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

May 28, 1998

NRC GENERIC LETTER 98-02: LOSS OF REACTOR COOLANT INVENTORY AND ASSOCIATED POTENTIAL FOR LOSS OF EMERGENCY MITIGATION FUNCTIONS WHILE IN A SHUTDOWN CONDITION

Addressees

All holders of operating licenses for pressurized-water reactors (PWRs), except those who have permanently ceased operations, and have certified that fuel has been permanently removed from the reactor vessel.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this generic letter to request that addressees (1) assess the susceptibility of their residual heat removal (RHR) and emergency core cooling (ECC) systems to common-cause failure as a result of reactor coolant system (RCS) draindown while in a shutdown condition, and (2) submit certain information, pursuant to Section 50.54(f) of Title 10 of the *Code of Federal Regulations* (10 CFR 50.54(f)), concerning their findings regarding potential pathways for inadvertent RCS drain-down and the suitability of surveillance, maintenance, modification and operating practices and procedures regarding configuration control during reactor shutdown cooling. The requested information will enable NRC staff to verify whether addressees comply with NRC regulatory requirements and conform with current licensing bases for their facilities, with regard to prescribing and accomplishing activities affecting quality per Criterion V of Appendix B to 10 CFR Part 50. The staff is specifically concerned about addressees' controls over the conduct of activities during hot shutdown conditions that may affect the safety-related functions of the RHR system and the ECCS, for example, the methods used to verify valve position, the controls in place to assure compliance with plant surveillance, maintenance, modification and operating procedures, and the adequacy of operator training for such activities.

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Discussion

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The NRC issued Information Notice (IN) 95-03, "Loss of Reactor Coolant Inventory and Potential Loss of Emergency Mitigation Functions While in a Shutdown Condition," on January 12, 1995, to alert addressees to an incident at the Wolf Creek plant involving the loss of reactor coolant inventory while the reactor was in a hot shutdown condition. In that event, operators were attempting to reborate RHR train B, while at the same time maintenance personnel were repacking an RHR train A-to-train B crossover isolation valve. Train B is reborated by recirculating water through a loop that contains the RHR system piping, the

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refueling water storage tank (RWST), a containment spray pump, a manual RWST isolation valve, and an RHR system crossover line. When the RWST isolation valve was opened for the reboration process and the train A-to-train B crossover isolation valve was opened for stroke testing, a drain-down path was inadvertently created from the RCS to the RWST.

At Wolf Creek, all RHR and ECC system pump suction lines are tied into a common suction header. When the draindown event occurred, hot RCS water was introduced into this common suction header between the RWST and the RHR and ECC system pumps. This hot water flashed to steam, resulting in a steam/water mixture in the header. Had an ECCS actuation occurred, this mixture would have been introduced into the suction of the ECCS pumps. If operators had not been able to terminate the event, the hot water in the RWST suction piping might have led to steam binding, which could have adversely affected the pumps in both ECCS trains. In addition, water flashing to steam in the header and the RWST could have caused serious mechanical damage to the RHR piping and the RWST as a result of water hammer. Finally, steaming through the RWST establishes a containment bypass path.

The licensee estimated (using actual plant conditions) that for an unmitigated event, the reactor vessel water level could have drained to the bottom of the hot leg within 5 minutes and, as a consequence, RHR pump A would have lost suction, cavitated, and failed. Shortly thereafter, the common ECCS suction header could have reached a 90-percent steam/water ratio. The licensee also estimated that continued boil-off could have caused the pressure vessel water level to drop to the point of core uncovery in less than 1 hour.

