Content Guide for
Generic Letter 2004-02 Supplemental Responses

General Guidance

The purpose of the generic letter (GL) supplemental response, to be provided by December 31, 2007, is to provide remaining information to support NRC staff verification that corrective actions to address the GL are adequate. This verification will also include review of inspection results associated with TI 2515/166.

In keeping with the holistic resolution approach endorsed by the Commission in its Staff Requirements Memorandum dated November 16, 2006, each licensee may use any combination of measures that will provide reasonable assurance that long term core cooling is maintained. The GL supplemental response should begin with a description of the approach chosen.

It is suggested that licensees review audit reports for indications of staff expectations for content of each section of the GL supplemental response. A basis should be provided for key assumptions.

Licensees should ensure that GL supplemental response information fully addresses issues identified in the requests for additional information (RAIs) provided to each licensee in early 2006. A separate response to the RAIs is not necessary if they are appropriately addressed in the GL supplemental response.

Licensees should address commitments and/or descriptions of plant programs that support conclusions. Existing/previous commitments may be addressed by reference.

If a given plant was subjected to a GL 04-02 audit from which open items resulted, that plant's response should address all open items. For plants subjected to audits in December 2007, or later, the audit responses may be provided separately, but not later than 60 days from receipt of the final audit report.

In general, December 31, 2007, responses in each area should, as appropriate:

- state that the information previously provided continues to apply
- supplement previous information
- revise previous information

In each review area below, level of detail provided should include:

- summary/conclusive information needed to address the area; for example, describe break selection criteria used
- description of the method used to reach the conclusion, including significant references (e.g., NEI Guidance Report, Staff Safety Evaluation, NUREGs, etc.) on which the licensee relies; do not send the actual references in the submittal
- Basis for methods not consistent with NRC-approved guidance

Note: The description of the information needed that follows is not all-inclusive. Licensees need to provide sufficient information for the staff to have reasonable assurance that the issue has been addressed and the licensee complies with 10 CFR 50.46(b)(5) when all corrective actions are completed.

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Deleted: For example, numerous audit open items have resulted from lack of documented basis for key assumptions. This expectation of justification for key assumptions applies to GL supplemental responses as well.

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If a particular item sought is not applicable or necessary for a given plant's solution to GSI-191, the licensee should explain why that is the case.

Specific Guidance for Review Areas

1. Overall Compliance:

Provide information requested in GL 04-02 Requested Information Item 2(a) regarding compliance with regulations.

GL 2004-02 Requested Information Item 2(a) *Confirmation that the ECCS and CSS recirculation functions under debris loading conditions are or will be in compliance with the regulatory requirements listed inthe Applicable Regulatory Requirements section of this generic letter. This submittal should address the configuration of the plant that will exist once all modifications required for regulatory compliance have been made and this licensing basis has been updated to reflect the results of the analysis described above.*

2. General Description of and Schedule for Corrective actions:

Provide a general description of actions taken or planned, and dates for each. For actions planned beyond December 31, 2007, reference approved extension requests or explain how regulatory requirements will be met as per Requested Information Item 2(b). (Note: All requests for extension should be submitted to the NRC not later than October 1, 2007.)

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

3. Specific Information Regarding Methodology for Demonstrating Compliance:

a. Break Selection

- Describe and provide basis for break selection criteria used in evaluation.
- State whether secondary line breaks were considered in the evaluation (e.g., main steam and feedwater lines.)
- Discuss the basis for reaching the conclusion that the break size(s) and locations chosen present the greatest challenge to post-accident sump performance.

b. Debris Generation/Zone of Influence (ZOI) (excluding coatings)

The objective of the debris generation/zone of influence (ZOI) process is to determine, for each postulated break location; (1) the zone within which the break jet forces would be sufficient to damage materials and create debris; (2) the amount of debris generated by the break jet forces; and, (3) the size characteristics of the debris.

- Describe the methodology used to determine the ZOIs for generating debris.

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- Provide destruction ZOIs and basis for each applicable debris constituent.
- Provide the quantity of each debris type generated for limiting break locations.
- Provide total surface area of all signs, placards, tags, tape, etc.

