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

September 20, 1990

NRC INFORMATION NOTICE NO. 90-61: POTENTIAL FOR RESIDUAL HEAT REMOVAL PUMP DAMAGE CAUSED BY PARALLEL PUMP INTERACTION

Addressees:

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

Purpose:

This information notice is intended to alert addressees to the potential for flow stoppage caused by the interaction of the parallel pumps in residual heat removal systems that have discharge check valves located upstream of the recirculation lines. 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:

In December 1989, the staff at Unit 1 of the Sequoyah Nuclear Power Plant found that one of the residual heat removal pumps was running without flow (deadheading) during simultaneous surveillance testing of both pumps, a condition that can damage a pump from overheating. In this test, both residual heat removal pumps, operating in the safety injection mode, were to draw water from the refueling water storage tank suction lines and discharge it back through the "minimum flow" recirculation lines (see Figure of the residual heat removal system, attached). In the residual heat removal system at Sequoyah, each of the two trains has a check valve located on the discharge side of the pumps and upstream of the recirculation lines. A normally open crossover line connects the two trains downstream of the recirculation lines. Because one of the pumps had a higher discharge pressure than the other, the pressure of the stronger pump acting through the crossover line forced the discharge check valve of the weaker pump to close. This stopped the flow from the weaker pump. In its analysis of the event at Sequoyah, the Tennessee Valley Authority (the licensee) found that operating a pump with no flow for longer than 11 minutes may cause pump damage.

IDHR-11C

The NRC Office of Analysis and Evaluation of Operational Data has published a study of this issue entitled "Potential for Residual Heat Removal System Pump Damage," AEOD/E90-06. This study reviewed the RHR designs of nineteen randomly selected plants and found five of them with system piping configurations similar to that of the RHR system at the Sequoyah plant. The study indicates that the potential for the adverse pump-to-pump interaction, which can cause the discharge check valve to close, may not be detected during a surveillance test in which one pump is tested at a time.

Discussion of Safety Significance

In addition to providing core cooling when the reactor is shut down, the residual heat removal system provides low-pressure coolant injection (safety injection) during an accident. If a loss-of-coolant accident followed by the actuation of the safety injection system were to occur, both pumps would start running. However, until the primary system pressure has decreased to a level that is below the pump shutoff head of 184 psi, the pumps could not inject into the reactor. For a small break, the amount of time required to decrease the reactor pressure to the low-pressure injection point could cause deadheaded pumps to overheat. For this reason, the minimum flow bypass line valves are designed to open during this phase to permit sufficient flow through the pumps to cool them. During normal operation, the crossover line between the two residual heat removal trains is kept open. This is to assure a cooling water supply to the reactor from either of the RHR pumps under adverse conditions, such as a break in one of the lines to the reactor cold legs. Consequently, the conditions identified in the Sequoyah test would probably exist during a small break accident and could cause the failure of the weaker pump.

NRC Bulletin 88-04, "Potential Safety-Related Pump Loss," previously addressed the issue of the deadheading of a weaker pump during two-pump minimum flow operation. In its analysis that was performed in response to this bulletin, the Sequoyah staff concluded that the deadheading problem did not exist at Sequoyah. This conclusion was based on the use of a value of 11.1 psi for the differential pressure between the two pumps, which had been derived from the average values from several tests. This value was considered to be too low to cause the deadheading problem. Following the discovery of the deadheading problem in 1989, the Sequoyah staff recalculated the differential pressure between the two pumps based on individual pump pressures and concluded that the actual value was 17 psi, which was sufficient to block the flow from the weaker pump.

The staff at Sequoyah has made an interim change in its emergency operating procedures to prevent the damaging of a residual heat removal pump during a safety injection actuation. This change requires that one of the pumps be stopped and placed in the standby mode if the reactor coolant system pressure remains above 180 psi for longer than a specified time after the initiation of safety injection. However, this procedure has the disadvantage of requiring operator action within a short time during an emergency situation. As a permanent corrective action, the Sequoyah staff will install check valves in each train downstream of the recirculation lines. With these valves in place,

any backflow resulting from crossover from a stronger pump would close the new check valve in the lower pressure train and isolate the weak pump's recirculation line from the stronger pump.

