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June 22, 2000

MEMORANDUM TO: Samuel J. Collins, Director
Office of Nuclear Reactor Regulation

From: Ashok C. Thadani, Director **/RA/**
Office of Nuclear Regulatory Research

SUBJECT: DCH ISSUE RESOLUTION FOR ICE CONDENSER PLANTS

Attached for your information is a study the Office of Nuclear Regulatory Research recently published, NUREG/CR-6427, "Assessment of the DCH Issue for Plants with Ice Condenser Containments," April 2000. The study describes work which addressed resolution of the direct containment heating (DCH) issue for those PWRs with ice condenser containments. This research is the culmination of a comprehensive program which successfully resolved a longstanding issue which dominated our perspective of severe accident risk for many reactors. Past efforts reported in NUREG/CR-6475, "Resolution of the Direct Containment Heating Issue for Combustion Engineering Plants and Babcock & Wilcox Plants"; NUREG-6338, "Resolution of the Direct Containment Heating Issue for All Westinghouse Plants with Large Dry Containments or Subatmospheric Containments"; NUREG-6109, "The Probability of Containment Failure by Direct Containment Heating in Surry"; and NUREG-6075, "The Probability of Containment Failure by Direct Containment Heating in Zion," documented resolution of the issue for all large dry and subatmospheric PWR containments, on a plant specific basis. As a result of this research, we now know that the threat to containment integrity posed by DCH is vastly reduced and that DCH constitutes, for the overwhelming majority of plants, no substantive risk.

In a light water reactor core melt accident, if the reactor vessel fails while the reactor coolant system (RCS) is at high pressure, the ejection of the core debris into the containment atmosphere will cause the containment pressure to rise, and may result in early failure of the containment. Resolution of the DCH issue has been achieved by demonstrating that either the containment failure probability is highly unlikely based on the containment's strength alone (the case for virtually all PWRs with large dry and subatmospheric containments) or that the conditional probability of high pressure melt ejection leading to DCH, together with the containment strength, leads to acceptably small containment failure probabilities and a small probability of large early release.

The recent ice condenser study, peer reviewed by renowned experts in nuclear safety (as were earlier studies), concluded that the ice condenser plants are more vulnerable to early containment failure than large dry containments, but that this vulnerability is not due to DCH. In fact, early containment failure in ice condensers was dominated by non-DCH hydrogen combustion events rather than by DCH, and was seen to largely depend on plant specific probabilities for station blackout (ice condenser igniter systems are not operable during station blackout events). Even though the ice condenser plants were determined to be vulnerable to

blackout sequences, the weighted probability of early containment failure (i.e., averaged over all full power internal events), was generally within the goal for containment performance.

The implications of higher conditional failure probabilities for ice condenser plants, as well as BWR Mark III plants, during station blackout sequences will be considered as part of the initiative to risk inform Part 50.44 on an accelerated schedule.

General insights from the DCH research program include the confirmation that large integral testing, properly scaled, is particularly important to resolving difficult issues because of the ability to incorporate plant design characteristics which influence phenomenological behavior. Additionally, the research on DCH resolution for ice condensers confirmed the value of integrating the plant specific probabilistic treatments with more detailed phenomenological analysis. A research information letter will be developed describing in greater detail the technical findings of our overall DCH research program along with insights for regulatory applications.

With the publication of NUREG/CR-6427, the NRC has completed an important body of work to address, in a more realistic and integral fashion, the threat from a postulated failure mechanism once viewed to be dominant. The resolution of DCH is consistent with the agency performance objectives of maintaining safety without imposing unnecessary regulatory burden on licensees. This was accomplished by introducing realism in the analysis and peer reviewing the analysis.

Attachment: As stated

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