

# NRC INSPECTION MANUAL

SRXB

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Temporary Instruction 2515/142

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## DRAINDOWN DURING SHUTDOWN AND COMMON-MODE FAILURE (NRC GENERIC LETTER 98-02)

FUNCTIONAL AREA: ENGINEERING (ENG)

APPLICABILITY: This Temporary Instruction (TI) is to be performed at one Pressurized Water Reactor (PWR) unit per site, with confirmation of implementation at all other PWR units.

2515/142-01 OBJECTIVE

The Objective of this TI is to confirm that licensees: (1) have searched for potential draindown paths that could be created by operator error or equipment failures, and which could lead to a common-cause failure of residual heat removal (RHR) and emergency core cooling (ECC) system pumps, and if found susceptible, (2) have taken adequate measures to reduce the likelihood of a draindown similar to that of the Wolf Creek event of September 17, 1994.

2515/142-02 BACKGROUND

As discussed in Generic Letter (GL) No. 98-02 "Loss of Reactor Coolant Inventory and Associated Potential for Loss of Emergency Mitigation Functions While in a Shutdown Condition," (reference 1) which was issued pursuant to 10 CFR 50.54(f), the staff is concerned that the potential exists for common mode failure of the RHR and ECC system pumps following a loss of reactor coolant inventory while in a shutdown condition (such as occurred at Wolf Creek). On January 12, 1995, the staff issued Information Notice (IN) 95-03, "Loss of Coolant Inventory and Potential Loss of Emergency Mitigation Functions While in a Shutdown Condition," (reference 2) to alert addressees to an incident at Wolf Creek involving the loss of reactor coolant inventory while the reactor was in a shutdown condition. On March 25, 1996, the staff issued a supplement to IN 95-03 (reference 3) that further analyzed the event and provided additional insights. These insights also heightened awareness of the safety significance of similar events. As discussed in the above mentioned references, events of this nature are considered safety significant because they can result in the inadvertent loss of a significant quantity of reactor coolant, the rapid and uncontrolled cooldown and depressurization of the RCS, loss of emergency core cooling capability, and also involve the potential for containment bypass. The draindown event at Wolf Creek represents a shutdown vulnerability which was not previously recognized.

At Wolf Creek, all RHR and ECC system pump suction lines are supplied by 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, the flow path from the RCS through the RWST establishes a containment bypass path.

GL 98-02 requested that the addressees (1) perform an assessment to determine if their 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 their 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.

2515/142-03

## INSPECTION REQUIREMENTS

Review the assessment performed by all PWR licensees in response to GL-98-02 requirements, and their conclusions, to determine whether their 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 that of the Wolf Creek RCS drain-down event of September 17, 1994. If the licensee's assessment reveals that a susceptibility exists, then verify that the features of licensee's Appendix B quality assurance program has been implemented such that the likelihood of a draindown similar to that of the Wolf Creek is minimized. Such features of quality assurance program may include the methods used to verify valve position, the controls in place to assure compliance with plant surveillance, maintenance, modification and operating procedures, and the 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. At one PWR unit per site, perform a more detailed evaluation to verify implementation of the licensee's operational controls at hot shutdown as follows:

03.01 Review the licensee's assessment and conclusions to determine whether their emergency core cooling systems were susceptible to the common-cause failure similar to that of the Wolf Creek event. If it was determined that the susceptibility did not exist, then no further inspection is required. Otherwise, continue the inspection as instructed below.

03.02 Verify implementation of the licensee's documented operating practices and procedures, and training requirements performed to support implementation of their quality assurance

program. This may include a review to verify implementation of any modifications made or planned in the licensee's Appendix B program. The inspector's review shall include, but need not be limited to the following:

