Revised Content Guide for
Generic Letter 2004-02 Supplemental Responses
November 2007

General Guidance

The purpose of the generic letter (GL) supplemental response, to be provided to the U. S. Nuclear Regulatory Commission (NRC) 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, "Pressurized Water Reactor Containment Sump Blockage (NRC GL 2004-02)."

In keeping with the holistic resolution approach endorsed by the Commission in its Staff Requirements Memorandum dated November 16, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML063200471), 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 summary-level description of the approach chosen. This summary should identify key aspects of design modifications, process changes, and supporting analyses that the licensee believes are relevant or important to the NRC staff's verification that corrective actions to address the GL are adequate. The summary should address significant conservatisms and margins that are used to provide high confidence the issue has been addressed even with uncertainties remaining.

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

In general, the final supplemental responses in each area should, as appropriate:
1. state that the information previously provided continues to apply
2. supplement previous information
3. 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, ADAMS Accession No. ML050550138; Staff Safety Evaluation (SE) of the NEI Guidance Report, ADAMS Accession No. ML043280007; NUREGs, etc.) on which the licensee relies; do not send the actual references in the submittal
- basis for methods and key assumptions not consistent with NRC-approved guidance or not previously reviewed by the NRC staff
- sufficient information to show correct application of any NRC-approved guidance (e.g., specific section of document applied, with further summary-level description of application of the guidance if appropriate in licensee's judgment)

If a licensee has multiple pressurized-water reactors that have common or very similar configurations and solutions to strainer clogging and related issues, that licensee may submit a single response that addresses the subject areas in this content guide, noting any significant variations among the units.

If a licensee cannot provide complete information as requested by this Content Guide by December 31, 2007 (e.g., the licensee has received an extension), that licensee should provide all relevant and available information by that date. Remaining information should be provided within 90 days of completion of all actions needed to address GL 2004-02.

Information from Audits

Plants that have been subject to an NRC audit of corrective actions for GL 2004-02 should address all open items from the audit in their supplemental responses, briefly stating how each item was addressed. In responding to audit open items of a general nature, licensees should refer to the appropriate section within this content guide. For any subject area found to be acceptable during an audit, the licensee may briefly describe the approach taken in that area and refer to the audit report. In such cases the licensee should state that the NRC reviewed the subject matter and found it acceptable, and that the licensee believes the conclusions therein remain correct. If the audit report does not address specific information items in this content guide under one or more subject headings, they should be addressed in the GL supplemental response. If an audit report is not available for reference by the due date for the GL supplemental response, the affected licensee should provide a complete response by the due date. Licensees need not respond to draft open items that have been released to support communications among NRC and licensees. For plants subject to audits in December 2007 or later, the audit open items may be addressed separately, but not later than 60 days from receipt of the final audit report.

In conjunction with this guide, it is suggested that plants not audited review audit reports from other plants for indications of staff expectations for content of each section of the GL supplemental response. There is no expectation that a licensee explicitly address audit results at other plants in that licensee's GL supplemental responses.

2006 Requests for Additional Information (RAIs)

Licensees should ensure that GL supplemental response information fully address issues identified in the 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.

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 Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.46(b)(5) when all corrective actions are completed in accordance with the schedule outlined in GL 2004-02. 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 2004-02 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 in the Applicable Regulatory Requirements section of this GL. 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 as soon as the need becomes clear, preferably not later than October 1, 2007.)

> *GL 2004-02 Requested Information Item 2(b)*
> *A general description of and implementation schedule for all corrective actions, including any plant modifications, that you identified while responding to this GL. 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

The objective of the break selection process is to identify the break size and location that present the greatest challenge to post-accident sump performance.

- Describe and provide the basis for the break selection criteria used in the evaluation.
- State whether secondary line breaks were considered in the evaluation (e.g., main steam and feedwater lines) and briefly explain why or why not.
- 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/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; and (2) the amount of debris generated by the break jet forces.

- Describe the methodology used to determine the ZOIs for generating debris. Identify which debris analyses used approved methodology default values. For debris with ZOIs not defined in the guidance report/SE, or if using other than default values, discuss method(s) used to determine ZOI and the basis for each.
- Provide destruction ZOIs and the basis for the ZOIs for each applicable debris constituent.
- Identify if destruction testing was conducted to determine ZOIs. If such testing has not been previously submitted to the NRC for review or information, describe the test procedure and results with reference to the test report(s).
- Provide the quantity of each debris type generated for each break location evaluated. If more than four break locations were evaluated, provide data only for the four most limiting locations.
- Provide total surface area of all signs, placards, tags, tape, and similar miscellaneous materials in containment.

c. Debris Characteristics
The objective of the debris characteristics determination process is to establish a conservative debris characteristics profile for use in determining the transportability of debris and its contribution to head loss.

