To: D. Dorman
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Add'l Comments on DG-1107 Received on 5/14/03.

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Subject: Comments on Draft Regulatory Guide DG-1107, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident"

The NRC has issued Draft Regulatory Guide DG-1107, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident" for comment. The draft regulatory guide acts as a proposed revision (Revision 3) to Regulatory Guide 1.82, which describes methods acceptable to the NRC staff for implementing requirements with respect to the sumps and suppression pools acting as water sources for emergency core cooling, containment heat removal, or containment atmosphere clean-up. The guide also provided guidelines for evaluating the adequacy of the availability of the sump and suppression pool for long-term recirculation cooling following a loss-of-coolant accident (LOCA).

Westinghouse has reviewed the draft guidance and is providing the enclosed comments. The enclosed comments identify the Westinghouse position with respect to implementation of the draft guidance. These comments are being provided in an attempt to insure that Revision 3 of Regulatory Guide 1.82 represents a document that the industry can effectively implement, without incurring costs that are not commensurate with the safety significance. These comments are consistent with Westinghouse's understanding of the NRC's regulatory process regarding regulatory burden reduction to improve plant safety.

If you have any questions regarding these comments, please contact either Hank A. Sepp at 412-374-5282 (email: sepplha@westinghouse.com), or Timothy S. Andreychek at 412-374-6246 (email: andreyts@westinghouse.com).

Very truly yours,

H. A. Sepp, Manager
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Attachment

cc: D. Holland/NRR
B. Benney/NRR

E-RIDS = ADM-03
Add = B. Jain (BPS)
A. Clark (TLCS)

Template = ADM-013

Comments on

Draft Regulatory Guide DG-1107

"Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident"

The following pages provide Westinghouse's comments on draft Regulatory Guide DG-1107.

TECHNICAL COMMENTS

1. The text on the bottom of page 2 of Section B, "Discussion" states that:

   "The primary safety concerns regarding long-term recirculation ......",

   Due to the uniqueness of some containment designs, the containment spray system is realigned to draw suction from the containment sump early in the transient. The ECC is realigned to draw suction from the containment sump somewhat later in the transient. For example, a representative plant of this design might realign to draw suction for containment spray at about 300 seconds after a postulated LOCA, and realign the ECC to draw suction from the containment sump at about 2500 to 2900 seconds. For this class of plants, sump blockage may be a concern earlier in the transient.

   It is suggested that the use of the phrase, "long-term recirculation" be amended or footnoted to recognize that sump blockage may be a concern early in the postulated event.

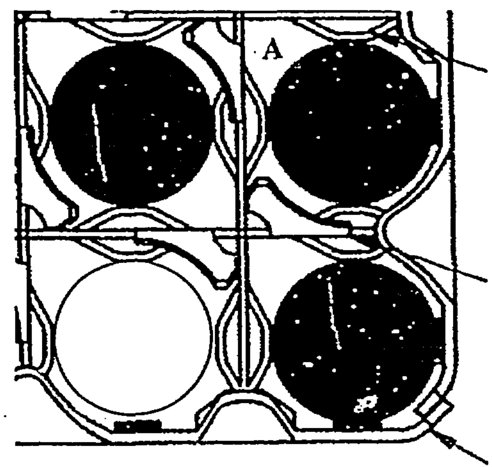
2. The text on page 3 of Section B, "Discussion" identifies three categories of debris:

   > "Debris can be further subdivided into (1) debris that has a high density and could sink but is still subject to fluid transport if local recirculation flow velocities are high enough, (2) debris that has an effective specific gravity of 1.0 and tends to be suspended or sink slowly but will nonetheless be transported by very low velocities or local fluid turbulence phenomena, and (3) debris that will float indefinitely by virtue of low density and will be transported to and possibly through the debris interceptors... All potential debris sources should be evaluated, including but not limited to, the fire barrier material, insulation materials (e.g., fibrous, ceramic, and metallic), filters, corrosion material, and paints and coatings."

