December 20, 2000

MEMORANDUM TO: Ashok C. Thadani, Director
Office of Nuclear Regulatory Research

FROM: Sher Bahadur, Chief /RA/ Sher Bahadur
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Office of Nuclear Regulatory Research

SUBJECT: REPRIORITIZATION OF GSI-71, "FAILURE OF RESIN DEMINERALIZER SYSTEMS AND THEIR EFFECTS ON NUCLEAR POWER PLANT SAFETY"

Background:

The failure of a resin demineralizer does not directly impact safety, but a resin demineralizer may be a part of systems that support or perform safety functions. Two types of failure modes may affect safety systems: (1) introduction of resin or gas into a system which subsequently causes one or more immediate failures of the safety system, and (2) loss of water chemistry control which can affect corrosion rates. GSI-71 was first prioritized in 1986, and was assigned a LOW priority ranking. In 1990, the issue was subjected to a second prioritization study and the LOW priority ranking was retained. Earlier studies mentioned, but did not address the second failure mode because the loss of water chemistry and subsequent change in corrosion rates (1) do not lead to immediate failures, (2) do not affect all parts of the reactor system at the same rate, and (3) can be detected and corrected prior to introducing a significant corrosion impact.

Current Evaluation:

A third evaluation (Ref. 1) included a prioritization calculation of the incremental risk of resin demineralizer failure and consideration of the corrosion effects of resin intrusion. An important element in this third re-prioritization effort was to review and analyze events associated with the failure of resin demineralizer systems based on reported events from 1973 through the end of 1997. These failure events were used to generate demineralizer-related initiating event frequencies for reactor scrams and shutdowns, as well as demineralizer-related un-availabilities for post-shutdown mitigating systems which were then used for calculating baseline and adjusted-case risk frequencies.

The re-calculated core damage frequency (F) and affected public risk (W) parameters are:

	Base Case	Adjusted Base Case	Change
F_{PWR}	3.6 E-7/ry	1.8 E-7/ry	1.8E -7/ry
F_{BWR}	4.9 E-8/ry	2.5 E-8/ry	2.4 E-7/ry
W_{PWR}	8.9 E-1	4.05 E-1	4.8 E-1 person-rem/ry
W_{BWR}	3.4 E-1	1.7 E-1	1.7 E-1 person-rem/ry

These values place GSI-71 into a DROP priority ranking.

Mitigating System Unavailability:

None of the reviewed BWR events involved the unavailability of ECCS or other accident mitigating systems other than the Power Conversion System (PCS). On the other hand, there were five PWR demineralizer-related failures (1977, 1978, 1982, 1984 and 1986) which resulted in the loss of HPSI and LPSI pumps and suggested a potential common cause failure mode. Although none of these incidents occurred during power operation, but rather during cold shutdown, refueling, or pre-operational testing, the licensees noted that operational procedures addressing pump and systems alignments would be revised. No additional PWR demineralizer related events have been reported after 1986, which is evidence that improvements have been made.

Corrosion Effects of Resin Intrusion:

The potential effects of ion exchange resins entering nuclear reactor water systems were reviewed from the perspective of possible chemistry/corrosion effects, plant events, research which has been conducted on this subject, and evidence of the sensitivity of licensees to the importance of water chemistry. In view of the fact that both ECP and crack growth can be restored to normal conditions when impurities are removed from the aqueous environment, the long-term consequences of resin intrusion can be minimized by rapid clean-up of the coolant system following such an event. The EPRI BWR and PWR Owner's Group Water Chemistry Guidelines are conservative, and if these guidelines are adhered to, should prevent any significant IGSCC consequences from inadvertent resin intrusion.

Conclusion: GSI-71 should be placed into a DROP category. This conclusion has been discussed with PRAB and REAFHB staff and found acceptable.

Reference 1: Sciacca, F. and Thomas, W., “Failure of Resin Demineralizer Systems and Their Effects on Nuclear Power Plant Safety,” March 1, 1999

cc: F. Eltawila
T.L. King
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