POLICY ISSUE
(Information)

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FOR: The Commissioners

FROM: R. W. Borchardt
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SUBJECT: STATUS OF APPLYING LESSONS LEARNED FROM PRESSURIZED WATER REACTORS TO EMERGENCY CORE COOLING SYSTEM SUCTION STRAINER PERFORMANCE FOR BOILING WATER REACTORS

PURPOSE:

This paper summarizes the activities of the U.S. Nuclear Regulatory Commission (NRC) staff to examine and apply lessons learned from the evaluation of pressurized water reactor (PWR) emergency core cooling system (ECCS) suction strainer performance to boiling water reactors (BWRs). This paper was prepared in response to Staff Requirements Memorandum (SRM) M081107, "Meeting with Advisory Committee on Reactor Safeguards (ACRS)," dated January 8, 2009.

SUMMARY:

The efforts to address Generic Safety Issue (GSI) 191, "Assessment of Debris Accumulation on PWR Sump Performance," have led to new information on the phenomena that could be relevant to previous assessments of ECCS suction strainer performance in BWRs. Both the NRC staff and the Boiling Water Reactor Owners Group (BWROG) are examining the GSI-191 lessons learned for significance and applicability to BWRs even though modifications to improve suction strainer performance were made by BWR licensees in the 1990s. Currently, BWR ECCS operability is not in question and continued operation of BWRs does not pose an undue risk to public health and safety.

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BACKGROUND:

In SRM M081107 the Commission directed the staff to consider lessons learned from the analyses of PWR sump strainer performance and to determine if issues have arisen that call for revisiting sump strainer performance in BWRs. The staff engaged the BWROG on this question in 2007, and there have been several interactions since.

DISCUSSION:

From 1992 to 2001, the NRC and the nuclear industry addressed the issue of potential debris blockage of ECCS suction strainers in BWRs. The NRC and industry conducted research and testing and developed guidance documents, and the industry made hardware and procedure changes. The NRC staff issued NRC Bulletin (NRCB) 95-02, "Unexpected Clogging of a Residual Heat Removal Pump Strainer While Operating in Suppression Pool Cooling Mode," dated October 17, 1995, and NRCB 96-03, "Potential Plugging of Emergency Core Cooling Suction Strainers by Debris in Boiling-Water Reactors," dated May 6, 1996. Both bulletins dealt with ensuring that debris generated during a loss-of-coolant accident would not clog ECCS suction strainers. The BWROG supported licensees by developing resolution guidance, referred to as the Utility Resolution Guide (URG), which the staff endorsed with conditions and limitations in an August 1998 safety evaluation.

BWR licensees performed plant-specific evaluations to determine necessary mitigation measures. Most BWR licensees installed larger strainers and established measures to clean and maintain the suppression pool free of foreign materials. In October 2001, the NRC staff concluded that generic and plant-specific activities associated with NRCB 95-02 and NRCB 96-03 were complete on the basis that licensees had designed their ECCS suction strainers with sufficient margin to remain operable even with the debris loads anticipated during a loss-of-coolant accident.

The NRC initiated GSI-191 in 1996 to examine whether the events and research associated with the BWR strainers warranted similar evaluations and/or changes for PWRs. The NRC staff concluded that plant-specific analyses should be conducted to determine whether debris accumulation in PWR containments could impede recirculation operation of the ECCS or containment spray system and that licensees should take any appropriate corrective actions. Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors," dated September 13, 2004, communicated this expectation to licensees. The industry developed guidance, submitted by the Nuclear Energy Institute (NEI) as NEI 04-07, "Pressurized Water Reactor Sump Performance Evaluation Methodology," Volume 2, dated May 28, 2004, for evaluating PWR recirculation issues. The NEI based its guidance, in part, on the methods and techniques previously used in the BWROG URG. The staff issued a safety evaluation dated December 6, 2004, endorsing the NEI guidance with certain conditions.

The efforts to address GSI-191 have led to new insights that could be relevant to previous assessments of ECCS suction strainer performance in BWRs. Both the NRC staff and the BWROG are examining the GSI-191 lessons learned for applicability to BWRs.

RECENT DEVELOPMENTS:

Staff Activities

The NRC staff is developing a revision to Regulatory Guide 1.82, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident." The staff is updating this document, in part, to reflect the latest available guidance on acceptable methods for evaluating ECCS strainer performance. The public comment period is scheduled to begin in November 2009, with issuance of the final regulatory guide in late 2010.

The NRC staff is also developing a report that evaluates the differences in treatment of the various phenomena in sump strainer evaluations. The intent is to focus attention on those lessons learned that could reduce margin in the BWR strainer evaluations. The staff expects to publish the report in the first quarter of 2010.

Further, the staff is consolidating the knowledge base that has been gained in evaluating GSI-191. It completed a similar effort for BWRs in report LA-UR-01-1595, "BWR ECCS Strainer Blockage Issue: Summary of Research and Resolution Actions," dated March 2001. The staff plans for the knowledge base to build on the 2001 BWR report and include international experience, as applicable. The staff also plans to lead an international effort through the Nuclear Energy Agency Committee on the Safety of Nuclear Installations to develop a comprehensive summary of knowledge and operating experience related to sump performance issues.

