

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

October 26, 1998

**NRC INFORMATION NOTICE 98-40: DESIGN DEFICIENCIES CAN LEAD TO
REDUCED ECCS PUMP NET POSITIVE
SUCTION HEAD DURING DESIGN-BASIS
ACCIDENTS**

Addressees

All holders of operating licenses for nuclear power reactors, except those licensees who have permanently ceased operations and have certified that fuel has been permanently removed from the vessel.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the fact that incorrect level instrument setpoints or other control deficiencies can render emergency core cooling system (ECCS) pumps inoperable during certain design-basis accidents. It is expected that recipients will review the 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

Oconee Nuclear Station

In late 1997, during a self-assessment audit of the high pressure injection (HPI) and low pressure injection (LPI) systems, the licensee noted that the design drawing for the borated water storage tank (BWST) did not have a zero reference point. Subsequently, the licensee's engineering staff determined that an elevation difference between the level transmitters and the instrument taps for the BWSTs of all three Oconee units had resulted in up to an 18-inch non-conservative error between indicated and actual BWST level. The difference was caused by a failure to compensate for instrument tap height when calibrating the BWST level instruments. At plant construction, the magnitude of the error was approximately 4 inches, but the error increased to approximately 18 inches following modifications in 1989 that replaced the BWST level transmitters. In addition, on February 19, 1998, the licensee's engineering staff determined that the emergency operating procedures (EOPS) did not adequately account for uncertainty in the reactor building emergency sump (RBES) wide-range level instruments,

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which could have resulted in the instruments reading up to 18 inches lower than the actual level. The RBES level instrument uncertainties were caused by inadequate design analysis. This was discussed in Inspection Report 50 50-269, 270, 287/98-12 and Licensee Event Report (LER) 50-269/98-04, Revision 1.

St. Lucie Nuclear Plant

During the Unit 1 steam generator replacement outage in 1997, the licensee replaced the engineered safety features actuation system (ESFAS) bistables. A system engineer later determined that the ESFAS recirculation actuation setpoint (RAS) bistable setpoint for the Refueling Water Tank (RWT) level was incorrect. An investigation of the discrepancy found that, during a setpoint calculation enhancement effort in 1993, a new calculation was created, which changed the span of the RWT level measurement and indication instrumentation loop. This calculation produced a new setpoint for the RWT level by revising the measurement span to indicate the actual tank level bottom as "0 feet". Previously, the measurement span indicated 0 at the 1-foot level where the RWT level instrument tap is located. The new setpoint information was not incorporated into the procedure used to calibrate the ESFAS bistables, resulting in a RAS setpoint of 3 feet from the tank bottom instead of 4 feet required by Technical Specifications. This was discussed in Inspection Report 50-335, 389/97-16 and LER 50-335/97-11.

H.B. Robinson Nuclear Plant

Between April 7 and May 23, 1997, NRC conducted a design inspection at Robinson and raised several Refueling Water Storage Tank (RWST) instrumentation related issues that impacted ECCS components. Plant Emergency Operating Procedures (EOPs) directed all ECCS pumps, except one safety injection (SI) pump and one containment spray (CS) pump, to be stopped when the RWST level reached 27 percent. The remaining SI and CS pumps were directed to be stopped when the RWST level reached 9 percent. The plant evaluated and modified the number of SI pumps starting following a LOCA. The modification resulted in two (as opposed to three) SI pumps starting following a LOCA. With two SI pumps getting a start signal, and assuming a single active failure of one SI pump, the NPSH requirement for the running SI pump was higher, and this higher NPSH requirement was not considered in the modification. A calculation to determine the level at which vortexing became a concern had not been performed prior to the modification. The licensee regained the margin by reducing instrument uncertainties and by raising the water level in the RWST.

The NRC design team also found that the containment sump level setpoints utilized channel uncertainty for normal environmental conditions rather than the adverse conditions that could exist in the containment after an accident. This had the potential for adversely affecting residual heat removal (RHR) pumps in the recirculation mode of operation. These items were discussed in Inspection Report 50-261/97-201 and LER 50-261/97-08.

Discussion


In the Oconee Nuclear Station's Final Safety Analysis Report (Sections 6.2 and 6.3), the licensee states that during certain loss-of-coolant accidents, reactor operators must be capable of manually providing a flowpath from either the BWST or the RBES to the HPI, LPI and reactor

building spray (RBS) pumps. The errors described above created a conflict between the BWST and RBES levels specified in the EOPs and the BWST and RBES levels indicated in the control room. As a result, during certain design-basis accident scenarios, including small-break LOCAs, the level errors could have delayed swapover initiation. This could have caused vortexing in the BWST or reduced NPSH to the ECCS pumps, or both.

The design basis of the St. Lucie facility requires that during certain LOCAs, ECCS subsystems must be capable of automatically transferring suction to the containment sump on receipt of a RAS. Because of the incorrect trip setpoint of the RWT level instrument bistables, automatic transfer of the ECCS pumps' suction source from the RWT to the containment sump, under certain conditions, would cause an open-channel flow condition. Without operator intervention to initiate manual transfer to the containment sump before the open-channel condition, damage to the ECCS pumps could occur as a result of air entrainment.

At H.B. Robinson, the cause of the reduction in SI pump NPSH was a failure to adequately assess the impact of single SI pump operation on system flow and NPSH during a 1988 modification. Inadequate NPSH to ECCS pumps could have led to the inoperability of critical safety-related systems and loss of core cooling under some design-basis LOCA conditions. The preceding examples demonstrate the importance of thorough assessment and analysis for any modification involving safety-related level instrumentation or ECCS pump operating conditions. Information Notice 98-22, "Deficiencies Identified During NRC Design Inspections," dated June 17, 1998, also described ECCS swapover analysis errors at D.C. Cook, H.B. Robinson, Three Mile Island, Wolf Creek, and Ginna.

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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Information Notice No.	Subject	Date of Issuance	Issued to
98-39	Summary of Fitness-for-Duty Program Performance Reports for Calendar Years 1996 and 1997	10/26/98	All holders of operating licenses for nuclear power reactors
98-38	Metal-Clad Circuit Breaker Maintenance Issued Identified By NRC Inspections	10/15/98	All holders of operating licenses for nuclear power reactors.
98-37	Eligibility of Operator License Applicants	10/01/98	All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.
98-36	Inadequate or Poorly Controlled Non-Safety-Related Maintenance Activities Unnecessarily Challenged Safety Systems	9/18/98	All holders of operating licenses for nuclear power reactors
98-35	Threat Assessments and Consideration of Heightened Physical Protection Measures	9/4/98	All U.S. NRC fuel cycle facilities power and non-power reactor licensees (Safeguard issues, not for public disclosure.)
98-34	NRC Configuration Control Errors	8/28/98	All holders of Operating licenses for nuclear power reactors, except for those who have ceased operations and have certified that fuel has been permanently removed from the reactor vessel

OL = Operating License
CP = Construction Permit

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The design basis of the St. Lucie facility requires that during certain LOCAs, ECCS subsystems must be capable of automatically transferring suction to the containment sump on receipt of a RAS. Because of the incorrect trip setpoint of the RWT level instrument bistables, automatic transfer of the ECCS pumps' suction source from the RWT to the containment sump under certain conditions would cause an open channel flow condition. Without operator intervention to initiate manual transfer to the containment sump before the open channel condition, damage to the ECCS pumps could occur as a result of air entrainment.

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