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

July 15, 1994

NRC INFORMATION NOTICE 94-52: INADVERTENT CONTAINMENT SPRAY AND REACTOR VESSEL DRAINDOWN AT MILLSTONE UNIT 1

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the potential for inadvertent containment spray and reactor vessel draindown as a result of valve misalignment caused by inadequate procedures. 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

Millstone Unit 1 was shut down in January 1994 for refueling. During the outage, the licensee planned to test the low-pressure coolant injection (LPCI) logic system. The LPCI logic system functional test procedure, which had been performed numerous times in the past, had been revised recently to permit the licensee to test system valves and the two-thirds core height LPCI/drywell spray interlock at the same time. This interlock permits manual initiation of drywell spray via the LPCI system after adequate core cooling has been achieved. When the event began, both recirculation pumps were running, both trains of shutdown cooling were operating, and LPCI was not operating (see Figure 1). The water level in the reactor vessel was 85 inches. Much of the equipment previously taken out of service during the outage had been restored to operable status and the licensee considered the shutdown risk from this test to be low. However, the test procedure included steps to rack out the breakers for the LPCI pumps and to place the control switch for the core spray pump in the "pull-to-lock" position, rendering these pumps incapable of automatically starting in response to a low water level in the reactor vessel.

Most boiling-water reactors use the same pumps for the shutdown cooling and LPCI functions, but Millstone Unit 1 has separate pumps. The licensee intended to functionally test the LPCI system valves without flow. While performing the test on April 10, 1994, the licensee opened the 10B valve,

pressurizing LPCI loop B and, through the normally open 8A valve, LPCI loop A. Continuing the procedure, the licensee opened the 15A and 16A valves in the LPCI system, opening a flow path from LPCI loop A to the drywell spray header. This alignment allowed approximately 9500 liters per minute (2500 gpm) from the discharge of the shutdown cooling pumps to be diverted from the reactor vessel to the drywell (see Figure 2).

The licensee did not realize that the test procedure had established this flow path. Within about two minutes a high-level alarm for the drywell sump was received. Approximately two minutes later a control room operator closed the drywell spray valves, isolating the flow path. The water level in the reactor vessel decreased approximately 180 cm (70 inches), and a corresponding volume of water (approximately 46,000 liters [12,000 gallons]) was sprayed into the drywell. Shutdown cooling continued during the event. If the operator had not closed the drywell spray valves, the shutdown cooling discharge and suction valves would have started to close automatically about 30 seconds later. These shutdown cooling valves would have closed in less than 48 seconds, ending the event. The level instrumentation that initiates this automatic closure is independent of the instrumentation being tested by the two-thirds core height interlock logic test.

Normally, if the water level in the reactor vessel had decreased further, LPCI and the core spray system would have initiated automatically to restore the level in the reactor vessel. However, the breakers for the LPCI pumps were racked out for the test, and the core spray pump control switch was in "pull-to-lock," so an operator would have had to start the system.

Discussion

The root cause of this event was the failure of the licensee to adequately review the procedure. The revised procedure had formal concurrence, including a determination that integrated review was not required. The combined procedure was primarily the product of the instrumentation and control staff. The operations staff was not involved in preparing the procedure or in the subsequent training, but gave approval to perform the test. The test procedure gave directions to open not only the drywell spray valves but also the torus spray valves (13A and 14A) and the valves in a test line to the torus (43A and 44A). Any of these flow paths would have drained the vessel. However, during the test one of the torus spray valves was inoperable and was not opened, so the torus spray flow path was not established. The test flow path to the torus was not established because the test procedure was stopped as soon as the drywell spray event occurred.

This event demonstrates the importance of rigorously reviewing procedures for potential systems interactions and of avoiding inadvertent system lineups that have the potential to drain the reactor vessel.

Related Generic Communications

- Information Notice 84-81, "Inadvertent Reduction in Primary Coolant Inventory in Boiling Water Reactors During Shutdown and Startup," dated November 16, 1984
- Information Notice 86-74, "Reduction of Reactor Coolant Inventory Because of Misalignment of RHR Valves," dated August 20, 1986
- Information Notice 91-42, "Plant Outage Events Involving Poor Coordination Between Operations and Maintenance Personnel During Valve Testing and Manipulations," dated June 27, 1991
- Bulletin 93-03, "Resolution of Issues Related to Reactor Vessel Water Level Instrumentation in BWRs," dated May 28, 1993

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

Brian K. Grimes, Director
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

Technical contact: Amy Cubbage, NRR
(301) 504-2875

Attachments:
1. Figure 1, System Alignment Prior to the Test
2. Figure 2, System Alignment During the Test
3. List of Recently Issued NRC Information Notices

