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

September 14, 1988

NRC INFORMATION NOTICE NO. 88-74: POTENTIALLY INADEQUATE PERFORMANCE OF ECCS IN PWRs DURING RECIRCULATION OPERATION FOLLOWING A LOCA

Addressees:

All holders of operating licenses or construction permits for Westinghouse (W) and Babcock and Wilcox (B&W)-designed nuclear power reactors.

Purpose:

This information notice is being provided to alert addressees to potential problems that could result in inadequate performance of the emergency core cooling system (ECCS) during the recirculation phase of operation following a loss-of-coolant accident (LOCA). 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 do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

The NRC has received two licensee event reports on potential deficiencies in performance of the ECCS during the recirculation phase of operation following a small-break LOCA. These events were reported by the licensees of the Oconee and Turkey Point facilities after engineering analysis for each facility had identified the potential problems.

Oconee Nuclear Station

During a technical review of nuclear safety-related mechanical calculations, the licensee discovered that the design analysis had not been adequately performed for the recirculation phase of operation following a small-break LOCA. Subsequent engineering analysis indicated the following design deficiencies:

(1) Under certain small-break LOCA scenarios, when the borated water storage tank (BWST) is depleted and the reactor coolant system (RCS) pressure remains high (greater than the low-pressure injection (LPI) pump shut-off head), a piggyback-type operation is required to ensure core cooling. This operation entails taking suction from the reactor building sump, through the LPI pumps, through the high-pressure injection (HPI) pumps,

IDHR-1C

and then to the RCS. However, because of (1) the high flow resistance in the cross-connect piping between the HPI and LPI pumps, (2) the potential for partially closed LPI discharge throttle valves, and (3) the high flow rate downstream of the LPI pumps, there may not have been adequate net positive suction head (NPSH) at the suction inlets of the HPI pumps. Inadequate NPSH would render the HPI system inoperable. The high flow rate would have occurred when the reactor building spray pumps and HPI pumps take suction simultaneously from the LPI pump discharge.

The licensee has corrected the problem by revising the operating procedures to provide guidance for maintaining adequate NPSH to the HPI pumps operating in the piggyback mode. The revised procedures provide for (1) HPI flow limitations when the HPI and reactor building spray pumps are piggybacked off the LPI pumps, (2) precautions on the use of reactor building spray, and (3) precautions on the throttling of the LPI discharge valves LP-12 and LP-14. (A simplified Oconee ECCS and reactor building spray system are shown in Attachment 1.)

(2) A single failure of the "TD" ECCS switchgear during loss of offsite power would have prevented the remote alignment of the LPI system to the HPI system in the piggyback mode because (1) valves LP-9, LP-15, and LPI pump B are powered by ECCS switchgear bus "TD" but their backup power supplies are classified as load shed power supplies, and (2) valves LP-9 and LP-15 were in the normally closed position.

The licensee has corrected the problem by (1) changing valve LP-9 to a normally open position so that it will not be required to operate when the LPI system is being aligned with the HPI system in the piggyback mode of operation, and (2) revising the emergency operating procedure to ensure time is available for operators to locally, manually open valves LP-15 and LP-16 (if the valves cannot be opened remotely) before LPI suction must be swapped from the BWST to the reactor building sump.

Turkey Point Nuclear Station

As part of its ongoing design-basis reconstitution program, the licensee discovered a condition of potentially inadequate NPSH for the containment spray and safety injection (SI) pumps during the recirculation mode of operation following a LOCA. Under these conditions, the low head residual heat removal (RHR) pumps are providing flow to the containment spray pumps and the SI pumps. A throttle valve in each RHR discharge line is normally throttled to 30 percent. However, an analysis to support this valve throttling position had not been performed. To resolve this discrepancy, the subject valves were locked in the fully open position until an engineering evaluation showed that the original configuration (30 percent open) was acceptable.

Discussion:

Following a small-break LOCA, the piggyback mode of operation may be required (depending on the size and location of the break) to sustain injection flow when the BWST (B&W plant) or refueling water storage tank (Westinghouse plant) has been depleted and RCS pressure remains above the shutoff head of the low head pumps. As previously described, two mechanisms could prevent this intended piggyback mode from operating: (1) insufficient NPSH at HPI (or SI) pump suction inlets, or (2) inadequate operating procedures combined with system design deficiencies for a loss-of-offsite-power condition. Although the low head pumps provide relatively high discharge pressure, the intervening cross-connect piping between the high head and low head systems and/or partially closed low head pump discharge valves could result in excessive hydraulic resistance and cause insufficient NPSH at the HPI (or SI) pump suction inlets. Insufficient NPSH could also be caused by running multiple pumps off the discharge of a single pump that may increase the flow above the design flow rate and consequently reduce the available pressure at the low head pump discharge. These are safety concerns because of the reliance on HPI (or SI) for mitigating small-break LOCAs, and in some cases, the piggyback-type operation is used for hot leg recirculation even for large-break LOCAs.

There are no redundant systems to perform the function of the HPI (or SI) system in the piggyback mode. Although the reactor vessel high-point vents and the power-operated relief valve(s) could be used to depressurize the RCS to low head pump operating pressures, the related safety analysis had never been performed -- thus, their effectiveness was not ensured.

No specific action or written response is required by this information notice. If you have any questions about this matter, please contact one of the technical contacts listed below or the Regional Administrator of the appropriate regional office.