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c. Debris Characteristics

- Provide the assumed size distribution for each type of debris.
- Provide bulk densities (i.e., including voids between the fibers/particles) and material densities (i.e., the density of the microscopic fibers/particles themselves) for fibrous and particulate debris.
- Provide assumed specific surface areas for fibrous and particulate debris.
- Provide the technical basis for any debris characterization assumptions that deviate from NRC-approved guidance.

d. Latent Debris

The objective of the latent debris evaluation process is to provide a reasonable approximation of the amount and types of latent debris existing within the containment, and its potential impact on sump screen head loss.

- Provide methodology used to estimate quantity and composition of latent debris.
- Provide the technical basis for assumptions used in the evaluation.
- Provide results of latent debris evaluation.
- Provide amount of sacrificial strainer surface area for miscellaneous latent debris.
- Provide amount of latent debris types.
- Provide physical data for latent debris as requested for other debris under c. above.

e. Debris Transport

- Describe the methodology used to analyze debris transport during the blowdown, washdown, pool-fill-up, and recirculation phases of an accident.
- Provide the technical basis for assumptions used in the analysis that deviate from the approved guidance.
- State whether computational fluid dynamics was used to compute debris transport fractions during recirculation and summarize the methodology used and results.
- Provide a summary of, and supporting technical basis for any credit taken for debris interceptors.
- State whether fine debris was assumed to settle and provide basis for any settling credited.
- Provide the calculated debris transport fractions and the total quantities of each type of debris transported to the strainers.

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f. Head Loss and Vortexing

- Provide a schematic diagram of the emergency core cooling system (ECCS) and containment spray systems (CSS).
- Provide the minimum submergence of the strainer under small break loss of coolant accident (SBLOCA) and large break loss of coolant accident (LBLOCA) conditions.
- Provide a summary of the methodology, assumptions and results of the vortexing evaluation.
- Provide a summary of the methodology, assumptions and results of prototypical head loss testing for the strainer, including chemical effects.
- Address the ability of the design to accommodate the maximum volume of debris that is predicted to arrive at the screen.
- Address the ability of the screen to resist the formation of a "thin bed" or to accommodate partial thin

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bed formation.
- Provide the basis for the strainer design maximum head loss.
- List all assumptions, margins, and conservatisms used in the head loss and vortexing calculations.
- Provide the methodology, assumptions, bases for the assumptions, and results for the clean strainer head loss calculation.
- Provide the methodology, assumptions, bases for the assumptions, and results for the debris head loss analysis.
- State whether the sump is partially submerged or vented (i.e., lacks a complete water seal over its entire surface) for any accident scenarios and describe what failure criteria in addition to loss of NPSH margin were applied to address potential inability to pass the required flow through the strainer.
- State whether near-field settling was credited for the head-loss testing and provide a description of the scaling analysis used to justify near-field credit.

g. Net Positive Suction Head (NPSH)
- Provide applicable pump flow rates, the total recirculation sump flow rate, sump temperature(s), and minimum containment water level.
- Describe the assumptions used in the calculations for the above parameters and the sources/bases of the assumptions.
- Describe the system response scenarios for large and small break LOCAs.
- Describe the operation status for each ECCS and spray pumps before and after the initiation of recirculation.
- Describe the single failure assumptions relevant to pump operation.
- Describe significant assumptions used in the NPSH analysis.
- Verify that the following volumes have been accounted for: empty spray pipe, water droplets, condensation and holdup on horizontal and vertical surfaces.
- Provide assumptions (and their bases) as to what equipment will displace water resulting in higher pool level.
- Provide assumptions (and their bases) as to what water sources provide pool volume and how much volume is from each source.
- Provide the NPSH margin results for pumps taking suction from the sump in recirculation mode.

h. Coatings Evaluation
- Provide details on type(s) of coating systems used in containment, e.g., Carboline CZ 11 Inorganic Zinc primer, Ameron 90 epoxy finish coat.
- Describe and provide bases for assumptions made in post-LOCA paint debris transport analysis.
- Discuss suction strainer head loss testing performed as it relates to both qualified and unqualified coatings and what surrogate material was used to simulate coatings debris. Provide bases for the choice of surrogates.
- Describe coatings debris generation assumptions. For example, describe how the quantity of paint debris was determined based on ZOI size for qualified and unqualified coatings.
- Describe what debris characteristics were assumed, i.e., chips, particulate, size distribution and provide bases for the assumptions.
- Describe any ongoing containment coating condition assessment program.

i. Debris Source Term Refinements
- Describe and provide a basis for source term refinements used beyond those described in Section 3 of the guidance report (GR Section 3) and Section 3 of the safety evaluation (SE Section 3).

