EVALUATION OF GENERIC SAFETY ISSUE-191 CLOSURE OPTIONS

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

Description: The U.S. Nuclear Regulatory Commission (NRC) staff would continue its holistic integrated review process for remaining licensee analyses related to Generic Safety Issue (GSI) -191, "Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance," and associated strainer demonstration tests. This includes evaluating new proposed approaches to justify some licensees' GSI-191 analysis assumptions that the NRC staff has not previously accepted (e.g., reduced zones of influence (ZOIs) and settling credit).

Pros:

- As long as a schedule for resolution is established, this option supports bringing the issue to closure relatively quickly, so it is the most supportive of nuclear safety.
- This option best maintains defense-in-depth.
- This option balances known conservatisms against potential nonconservatisms and uncertainties in licensees' analyses to reduce the likelihood of the NRC requiring overly conservative demonstration of adequate sump performance.
- The NRC staff continues to review new industry-proposed approaches to justify assumptions which differ from those recommended by the staff in an effort to reduce the likelihood for needed modifications to show adequate sump performance.
- This option utilizes current resources already budgeted.
- This option represents a demonstrably successful process which has led to resolution of sump performance issues (except in-vessel effects) for 44 of 69 pressurized-water reactors (PWRs).

Cons:

- Licensees with large amounts of fibrous insulation have not been able to bring the issue to closure under the existing regulatory framework.
- Continuance of this approach would likely lead to replacement of substantial amounts of problematic insulation at approximately 15 or so affected units, resulting in dose and monetary cost.
- Absent a new regulatory framework, new approaches that would remove the need for additional modifications for some remaining licensees may never materialize. These new approaches may simply delay needed modifications.

- The staff has had technical concerns with past industry test methods and is skeptical that new approaches or testing will be successful in supporting demonstrations of adequate strainer performance.

- Allowing time for staff evaluation of each new industry-proposed method results in additional delays in issue closure (likely to be several years).

Suboption to require a date or dates by which licensees must evaluate GSI-191 using staff-accepted methods

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.

In early 2010, the NRC staff determined that it would reject the industry-sponsored reduced ZOI testing. Having concluded that industry attempts to refine test and evaluation methods to reduce perceived conservatisms would not be successful in the near term, the staff planned to issue letters under Title 10 of the *Code of Federal Regulations* (10 CFR) 50.54(f) to some licensees (Option 1.a) requesting that they provide information on how they would show adequate strainer performance by a date certain using methods consistent with the 2004 safety evaluation (SE) for Nuclear Energy Institute (NEI 04-07), "Pressurized Water Reactor Sump Performance Methodology" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML043280007). Additional regulatory measures would be taken as warranted. As such, the staff intended to set a schedule for further evaluations of new methods. The Commission halted these plans in Staff Requirements Memorandum (SRM) M100415, dated May 17, 2010 (ADAMS Accession No. ML101370261), pending further direction. Therefore, the staff believes it is appropriate to also present this suboption of setting a schedule for further discussions under Option 1.

Within this suboption, the Commission could choose a separate schedule for smaller versus larger breaks (Option 1.b). The rationale for this distinction is based on the differing risk for sump performance posed by smaller breaks versus larger breaks and the possibility of revised regulatory treatment of the latter.

Smaller break loss-of-coolant accidents (LOCAs) are orders of magnitude more likely than larger break LOCAs. In addition, for some plants, smaller break LOCAs are the limiting pipe breaks for sump performance. Testing experience has shown that a relatively small amount of debris of the right type can lead to a clogged strainer with high headloss. The thickness of a filtering debris bed that could lead to such losses is on the order of 1/8 inch or less. Therefore, given the very small probability of the largest pipe breaks, smaller breaks are potentially of more significant concern, depending on the plant. Further, smaller breaks would not be affected by the potential for leak-before-break (LBB) credit (Option 3) or risk-informed treatment (Option 2). Hence, the staff believes it would be reasonable to expect a near-term resolution for smaller breaks, with additional time allotted for larger breaks if the Commission also chooses Option 2.