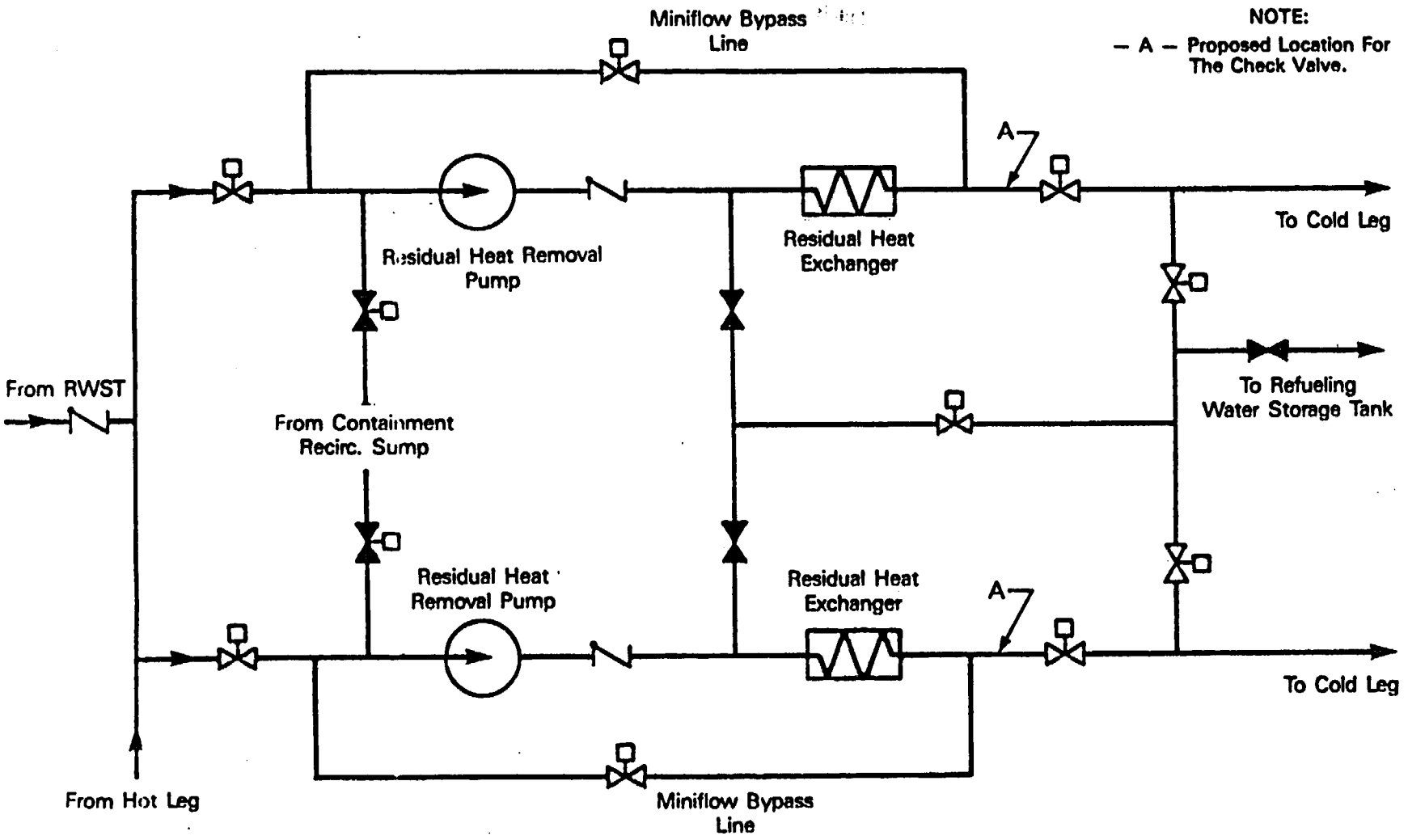
This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate NRR project manager.

Charles E. Rossi

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

Technical Contact: Chuck Hsu, AEOD
(301) 492-4443

Attachments:
1. Figure of Residual Heat Removal System - Minimum Flow Lineup
2. List of Recently Issued NRC Information Notices



Residual Heat Removal System - Minimum Flow Lineup

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
90-60	Availability of Failure Data In the Government-Industry Data Exchange Program	9/20/90	All holders of OLs or CPs for nuclear power reactors.
90-59	Errors In the Use of Radioactive Iodine-131	9/17/90	All medical licensees.
90-58	Improper Handling of Ophthalmic Strontium-90 Beta Radiation Applicators	9/11/90	All NRC medical licensees.
90-57	Substandard, Refurbished Potter & Brumfield Relays Misrepresented As New	9/5/90	All holders of OLs or CPs for nuclear power reactors.
90-56	Inadvertent Shipment of A Radioactive Source In A Container Thought To Be Empty	9/4/90	All U.S. Nuclear Regulatory Commission (NRC) licensees.
90-55	Recent Operating Experience on Loss of Reactor Coolant Inventory While In A Shutdown Condition	8/31/90	All holders of OLs or CPs for nuclear power reactors.
83-44 Supp. 1	Potential Damage to Redundant Safety Equipment As A Result of Backflow Through the Equipment and Floor Drain System	8/30/90	All holders of OLs or CPs for nuclear power reactors.
90-54	Summary of Requalification Program Deficiencies	8/28/90	All holders of OLs or CPs for nuclear power reactors.
89-18 Supp. 1	Criminal Prosecution of Wrongdoing Committed by Suppliers of Nuclear Products or Services	8/24/90	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

any backflow resulting from crossover from a stronger pump would close the new check valve in the lower pressure train and isolate the weak pump's recirculation line from the stronger pump.

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Original Signed By
Charles E. Rossi

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Office of Nuclear Reactor Regulation

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*SEE PREVIOUS CONCURRENCES

			D/DOEA:NRR CERossi 09/17/90	C/OGCB:DOEA:NRR CHBerlinger 09/13/90
*OGCB:DOEA:NRR DCKirkpatrick 08/29/90	*ROAB:DSP:AEOD CCHsu 08/31/90	*ROAB:DSP:AEOD JERosenthal 09/06/90	*D/DSP:AEOD TMNovak 09/06/90	*RPB:ADM TechEd 08/29/90

Document Name: IN 90-61

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Document Name: IN ON RHR PUMP MINIMUM FLOW

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DOCUMENT NAME: IN ON RHR PUMP MINIMUM FLOW

OGCB:DOEA:NRR	RPD:ADM	ROAB:DSP:AECD	ROAB:DSP:AEOD
DCKirkpatrick	Tech Ed JMcGM	CCHsu cnt.	JERosenthal
08/29/90 DCK	08/29/90	08/31/90	08/16/90

JER concur with adoption of inter-l corrections

D/DSP:AEOD	D/DOEA:NRR	C/OGCB:DOEA:NRR
TMNovac	CERossi	CHBerlinger
08/6/90	08/ /90	08/ /90

with corrections R W