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- If any or all of the 5 suggested design and operational refinements given in the guidance report (GR Section 5) and safety evaluation (SE Section 5.1) were used, briefly summarize the application of the refinements.
- Describe any programs that have been implemented to ensure that materials detrimental to the containment sump recirculation function will not be installed or left in containment.

j. Screen Modification Package
- Provide a description of the major features of the sump screen design modification.

k. Sump Structural Analysis
- Provide a description of the sump structural analysis including assumptions on which the analysis was based.
- If a backflushing strategy is credited, provide structural analysis considering reverse flow.
- Provide a summary description of the ECCS sump strainer structure for the modified sump strainer assembly.
- In the summary description, clarify whether the strainer assembly is entirely inside the crane wall, partially inside and partially outside the crane wall, or entirely outside the crane wall.
- Provide sketches showing the layout of the existing and modified sump strainer structural assembly. Identify and label the various components.
- Provide a summary analysis showing structural qualification of modified sump strainer assembly. Provide a reference list of the source qualification documents.
- Summarize the design inputs, loads and load combinations utilized.
- List the design codes utilized in the structural design qualification of the sump strainer assembly.
- Provide a summary of the structural qualification results and design margins for the various components of the sump strainer structural assembly. Address GL 2004-02 Item 2.(d)(vii).
- Provide a summary of evaluations performed for dynamic effects such as pipe whip and jet impingement associated with high energy line breaks (as applicable). List the reference evaluation documents and calculations.
- Provide a summary of evaluations performed for dynamic effects such as the effects of missile impact (as applicable). List the reference evaluation documents and calculations.
- Provide confirmation that outage maintenance and inspection activities will include checking for or prevention of any damage to the new sump strainer assembly during outage maintenance activities.

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

l. Upstream Effects

The objective of the upstream effects assessment is to evaluate the flowpaths upstream of the containment sump for holdup of inventory which could reduce flow to and possibly starve the sump. Section 7.2 of the GR and the SE provide guidance to be considered in the upstream effects process to evaluate holdup or choke points which could reduce flow to and possibly cause blockage upstream of the containment sump.

- Provide a summary of the upstream effects evaluation.

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- Summarize the evaluation of the flow paths from the postulated break locations and containment spray washdown to identify potential choke points in the flow field upstream of the sump.
- Summarize measures taken to mitigate potential choke points.
- Summarize the evaluation of water holdup at installed curbs and/or debris interceptors.
- Describe how potential blockage of reactor cavity and refueling cavity drains has been evaluated, including likelihood of blockage and amount of expected holdup.

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

m. Downstream effects - Components and Systems

- Provide the information requested in GL 04-02 Requested Information Item 2.(d)(v) and 2.(d)(vi) regarding blockage, plugging, and wear at restrictions and close tolerance locations in the ECCS and CSS downstream of the sump.

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

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

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- If approved methods were used (e.g., WCAP-16406-P), briefly summarize the application of the methods.
- Provide a summary and conclusions of downstream evaluations.
- Provide a summary of design or operational changes made as a result of downstream evaluations.

m. Downstream Effects - Fuel and Vessel

- Show that the in-vessel effects evaluation is consistent with or bounded by the industry generic guidance. Provide a basis for any exceptions.

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n. Chemical Effects*

- Provide a summary of evaluation results that show that chemical precipitates formed in the post-LOCA containment environment, either by themselves or combined with debris, do not deposit at the sump screen to the extent that an unacceptable head loss results, or deposit downstream of the sump screen to the extent that long-term core cooling is unacceptably impeded.