If the Commission determines that a schedule should be implemented for Option 1, the staff could set schedules using 10 CFR 50.54(f) letters, and additional regulatory measures if warranted, which would call for an affected licensee to complete testing and evaluation using staff-accepted methods and to complete all needed modifications within a near-term schedule. The near-term schedule (for either smaller breaks or all breaks, as the Commission directs) would allow sufficient time (e.g., two operating cycles) for as low as reasonably achievable (ALARA) planning for any needed modifications. The longer term schedule for larger breaks (if directed by the Commission) would be set to allow sufficient time to develop implementing guidance either for the existing risk-informed framework or for the final rule under 10 CFR 50.46a rulemaking, "Risk-Informed Redefinition of Large Break LOCA ECCS Requirements" (Option 2), assuming it is approved by the Commission. It is expected that the longer schedule would extend approximately 2 years beyond the near-term schedule.

The following pros and cons apply to the suboptions (Option 1.a or Option 1.b) of requiring a date or dates by which licensees must evaluate GSI-191 using staff-accepted methods:

Pros:

- This option includes all of the pros listed above.
- This option would likely result in nearer term closure of GSI-191.
- This option would likely result in replacement of large amounts of problematic fibrous insulation with less problematic materials (e.g., reflective metallic insulation (RMI)) for strainer performance,
- This option would free up staff resources sooner.
- This option would ensure equitable treatment for those licensees that made modifications early in response to GSI-191.
- Given staff skepticism about the likelihood of proposed industry refinements to sump methodology being successful, this option avoids unnecessary delay in issue resolution.

Cons:

- This option would likely result in near-term capital expenditure for additional modifications at some remaining high-fiber plants in the form of insulation replacements, banding of installed insulation, or new mitigation systems.
- Modifications would result in additional occupational exposures.
- If insulation replacements are selected, replacement insulation may not have the same performance characteristics. (RMI is not as effective an insulator for a given thickness as fibrous insulation. Nevertheless, numerous PWRs have operated successfully for many years using effectively all RMI insulation in containment).

Some of the cons could potentially be mitigated by setting different schedules for smaller and larger breaks, since configurations subject to larger breaks might not need to be subjected to insulation replacement in the near term. The downside to this approach is that the issue resolution framework would be more complex. Affected plants would need to make two submittals, one for smaller breaks and one for larger breaks. The NRC staff would need to review those submittals and carry the affected plants in a "partially resolved" status for some time. As a result, two strainer tests that demonstrate adequate strainer performance may also be needed.

Regardless of whether a schedule is implemented for this option or not, the staff believes that the issue of in-vessel effects needs to be resolved before GSI-191 is considered resolved. The timeline for resolution of in-vessel effects depends on the issuance of an NRC SE on the subject. The SE has been drafted and is under management review, and the staff expects to issue the draft in September 2010. Issuance of the final SE may await the conclusion of the cross-testing discussed in this paper. It is possible that some licensees, having resolved emergency core cooling system (ECCS) strainer performance issues, may find that further modifications are needed to address in-vessel effects. Certain aspects of enhancing strainer performance (e.g., making strainers larger) may have a deleterious effect on intrusion of debris into the core, since more strainer surface area will allow more debris to pass through the strainer and potentially into the core. This is one principal reason the staff believes that in-vessel effects should be resolved in conjunction with the resolution of strainer performance issues.

The issue resolution process for GSI-191 focuses on the licensee's evaluation and testing methods. Once the methods are acceptable, the staff will be confident that the licensee is on a path to successful issue resolution. The staff SE on the subject will provide the method for in-vessel effects evaluations, while strainer testing and evaluation methods are being resolved on a plant-specific basis. The sequence of strainer performance issue resolution and issuance of the in-vessel effects SE will depend on several factors and will be plant specific. In any event, each plant must address both before the staff will close GSI-191 and 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, for that plant.

Resources to support evaluation of remaining PWR licensee submittals and issuance of 10 CFR 50.54(f) letters to approximately 15 plants are 5 full-time equivalents (FTEs) in fiscal year (FY) 2011 and 3 FTEs in FY 2012. As the staff has already drafted 10 CFR 50.54(f) letters, no additional resources are necessary for this activity. Therefore, the resources in FY 2011 and FY 2012 are identical for options 1.a, 1.b. and 1.c. The resources in FY 2011 are included in the FY 2011 President's Budget; FY 2012 resources will be addressed through the planning, budgeting, and performance management (PBPM) process and are included in the FY 2012 Performance Budget to the Office of Management and Budget (OMB). FY 2013 and beyond resources necessary for Option 1.c (no schedule for issue resolution) would depend on as yet to be proposed industry refinements and would be requested through the PBPM process.