- a. Licensee's design features and/or administrative controls in place or planned to prevent inadvertent RCS draindown in the shutdown mode caused by misoperation of valves. This review shall include verifying installation of devices, if any, such as padlocks for valves or interlocks to prevent overlapping valve manipulation, or any other modifications implemented or planned to be implemented. For example, the misaligned valves during Wolf Creek event were the RHR cross-over isolation valves (HV- 8716A & HV-8716B) and the boron recirculation valve (BN-8717). [See Figure 1 for a simplified diagram of the RHR and the RWST systems at Wolf Creek plant.] The boration of one RHR train (with BN-8717 open) concurrent with testing of valve HV-8716A in the other operating train should not have been permitted.
- b. Configuration controls in place to prevent RCS draindown during shutdown, particularly to prevent RCS draindown to the water supply line for the RHR and ECC system pumps.
- c. Changes made, if any, in the licensee's maintenance and surveillance program. This shall include changes to the licensee's In-Service Testing (IST) program and Appendix J testing program.
- d. Changes made to the operating practices and procedures used during shutdown mode. This shall include changes in the boron concentration requirement in the RHR procedures to minimize the need to perform a boration evolution while shutting down. In addition, any modifications made to procedures for the use of the RHR-RWST discharge line (at Wolf Creek, it connects the RHR crossover line to the common header line from the RWST) for RHR boration.

03.03 Identify and verify implementation of any corrective actions taken by the license for human factor contributors to the initiation of the event, such as:

- a. Enhanced training may be required to alert operators of a potential RCS blowdown resulting in a common-cause failure of the RHR and ECC system pumps should a misalignment occur such as occurred at Wolf Creek with valves HV-8716A, HV-8716B and BN-8717. Operating procedures may be revised to perform additional valve checks to ensure an appropriate flow path is established when starting an RHR pump and when placing a train on recirculation to the RWST.
- b. On the relevant valves, placards may be installed that require the operators to follow certain steps before opening any of those valves. For example, at Wolf Creek, a placard could have been installed on BN-8717 which would have directed the operator to check with the Control Room that valves HV-8716A and HV-8716B are in the appropriate position to prevent inadvertent transfer of water from the RCS to the RWST. Likewise, placards on valves HV-8716A and HV-8716B could have directed operators to verify the appropriate positions of the other valve and BN-8717 before opening either of these valves.
- c. The licensee's "Incident Investigation Team Report" on the Wolf Creek event may be placed in the required reading file for operators, and a continuing feedback be provided to planners and schedulers of refueling outages. The Training program may include this report in the operator training syllabus.

2515/142-04

GUIDANCE

No guidance is provided.

2515/142-05

REPORTING REQUIREMENTS

The inspection findings will be documented in a routine inspection report. Send a copy of the inspection report to Jared Wermiel, Chief, Reactor Systems Branch, NRR, OWFN, 10-B-3.

2515/142-06

COMPLETION SCHEDULE

The inspection requirements of this TI are to be completed within one year from the date of issuance.

2515/142-07

EXPIRATION

This temporary instruction will remain in effect until September 30, 2000.

2515/142-08

CONTACT

Please address general questions regarding this temporary instruction to M. Razzaque at (301)-415-2882.

2515/142-09

STATISTICAL DATA REPORTING

Record actual inspection time to 2515/142 for the regulatory information tracking system (RITS) with an IPE code of SI.

2515/142-10

ORIGINATING ORGANIZATION INFORMATION

10.01 Organizational Responsibility. The Reactor Systems Branch (SRXB) originated this temporary instruction.

10.02 Resource Estimate. The estimated number of onsite inspection hours necessary to complete this temporary Instruction is 8 hours, if the plant was determined not to be vulnerable, and 36 hours if it was determined to be vulnerable.

10.03 Follow up Inspection. Use IP 62704 for inspection Follow up to this TI.

2515/142-11

TRAINING

No special training is planned for the conduct of this temporary instruction.

2515/142-12

REFERENCES

1. Generic Letter No. 98-02 "Loss of Reactor Coolant Inventory and Associated Potential for Loss of Emergency Mitigation Functions While in a Shutdown Condition," May 28, 1998.

2. Information Notice 95-03 "Loss of Coolant Inventory and Potential Loss of Emergency Mitigation Functions While in a Shutdown Condition," January 12, 1995.

3. Supplement to Information Notice 95-03, March 25, 1996.

END

**Figure 1. Simplified residual heat removal-refueling water storage tank**