   In the subsequent section on Pressurized Water Reactors, page 6, third paragraph, it states the following with respect to sump screen sizing:

   > "The size of openings in the screens is dependent on the physical restrictions that may exist in the systems that are supplied with coolant from the ECC sump. The size of the mesh of the fine debris screen is determined by considering a number of factors, including the size of the openings in the containment spray nozzles, coolant channel openings in the core fuel assemblies, the presence of fuel assembly inlet debris screens, the minimum dimension within the flow-path (e.g., high pressure safety injection (HPSI) throttle valves), and such pump design characteristics as seals, bearings, and impeller running clearances."

Based on the sump screen sizing requirements, it is suggested that it is not physically possible to develop a sump screen that would filter out debris that could potentially cause blockage concerns downstream of the ECC sump. For example, an illustrative top view portion of a fuel assembly mid-grid is provided in the figure to the right. If the coolant channel opening in the fuel assembly is identified channel 'A', then it can be shown, based on geometrical calculations, that the effective flow diameter of 'A' meets the sump screen sizing requirements at initiation for a post-LOCA long-term core cooling scenario. If fibrous material and paint chips/coatings are accounted for in an analysis, fibrous material may be considered to wrap around the components of a mid-grid (like hair around a strainer in a sink drain). With time, the build-up of this type of debris could potentially block the coolant channel opening. This example can be extended to other components downstream of the ECC sump, i.e., seals, bearings and impeller clearances.



Thus, given the set of boundary conditions and assumptions to be accounted for in the analysis, the requirement to show no blockage is not possible.

3. At the bottom of page 3, the end of the first sentence under "Pressurized Water Reactors." Suggest adding that the sump also serves as a source of water for containment cooling.

4. On page 4, the last sentence of the second paragraph. Suggest adding, ". . in a slower containment depressurization and cooldown that is unacceptable to the safety equipment and components, and an increase in the offsite dose . .".

5. At the top of page 5, the guide notes that the design of drains or flow paths that might result in holdup of water away from the containment sump is not addressed by this document. It goes on to note that these flow paths are best terminated in a manner that will prevent debris from being transported to and accumulating on or within the containment sump. The concern of debris blockage of containment drainage flow paths is again identified in the middle of the last paragraph on page 11.

   It is suggested that if the issue is of sufficient concern as to be mentioned twice in the guide, guidance on how to address the concern should be provided.

6. Sections C1.1.1.1 and C1.1.1.2 state that "a minimum of two sumps should be provided" and "to the extent possible, the redundant sumps should be physically separated", respectively. The impact of multiple redundant sumps is not discussed further in this guide. Redundant sumps may have an impact on post-LOCA subcriticality when the ECCS is realigned to draw suction from the containment sump, and again at the time when the recirculation flow path is realigned from the cold leg to the hot leg (hot leg switch over). Additional discussion of these concerns is provided below.

Post-LOCA Subcriticality

Subcriticality at start of recirculation is confirmed by calculating the mixed mean boron concentration in the sump at the time entering recirculation. These calculations use conservative assumptions (boration sources are minimized, dilution sources are maximized) regarding water sources that end up in the sump. Complete and instantaneous mixing is assumed. Redundant sumps would likely complicate these calculations.

If regulatory guidance will recommend that two redundant and physically separated sumps are provided, it is suggested that additional guidance be given regarding the following:

- Factors to consider in determining the distribution of the various water sources between the sumps.
- Factors to consider in determining the distribution of containment spray between the sumps (min/max spray and no spray must be considered).
- Factors to consider in determining the distribution of the RCS spill (initial and recirculation spill) between the sumps (all breaks must be considered).
- The relationship between the redundant sumps, inactive sump volumes and the reactor cavity volume.
- Desirable and non-desirable alignments for drawing recirculating flow from the sumps.
- Factors to consider in determining if the sumps communicate during the event and desirable design features to accomplish that communication.
- The consideration and treatment of single failures. (Do two sumps introduce additional single failures, either active or passive, that must be considered?)
- The desirability of enabling suction to be switched from one sump to another, and factors to consider when providing for the capability of switching suction between sumps.

