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

June 18, 1996

NRC INFORMATION NOTICE 96-37: INACCURATE REACTOR WATER LEVEL INDICATION AND INADVERTENT DRAINDOWN DURING SHUTDOWN

Addressees

All pressurized water reactor facilities holding an operating license or a construction permit.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to potential operational errors that may result in the inadvertent loss of reactor coolant system (RCS) inventory during refueling operations. 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 September 13, 1995, Surry Unit 1 was in a shutdown condition, cooled down, and depressurized, preparatory to a refueling outage. A pressurizer power-operated relief valve (PORV) and its block valve had been opened, connecting the pressurizer to the pressurizer relief tank (PRT) which was pressurized with nitrogen to 11 psig. The reactor head vent was open to the top of the reactor water level indicating standpipe through the vent connection to the PORV relief line (see Figure 1). The reactor coolant loop stop valves had been closed, isolating the steam generators and reactor coolant pumps from the reactor vessel and pressurizer. The water level in the reactor and pressurizer had been lowered to slightly below the level of the reactor vessel flange (elevation 18 feet) so that the vessel head studs could be de-tensioned. The pressurizer was empty, and the reactor coolant piping was full to part way up the surge line. The isolated portion of the "A" reactor coolant loop was being drained.

To install the cavity seal ring so that the cavity could be flooded up to permit lifting the reactor head, the reactor head vent was closed and the ventline spoolpiece was disconnected. After the seal ring was in place, the spoolpiece was re-connected but the reactor head vent valve was not reopened (no step in the procedure being used called for opening the valve). This resulted in loss of function of the only reactor water level indication available while the reactor vessel head was still installed. [The reactor vessel level indication system (RVLIS) had been used during the earlier draindown process, but had been disconnected, as usual, in anticipation of the removal of the reactor vessel heads.]

The PRT nitrogen pressure was gradually being reduced. An operator saw the standpipe indicated level increase as the gas bubble trapped in the reactor vessel head expanded, forcing water out of the reactor and up the surge line and standpipe. Unaware of the closed head vent and believing the standpipe level indication, the operator increased letdown from the reactor coolant system cold leg piping to maintain the indicated 18-foot level. As the increased letdown raised the water level in the volume control tank (VCT), the automatic VCT level control bypassed some of the letdown from the VCT to a holdup tank. This effectively reduced the inventory in the reactor coolant system by approximately 4500 gallons over a period of approximately 5 hours.

When the PRT pressure was subsequently reduced to atmospheric pressure and the reactor vessel head studs were de-tensioned, the vessel internals spring loading lifted the head enough to relieve the reactor internal pressure, which caused a sudden drop in indicated level in the standpipe. The indicated level dropped from elevation 18 feet to elevation 13.3 feet. The operator immediately took action to restore the level to elevation 18 feet.

The capability to maintain decay heat removal was not reduced during this event because adequate suction head remained on the residual heat removal (RHR) pumps; the 13.3-foot water level is 1.5 feet above mid-loop and more than 6 feet above the core. There was never an indication of reduction in RHR flow during the event. If the gas bubble had continued to expand, the reactor vessel water level would not have dropped lower than just below the top of the reactor coolant system hot leg pipe; at that point the gas bubble would vent through the hot leg pipe into the pressurizer and into the PRT, equalizing pressure between the PRT and vessel atmosphere. The standpipe indicated level would then have been correct.

Discussion

Factors contributing to this event involved apparent weaknesses in operational procedures:

1. The procedure for reconnecting the standpipe did not require re-opening of the vessel head vent valve.

2. Operability of the water level indication system was not determined after it had been disabled when the cavity seal ring was to be installed.

3. The relationship between the reactor vessel head vent and the capability of the standpipe to indicate water level accurately was apparently not clear to the control room operators.

4. With the loop stop valves closed, there was no apparent reason why standpipe level should rise. This relationship apparently was not clear to the operators.

