

WATER SOURCES FOR LONG-TERM RECIRCULATION COOLING FOLLOWING A LOSS-OF COOLANT ACCIDENT

REGULATORY ANALYSIS

Statement of the Problem

The Nuclear Regulatory Commission first issued Regulatory Guide 1.82, Revision 0, in June 1974 to provide guidance on the design of emergency sumps that served as a source of water during the recirculation core cooling phase of a postulated loss-of-coolant accident (LOCA). The NRC initiated a generic assessment of pressurized-water reactor (PWR) sump and boiling-water reactor (BWR) suction strainer performance in 1979 and designated it Unresolved Safety Issue (USI) A-43, “Containment Emergency Sump Performance.”¹ The NRC completed its effort on USI A-43 in 1985. In the mid-1990s, following emergency core cooling system (ECCS) strainer blockage events at operating BWRs, the NRC undertook a reassessment of BWR suction strainer performance. Based on this effort and on the parallel analysis and testing conducted by industry, BWR licensees performed plant modifications to enhance strainer performance. The references provide additional information on industry events and regulatory expectations.

In 1996, the NRC began work on GSI 191² to reassess PWR sump performance to determine whether new information obtained from recent BWR strainer activities could impact PWRs. The resolution of GSI-191 is presently ongoing. The NRC issued a revision to Regulatory Guide 1.82 in November 1985, another in May 1996, and the most recent one in November 2003. These three revisions address issues associated with state-of-knowledge increases in containment sump performance, particularly debris blockage on the ECCS strainers, and provide guidance in determining NPSH margin for the ECCS and the containment heat removal system.

The NRC issued the current Regulatory Guide 1.82, (Revision 3), in November 2003 to enhance the debris blockage evaluation guidance that could be used for the resolution of GSI-191. However, new findings from followup studies of GSI-191, NRC-sponsored research, and plant-specific analysis and testing indicate that the NRC should update the previous guidance in Regulatory Guide 1.82, Revision 3, for evaluating ECCS strainer performance for PWRs and BWRs following a postulated design basis accident (DBA). Therefore, the staff has determined that, based on the new information identified, a revision to this regulatory guide is necessary for guidance for the evaluation of ECCS strainers and debris blockage by LOCA-generated debris.

In 2008, the staff began to reevaluate the potential for BWR strainer blockage based on updated knowledge gained from the GSI-191 evaluations of PWR sump performance. Although the agency has not completed the BWR reevaluation, this regulatory guide attempts to be consistent with one high-level objective of the reevaluation—where similar technical phenomena exist between BWRs and PWRs, the NRC has provided similar regulatory guidance.

¹ NEDO-32686-A, “Utility Resolution Guide for ECCS Suction Strainer Blockage,” Volumes 1-4, BWR Owners Group, (ADAMS Accession Nos. ML092530482, ML092530500, ML092530505, ML092530507)

² GSI-191, “Assessment of Debris Accumulation on PWR Sump Performance,” U.S. Nuclear Regulatory Commission, Washington, DC.

This proposed revision reformats Section C extensively by combining, where appropriate, common regulatory positions for PWRs and BWRs with smaller PWR- and BWR-specific sections containing additional reactor design-specific regulatory positions. Lessons learned from the resolution of GSI-191 indicate that the previous guidance was not comprehensive enough to ensure adequate evaluation of a plant's ECCS and CSS sump performance following a LOCA. As a result, the staff has revised the regulatory position sections of the guide to make them consistent with staff positions described in safety evaluations (SEs) on industry guidance documents and several industry topical reports (TRs) that are associated with GSI-191 and NRC GL 2004-02.³ This proposed revision references NEI 04-07, Revision 0,⁴ and its accompanying NRC staff SE.⁵ Additionally, this revised guide references three Westinghouse TRs—WCAP-16793-NP, Revision ;⁶ WCAP-16406-P-A, Revision 1,⁷ and WCAP-16530-P-A,⁸ and the NRC staff's SE associated with each TR⁹,¹⁰,¹¹, respectively. Regulatory Guide 1.82, Revision 3, does not reflect the latest staff positions based on the above guidelines.