Having two redundant and physically separated sumps will likely impact shutdown calculations for PWRs. Providing guidance to address the items identified above will enable that impact to be assessed.

Hot Leg Switchover (HLSO)

The time at which HLSO is required is calculated using initial conditions based on the containment sump mixed mean boron concentration. These calculations use conservative assumptions (boration sources are maximized, dilution sources are minimized) regarding water sources that released to the containment sump. As with the post-LOCA subcriticality calculations, complete and instantaneous mixing is assumed. As with the post-LOCA subcriticality calculations, redundant sumps would complicate these calculations. The post-LOCA subcriticality issues identified with two redundant and physically separated sumps, and guidance that would be applicable to addressing those issues, are also applicable to HLSO calculations.

Given the above, it is suggested that either:

- The guidance of Sections C1.1.1.1 and C1.1.1.2 be reconsidered in light of these concerns, or,
- Guidance is added to DG-1107 to address the issues associated with post-LOCA subcriticality and hot-leg switchover margin that are associated with having two redundant and physically separated sumps.

7. Section C1.1.2.2 states that, "Procedures should be established for using alternative water sources to be activated when unacceptable head loss renders the sump inoperable." The concept of alternate water sources is not discussed further in the guide. It is unclear what is meant by "alternate water sources."

   It is suggested that, for this guidance to be meaningful, an explanation of "alternate water sources" should be added.

8. In Section C.1.3.1.2 and C.1.3.1.3, the staff specifically notes that certain existing plants cannot meet the regulatory position on containment overpressure. There are a number of other provisions of this draft guide, such as C.1.1.1.1 that identifies that a minimum of two sumps should be provided, that many existing plants do not meet. It is suggested that either:

   - A general position statement in the introduction to Section C be added on the conformance of existing plant designs, or,
   - Provide guidance for each position in Section C regarding what are the alternative positions for current plants.

9. The Regulatory Positions requiring application of large breaks at essentially all locations in the Reactor Coolant System (RCS) for debris generation based on the requirements of 10 CFR 50.46 is inconsistent with other regulations. For example:

   - The NRC allows the application of Leak Before Break (LBB) and the consideration of specific break locations as described in Branch Position MEB-3.1 in evaluating the dynamic effects of a postulated pipe break. These considerations directly affect the design of the ECCS systems and the requirements for a coolable geometry as stated in 10 CFR 50.46(b)(4).
   - Instruments, valves, smaller RCS piping, other piping inside containment, and cables needed to assure transmittal of either ECCS signals or system functions necessary to assure ECCS performance are either:
     - Evaluated based on specific break locations, or,
     - Do not have to be evaluated for pipe whip and jet impingement based on LBB considerations.
   - If the requirement for a break anywhere was imposed for jet impingement and pipe whip for equipment required for ECCS to function, system redesigns would be required or pipe whip restraints and guard pipes would have to be installed to show conformance with 10 CFR 50.46.

- Similarly, almost every PWR in the United States uses LBB as the basis for limiting hydrodynamic loads on the fuel to assure a coolable core geometry as required by 10 CFR 50.46.

Given that debris generation is clearly a dynamic effect of a pipe break, and that other features of ECCS design do not require double ended breaks for dynamic effects, it is suggested that the requirements of this section be revised to allow the same treatment.

If this position is retained without modification, some utilities may conclude that the addition of guard pipes or pipe restraints will be necessary to reduce the amount of debris generation to a level that can be accommodated even with large sump screens. Such actions would be a step backwards in both risk and in regulation.

10. Section C.1.1.1.12 identifies that the size of the opening in a fine screen mesh should be smaller than the minimum restrictions found in the systems served by the containment sumps.

    - Clearances in pumps and seals can be very small. For many current plants, the screen hole size is larger than the minimum clearance associated with ECCS or Containment Spray pump designs.
    - Experimental data and current evaluations show that debris made of dense, hard materials such as metals would not be transported to the screens under the fluid velocities associated with containment sump operation for most operating PWRs.
    - Other particles, such as paint chips, are brittle enough that the pump impeller would further break up the particles and, if the resulting debris was transported to the reactor vessel, this debris would settle out in the bottom head.
    - Small soft particles would not damage impellers or seals.