Resource Estimate for Evaluating Industry-Proposed New Testing To Justify Settling Credit

The NRC staff is currently interacting with affected licensees and test vendors regarding the development of a revised strainer test protocol that credits debris settlement. Although the

industry vendors that perform these tests have recently suggested test protocol revisions that would likely address the staff's concerns regarding debris preparation and addition for future tests, limited progress has been made with respect to the most significant issues associated with prototypical flows and the narrowness of the test flume. It remains uncertain whether the revised methodology being developed by the test vendors could ultimately result in a successful testing approach. The staff expects that the effort necessary to evaluate revised testing methodology, as well as new tests and test results, assuming they are performed, would be as follows:

Fiscal Year	NRR Budget
FY 2011	0.5 FTE
FY 2012	0.3 FTE

These resources are included in the FY 2011 President's Budget; FY 2012 resources will be addressed through the PBPM process and are included in the FY 2012 Performance Budget to OMB.

Resource Estimate for Evaluating Industry-Proposed New Testing To Justify Reduced ZOIs

The Pressurized-Water Reactor Owners Group (PWROG) has proposed a project to perform testing combined with computational fluid dynamics modeling to determine realistic jet impingement damage thresholds for insulation systems. The staff has proposed that a contract be awarded to an expert in this area to validate the PWROG work. The industry has not yet funded this testing because the PWROG membership has not approved this project to date. If the PWROG membership elects to fund and perform new ZOI testing, the PWROG plan is to complete the work in order to issue the associated topical report in October 2011. The staff would write an SE on the topical report, a task that typically consumes a year or more. This work could help to define the debris generation that could occur during a LOCA. As stated elsewhere in this paper, the staff is not confident, even if it were to accept the methods for testing and evaluation, that the results will support significantly reduced ZOIs. However, the effort should enhance the industry and staff understands of the debris generation issue. The staff expects that the effort necessary to evaluate revised testing methodology, as well as new tests and test results, assuming they are performed, would be as follows:

Fiscal Year	NRR Budget
FY 2011	0.3 FTE, $115 K
FY 2012	0.3 FTE, $60 K

These resources are included in the FY 2011 President's Budget; FY 2012 resources will be addressed through the PBPM process and are included in the FY 2012 Performance Budget to OMB.

Resource Estimate for Evaluating In-Vessel Cross-Tests of Westinghouse and AREVA Fuels Assuming Both Vendors Agree To Perform Tests

The staff has requested that Westinghouse and AREVA perform cross-tests because of the large, unexpected differences in test results between the two fuel vendors at low particulate-to-fiber ratios. Such tests would involve placing one vendor's mockup fuel assembly in the other vendor's test facility. Discussions with the vendors on performing these tests are ongoing. The staff expects the effort necessary to evaluate cross-tests would be small and is provided below:

Fiscal Year	NRR Budget
FY 2011	0.2 FTE

These resources are included in the FY 2011 President's Budget.

Total Resources for Option 1

Description	FY 2011		FY 2012	
	CS&T	FTE	CS&T	FTE
Evaluation of remaining PWR submittals and additional regulatory measures as needed		5.0		3.0
Evaluation of industry ZOI testing	$115 K	0.3	$60 K	0.3
Evaluation of industry settling testing		0.5		0.3
Evaluation of cross-tests of AREVA fuel		0.2		0.0
Total Resources	$115 K	6.0	$60 K	3.6

If the industry proposes any other refinements, they would need to be timely in response to the timeframe of the suboption selected by the Commission, if applicable. The staff would request resources for any such refinement reviews through office reallocation or as an item on the shortfall list during future PBPM processes.

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

Description: If the Commission issues the proposed 10 CFR 50.46a rule, it would potentially provide flexibility to licensees whose limiting challenge to strainer performance is posed by larger LOCAs. The transition break size (TBS) associated with the proposed rule would result in a much smaller ZOI for which design-basis analysis conservatisms would be required. While the ZOI for breaks larger than the TBS up to the double-ended guillotine break of the largest pipe in the reactor coolant system would still need to be addressed, mitigation could credit use of nonsafety equipment and less stringent model assumptions, inputs, and justification. The staff believes that the following two options exist for developing risk-informed implementing guidance for GSI-191:

a) Expand existing guidance in Section 6 of the 2004 SE for NEI 04-07.
b) Generate new guidance assuming the proposed 10 CFR 50.46a rule is approved.