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

e. Debris Transport
The objective of the debris transport evaluation process is to estimate the fraction of debris that would be transported from debris sources within containment to the sump suction strainers.

- 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 and methods used in the analysis that deviate from the approved guidance.
- Identify any computational fluid dynamics codes used to compute debris transport fractions during recirculation and summarize the methodology, modeling assumptions, and results.
- Provide a summary of, and supporting 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.

f. Head Loss and Vortexing

The objectives of the head loss and vortexing evaluations are to calculate head loss across the sump strainer and to evaluate the susceptibility of the strainer to vortex formation.

- 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 bases for key assumptions.
- Provide a summary of the methodology, assumptions, and results of prototypical head loss testing for the strainer, including chemical effects. Provide bases for key assumptions.
- 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 bed formation.
- Provide the basis for the strainer design maximum head loss.
- Describe significant margins and conservatisms used in the head loss and vortexing calculations.
- Provide a summary of the methodology, assumptions, bases for the assumptions, and results for the clean strainer head loss calculation.
- Provide a summary of 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 net positive suction head (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, if so, provide a description of the scaling analysis used to justify near-field credit.
- State whether temperature/viscosity was used to scale the results of the head loss tests to actual plant conditions. If scaling was used, provide the basis for concluding that boreholes or other differential-pressure induced effects did not affect the morphology of the test debris bed.
- State whether containment accident pressure was credited in evaluating whether flashing would occur across the strainer surface, and if so, summarize the methodology used to determine the available containment pressure.

g. Net Positive Suction Head (NPSH)
The objective of the NPSH section is to calculate the NPSH margin for the ECCS and CSS pumps that would exist during a loss-of-coolant accident (LOCA) considering a spectrum of break sizes.

- 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.
- Provide the basis for the required NPSH values, e.g., three percent head drop or other criterion.
- Describe how friction and other flow losses are accounted for.
- Describe the system response scenarios for LBLOCA and SBLOCAs.
- Describe the operational status for each ECCS and CSS pump before and after the initiation of recirculation.
- Describe the single failure assumptions relevant to pump operation and sump performance.
- Describe how the containment sump water level is determined.
- Provide assumptions that are included in the analysis to ensure a minimum (conservative) water level is used in determining NPSH margin.
- Describe whether and how the following volumes have been accounted for in pool level calculations: empty spray pipe, water droplets, condensation and holdup on horizontal and vertical surfaces. If any are not accounted for, explain why.
- 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.
- If credit is taken for containment accident pressure in determining available NPSH, provide description of the calculation of containment accident pressure used in determining the available NPSH.
- Provide assumptions made which minimize the containment accident pressure and maximize the sump water temperature.
- Specify whether the containment accident pressure is set at the vapor pressure corresponding to the sump liquid temperature.
- Provide the NPSH margin results for pumps taking suction from the sump in recirculation mode.

h. Coatings Evaluation
The objective of the coatings evaluation section is to determine the plant-specific ZOI and debris characteristics for coatings for use in determining the eventual contribution of coatings to overall head loss at the sump screen.

- Provide a summary of 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 and provide bases for 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

The objective of the debris source term section is to identify any significant design and operational measures taken to control or reduce the plant debris source term to prevent potential adverse effects on the ECCS and CSS recirculation functions.

- Provide the information requested in GL 04-02 Requested Information Item 2.(f) regarding programmatic controls taken to limit debris sources in containment.

  GL 2004-02 Requested Information Item 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.

In responding to GL 2004 Requested Information Item 2(f), provide the following:

- A summary of the containment housekeeping programmatic controls in place to control or reduce the latent debris burden. Specifically for RMI/low-fiber plants, provide a description of programmatic controls to maintain the latent debris fiber source term into the future to ensure assumptions and conclusions regarding inability to form a thin bed of fibrous debris remain valid.
- A summary of the foreign material exclusion programmatic controls in place to control the introduction of foreign material into the containment.
- A description of how permanent plant changes inside containment are programmatically controlled so as to not change the analytical assumptions and numerical inputs of the licensee analyses supporting the conclusion that the reactor plant remains in compliance with 10 CFR 50.46 and related regulatory requirements.
- A description of how maintenance activities including associated temporary changes are assessed and managed in accordance with the Maintenance Rule, 10 CFR 50.65.