Events of this nature are considered particularly significant because they can result in loss of emergency core cooling capability and involve the potential for containment bypass. On March 25, 1996, the staff issued a supplement to IN 95-03 that further analyzed the event. The NRC has also issued a number of other communications describing events at reactor facilities involving inadvertent loss of reactor coolant inventory while the reactor was in a shutdown condition. The Office for Analysis and Evaluation of Operational Data (AEOD) published AEOD/E704, "Discharge of Primary Coolant Outside of Containment at PWRs While on RHR Cooling," in March 1987, which documented six events involving RCS backflow into the RWST. In Generic Letter 88-17, "Loss of Decay Heat Removal (DHR) 10 CFR 50.54(f)," dated October 17, 1988, the NRC requested several actions to address loss-of-DHR events that occurred while reactors were in a shutdown condition. In IN 91-42, "Plant Outage Events Involving Poor Coordination Between Operations and Maintenance Personnel During Valve Testing and Manipulations," dated June 27, 1991, the NRC discussed inadvertent loss-of-inventory events. The AEOD report "Reactor Coolant System Blowdown at Wolf Creek on September 17, 1994," (AEOD/S95-01), dated March 1995, noted 19 events in which RCS water was transferred to the RWST. These events were primarily caused by personnel errors, poor coordination between operations and maintenance personnel, and inadequate procedures associated with the operation of the RHR system in the shutdown cooling mode. The personnel errors were primarily caused by inattention or lack of training; while the procedural deficiencies were related to omissions or lack of specificity in sequential valve operations when conducting tests on the RHR system. On the basis of this history and the potential for containment bypass, the staff has concluded that additional information is required to confirm the adequacy of existing configuration control, operating practices, and training for assuring the safety function capability of the RHR and ECC systems.

Required Information

Within 180 days of the date of this generic letter, addressees are required to perform the following: (1) an assessment of whether your emergency core cooling systems include certain design features, such as a common pump suction header, which can render the systems susceptible to common-cause failure as a result of events similar to the Wolf Creek RCS drain-down event of September 17, 1994; and if this susceptibility is found, (2) prepare, with consideration of plant-specific design attributes, a description of the features of your Appendix B quality assurance program (for example, the methods used to verify valve position, the controls in place to assure compliance with plant surveillance, maintenance, modification and operating procedures, and the adequacy of operator training for such activities) that provide assurance that the safety-related functions of the RHR system and ECCS will not be adversely affected by activities conducted at hot shutdown (such as occurred at Wolf Creek). Addressees may limit their attention to those surveillance, maintenance, modification and operational activities at hot shutdown during which it is feasible to divert RCS fluid to the RWST, resulting in simultaneous drain-down of the RCS and voiding in the suction header for the RHR and ECC system pumps. Addressees may further limit their response to the consideration of potential configurations and conditions that involve flow paths with pipe diameters equal to or greater than 2 inches. If the assessment performed in response to part (1) of the above requested information does not reveal that a susceptibility exists, then no submittal is necessary.

If the assessment performed in response to part (1) of the above required information reveals that the susceptibility exists, then the result of the assessment shall be submitted in writing, pursuant to 10 CFR 50.54(f) and 10 CFR 50.4, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555-0001, signed under oath or affirmation under the provisions of Section 182a of the Atomic Energy Act of 1954, as amended, with a copy to the appropriate regional administrator and the appropriate NRC resident inspector. The response to part (2) of the above information request need not be submitted to the NRC. However, responses to parts (1) and (2) of the required information shall be kept in a retrievable licensee system that NRC can verify on an as-needed or sample basis.

Backfit Discussion

This generic letter only requests information from the addressees under the provisions of Section 182a of the Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f), to verify addressee compliance with the Commission's regulations and conformance with the current licensing-basis of their respective facilities relative to the safety-related functions of the RHR and ECC systems, and the requirements of Appendix B to 10 CFR Part 50. With respect to Appendix B to 10 CFR Part 50, the requested information will enable the NRC staff to determine whether adequate control is being exercised over surveillance, maintenance, modification and operational activities conducted at hot shutdown which can adversely affect the safety-related functions of the RHR and ECC systems. No backfit is either intended or approved in the context of issuance of this generic letter. Therefore, the staff has not performed a backfit analysis.