Enclosure 4 presents a more detailed description of the 10 CFR 50.46a rulemaking, including a review of the differences between new implementing guidance and the current risk-informed approach in Section 6 of the 2004 staff SE.

Pros:

- The technical basis for this option is already established.
- This option allows more flexibility for addressing larger LOCAs based on reclassification as beyond-design-basis accidents, if the proposed 10 CFR 50.46a rule is promulgated.
- This option is consistent with policy on risk-informed regulation.
- Mitigation of larger breaks is still maintained.
- This option involves no exemptions or additional policy questions.
- The initial burden on licensees could be offset by future risk-informed changes enabled by the proposed 10 CFR 50.46a rule.
- This option relaxes conservatisms for the less likely breaks, but still retains the rigorous design-basis evaluations for the higher probability smaller breaks.
- This option would likely result in a reduction in the scope of modifications needed for some plants to address GSI-191.

Cons:

- Modifications could still be required at some plants to support resolution of GSI-191 based on design-basis breaks below the TBS, beyond-design-basis breaks above the TBS, or both.
- Additional analysis would be needed to adopt 10 CFR 50.46a for GSI-191, although this is not expected to be difficult for most licensees.
- Analyses for breaks above the TBS would still be required, using different assumptions than those for smaller breaks, leading to additional complexities in each plant's licensing basis, including the potential for separate demonstration tests of adequate strainer performance.
- Sufficient basis for "realistic" ZOI, debris transport, and debris characteristics for beyond-design-basis accidents still needs to be worked out. Relaxations in these areas may be limited unless proposed industry testing of ZOI and settling yields favorable results.

- Implementation guidance would need to be developed and licensee submittals would need to be evaluated, which would extend GSI-191 issue closure by approximately 2 years.

Section 6 of the 2004 staff SE for GSI-191 is an existing limited risk-informed approach to sump evaluations. This approach was the result of a risk-informed effort 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, and based on an early proposed version of 10 CFR 50.46a. The staff understands from discussions with the industry that licensees have not taken advantage of this alternate approach because it requires exemptions and it does not provide relaxations in the areas of debris generation and debris transport analyses because of the lack of realistic models. Given the current improved state of knowledge, as compared to 2004, the NRC staff believes that some relaxations may be possible in these and other areas in the form of new implementing guidance for GSI-191, either in conjunction with the proposed 10 CFR 50.46a rule or as an enhancement to the existing SE Section 6 approach. However, the staff does not believe that the currently approved assumptions in these areas are grossly overconservative, so the benefit of adding realism to the larger break analyses may be limited unless new industry ZOI and settling testing yields favorable results. The benefits would also depend on limiting factors for a given plant.

Assuming the Commission approves the 10 CFR 50.46a rule, Section 6 of the SE for NEI 04-07 would likely be superseded by issuance of the new rule and would no longer exist in its current form. The guidance in Section 6 would be used as a starting point for new implementing guidance for licensees that adopt 10 CFR 50.46a for GSI-191. Working with industry, the staff would expand on the guidance in Section 6, to the extent feasible, to include alternate guidance for additional technical areas for beyond-design-basis breaks. The staff would modify any guidance in Section 6 that differs from the final version of 10 CFR 50.46a to align with the rule. For example, the transition break defined in Section 6 would be reduced from a double-sided break to a single-sided break to be consistent with the break area included in the proposed 10 CFR 50.46a rule. Additionally, guidance for beyond-design-basis breaks would focus on best-estimate realistic methods, rather than on methods that are conservative with respect to the worst possible conditions, including uncertainties. This guidance could be updated at a later date if industry testing currently planned for completion by the end of 2011 shows that major changes in realistic assumptions for ZOI and settling are justified. The staff estimates that new implementation guidance could be issued within 12 months after final issuance of the new rule with 1 FTE of staff effort in FY 2011. Additionally, the resources required to evaluate new submittals for breaks above the TBS, using assumptions different from those for smaller breaks and potentially new strainer tests, would require 2 FTEs in FY 2012, 1 FTE in FY 2013, and 0.5 FTE in FY 2014, including review of additional submittals from some licensees that have already shown adequate strainer performance but wish to reclaim margin. These resources are included in the FY 2011 President's Budget in addition to resources needed for Option 1; FY 2012 resources and beyond will be addressed through the PBPM process and FY 2012 resources are included in the FY 2012 Performance Budget to OMB. Additionally, resources included under this option regarding proposed 10 CFR 50.46a implementation guidance and evaluation activities are specific to GSI-191 and do not include rulemaking activities associated with the proposed rule.

