STATUS OF STAFF ACTIVITIES TO RESOLVE GENERIC SAFETY ISSUE 189, "SUSCEPTIBILITY OF ICE CONDENSER AND MARK III CONTAINMENTS TO EARLY FAILURE FROM HYDROGEN COMBUSTION DURING A SEVERE ACCIDENT"

BACKGROUND

GSI-189 concerns the need for a backup power supply to the hydrogen igniters for combustible gas control during station blackout-related severe accidents in pressurized water reactors (PWRs) with ice condenser containments and boiling water reactors (BWRs) with Mark III containments. (The NRC staff prefers the use of the phrase "reliable power to operate the hydrogen igniters during an SBO," but uses the term "backup power" in this paper when citing earlier documents involving GSI-189.) During station blackout (SBO) accidents, the hydrogen igniters are unavailable, and hydrogen inside containment can rise to levels at which hydrogen deflagration or detonation may occur. In 1985, the Commission required by rulemaking (50 FR 3498; January 25, 1985) that the 13 susceptible units (4 dual-unit and 1 single-unit ice condenser containment plants and 4 single-unit Mark III containment plants) be retrofitted with a hydrogen control system (e.g., alternating-current (AC)-powered igniters) to limit hydrogen concentration. The unavailability of the igniters during an SBO event does not affect the core damage frequency (CDF), but does affect the likelihood of a significant release of radioactive material to the environment from early containment failure if the SBO event progresses to severe core damage.

In the statements of consideration for the 1985 rule (50 FR 3498) that required Mark III BWR and PWR ice condenser containments be provided with a hydrogen control system, the Commission did not require that backup power be provided. The Commission stated: "The staff has accepted ac-powered igniters without requiring a backup supply to the two examples cited above. The judgment was based upon the staff's perception that the incremental risk reduction associated with provision of the igniter system backup power supply did not warrant the additional cost at these particular facilities. Provision of a backup power supply is not required by this rule."

More recent severe accident risk and containment performance evaluations (e.g., NUREG/CR-6427, "Assessment of the Direct Containment Heating Issue for Plants With Ice Condenser Containments," April 2000) have shown a possibly greater risk reduction with backup power provided to igniters than previously estimated. The staff therefore concluded that further action on this issue was justified. In SECY-00-198, "Status Report on Study of Risk-Informed Changes to the Technical Requirements of 10 CFR Part 50 (Option 3) and Recommendations on Risk-Informed Changes to 10 CFR 50.44 (Combustible Gas Control)," dated September 14, 2000, the staff recommended that combustible gas control safety enhancements that could pass the backfit test be assessed for mandatory implementation through the generic issues program. The Commission approved the staff's recommendations in a staff requirements memorandum dated January 19, 2001. Subsequently, providing backup power to the hydrogen igniters was formally identified as GSI-189.

In accordance with the "initial screening stage" of Management Directive 6.4, "Generic Issues Program," the Office of Nuclear Regulatory Research (RES) staff determined in February 2002, that this generic issue passes the screening criteria and should go on to the technical assessment stage. This decision was based on the change in large early release frequency (LERF) for PWR ice condenser and BWR Mark III containment designs, and on the change in risk (as measured by person-rem per year) for the ice condenser designs. Subsequently, RES conducted a technical assessment that included targeted plant analyses. The analyses were then used as the basis of a preliminary cost-benefit assessment of the susceptible plants. However, the results of the analyses suggested that there were large uncertainties, particularly on the benefit side of the equation, and that the results were highly sensitive to plant-specific considerations.

On June 6, 2002, the staff met with the Advisory Committee on Reactor Safeguards (ACRS) and the industry to discuss the results of the RES technical assessment. The ACRS recommended that RES complete the additional analyses to quantify the uncertainties before giving the technical assessment results to NRR, and that NRR should factor the uncertainties into the final resolution of GSI-189. On November 7, 2002, RES again briefed the ACRS and industry, and stated that further regulatory action was needed to resolve GSI-189 based on the findings of the technical assessment. In a November 13, 2002, letter to Chairman Merserve, the ACRS agreed that further regulatory action was warranted and recommended providing backup power to the igniters through the licensees' Severe Accident Management Guidelines (SAMGs), rather than by a rule or order. The Office of the Executive Director for Operations (EDO) responded to the ACRS in a January 14, 2003, letter stating that the NRR staff would engage the affected licensees to develop additional information to assess various alternatives, including the option of using SAMGs.

The staff and the industry discussed the feasibility of using SAMGs to resolve GSI-189 at a public meeting on June 18, 2003. They also discussed the possibility of a rulemaking to resolve this issue. Licensees said that the use of SAMGs to resolve GSI-189 was inappropriate because backup power to the hydrogen igniters must be provided early in the accident sequence, but SAMGs are not implemented until late in the accident sequence. The licensees said that any procedures to power the igniters would probably be incorporated in their emergency operating procedures. On November 6, 2003, the NRR staff briefed the ACRS on the status of GSI-189, and said that SAMGs could not be used to resolve this issue. At this meeting, the industry also requested that staff develop design criteria for the backup power supply. In a November 17, 2003, letter to Chairman Diaz, the ACRS recommended that NRR proceed with rulemaking to require backup power to the hydrogen igniters for PWR ice condensers and BWR Mark III plants, and said this action was justified on a defense-in-depth basis. In a December 24, 2003, letter, the staff agreed with the recommendation to proceed with rulemaking.