Quality Assurance Criterion V of Appendix B to 10 CFR Part 50 requires that "activities affecting quality shall be prescribed by documented instructions, procedures, or drawings of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings." Furthermore, licensees' technical specifications include requirements to establish, implement, and maintain written administrative procedures to address startup, operation, and shutdown of a shutdown cooling system. Maintenance and testing activities at Wolf Creek during hot shutdown were carried out contrary to documented procedures and the technical specifications, resulting in RCS drain-down and the potential for common-cause failure of the RHR and ECC system pumps, which could have compromised the ability of the RHR and ECC systems to fulfill their safety functions. Furthermore, the staff has determined that similar loss-of-coolant events while on RHR cooling have occurred at over 19 plants. These events were due to the failure on the part of licensees to either establish adequate procedures or follow procedures and applicable technical specifications. Both of these conditions involve non-compliance with the requirements of Criterion V of Appendix B to 10 CFR Part 50, and, therefore, non-compliance with the current licensing basis for a facility. Since, a relatively large number of the operating PWRs have experienced similar events, the staff believes that additional information is required to confirm the adequacy of existing configuration control practices, operating practices, and training for assuring the safety function capability of the RHR and ECC systems. In accordance with the provisions of 10 CFR 50.54(f), an approved evaluation of the rationale for the information request contained herein is not a prerequisite to issuance of the generic letter because the information being requested is needed by the NRC staff to verify addressee compliance with the current licensing bases of their respective facilities.

Federal Register Notification

A notice of opportunity for public comment was published in the *Federal Register* (62 FR 7075) on February 14, 1997. Comments were received from four nuclear utility companies, the Nuclear Energy Institute, and the Nuclear Utility Backfitting and Reform Group. The staff's evaluation of the comments is available from the NRC Public Document Room. The generic letter has been appropriately revised to reflect the comments received.

Paperwork Reduction Act Statement

This Generic Letter contains information collections that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These information collections were approved by the Office of Management and Budget, approval number 3150-0011, which expires - September 30, 2000.

The public reporting burden for this mandatory information collection is estimated to average 80 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. The U.S. Nuclear Regulatory Commission is seeking public comment on the potential impact of the information collections contained in the generic letter and on the following issues:

1. Is the proposed information collection necessary for the proper performance of the functions of the NRC, including whether the information will have practical utility?

2. Is the estimate of burden accurate?

3. Is there a way to enhance the quality, utility, and clarity of the information to be collected?

4. How can the burden of the information collection be minimized, including the use of automated collection techniques?

Send comments on any aspect of this information collection, including suggestions for reducing the burden, to the Information and Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet electronic mail at BJS1@NRC.GOV; and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0011), Office of Management and Budget, Washington, DC 20503.

Public Protection Notification

If an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

If you have any questions about this matter, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

Original signed by

Jack W. Roe, Acting Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

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OFFICE	SXRB*		OGC*		PECB*		(A)D:DRPM	
NAME	MRazzaque		JGoldberg		JStolz		JRoe	
DATE	5/27/98		3/16/98		5/27/98		5/28/98	

LIST OF RECENTLY ISSUED GENERIC LETTERS

GENERIC LETTER	SUBJECT	DATE OF ISSUANCE	ISSUED TO
98-01	Year 2000 Readiness of of Computer Systems at Nuclear Power Plants	05/12/98	All holders of OLS for nuclear power plants, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel
97-06	Degradation of Steam Generator Internals	12/30/97	All holders of OLS for pressurized-water reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel
97-05	Steam Generator Tube Inspection Techniques	12/17/97	All holders of OLs for pressurized-water reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel
96-06, Sup. 1	Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions	11/13/97	All holders of OLs for nuclear power reactors except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel

OP = Operating License
CP = Construction Permit
NPR = Nuclear Power Reactors

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Management

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