Should the 10 CFR 50.46a rule not be 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 expand the Section 6 guidance or to eliminate the approach entirely, depending on the Commission's views on the subject. Total resources for Option 2 are shown below:

Fiscal Year	NRR Budget
FY 2011	1 FTE
FY 2012	2 FTEs
FY 2013	1 FTE
FY 2014	0.5 FTE

Total Resources for Option 1.b and Option 2 combined

	FY 2011		FY 2012		FY 2013		FY 2014	
	CS&T	FTE	CS&T	FTE	CS&T	FTE	CS&T	FTE
Option 1.b	$115K	6.0	$60K	3.6	0	0	0	0
Option 2	0	1.0	0	2.0	0	1.0	0	0.5
Total Resources	$115K	7.0	$60K	5.6	0	1.0	0	0.5

The resource for Option 1.b and Option 2 are included in the FY 2011 President's Budget; FY 2012 resources and beyond will be addressed through the PBPM process and FY 2012 resources are included in the FY 2012 Performance Budget to OMB.

Option 3: Allow application of GDC 4 exclusion of jet effects to debris generation for GSI-191.

Description: The staff had previously rejected, a number of years ago, the industry's request to use LBB to resolve GSI-191 concerns because the staff had seen expanding the scope of LBB application as beyond the Commission's intent with regard to General Design Criterion (GDC) 4, "Environmental and Dynamic Effects Design Bases," and representing a reduction in defense-in-depth. The staff believes that such expansion would require a policy decision by the Commission and would require revision to the rule or a new Statement of Considerations to be issued for the rule. Additionally, the expansion in scope might set a precedent for the use of GDC 4 that could affect other areas of accident analyses. However, SRM M100415 requested that the staff evaluate potential approaches and options to bring GSI-191 to closure, including a discussion of the use of GDC 4. Enclosure 3 presents a detailed discussion of staff views on GDC 4, as well as a review of past and recent correspondence from NEI and other stakeholders.

The staff considers it likely that application of GDC 4 to GSI-191 would have a significant impact on licensee analyses regarding debris generation because the debris source term would likely be zero for all LBB-qualified piping. The staff notes that not all piping inside PWR containments would meet LBB qualification requirements; therefore, the need for additional modifications at some high-fiber plants could not be ruled out. Additionally, other potential debris generation

sources exist for which 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 containment atmosphere (e.g., safety/relief and squib valves). But for many PWR plants, the NRC staff believes that GDC 4 credit would significantly reduce the amount of potential modifications at remaining plants with large quantities of fibrous insulation. The staff also believes that GDC 4 credit could result in substantial operational margins for those plants that have already shown acceptable strainer performance with respect to debris-induced sump clogging using analysis methods acceptable to the staff. In general, the staff evaluated the pros and cons of crediting LBB to close out GSI-191 as follows:

Pros:

- This option would likely eliminate the need for some additional modifications, though some reduced-scope modifications cannot be ruled out, particularly at plants for which smaller breaks are limiting breaks from non-LBB piping or breaks from components such as manways.

- This option might eliminate the need for additional strainer testing, since reduced calculated debris generation might compensate for staff questions on some licensee test and evaluation methods.

- Application of GDC 4 credit to licensees already considered complete for GSI-191 could permit recovery of calculated operational margins.

- Large margins could allow the use of simplified bounding assumptions, which would simplify staff technical reviews for GSI-191 and reduce needed GSI-191 staff resources.

Cons:

- This option would leave large amounts of problematic materials inside containment in some plants that could result in ECCS system failure if a larger break occurred in LBB-qualified piping despite the low probability of the event. The staff believes that applying GDC 4 credit to GSI-191 would represent a decrease in defense-in-depth.

- Applying LBB credit to GSI-191 is not consistent with the Statement of Considerations for GDC 4 (Volume 52, page 41288, of the *Federal Register*) which stated, “The proposed rule allows the removal of plant hardware which it is believed negatively affects plant performance, while not affecting emergency core cooling systems, containments, and environmental qualification of mechanical and electrical equipment.”