5. Although tank levels were noted three times a day, inventory balances were not determined from the data.

Surry and a few other pressurized water reactor (PWR) plants have reactor coolant loop stop valves. Most PWRs do not. Should a similar event occur at a plant without these valves, the course of the event would not be significantly different from that which occurred at Surry. The water in the steam generator tubes would drain through the reactor coolant piping into the reactor vessel as the gas pressure in the PRT was reduced, extending the time required for reactor vessel water level to reach the top of the inside of the hot leg pipe. An event similar to this Surry event occurred at the Sequoyah Nuclear Plant, which does not have loop stop valves. The Sequoyah event was the subject of NRC Information Notice 94-36, "Undetected Accumulation of Gas in Reactor Coolant System," issued May 24, 1994.

Further information concerning the Surry event may be found in NRC Inspection Report 50-280/95-20 and 50-281/95-20.

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

Brian K. Grimes, Acting Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Muhammad M. Razzaque, NRR
(301) 415-2882
Internet:mmr1@nrc.gov

Morris Branch, RII
(804) 357-2101
Internet:mxb2@nrc.gov

Robert A. Benedict, NRR
(301) 415-1157
Internet:rab1@nrc.gov

Attachments:
1. Figure 1. Reactor Vessel Head Vent and Standpipe Diagram
2. List of Recently Issued NRC Information Notices

