modifications (e.g., replacement of fibrous insulation with less problematic materials such as reflective metal). Pursuit of a solution to the sump clogging issue without concurrently addressing in-vessel effects could result in a strainer that would not clog, and a core that would, clearly an unacceptable result. It is possible that a "high-fiber" plant could succeed in showing adequate strainer performance using one of the options above, yet still have to replace insulation to address in-vessel effects. Lastly, while the staff has not yet issued an SE for in-vessel effects, an SE has been drafted and is under management review. The staff expects to issue the draft in September 2010. Success in near-term issuance of a final SE would lead to near-term resolution of in-vessel effects, and would allow that resolution to not interfere with the expected timelines for the options discussed above. Enclosure 1 presents a more detailed description of the in-vessel issue, as well as the basis for the staff's recent request for at least one fuel vendor to perform a "cross-test" of another vendor's fuel.

Deterministic versus Risk-Informed Treatment of Remaining Items

The NRC's current ECCS requirements, at 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Nuclear Power Reactors," allow licensees to select among two types of deterministic evaluation models that can be used to demonstrate compliance with the ECCS systems design requirements, one of which is a bounding analysis and the other a best-estimate analysis. Currently, accepted evaluation methods for GSI-191 are bounding analyses that are used to generate the parameters and inputs for plant-specific demonstration testing of strainer performance. A best-estimate analysis of the probability of successful sump performance, which would be necessary to support a best-estimate compliance evaluation permitted by 10 CFR 50.46, is not presently possible because of the complex phenomena that are not understood well enough for industry to develop, or staff to evaluate, an integrated model of debris generation, transport, and deposition on the sump screens. Similarly, a more complete understanding of the complex phenomena would be needed to develop more detailed models to support risk-informed analysis via a probabilistic risk assessment. Enclosure 5 provides a detailed discussion regarding risk-informed and deterministic treatment.

In addition, the staff recognized several years ago that some relaxations could be made to 10 CFR 50.46 based on the low probability of large LOCAs. As a result, the staff worked with industry and stakeholders to develop a proposed risk-informed alternate ECCS rule,

10 CFR 50.46a, which would provide some analyses relaxations but still require mitigation of large LOCAs as discussed in Option 2.

Dose Considerations

Licenseses are required to perform those activities that ensure public health and safety in a manner that maintains radiation exposure ALARA. There is no established standard for how much collective dose is, or is not, warranted in any specific operational situation. Historically, the NRC has typically not accepted requests by reactor licenseses to delete or defer safety-related tests based solely on the regulatory requirement to maintain occupational dose ALARA. Enclosure 6 provides a detailed discussion of radiation protection as practiced internationally and in the United States.

Based on a limited staff survey of 9 licenseses known to have performed significant insulation replacements associated with steam generator replacement and activities associated with GSI-191, the average total reported dose for insulation replacements was 19 person-rem. In contrast, the highest estimated dose of future insulation replacements provided by the industry in presentations at the April 15, 2010, Commission meeting was 600 person-rem with an average dose of 200 person-rem. Although the modification scope for the plants surveyed may be less than could be required for some plants to fully address sump performance issues, these latter values seem excessively conservative compared to the actual industry experience noted above and further described in Enclosure 6. Regardless of the accuracy of the industry estimates, the staff recognizes that the need to resolve GSI-191 could result in significant collective occupational dose at some plants as a consequence of insulation replacements, and that the amount of such dose could vary depending on the option for path forward chosen by the Commission. However, the staff does not believe that the dose likely to be received in support of resolving GSI-191 is excessive given the safety and compliance issues stated in this paper.

Backfit Considerations and the Committee To Review Generic Requirements

When the staff issued GL 2004-02, it determined, under 10 CFR 50.54(f), that the information requested was necessary in order for the NRC to determine compliance with 10 CFR 50.46(b)(5), because adequate sump performance is necessary following a LOCA to maintain long-term core cooling. In addition, consistent with the staff's practice that actions that the NRC may impose as a result of a GL 2004-02 be evaluated for backfitting at the time of issuance of the GL, the staff determined that any actions that the NRC may impose as a result of GL 2004-02 would fall under the compliance exception of the backfit rule, for largely the same reason that the 10 CFR 50.54(f) information request was necessary to determine compliance with 10 CFR 50.46(b)(5).