- The staff believes a new Statement of Considerations or revision to GDC 4 is needed if LBB is applied to GSI-191 to redefine the scope of LBB and to minimize the chance of unintended consequences (licensees taking LBB credit for other applications, such as other areas of ECCS analysis, containment accident pressure analysis, and environmental qualifications).

- Consistent with concerns expressed by the Commission in the Statement of Considerations for the rulemaking, expansion of GDC 4 would effectively reduce regulatory requirements with no perceived safety benefit.

- Applying GDC 4 to GSI-191 could create regulatory inconsistency with the intent of the proposed risk-informed ECCS regulation, 10 CFR 50.46a. With GDC 4, no evaluation of sump performance would be required for larger breaks, while under the proposed 10 CFR 50.46a mitigation would still be required, albeit with more realistic assumptions and evaluations.

- Most PWR owners are still in the process of addressing PWSCC in Alloy 82/182 dissimilar welds in their large LBB piping (nominal diameter of 20 inches and greater) through mitigation, enhanced inspection, or both. The staff believes that this is adequate from a safety perspective to address the current application of LBB with respect to GDC 4. However, the staff does not believe it is appropriate to expand the use of LBB beyond current application of GDC 4 since licensees are still in the process of addressing PWSCC issues. If GDC 4 is expanded to apply to resolving GSI-191 issues, the staff believes that the application of GDC 4 will require additional analyses and potentially additional requirements and guidance to address PWSCC in LBB piping. This may result in additional licensee costs and outage schedule impacts if the staff determines that mitigation of the nickel-Alloy 82/182 welds in LBB piping is needed to support GSI-191.

- Would delay resolution of GSI-191 for all LOCA sizes because 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 Statement of Considerations for the rule.

- Identification of large operational margins may result in licensees installing more problematic materials in containments in the future, a result with which the staff has a concern given the large uncertainties involved with this issue.

For reasons discussed above, the staff believes that expansion of GDC 4 for GSI-191, if this option is chosen by the Commission, involves a deliberate process that permits further staff evaluation while also considering stakeholder input and an evaluation of its effects on dissimilar metal butt welds in LBB piping. The staff estimates that resource needs for this option would be 2.0 FTEs in FY 2011, 1 FTE in FY 2012, and 0.5 FTE in FY 2013. These resources would be budgeted through a reallocation of resources from Option 1 because plant-specific holistic reviews for many remaining plants would likely be delayed until after Option 3 was implemented. Additionally, plant-specific holistic reviews of remaining plants following expansion of GDC 4

credit are expected to require 3.5 FTEs in FY 2013 and 1.5 FTEs in FY 2014, as compared to 5 FTEs in FY 2011 and 3 FTEs in FY 2012 under Option 1, in large part because of expected GSI-191 evaluation simplifications resulting from GDC 4 credit. However, under Option 3, 1 additional FTE is expected in both FY 2013 and FY 2014 to support likely submittal of new evaluations by licensees whose methods are already acceptable but who want to recover operating margin. The total resources needed for Option 3 are currently bounded in FY 2011 and FY 2012 by the combined resources of Option 1.b and Option 2, and therefore the FY 20122 resources are included in the FY 2011 President's Budget; FY 2012 resources and beyond would be addressed through the PBPM process and FY 2012 resources are included in the FY 2012 Performance Budget to OMB. The total funding for Option 3 is shown in the table below:

Fiscal Year	NRR Budget
FY 2011	2.0 FTEs
FY 2012	1.0 FTE
FY 2013	5.0 FTE
FY 2014	2.5 FTEs

Options Considered but Determined Not Viable

- The NRC staff considered whether it might attempt to determine that remaining plants have demonstrated adequate protection without having demonstrated compliance, and therefore, forcing compliance would not be worth the occupational dose and capital costs some remaining plants might incur from additional modifications. The staff considered the question of whether the regulatory requirement that criteria are not exceeded for the "most severe" break may be more than what is needed for adequate protection.