ATTACHment filed in JACKET

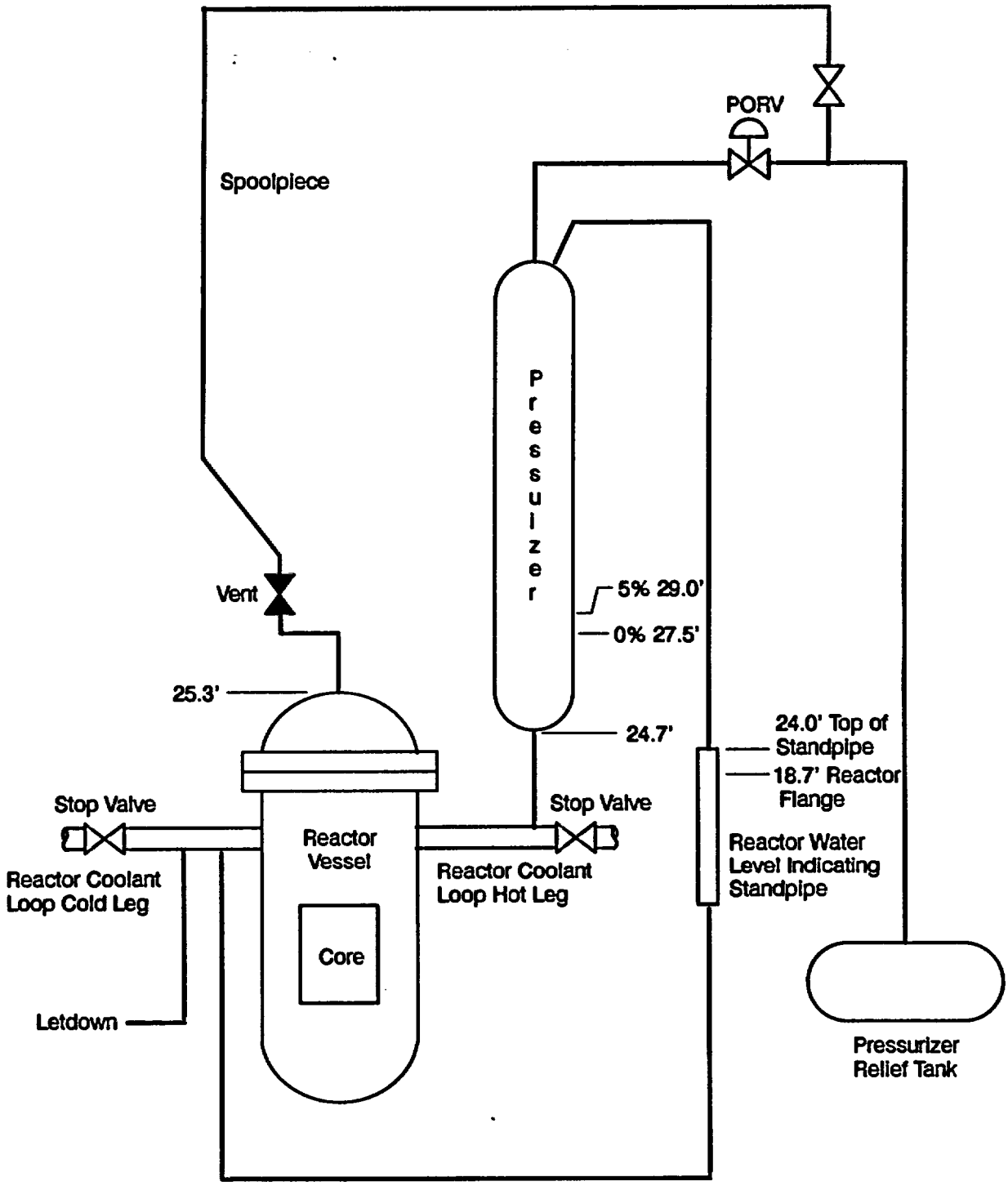

Figure 1. Reactor Vessel Head Vent and Standpipe Diagram

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
96-36	Degradation of Cooling Water Systems Due to Icing	06/12/96	All holders of OLs or CPs for nuclear power reactors
96-35	Failure of Safety Systems on Self-Shielded Irradiators Because of Inadequate Maintenance and Training	06/11/96	All U.S. Nuclear Regulatory Commission irradiator licensees and vendors
96-34	Hydrogen Gas Ignition during Closure Welding of a VSC-24 Multi-Assembly Sealed Basket	05/31/96	All holders of OLs or CPs for nuclear power reactors
96-33	Erroneous Data From Defective Thermocouple Results in a Fire	05/24/96	All material and fuel cycle licensees that monitor temperature with thermocouples
96-32	Implementation of 10 CFR 50.55a(g)(6)(ii)(A), "Augmented Examination of Reactor Vessel"	06/05/96	All holders of OLs or CPs for nuclear power reactors
96-31	Cross-Tied Safety Injection Accumulators	05/22/96	All holders of OLs or CPs for pressurized water reactors
96-30	Inaccuracy of Diagnostic Equipment for Motor-Operated Butterfly Valves	05/21/96	All holders of OLs or CPs for nuclear power reactors
96-29	Requirements in 10 CFR Part 21 for Reporting and Evaluating Software Errors	05/20/96	All holders of OLs or CPs for nuclear power reactors
96-28	Suggested Guidance Relating to Development and Implementation of Corrective Action	05/01/96	All material and fuel cycle licensees

OL = Operating License
CP = Construction Permit

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Original signed by Brian K. Grimes

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Office of Nuclear Reactor Regulation

Technical contacts: Muhammad M. Razzaque, NRR
(301) 415-2882
Internet:mmr1@nrc.gov

Morris Branch, RII
(804) 357-2101
Internet:mxb2@nrc.gov

Robert A. Benedict, NRR
(301) 415-1157
Internet:rab1@nrc.gov

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NOTE: Regional and Project Manager comments have been included.
Tech Editor has reviewed and concurred on 02/20/96
*See previous concurrence
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DATE	02/16/96		04/26/96		06/ /96	

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Technical contacts: Muhammad M. Razzaque, NRR
(301) 415-2882
Internet:mmrl@nrc.gov

Morris Branch, RII
(804) 357-2101
Internet:mxb22nrc.gov

Robert A. Benedict
(301) 415-1157
Internet:rab1@nrc.gov

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5. Although tank levels were noted three times a day, inventory balances were not determined from the data.

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.

Dennis M. Crutchfield, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Muhammad M. Razzaque, NRR
(301) 415-2882

Robert A. Benedict
(301) 415-1157

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5. Although operators noted tank levels three times a day, they did not determine inventory balances from the data.

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