  * NRC Staff is developing evaluation guidance for chemical effects and anticipates a draft will be available to stakeholders in September 2007.

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o. License Amendments

Provide the information requested in GL 04-02 Requested Information Item 2.(e) regarding changes to the plant licensing basis. The effective date for changes to the licensing basis should be specified. This date should correspond to that specified in the 50.59 for the change to the licensing basis.

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

p. Foreign Material Control Programs

- Provide the information requested in GL 04-02 Requested Information Item 2.(f) regarding programmatic controls taken to limit debris sources in containment.
- In particular, for all-RMI/low fiber plants, provide a description of programmatic controls to maintain the latent debris fiber source term into the future.

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

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Table 3a – Break Selection – Illustrative Example

Example:
[Plant] evaluated a number of break locations and piping systems, and considered breaks that rely on recirculation to mitigate the event. The following break location criteria were considered:
Break Criterion No. 1 - Breaks in the RCS with the largest potential for debris;
Break Criterion No. 2 - Large breaks with two or more different types of debris;
Break Criterion No. 3 - Breaks with the most direct path to the sump;
Break Criterion No. 4 - Large breaks with the largest potential particulate debris to insulation ratio by weight; and
Break Criterion No. 5 - Breaks that generate a "thin-bed" - high particulate with 1/8" fiber bed.

This spectrum of breaks is consistent with that recommended in the SE and is also consistent with regulatory position 1.3.2.3 of Regulatory Guide 1.82, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," Revision 3 [4].

[Plant] considered breaks in the primary coolant system piping having the potential for reliance on ECCS sump recirculation. The review determined that a primary coolant system piping large break loss of coolant accident (LBLOCA) and certain primary coolant system piping small break LOCAs (SBLOCAs) would require ECCS sump recirculation. [Plant]considered other high energy line breaks (e.g., secondary side breaks) and determined that sump operation was not required.

For small breaks, only piping that is 2" in diameter and larger was considered. This is consistent with the Section 3.3.4.1 of the SE, which states that breaks less than 2 inches in diameter need not be considered. Section 3.3.5 of the SE describes a systematic licensee approach to the break selection process which includes beginning the evaluation at an initial location along a pipe and stepping along in equal increments (5 foot increments per the SE) considering breaks at each sequential location. However, due to the size of the ZOI applied in the analyses, and the consequent volume of debris generated, it was not necessary to evaluate 5-ft increments.

The evaluation identified break locations that provided limiting conditions for each of the 5 break selection criteria above. For SE break selection criterion No. 1, three possible breaks locations were identified: both loops of the RCS hot leg inside steam generator compartments inside the bioshield; and a break at the reactor vessel nozzles. The results of the evaluation of insulation debris generation for Break Criterion No. 1 determined that all three breaks are limiting based on either the type or amount of debris generated.

It was determined that the debris generated by the three limiting cases for Break Criterion No. 1 bounded the debris generated for Break Criterion No. 2 "large breaks with two or more different types of debris." The debris combinations generated by the breaks of Break Criterion No. 1 are reflective metal insulation (RMI) and mineral wool, and RMI and MicrothermTM. The evaluation concluded that these three breaks generate the largest amount of debris, and also the most limiting combinations of debris.

For Break Criterion No. 3, "breaks with the most direct path to the sump," the evaluation concluded that the most limiting case is a break at the 16-in shutdown cooling line. P&IDs (piping and instrument diagrams), as well as piping arrangement, plan and physical arrangement drawings were used to determine possible break locations.

For break selection criterion No. 4, "large breaks with the largest potential particulate debris to insulation ratio by weight," the evaluation concluded that the most limiting case is a break at a reactor vessel nozzle within the reactor cavity, which is bounded by Break Criterion No. 1. Of the three different types of insulation identified within the containment, MicrothermTM is predominately particulate insulation material. This type of insulation is on the reactor vessel.

For break selection criterion No. 5, "breaks that generate a thin-bed," the evaluation identified two possible breaks locations: break at the hot leg and a break at the reactor vessel nozzle, which are bounded by Break Criterion No. 1

To develop a head-loss margin analytical conservatism for possible future use, [plant] evaluated the potential reduction in debris source term following replacement of the mineral wool on the steam generators with RMI. The insulation replacements will be performed in the Unit 2 October, 2009 outage and in the Unit 3 October, 2010 outage. The insulation replacement does not change the break selection results.

