UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

August 1, 1997

NRC INFORMATION NOTICE 97-60: INCORRECT UNREVIEWED SAFETY QUESTION DETERMINATION RELATED TO EMERGENCY CORE COOLING SYSTEM SWAPOVER FROM THE INJECTION MODE TO THE RECIRCULATION MODE

Addressees

All holders of operating licenses or construction permits for pressurized-water reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to an instance in which a licensee has incorrectly determined that changes to its emergency core cooling system (ECCS) swapover procedures that resulted in interruption of flow and a consequent core heatup in the long-term cooling phase of a potential loss-of-coolant accident (LOCA) did not involve an unreviewed safety question (USQ). It is expected that recipients will review this information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

On May 1, 1989, a license amendment was issued approving a semi-automatic ECCS swapover procedure for Salem Nuclear Unit 2. This procedure provided the plant with the capability to switch the ECCS suction from the refueling water storage tank (RWST) to the containment sump (i.e., from the injection mode of operation to the recirculation mode of operation) without interruption of ECCS flow to the core. It further provided continuous suction to the high-head safety injection (HHSI) and intermediate-head safety injection (IHSI) pumps. The semi-automatic swapover design provided this capability by automatically completing the following steps: (1) opening the suction line valves between the residual heat removal (RHR) pump and the sump; (2) starting component cooling water to the RHR heat exchangers; (3) opening the suction crosstie valves between the HHSI and IHSI pumps; and (4) when the sump line valves are fully open, closing the suction line to the RWST. Manual

operator action was still required to align the suction of the HHSI and IHSI pumps to the discharge of the RHR pumps (i.e., the piggy-back mode of operation) and to trip the containment spray pumps. Subsequently, both the licensee's individual plant examination and the NRC technical evaluation report on Salem human reliability analysis issued in August 1995 identified ECCS swapover as one of the most risk-significant operator actions for Salem.

For Salem Unit 2, ECCS swapover is initiated when the level in the RWST reaches the low-level alarm setpoint. In addition, to prevent vortexing in the RWST and to protect the ECCS pumps, emergency operating procedures (EOPs) direct operators to trip all ECCS pumps taking suction from the RWST if the RWST low-low level alarm setpoint is reached. Therefore, the maximum time available for successful completion of ECCS swapover is the time that it would take the RWST to drain from the low-level alarm setpoint to the low-low level alarm setpoint. In 1995 and 1996 the licensee performed evaluations that considered: (1) uncertainties in specific operator action times, (2) the introduction of "three-point" communications, (3) higher than previously assumed containment spray pump flow, and (4) the identification of more limiting single-failure scenarios. The licensee concluded that under certain accident conditions, the operators may not be able to complete the swapover before reaching the low-low level alarm setpoint. For such scenarios, the operators would be directed to trip the ECCS pumps taking suction from the RWST, thereby interrupting ECCS flow to the core.

The licensee's analyses for the small break loss-of-coolant accident (SBLOCA) and accumulator line break accidents allotted the operators 11.8 minutes and 12.9 minutes, respectively, for completing the ECCS swapover procedure from the point that the RWST level reaches the low-level alarm setpoint. Licensee calculations showed that the low-low level alarm setpoint would be reached at 10 minutes for the SBLOCA and 7.9 minutes for the accumulator line break. As discussed above, this is the point at which the operators are directed to stop all ECCS pumps taking suction from the RWST, thereby interrupting ECCS flow to the core. Therefore, for the balance of the time allotted for completing the swapover procedure (i.e., 1.8 minutes for the SBLOCA and 5 minutes for the accumulator line break), core cooling would have to be provided without ECCS flow. The licensee evaluated these changes to the swapover procedure, including the introduction of interruption of ECCS flow, pursuant to 10 CFR 50.59 and determined that the changes did not involve a USQ. Accordingly, the licensee implemented the changes without NRC staff approval.

The NRC became aware of the above-described changes to Salem Unit 2's semi-automatic ECCS swapover procedure during a special NRC inspection conducted between March 24 and April 17, 1997. The inspectors were concerned with the introduction of interruption of flow into the ECCS swapover procedure as the NRC staff had not reviewed this approach for Salem Unit 2. Additionally, the inspectors were concerned about the potential for such scenarios to violate the requirement contained in 10 CFR 50.46(b)(5), "Long term cooling."

Discussion

Pursuant to 10 CFR 50.59, a licensee may make changes in its facility and procedures as described in the safety analysis report (SAR) without prior Commission approval, unless the proposed change involves a USQ. In part, 10 CFR 50.59 states that changes shall be deemed to involve a USQ if the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the SAR may be increased, or if a possibility for a malfunction of a different type than any evaluated previously in the SAR may be created.

The changes to the swapover procedure in the Salem case introduced reliance on manual operator actions, where such actions were not previously required to stop and restart ECCS pumps, and reliance on ECCS pumps to restart shortly after being stopped during an accident.

This was contrary to the intent of the 1989 design change, which was to increase the reliability of ECCS swapover by automating certain features, so that the RHR pumps would not have to be stopped and restarted, and reduce susceptibility to human error in ECCS swapover. As a result of the inspection findings, the staff evaluated these changes and found them to have increased the probability of a malfunction of equipment important to safety in that the changes provide additional opportunities for operator error, especially considering the conditions and the time constraints under which the operators would be working. In addition, restarting ECCS pumps shortly after they have been stopped involves uncertainties as to whether the pumps will restart and is not recommended by pump vendors. Therefore, an increase in the probability of malfunction of the ECCS pumps was also introduced. On the basis of the above discussion, the staff concluded in Inspection Report 50-311/97-11 that these changes did involve a USQ.

In addition, the interruption of flow during ECCS swapover could potentially result in another fuel uncovery following the initial blowdown and reflood phase of a LOCA. Consequently, the fuel could reheat during that phase of the accident. Therefore, such an interruption of ECCS flow could violate the long-term cooling requirement of 10 CFR 50.46 (b)(5). Additional cycling of the fuel (i.e., introduction of heatups in the long-term cooling phase of the accident) also increases the probability of cladding failure and therefore involves a USQ as defined in 10 CFR 50.59. For the Salem case, the licensee evaluated the effects of the interruption of flow on the core. The licensee wanted to maximize the time available to the operators to complete the swapover. The allowable times for flow interruptions as noted above were calculated on the basis of maintaining the core under water to avoid core heating. The licensee has since implemented EOP changes to allow operators to complete the swapover without interruption of flow. In addition, the licensee verified through simulator exercises that all operating crews could perform the revised EOPs well within the time frame required to prevent interruption of flow. The NRC found the licensee's actions to resolve these issues to be acceptable.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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OL = Operating License
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