Finally, the NRC staff is planning the necessary resources to support review of the technical documents developed by the BWROG in 2010 and 2011 and to review a sample of plant-specific evaluations.

BWROG Activities

In a letter dated July 17, 2009, the BWROG outlined its plans for evaluating the impact of the GSI-191 lessons learned on BWRs. The NRC staff met with the BWROG on July 23 and July 30, 2009, to discuss the plans in more detail. The BWROG has developed the ECCS Suction Strainer Committee and four subcommittees, discussed below.

Source Term Subcommittee

This subcommittee will address new insights regarding the debris that is generated during a loss-of-coolant accident, including chemical effects. For chemical effects, the BWROG plans to submit a position paper in fall 2009, conduct testing in spring 2010, and perform plant-specific evaluations in summer 2010. For the zone of influence, the BWROG plans to submit a position paper in fall 2009 on the conservatism of the air-jet testing that was used as basis for the URG. The staff has informed the BWROG that submittal of licensing topical reports (LTRs) would be necessary for the staff to review and potentially approve the information in the position papers. Regarding debris sources, the NRC staff has reviewed the containment walkdown guidance, and the BWROG plans to complete walkdowns by 2011.

Head Loss Subcommittee

This subcommittee will address new insights regarding the pressure drop across a debris-laden strainer. BWR licensees generally used correlations that were based on generic testing to predict head loss, while PWR licensees employed plant-specific testing. The BWROG will ensure that the testing database adequately covers limiting debris cases, considering the NRC staff's strainer testing guidance provided in a letter to the Nuclear Energy Institute, "Revised Guidance for Review and Approval of Final Licensee Responses to Generic Letter 2004-02," dated March 28, 2008. The BWROG has not determined whether additional head loss testing is needed.

Downstream Effects - Components Subcommittee

This subcommittee will address the adverse effects of debris that bypasses the suction strainer and enters downstream components such as pumps and valves. This subcommittee is developing an LTR, similar to the one for PWRs, for submittal in summer 2011.

Downstream Effects - In-Vessel Subcommittee

This subcommittee will address the effects of debris and chemicals on the reactor core. The BWROG is developing an LTR with generic analysis and testing protocol for Global Nuclear Fuels (GNF) fuel bundle designs. Testing of the GNF fuels will follow NRC staff approval of the LTR. A separate LTR will compare the analysis of GNF fuel with other BWR fuel types, and additional LTRs will cover testing if necessary. The subcommittee expects to submit the first LTR before May 2010.

STAFF EVALUATION:

Based on the evaluation of currently available information, the staff believes that, although uncertainties in the technical areas discussed above warrant further evaluation, BWR ECCS operability is not in question and continued operation of BWRs does not pose an undue risk to public health and safety.

The staff considered the need for a generic communication and determined that no generic communications are needed at this time. The BWROG is actively addressing the insights gained from GSI-191 efforts identified by the NRC in its April 10, 2008, letter and the NRC staff generally agrees with the licensees' approach and the established schedules. The NRC staff will periodically reassess the need for generic communications.

CONCLUSIONS:

The staff has found that the BWROG is generally addressing the lessons learned from GSI-191 with sufficient timeliness and rigor. The staff concludes that the issues identified as a result of GSI-191 evaluations, as discussed in this paper, do not pose an undue risk to public health and safety and that continued plant operation is justified. Furthermore, the staff does not believe there is a need at this time for plant-specific regulatory actions or generic communications. The staff will periodically reassess the BWROG progress and will reconsider the need for additional regulatory measures as part of that reassessment.

RESOURCES:

The staff's efforts to evaluate lessons learned from GSI-191 for implications on the performance of BWR ECCS suction strainers will require resources in fiscal year (FY) 2010 to FY 2013. As stated in industry correspondence, the BWROG expects to submit at least two and probably four LTRs in FY 2010 and two in FY 2011. The staff will need eighteen months and two full-time equivalents (FTEs) for each LTR review. The staff also plans to review plant-specific evaluations on a sampling basis in FY 2012 and FY 2013. In summary, the staff expects to spend the following resources:

Fiscal Year	NRR Budget	RES Budget	Total
FY 2010	3 FTE	1 FTE, $185K	4 FTE, $185K
FY 2011	3 FTE	1 FTE, $184K	4 FTE, $184K
FY 2012	6 FTE		
FY 2013	1 FTE		

FY 2010 and FY 2011 resources have been requested and FY 2012 and FY2013 resources will be requested through the respective PBPM process. This budget estimate assumes that the staff will only need to review a sample of plant-specific evaluations, similar to what was done for the BWRs in the 1990s, and not detailed plant-specific reviews similar to those that are currently being conducted for PWRs.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection. The Office of the Chief Financial Officer has reviewed this paper for resource implications and concurred.

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