In summary, [plant] determined that a postulated LBLOCA within Loop 1 and 2 at the steam generator hot legs generates the largest quantities of mineral wool and RMI debris. A break near the reactor vessel nozzle generates a large amount of RMI and MicrothermTM debris. A break at the 16-in shutdown cooling line is considered in the proximity of the sump, and generates mineral wool and RMI debris which will likely transport to the containment emergency sump. It was concluded that these reactor coolant system breaks generate the largest amount of debris, and also the worst combination of debris with the possibility of being transported to the containment emergency sump strainer.

All phases of the plant-specific accident scenarios were evaluated to develop debris generation values for the breaks listed in the previous summary paragraph. These accident scenario cases are:

1. Case 1: RCS hot leg break inside steam generator compartment Loop 1 (limiting break for SE break selection criteria 1, 2 and 5);
2. Case 2: RCS hot leg break inside steam generator compartment Loop 2 (limiting break for SE break selection criteria 1, 2 and 5);
3. Case 3: Nozzle break in reactor cavity (limiting break for SE break selection criteria 1, 2, 4 and 5)
4. Case 4: Shutdown cooling line break outside steam generator compartments (limiting break for SE break selection criterion 3); and
5. Case 5: Hot leg break after steam generator replacement.

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Table 3b

Example:
[Plant] applied the ZOI refinement discussed in Section 4.2.2.1.1 of the SE, which allows the use of debris-specific spherical ZOIs. Using this approach, the amount of debris generated within each ZOI is calculated and the individual contributions from each debris type are summed to arrive at a total debris source term.

The sources of debris at [Plant] include insulation debris, coatings debris, and latent debris. The evaluation concluded that there are two types of insulation inside the containment that could potentially form debris following a LOCA. These insulations are: 1) Transco reflective metallic insulation (RMI) and 2) mineral wool encased inside a Transco stainless steel (SS) cassette.

Damage Pressures and Corresponding Volume-Equivalent Spherical ZOI Radii

Insulation Types	Destruction Pressure (psig)	ZOI Radius/Break Diameter
Transco RMI	114	2.0
Jacketed Mineral Wool		4.0

For the Transco RMI and unjacketed NUKON insulation at [plant], the evaluation assumed a ZOI size in accordance with the guidance in the SE. For the mineral wool at [plant], the SE Table 3-2 does not provide specific guidance. The mineral wool insulation that will remain in service at [plant] is contained in an engineered system comprised of cassettes that are constructed exactly the same as the Transco RMI used at [plant]. These cassettes are constructed of 24 gauge steel with the casing end seams seal welded. Based on the robust nature of this encapsulation/jacketing system, the ZOI for the mineral wool would be closer to Transco RMI than unjacketed NUKON. To ensure conservatism, the evaluation doubled the ZOI from the Transco RMI (2D out to 4D).

Insulation Debris Quantities

Insulation	Case 1	Case 2	Case 3	Case 4	Case 5
Transco RMI	7096 ft2	7549 ft2	7530 ft2	815 ft2	7096 ft2
Mineral Wool	81 ft3	81 ft3	0	0	12 ft3

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Table 3d

Example:
The evaluation for Latent Debris at [plant] was performed in a manner consistent with the SE approved methodology. The total source term was determined through the collection of debris samples from multiple locations throughout the containment. From this, a calculation was performed to provide an estimate of the total amount of latent debris in containment. Conservatisms were added to the calculated source term to account for uncertainties and provide a bounding estimate for screen evaluation purposes. The characterization of latent debris followed the guidance in the SE.

[Plant] did not make any allowances for tags and labels, or provide sacrificial screen area for any miscellaneous debris in containment. For tags and labels, [plant] has an ongoing program to replace all equipment tags, labels, signs, and placards in containment with ceramic-lined metal. They are very robust, and quite heavy. Because of this, they have no probability of transport to the sump strainer, and are not considered in the sump strainer evaluation.

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