  The staff determined that there is insufficient technical information at this time to support an NRC decision that current operating license holders need not comply with current ECCS regulations. Assuming that such a decision can be made in the future, the NRC could implement such a decision through issuance of exemptions, or by rulemaking, or both (to amend the rules to address future plant designs). One implication of such a decision would be that some LOCAs that could lead directly to core damage do not represent undue risk to public health and safety apparently based solely on their low probability of occurrence. In evaluating the viability of this option, the staff considered the proposed 10 CFR 50.46a rulemaking, which is a risk-informed effort that is intended to determine what relaxations in ECCS analyses are appropriate. In its July 1, 2004, SRM directing the staff to develop 10 CFR 50.46a, the Commission determined that LOCAs with a frequency of occurrence of 1 in 100,000 reactor years is an appropriate guideline for selecting the maximum design-basis LOCA, since it is complemented by the requirement that appropriate mitigation capabilities must be retained for beyond-design-basis LOCAs. As such, the staff believes the Commission would need to modify its previous position for this option to be viable.

- The staff considered an option of attempting to generate an integrated probabilistic model for sump phenomena that would risk inform remaining aspects of sump modeling

for which large uncertainties still exist. The staff could update and enhance early generic and simplistic integrated probabilistic models of sump performance in an effort to provide insights into plant-specific sump failure probabilities accounting for plant-specific improvements completed to date. Licensees might use such a generic integrated model as a template to generate plant-specific integrated models that might support realistic determinations of sump performance under the requirements of 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Nuclear Power Reactors." However, absent additional research and test data evaluation to develop realistic models that would further delay the generic effort by an estimated additional five years and involve significant resources and costs, large uncertainties in some vital modeling aspects, if accounted for as required, would likely show that some remaining plants still need to make modifications. Additionally, results of additional research might also show, after uncertainties were reduced, that some modifications were still required. Initial estimates are that the staff could generate a generic integrated model absent additional research at a cost of four FTEs over five to seven years and multimillions of dollars. Based on the discussion above, the staff does not consider this option viable because it would not likely provide any tangible benefit in the foreseeable future related to issue resolution.

- The staff also considered an option under which the staff might conclude that a separate conservatism associated with a nonsafety system with mitigation capability related to GSI-191 (e.g., strainer backflush capability) could result in a holistic conclusion of adequate strainer performance where a strainer is successfully tested by a licensee but uncertainties exist, either in the test assumptions or methods, that would normally cause the staff to determine that adequate strainer performance had not been demonstrated. This would be distinct from the risk-informed Option 2 in that the representative conservatism associated with the nonsafety system could be credited for mitigation of any break, whereas the risk-informed Option 2 would only allow nonsafety system credit for the less likely larger breaks that are intended to be beyond-design-basis breaks, assuming the proposed 10 CFR 50.46a is approved. It is also distinct from the existing holistic staff review process for GSI-191 in that the holistic process requires an overall conclusion of adequate sump performance, given the uncertainties, without reference to a nonsafety system.

  The staff considered this option nonviable for design-basis accidents because crediting the conservatism of a nonsafety system to account for an ECCS analysis that does not meet the regulations because of inadequate consideration of uncertainties would still be relying on a nonsafety system for design-basis accidents. Additionally, extensive analysis and stakeholder interactions on the proposed 10 CFR 50.46a rule were specifically focused on defining a TBS that serves to identify the largest break size that would need to be treated as a design-basis LOCA. While this approach would be allowed for breaks larger than the TBS that would be beyond-design-basis LOCAs, extending the relaxations afforded by the proposed 10 CFR 50.46a (such as credit for nonsafety systems) to LOCAs equal to or smaller than the TBS would be inconsistent with the conclusions of the lengthy 10 CFR 50.46a rulemaking process.

  Such an approach may be feasible for design-basis LOCAs for a limited application on a plant-specific basis, however. But, given the findings of the technical basis development

for 10 CFR 50.46a, such a request would likely need to be supported by a risk-informed licensing action in accordance with Regulatory Guide 1.174, “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis.” The feasibility of performing an adequate risk analysis would depend upon the extent of credit being requested. It is also likely than an exemption would be required because of the following definition of safety-related structures, systems, and components provided in 10 CFR 50.2, “Definitions”:

> *Those structures, systems, and components that are relied upon to remain functional during and following design basis events to assure: (1) the integrity of the reactor coolant pressure boundary, (2) The capability to shut down the reactor and maintain it in a safe shutdown condition; or (3) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guidelines set forth in 50.34(a)(1) or 100.11 of this chapter, as applicable.*

However, the option of using a risk-informed exemption request has always been available to licensees and does not need any Commission action.