Enclosure FILED in Jacket

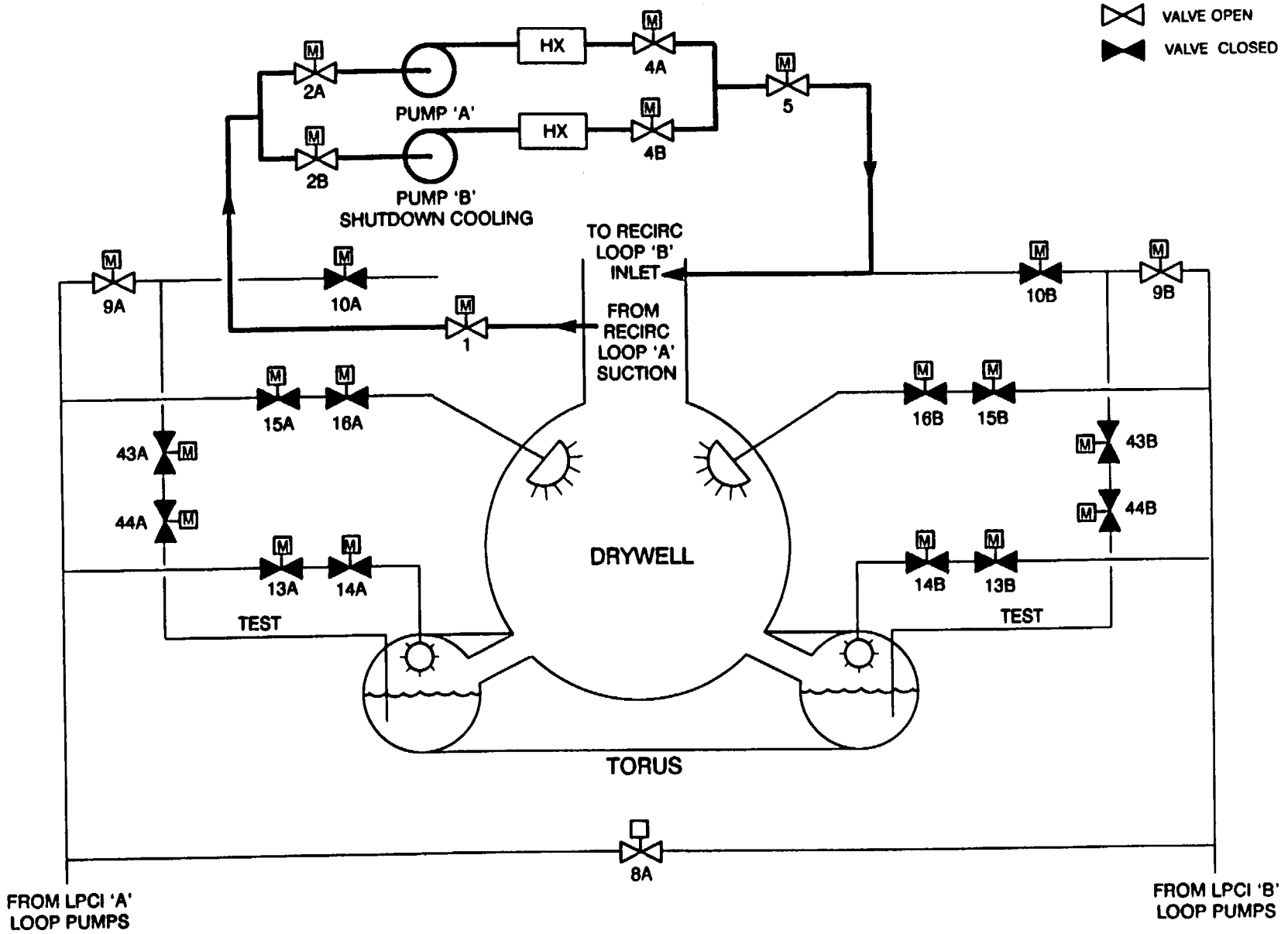

Figure 1 System Alignment Prior to the Test

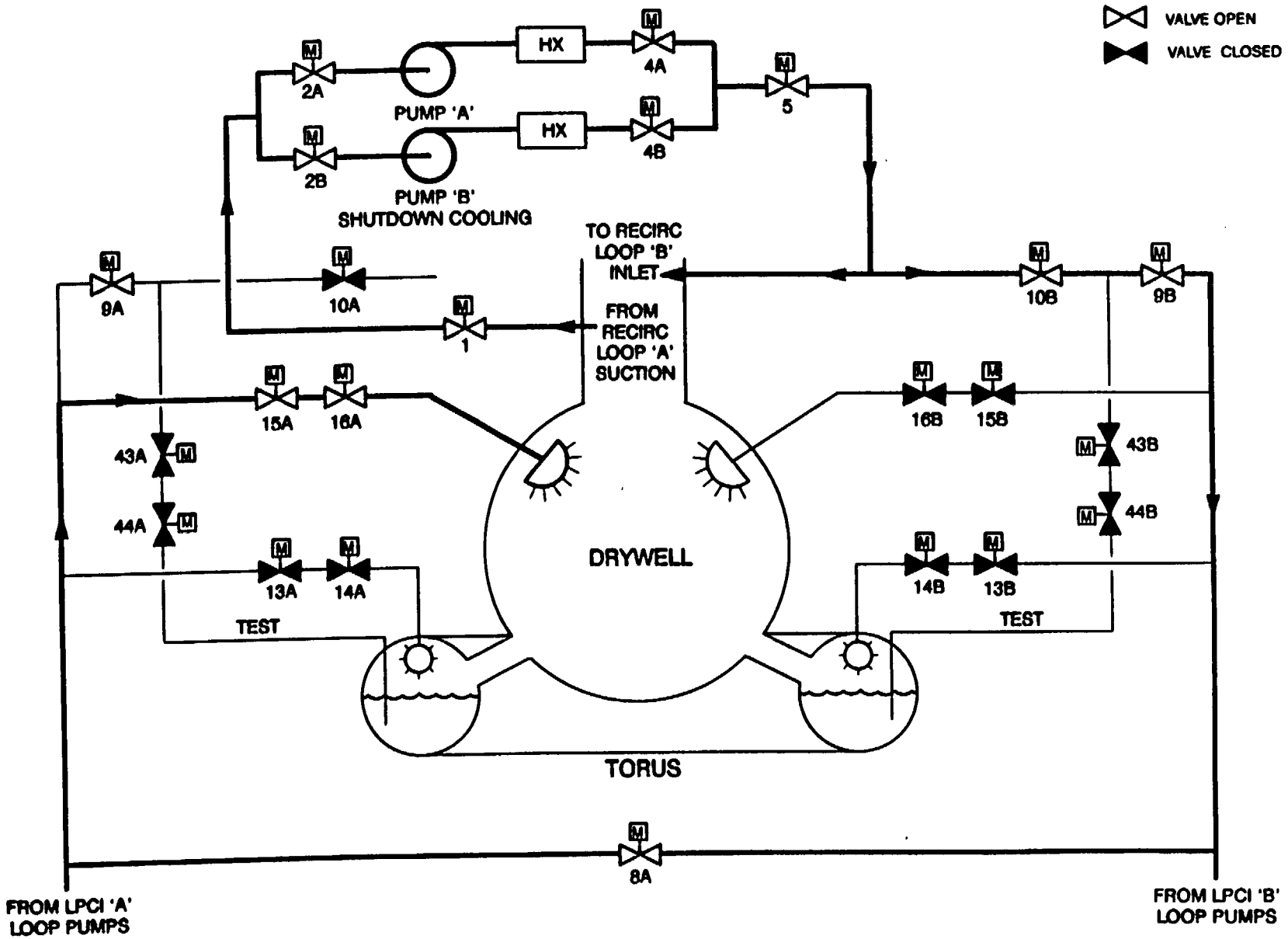

Figure 2 System Alignment During the Test

LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
94-51	Inappropriate Greasing of Double Shielded Motor Bearings	07/15/94	All holders of OLs or CPs for nuclear power reactors.
94-50	Failure of General Electric Contactors to Pull in at the Required Voltage	07/14/94	All holders of OLs or CPs for nuclear power reactors.
94-49	Failure of Torque Switch Roll Pins	07/06/94	All holders of OLs or CPs for nuclear power reactors.
94-48	Snubber Lubricant Degradation in High-Temperature Environments	06/30/94	All holders of OLs or CPs for nuclear power reactors.
94-13, Supp. 1	Unanticipated and Unintended Movement of Fuel Assemblies and other Components due to Improper Operation of Refueling Equipment	06/28/94	All holders of OLs or CPs for nuclear power reactors.
94-47	Accuracy of Information Provided to NRC during the Licensing Process	06/21/94	All U.S. Nuclear Regulatory Commission Material Licensees.
94-46	NonConservative Reactor Coolant System Leakage Calculation	06/20/94	All holders of OLs or CPs for nuclear power reactors.
94-45	Potential Common-Mode Failure Mechanism for Large Vertical Pumps	06/17/94	All holders of OLs or CPs for nuclear power reactors.
94-44	Main Steam Isolation Valve Failure to Close on Demand because of Inadequate Maintenance and Testing	06/16/94	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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Original signed by
Brian K. Grimes
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*SEE PREVIOUS CONCURRENCES
The site Sr. Resident Inspector and the PM have reviewed this IN

OFFICE	RPB:ADM*	OGCB:DORS*	RI*	OEAB:DORS*	SRXB:DSSA*
NAME	TechEd	AJKugler	LTDoerflein	TJCarter	AECubbage
DATE	06/10/94	06/13/94	06/24/94	06/13/94	06/13/94
OFFICE	AC/SRXB:DSSA*	AD/DSSA*	AC/OGCB:DORS*	D/DORS	
NAME	TECollins	MJVirgilio	RLDennig	BKGrimes	
DATE	06/15/94	06/17/94	06/24/94	07/8 /94	

DOCUMENT NAME: 94-52.IN

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