The staff believes that any additional information requests, which would be issued in the future to provide the basis for NRC resolution and closure of GSI-191, are necessary to determine compliance with 10 CFR 50.46, and that the compliance backfit exception in 10 CFR 50.109(a)(4)(i) continues to apply for any future modifications a licensee determines are necessary to resolve GSI-191.

Several times during the staff's consideration of GSI-191, the staff consulted with the Committee to Review Generic Requirements (CRGR) regarding GSI-191 as discussed in Enclosure 1. At

each consultation, the CRGR concurred with the staff's determination that information requests were justified to determine compliance with 50.46, and that the compliance backfit exception applied to any actions that may be imposed on a licensee to resolve GSI-191. In preparing this paper, the staff again consulted the CRGR (ADAMS Accession Nos. ML101720380 and ML102090113) to determine whether the staff's proposed path forward, including the staff's planned issuance of 10 CFR 50.54(f) letters to some remaining licensees, would be in accordance with 10 CFR 50.54(f) and the compliance exception to the backfit rule. The staff additionally consulted with CRGR on whether the adequate protection exception to the backfit rule also applied. In the most recent instance, the CRGR stated the following:

The CRGR supports the conclusion by the staff that, as documented in GL 2004-02, the information requested of licensees regarding the operability of their ECCS system post-accident falls under the provisions of 10 CFR 50.109(a)(4)(i), the compliance exception to the backfit requirements... In addition, the CRGR concluded that the compliance exception to the backfit rule was sufficient for the staff to proceed without a cost-benefit analysis, and therefore did not approve the use of the adequate protection exception, 10 CFR 50.109(a)(4)(ii).

POLICY DISCUSSION:

Expanding the scope of GDC 4 to allow LBB credit for resolving ECCS performance issues is a policy issue. The staff believes that excluding consideration of debris generated from LOCAs in LBB-qualified piping is inconsistent with the agency's longstanding implementation of basic defense-in-depth principles. Specifically, an important consideration in defense-in-depth is that the initiating event for accidents included in a plant's licensing analyses should not result in core damage in the absence of additional independent failures. Strainer testing however has repeatedly demonstrated potential for LOCA-generated debris to cause sump failure, and, given a LOCA, no additional independent protection system failures are needed for debris-induced sump failure. A second consideration in defense-in-depth is the independence of features that prevent severe accidents from those features that mitigate accident consequences. Implementation of the principle of independence of prevention and mitigation features means minimizing the likelihood that failure of a prevention feature will also fail a mitigation feature. However, sump failure causes a loss of the ECCS core cooling (a prevention feature) and also results in the loss of the containment spray system (a mitigation feature). Therefore, the staff believes that excluding consideration of debris from LOCAs in LBB-qualified piping is inconsistent with the agency's longstanding implementation of basic defense-in-depth principles in that an initiating event in the licensing basis could proceed to a severe accident state without any additional protection system failures, and could, at the same time, degrade accident mitigation systems.

A policy decision to expand GDC 4 to allow credit for GSI-191 would require an initial Commission decision that expanding GDC 4 does not result in an unacceptable reduction in defense-in-depth, is appropriate given that there is no perceived safety benefit, and that it would not result in unintended consequences (e.g., unacceptable precedent for the use of LBB). The staff would then complete an evaluation of how PWSCC should be addressed for LBB piping susceptible to PWSCC under an expanded GDC 4 such that there is sufficient technical basis for the expansion. Lastly, the staff would present its findings to the Commission for a final policy

decision. Implementation of this final policy decision would require exemptions to GDC 4, rulemaking to revise GDC 4, or rulemaking to issue a new SOC for the rule.