The NRC issued Generic Letter 2008-01 to address gas accumulation issues in several safety systems. Significant testing and analysis methodology information has been obtained relative to such areas as pump response to voids and gas transport as a function of flow conditions. The NRC is consistent with this information in the draft regulatory guide but notes that work associated with the generic letter is ongoing and the information may change.

Objective

The objective of this regulatory action is to update the current Regulatory Guide 1.82, (Revision 3), to make it consistent with existing guidance in other documents prepared for the resolution of GSI-191

³ GL 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors," U.S. Nuclear Regulatory Commission, Washington, DC.

⁴ Safety Evaluation for NEI Guidance Report 04-07, "PWR Sump Performance Evaluation Methodology," U.S. Nuclear Regulatory Commission, Washington, DC. (ADAMS Accession No. ML050550156)

⁵ "NRC Staff Review Guidance regarding Generic Letter 2004-02 Closure in the Area of Coatings Evaluation," U.S. Nuclear Regulatory Commission, Washington, DC, (ADAMS Accession No. ML080230462)

⁶ WCAP-16793-NP, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid," Revision 0, Westinghouse Electric Company, LLC, Pittsburgh, PA, April 2009. (ADAMS Accession No. ML091190484) (Revision 1 is currently under staff review and was not yet approved when this guide was developed.)

⁷ WCAP-16406-P-A, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191," Revision 1, Westinghouse Electric Company, LLC, Pittsburgh, PA. (ADAMS Accession No. ML081000027)

⁸ "Final Safety Evaluation by the Office of Nuclear Reactor Regulation, Topical Report WCAP-16530-NP-A 'Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids To Support GSI-191,'" U.S. Nuclear Regulatory Commission, Washington, DC, and Topical Report WCAP-16530-NP-A. (ADAMS Accession Nos. ML081150379, ML073520891)

⁹ Regulatory Guide 1.92, "Combining Modal Responses and Spatial Components in Seismic Response Analysis," U.S. Nuclear Regulatory Commission, Washington, DC.

¹⁰ Safety Evaluation by the Office of Nuclear Reactor Regulation, Topical Report (TR) WCAP-16406-P-A, Revision 1, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191,'" U.S. Nuclear Regulatory Commission, Washington, DC. (ADAMS Accession No. ML073520295)

¹¹ Regulatory Guide 1.92, "Combining Modal Responses and Spatial Components in Seismic Response Analysis," U.S. Nuclear Regulatory Commission, Washington, DC.

and GL 2004-02 for PWRs and to increase the consistency between the regulatory positions, as appropriate, that are specified for PWRs and BWRs. The intent of this guide is to continue to provide guidance on methods that the NRC staff considers acceptable for evaluating the adequacy of ECCS strainer performance for long-term recirculation cooling following a LOCA.

Alternative Approaches

The NRC staff considered the following alternative approaches:

Do not revise Regulatory Guide 1.82.
Revise Regulatory Guide 1.82.

Alternative 1: Do Not Revise Regulatory Guide 1.82

Under this alternative, the NRC would not revise this guidance, and the current version of guidance would be retained. This alternative is considered the baseline or “no-action” alternative and, as such, involves no value/impact considerations. However, this alternative would not provide licensees with the current staff positions on the approved NEI 04-07, Revision 0, guidance; other industry TRs; and other lessons learned from industry testing and analysis conducted in response to GL 2004-02.

Alternative 2: Revise Regulatory Guide 1.82

Under this alternative, the NRC would revise Regulatory Guide 1.82 to reference NEI 04-07, Revision 0, and to provide the NRC staff positions on the approved NEI 04-07 guidance. The document would also provide additional guidance based on information obtained since the issuance of NEI 04-07. Revising the regulatory guide would also increase the consistency between the regulatory positions, as appropriate, that are specified for PWRs and BWRs.

One benefit of this action is that it would provide licensees and applicants a consistent approach to implementing an acceptable method for the evaluation of ECCS strainer performance and would comply with the licensing requirements.

The cost to the NRC would be the one-time cost of issuing the revised regulatory guide, which is expected to be relatively small; applicants would be provided updated and current guidance that should facilitate design and staff review; and licensees would incur little or no cost.

Conclusion

Based on this regulatory analysis, the staff recommends that the NRC revise Regulatory Guide 1.82. The staff concludes that the proposed action reflects the current staff positions on an acceptable method for the evaluation of sump performance following a postulated LOCA or DBA.