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RESOLUTION OF USI A-43

"CONTAINMENT EMERGENCY SUMP PERFORMANCE"

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ABSTRACT

The Unresolved Safety Issue, A-43, "Containment Emergency Sump Performance," deals with sump performance and safety considerations associated with long-term cooling following a LOCA. Although initially, emergency core cooling systems (ECCS) draw water from the refueling water storage tank (RWST), long-term cooling is implemented by ECCS realignment which then utilizes the containment emergency sump as the pump suction source. Thus, the sump design and location, must provide an adequate, debris free, water source for the residual heat removal (RHR) pumps. These safety concerns were primarily related to potential debris generation due to pipe breaks, and sump hydraulic performance under adverse, post-LOCA conditions. The generic nature of these concerns resulted in designation of A-43 as an unresolved safety issue in 1979.

Investigation of sump hydraulics for a wide range of design characteristics was conducted in full-scale, at the Alden Research Laboratories (ARL) under Department of Energy sponsorship. The results show the following: a) measured air ingestion levels are generally low (i.e., $< 2\%$) even under simulated adverse conditions (i.e., screen blockage) and with free-standing air-core vortices present, b) experimentally derived sump suction inlet losses support use of loss coefficients

found in accepted hydraulic design handbooks, c) suction pipe flow swirl is low (i.e., 5-7^{o}), d) surface vortex activity (or observations) is not a reliable indicator of sump performance, e) vortex suppressors fabricated from floor grating are very effective in reducing air ingestion to essentially zero. The ARL data base did not support development of sump performance correlations based on vortex observations, nor development of refined sump design guidelines. However, "bounding" data analyses, based on a submergence Froude number concept (which incorporates submergence and suction velocity effects) can be used to establish acceptable sump hydraulic performance guidelines.

The debris related questions were addressed through surveys of the types and amounts of different insulations employed in nuclear power plants. In addition, a calculation methodology was developed for estimating: a) the amount of debris which might result from a pipe break, b) the migrating of such insulation debris to the sump vicinity, and c) potential screen blockages which might occur. The results show that debris evaluations are very plant dependent, and that the type(s) of insulation employed is the key factor (i.e., mirror-insulation versus mineral fiber blanket). The plant surveys also show that the newer plants utilize metallic, or encapsulated insulations, which pose a significantly reduced safety picture than previously hypothesized.

In addition, pump performance under adverse conditions, such as air ingestion and particulate ingestion was assessed. Low levels of air ingestion ($< 2\%$) should not degrade pumping capabilities; ingestion of "hard" particulates could lead to undesirable seal wear.

The resolution of A-43 is therefore based on considerable experimental and plant survey data, plus plant evaluations which do not support the levels of safety concerns previously raised. The current findings can be used for both operating plant and proposed plant assessments. R.G. 1.82, "Sumps for Emergency Cooling and Containment Systems," (1974) will be basically maintained, with some changes such as removal of the 50 percent screen blockage assumption and inclusion of references to data and studies. Sump design and review guidelines in NRC's Standard Review Plan will also be modified to reflect these data and findings.