An expansion in scope of GDC 4 for GSI-191 is inconsistent with the intent of the exclusion in the rule, because the staff is unaware of any safety benefit in allowing the dynamic effects exclusion in GDC 4 to be applied to GSI-191 to reduce assumed debris generation. On the contrary, large amounts of problematic insulation would potentially remain in containment. The dynamic effects exclusion in GDC 4, as described in the SOC, provides an exception to the way in which the dynamic effects of postulated pipe breaks are considered for the purpose of removing plant hardware that negatively affects plant performance; specifically, removal of pipe whip restraints and jet impingement barriers to permit accessibility for in-service inspections of safety-related structures, systems and components. The staff has also not performed the evaluation that is described in the SOC as needed prior to allowing credit that would affect ECCS system performance. Furthermore, the application of expanded LBB may be inconsistent with the implementation of proposed 10 CFR 50.46a, and specifically with Commission direction in its SRM dated July 1, 2004, related to SECY-04-0037, "Issues Related to Proposed Rulemaking to Risk-Inform Requirements Related to Large Break Loss-Of-Coolant Accident (LOCA) Break Size and Plans for Rulemaking on LOCA with Coincident Loss-Of-Offsite Power," dated March 3, 2004. In that SRM, the Commission stated the following:

Licensees should be required, by regulation, to retain the capability to successfully mitigate the full spectrum of LOCAs for break sizes between the new maximum break size and the double-ended guillotine break of the largest pipe in the reactor coolant system.

The staff views the use of 10 CFR 50.46a as a more technically complete and defensible approach to assist in the resolution of the GSI-191 sump performance issue than would be implementation of LBB for this purpose. The 10 CFR 50.46a rulemaking developments represent the agency's current approach to risk-informing ECCS performance issues.

NEW REACTORS:

In its review of new reactor designs, the staff continues to incorporate experience gained from the evaluations of operating reactors. New reactor designs have advanced strainers with large screen areas and typically generate fewer debris types and less problematic debris during a postulated accident as compared to operating plants. In addition, new reactor testing is being reviewed with the guidance developed for operating reactors and has resulted in design changes to address issues identified during testing. New reactor designs use staff-accepted ZOIs and do not credit debris settlement during testing. In-vessel effects are being considered for all new reactor designs and, when applicable, data from design-specific fuel assembly headloss tests will be evaluated to ensure that long-term core cooling will be maintained.

RECOMMENDATION:

The staff recommends a combination of Options 1 and 2 with an implementation schedule that is both risk-informed and takes into account the amount of planning and effort required for licensee implementation. The staff recommends the implementation schedule of Option 1.b because it brings to near-term closure the issues associated with more risk-significant smaller

LOCAs. It also maintains defense-in-depth for long-term operation while still providing licensees sufficient time to efficiently schedule and implement solutions. This option utilizes an integrated resolution approach that balances known conservatisms against potential nonconservatisms in licensees' analyses to avoid a requirement for overly conservative demonstration of adequate sump performance and sets an overall schedule for resolution. The staff also recommends Option 2 in combination with Option 1.b. because it would likely reduce the scope of modifications needed to address GSI-191 for some plants and would be consistent with agency policy regarding risk-informed regulation.

The staff does not recommend Option 3. The staff evaluated the recent request by industry to credit LBB for sump evaluations and agrees that all PWR sumps are less likely to clog because of larger strainers and additional modifications made to date. However, the emergence of issues regarding sump performance has prevented the staff from concluding that the modifications made to date have been sufficient for the plants that have not yet demonstrated adequate strainer performance. The staff believes that applying LBB credit for sump evaluations would still result in an unacceptable reduction in defense-in-depth because it would allow large amounts of problematic insulation to remain in PWR containments. Given this option, a LOCA in LBB-qualified piping could proceed to a severe accident state without any additional protection system failures, and could at the same time degrade accident mitigation systems. If the Commission selects this option, it would also not reduce the closure time for GSI-191 because the staff would need to complete an evaluation of how PWSCC should be addressed for LBB piping susceptible to PWSCC under an expanded GDC 4 such that there is sufficient technical basis for the expansion. In addition, implementation of this option would require exemptions to GDC 4, rulemaking to revise GDC 4, or rulemaking to issue a new SOC for the rule.