If any of the following suggested design and operational refinements given in the guidance report (guidance report, Section 5) and SE (SE, Section 5.1) were used, summarize the application of the refinements.

- Recent or planned insulation change-outs in the containment which will reduce the debris burden at the sump strainers
- Any actions taken to modify existing insulation (e.g., jacketing or banding) to reduce the debris burden at the sump strainers
- Modifications to equipment or systems conducted to reduce the debris burden at the sump strainers
- Actions taken to modify or improve the containment coatings program

j. Screen Modification Package
The objective of the screen modification package section is to provide a basic description of the sump screen modification.

- Provide a description of the major features of the sump screen design modification.
- Provide a list of any modifications, such as reroute of piping and other components, relocation of supports, addition of whip restraints and missile shields, etc., necessitated by the sump strainer modifications.

k. Sump Structural Analysis
The objective of the sump structural analysis section is to verify the structural adequacy of the sump strainer including seismic loads and loads due to differential pressure, missiles, and jet forces.

Provide the information requested in GL 2004-02 Requested Information Item 2(d)(vii).

> *GL 2004-02 Requested Information Item 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 flow conditions.*

- Summarize the design inputs, design codes, loads, and load combinations utilized for the sump strainer structural analysis.
- Summarize the structural qualification results and design margins for the various components of the sump strainer structural assembly.
- Summarize the evaluations performed for dynamic effects such as pipe whip, jet impingement, and missile impacts associated with high-energy line breaks (as applicable).
- If a backflushing strategy is credited, provide a summary statement regarding the sump strainer structural analysis considering reverse flow.

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.

Provide a summary of the upstream effects evaluation including the information requested in GL 2004-02 Requested Information Item 2(d)(iv).

GL 2004-02 Requested Information Item 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.

- 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.

m. Downstream effects - Components and Systems
The objective of the downstream effects, components and systems section is to evaluate the effects of debris carried downstream of the containment sump screen on the function of the ECCS and CSS in terms of potential wear of components and blockage of flow streams. 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.

GL 2004-02 Requested Information Item 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.

GL 2004-02 Requested Information Item 2(d)(vi)
Verification that the close-tolerance subcomponents in pumps, valves and other ECCS and CSS components are not susceptable to plugging or excessive wear due to extended post-accident operation with debris-laden fluids.

- If NRC-approved methods were used (e.g., WCAP-16406-P with accompanying NRC SE)[1], briefly summarize the application of the methods. Indicate where the approved methods were not used or exceptions were taken, and summarize the evaluation of those areas.
- Provide a summary and conclusions of downstream evaluations.
- Provide a summary of design or operational changes made as a result of downstream evaluations.

[1] The draft NRC SE for this document was issued to the applicant in November 2007.

n. Downstream Effects - Fuel and Vessel

The objective of the downstream effects, fuel and vessel section is to evaluate the effects that debris carried downstream of the containment sump screen and into the reactor vessel has on core cooling.

- Show that the in-vessel effects evaluation is consistent with, or bounded by, the industry generic guidance (WCAP-16793)[2], as modified by NRC staff comments on that document. Briefly summarize the application of the methods. Indicate where the WCAP methods were not used or exceptions were taken, and summarize the evaluation of those areas.

o. Chemical Effects[3]

The objective of the chemical effects section is to evaluate the effect that chemical precipitates have on head loss and core cooling.

- 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.
- Content guidance for chemical effects is provided in Enclosure 3 to a letter from the NRC to NEI dated September 27, 2007 (ADAMS Accession No. ML0726007425).

p. Licensing Basis

The objective of the licensing basis section is to provide information regarding any changes to the plant licensing basis due to the sump evaluation or plant modifications.

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 10 CFR 50.59 evaluation for the change to the licensing basis.

---

[2]Because this document is still under NRC review, licensees should be aware of any NRC RAIs on it. The draft NRC SE for WCAP-16793 is expected to be issued in December 2007. After resolution of any open items from the staff's evaluation of this document, the staff will determine whether additional information is needed from licensees. Licensees should not delay their GL responses pending this information.

[3]The NRC staff expects to issue a draft SE on WCAP-16530, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191," in November 2007.

<u>GL 2004-02 Requested Information Item 2(e)</u>
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 GL. Any licensing actions or exemption requests needed to support changes to the plant licensing basis should be included.