Charles E. Rossi

Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

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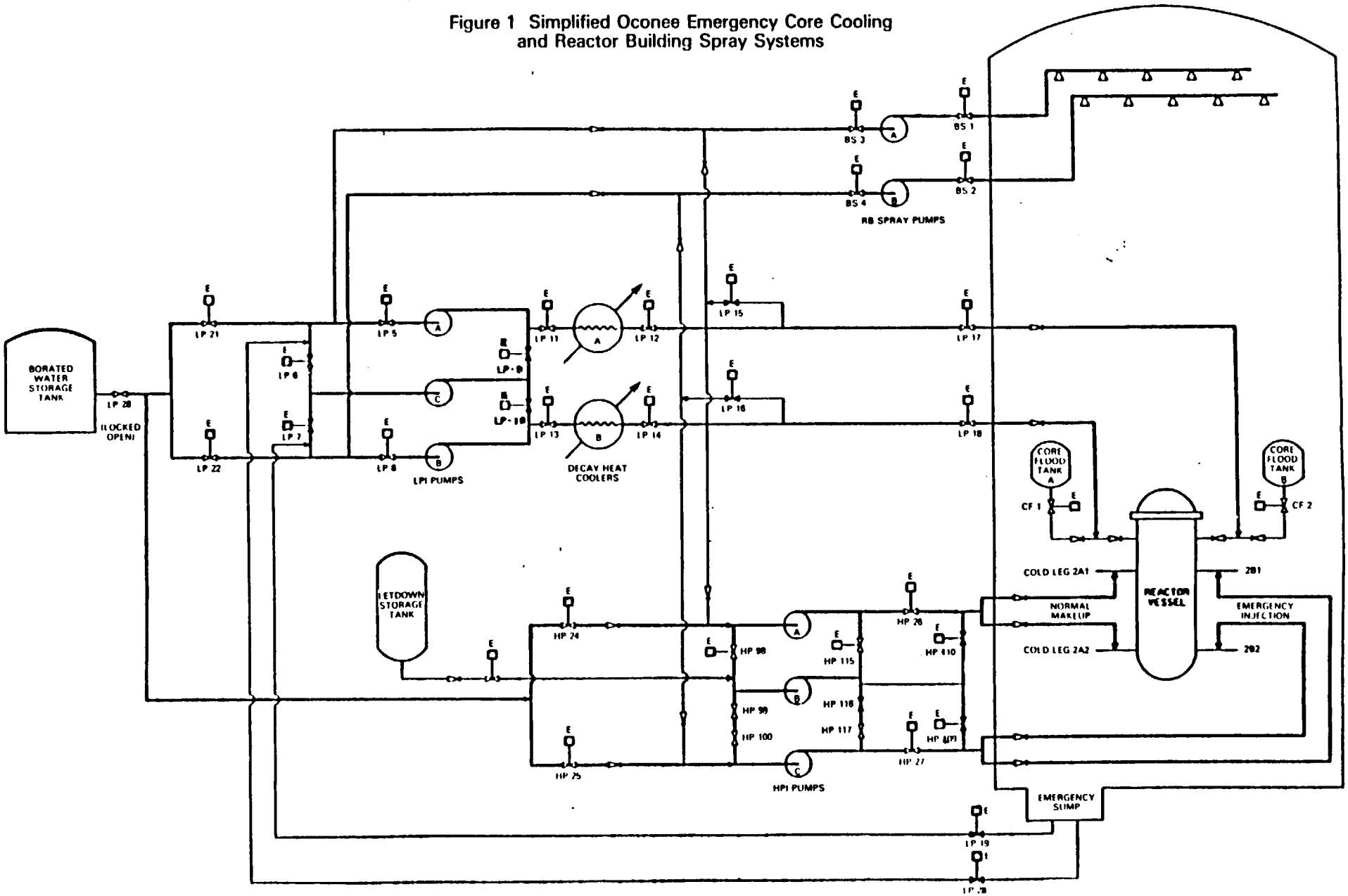
(301) 492-4437

J. Thompson, NRR
(301) 492-1175

P. Wen, NRR
(301) 492-1172

Attachments:
1. Figure 1, Simplified Oconee Emergency Core Cooling and Reactor Building Spray Systems
2. List of Recently Issued NRC Information Notices

Figure 1 Simplified Oconee Emergency Core Cooling and Reactor Building Spray Systems



Attachment 1

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
88-73	Direction-Dependent Leak Characteristics of Containment Purge Valves	9/8/88	All holders of OLs or CPs for nuclear power reactors.
88-72	Inadequacies in the Design of dc Motor-Operated Valves	9/2/88	All holders of OLs or CPs for nuclear power reactors.
88-71	Possible Environmental Effect of the Reentry of COSMOS 1900 and Request for Collection of Licensee Radioactivity Measurements Attributed to That Event	9/1/88	All holders of OLs or CPs for nuclear power reactors, fuel cycle licensees, and Priority 1 material licensees.
88-70	Check Valve Inservice Testing Program Deficiencies	8/29/88	All holders of OLs or CPs for nuclear power reactors.
88-69	Movable Contact Finger Binding in HFA Relays Manufactured by General Electric (GE)	8/19/88	All holders of OLs or CPs for nuclear power reactors.
88-48, Supplement 1	Licensee Report of Defective Refurbished Valves	8/24/88	All holders of OLs or CPs for nuclear power reactors.
88-68	Setpoint Testing of Pressurizer Safety Valves with Filled Loop Seals Using Hydraulic Assist Devices	8/22/88	All holders of OLs or CPs for nuclear power reactors.
88-67	PWR Auxiliary Feedwater Pump Turbine Overspeed Trip Failure	8/22/88	All holders of OLs or CPs for nuclear power reactors.
88-66	Industrial Radiography Inspection and Enforcement	8/22/88	All NRC industrial radiography licensees.

OL = Operating License
CP = Construction Permit

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*SEE PREVIOUS PAGE FOR CONCURRENCE

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8/30/88	8/30/88	8/30/88	8/30/88	8/30/88	8/31/88

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