For new reactors, the staff plans to continue its reviews using current staff guidance and design-specific testing; and will resolve the GSI-191 issue as part of issuing new Design Certifications and Combined Licenses.

RESOURCES:

Estimated resource needs of 6 full-time equivalents (FTE) are included in the fiscal year (FY) 2010 budget as Option 1 is the current process, 7 FTE and \$115K are included in the FY 2011 President's Budget; FY 2012 resources have been included in the Commission-approved budget; FY 2013 resources and beyond will be addressed through the PBPM process. A detailed resource discussion for each option is presented in Enclosure 2.

Fiscal Year	Option 1	Option 2	Option 1.b. and 2	Option 3
FY 2010	6.0 FTE for reviews			
FY 2011	6.0 FTE for reviews 115K ZOI test review for 1.a, 1.b, and 1.c	1.0 FTE for guidance	7.0 FTE, 115K	1.0 FTE for evaluation 1FTE for GDC 4 SOC
FY 2012	3.6 FTE for reviews 60K ZOI test review for 1.a, 1.b, and 1.c	2.0 FTE for reviews	5.6 FTE, 60K	0.5 FTE to complete evaluation 0.5 FTE for GDC 4 SOC
FY 2013	None for 1.a or 1.b TBD for 1.c	0.5 FTE for reviews 0.5 FTE margin reviews	1.0 FTE	0.5 FTE for GDC 4 SOC 3.5 FTE for reviews 1 FTE margin reviews
FY 2014	None for 1.a or 1.b TBD for 1.c	0.5 FTE margin reviews	0.5 FTE	1.5 FTE for reviews 1 FTE margin reviews

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection. The Office of the Chief Financial Officer has reviewed this paper for resource implications and concurred.

/RA by Martin J. Virgilio for/

R. W. Borchardt
Executive Director
for Operations

Enclosures:

1. Background Discussion and Technical Issues
2. Evaluation of GSI-191 Closure Options
3. Discussion of Leak-Before-Break
4. Discussion of Proposed 10 CFR 50.46a
5. Risk-Informed Versus Deterministic Treatment
6. Radiation Protection and Dose Evaluation

Fiscal Year	Option 1	Option 2	Option 1.b. and 2	Option 3
FY 2010	6.0 FTE for reviews			
FY 2011	6.0 FTE for reviews 115K ZOI test review for 1.a, 1.b, and 1.c	1.0 FTE for guidance	7.0 FTE, 115K	1.0 FTE for evaluation 1FTE for GDC 4 SOC
FY 2012	3.6 FTE for reviews 60K ZOI test review for 1.a, 1.b, and 1.c	2.0 FTE for reviews	5.6 FTE, 60K	0.5 FTE to complete evaluation 0.5 FTE for GDC 4 SOC
FY 2013	None for 1.a or 1.b TBD for 1.c	0.5 FTE for reviews 0.5 FTE margin reviews	1.0 FTE	0.5 FTE for GDC 4 SOC 3.5 FTE for reviews 1 FTE margin reviews
FY 2014	None for 1.a or 1.b TBD for 1.c	0.5 FTE margin reviews	0.5 FTE	1.5 FTE for reviews 1 FTE margin reviews

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection. The Office of the Chief Financial Officer has reviewed this paper for resource implications and concurred.

/RA by Martin J. Virgilio for/

R. W. Borchardt
Executive Director
for Operations

Enclosures:

1. Background Discussion and Technical Issues
2. Evaluation of GSI-191 Closure Options
3. Discussion of Leak-Before-Break
4. Discussion of Proposed 10 CFR 50.46a
5. Risk-Informed Versus Deterministic Treatment
6. Radiation Protection and Dose Evaluation

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DATE	07/26/10	07/21/10	07/20/10	07/29/10	08/10/10	08/11/10
OFFICE	NRR	EDO				
NAME	ELeeds (BBoger for)	RBorchardt (MVirgilio for)				
DATE	08/17/10	08/26/10				

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