    A screen mesh that has openings smaller than seal or impeller clearances will have a dimension on the order of mils. Sump screen meshes this fine will result in a higher, perhaps significantly higher, pressure drop than what is calculated for current screen designs. This result may lead a plant to design and install a sump screen area that is so large that may not be practical to install in the plant. Also, having very small openings in fine screens make them more susceptible to plugging than current screen designs.

    It is suggested that this position be reconsidered with the objective to determine if it can be met given reasonable containment volumes, configurations, and water levels associated with current PWR containment designs.

11. In public meetings addressing Generic Safety Issue GSI-191, NRC has several times stated that it is not their intent to suggest or require that CFD calculations be performed for plants to demonstrate their sumps are operable. Section C.1.3.3.4 specifically identifies the use of computational fluid dynamics (CFD) as an acceptable analytical approach to predict debris transport within the sump pool. This statement appears to contradict the earlier public statements made by NRC. Channel flow has also been successfully used to demonstrate debris transport in both the nuclear industry and other industries and also have data base to support this approach. This position should be reconsidered to identify other acceptable methods or predicting debris transport.

12. Section 1.3.3.8 states that all debris transported to the sump may be assumed in lieu of performing debris transport analyses. The inherent assumption in this statement is that the transport of all debris to the sump screen is a more limiting condition than debris blocking or partially blocking the drains leading to the sump (holdup of water away from the containment sump). This may not be the case. More limiting cases might be the assumption that all drains leading to the containment sump are completely blocked, or a combination of inventory holdup in containment coupled with debris loading on the sump screen.
Suggest that this needs to be either addressed or closed as not a concern. (See comment 5, above.).

13. Westinghouse agrees with and supports the statement in Section D, "Implementation," that no backfitting is intended with the issuance of this guide. However, the last sentence of Section D states that the guide will be used to evaluate licensee compliance with 10 CFR 50.46. This statement suggests that this guide will be the basis for compliance with 50.46. Since it is already known that many current plants do not conform to this guide, it is likely that the application of this guide will lead to the conclusion that plants do not comply with 50.46. Therefore, the application of this guide is likely to result in backfit actions.

14. Appendix A provides guidelines for review of water sources for emergency core cooling. These guidelines, developed from extensive hydraulic tests on full-scale sumps, have been issued previously by NRC. The guidelines of Appendix A provide a rapid means of assessing sump hydraulic performance. For example, Appendix A indicates that:

    - Zero air ingestion into the sump intake piping can be ensured by the use of submergence > 9 ft, Fr < 0.25 and V < 4 fps (Table A-1), and,
    - Sump designs having ingestion levels of 2% or less can be obtained using correlations given in Table A-2.

    The guidance of Appendix A also indicates that if the PWR sump design deviates significantly from the design boundaries noted, similar performance data should be obtained to verify adequate sump hydraulic performance. Therefore, it may very well be the case that plant particular sump hydraulic model testing may need to be performed by each utility.

    It is noted that the guidelines given in Appendix A are more restrictive than parameters used for design of containment sumps for a number of current operating plants. For example, a representative plant might have a submergence = 4 feet, Fr = 1.5, and V =10 fps. Appendix A indicates that the NPSH requirements should be increased rather significantly when the guidelines in Table A-1 are not met.

    It is suggested that a statement be added at the beginning of Appendix A recognizing that licensed operating plant designs having design parameters different from those in Appendix A have been demonstrated to provide acceptable hydraulic performance.

EDITORIAL COMMENTS

1. Suggest adding titles to Figure 1 and Figure 2.
2. Figure 3, upper left hand portion of the Zone of Influence pictorial, suggest amend "Targete Pipin" to read as "Targeted Piping".
3. In Figures 1, 2, 4 & 5, suggest adding a note to identify if these figures apply to both PWRs & BWRs.