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

December 5, 1997

NRC INFORMATION NOTICE 97- 83: RECENT EVENTS INVOLVING REACTOR COOLANT SYSTEM INVENTORY CONTROL DURING SHUTDOWN

Addressees

All holders of operating licenses for pressurized-water reactors (PWRs), except those licensees 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 information notice to alert addressees to two events involving inadequate control of reactor coolant system (RCS) inventory. 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

SEQUOYAH UNIT 1

At approximately 11 p.m. on March 23, 1997, with Sequoyah, Unit 1 in Mode 5 (cold shutdown), operators initiated a draindown of the unit from solid conditions intending to achieve a pressurizer level of approximately 25 percent. Operators were using cold-calibrated level instrumentation to monitor pressurizer level during the evolution, as specified in plant procedures.

The draindown was interrupted at approximately 1:50 a.m. on March 24, 1997, to perform a diesel generator test and was resumed at approximately 7 a.m. Throughout most of the draindown, the cold-calibrated level instrument provided level indications later found to be inaccurate, but continued to trend down along with actual pressurizer level. Plant operators did not recognize that the cold-calibrated instrument was providing erroneous indications and continued the draindown until the problem was discovered at approximately 7:45 a.m. when a member of the incoming operations crew recognized that the cold-calibrated instrument had stopped trending down and was holding steady at 38 percent level. The draindown was

stopped and charging flow was increased until the pressurizer was refilled to approximately 25 percent at 9:16 a.m. Approximately 3300 gallons of water were required to refill the pressurizer. During this event, shutdown cooling was not affected and the core remained covered.

The excessive draindown occurred as a result of erroneous level indications due to gas accumulating in the reference leg of the cold-calibrated instrument. The gas buildup occurred as a result of depressurization from approximately 325 psig to approximately 30 psig just before initiating the draindown. The rapid depressurization caused gas within the RCS water to come out of solution and displace approximately 182 inches of water from the instrument reference leg.

Hot-calibrated level instrumentation was also available to monitor pressurizer level during this evolution. Normally, from solid conditions to approximately 21 percent pressurizer level, the cold-calibrated level instrument reads lower than the hot-calibrated level instrument and, therefore, is the more conservative measure of pressurizer level. Both plant procedures and operator training instruct the operator to monitor the cold-calibrated instrument during draindown from solid conditions to 25 percent pressurizer level. During this event, however, the cold-calibrated instrument was reading higher than the hot-calibrated instrument due to the voided reference leg. Plant operators did not recognize that the relationship between the hot- and cold-level instruments was not correct and continued to rely on the cold-calibrated instrument as the primary level indicator.

Another reactor coolant system draindown event occurred on Unit 1 in 1993 when approximately 10,000 gallons of water were drained from the RCS as a result of inaccurate level indication caused by drainage of the reference leg of the cold-calibrated level instrument. In this case, level was lost in the reference leg as a result of leakage past an instrument vent valve. The corrective actions that were developed as a result of this event included modifications to plant procedures instructing the operators to utilize various pressurizer level indications during plant evolutions. However, these modifications were only implemented in the licensee's procedures for reduced inventory and not in the plant shutdown procedures, which were in use during the event.

ZION UNIT 2

On March 7, 1997, with Unit 2 in cold shutdown, the licensee identified a gas bubble in the reactor vessel head. It was discovered when an operator questioned the discrepancy between the computer trend plots for the volume control tank (VCT) and pressurizer levels. The head was vented and approximately 6900 gallons of water were required to refill the head. It was later determined that vessel level had decreased to approximately 2.6 feet below the vessel flange.

The source of the gas was the nitrogen blanket on the VCT. As nitrogen is water soluble, the nitrogen gas present in the free space of the VCT tends to dissolve in the VCT water volume until an equilibrium is established. Because the VCT temperature was lower than that of the RCS, the solubility of nitrogen in the RCS was less than that of the VCT. When water was

transferred from the VCT to the RCS, the water was heated, causing nitrogen gas to come out of solution and accumulate in the reactor vessel head.

Given the geometry and configuration of the facility, the plant conditions and the operating practices at that time, the potential existed for a void to have been created in the reactor vessel that could have impacted decay heat removal. Additionally, the accumulation of gas in the steam generators could have prevented the preferred alternative method of RCS cooling due to obstruction of primary natural circulation flow in the steam generators.

The Reactor Vessel Level Indicating System (RVLIS) was available but not in service during this event. The licensee's procedures did not require RVLIS to be in service and did not direct the operators to monitor RVLIS during this mode of operation (cold shutdown) nor during a loss-of-shutdown-cooling condition.

A precursor to this event occurred on Unit 1 in September of 1996 when Unit 1 experienced an unexpected gas accumulation in the reactor vessel head. The licensee initiated a root cause investigation. However, approval of the investigation and implementation of the corrective actions were postponed by plant management pending completion of the ongoing Unit 2 refueling outage. If the identified corrective actions had been implemented in a timely manner on both units, the March 7 event probably would not have occurred. Further, had the licensee more aggressively reviewed operating experience and applied industry lessons learned, both events might have been avoided.

Discussion

These events illustrate the importance of timely review of operating experience and prompt implementation of corrective actions. In each case, the timely review of previous events and implementation of corrective actions for those events, including modifications to operating procedures and operator training (in particular, procedures and training stressing the importance of monitoring and understanding the relationship between multiple level indicators) could have prevented these similar loss-of-RCS-inventory events. In addition to monitoring level indications, routine inventory balances provide another independent method to determine RCS inventory.

Related Generic Communications

Information Notice (IN) 96-65, "Undetected Accumulation of Gas in Reactor Coolant System and Inaccurate Reactor Water Level Indication During Shutdown," dated December 11, 1996.

IN 96-37, "Inaccurate Reactor Water Level Indication and Inadvertent Draindown During Shutdown," dated June 18, 1996.

IN 96-15, "Unexpected Plant Performance During Performance of New Surveillance Tests," dated March 8, 1996.

IN 95-03, "Loss of Reactor Coolant Inventory and Potential Loss of Emergency Mitigation Functions While in a Shutdown Condition," dated January 18, 1995.

Bulletin 93-03, "Resolution of Issues Related to Reactor Vessel Water Level Instrumentation in BWRs," dated May 28, 1993.

IN 94-36, "Undetected Accumulation of Gas in Reactor Coolant System," dated May 27, 1994.

IN 93-27, "Level Instrumentation Inaccuracies Observed During Normal Plant Depressurization," dated April 3, 1993.

IN 92-54, "Level Instrumentation Inaccuracies Caused by Rapid Depressurization," dated July 24, 1992.

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

JW Roe

Jack W. Roe, Acting Director
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LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
97-82	Inadvertent Control Room Halon Actuation Due to a Camera Flash	11/28/97	All holders of OLs for nuclear power reactors
97-81	Deficiencies in Failure Modes and Effects Analyses for Instrumentation and Control Systems	11/24/97	All holders of OLs for nuclear power reactors except those who have ceased operations and have certified that fuel has been permanently removed from the vessel
97-80	Licensee Technical Specifications Interpretations	11/21/97	All holders of OLs for nuclear power reactors
97-79	Potential Inconsistency in the Assessment of the Radiological Consequences of a Main Steam Line Break Associated with the Implementation of Steam Generator Tube Voltage-Based Repair Criteria	11/20/97	All holders of OLs for pressurized-water reactors implementing a steam generator tube voltage-based repair criteria in accordance with the guidance presented in Generic Letter 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking," issued August 3, 1995

OL = Operating License
CP = Construction Permit

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original signed by J.W. Roe
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