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

August 20, 1992

NRC INFORMATION NOTICE 92-61: LOSS OF HIGH HEAD SAFETY INJECTION

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 an event involving the loss of High Head Safety Injection (HHSI) function due to water hammer in the associated alternate minimum flow (AMF) system. 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

On April 3, 1991, Carolina Power & Light Company (the licensee) determined that the HHSI system for the Shearon Harris Nuclear Power Plant had been in a degraded condition during the previous operating cycle. The degraded condition resulted from relief valve and drain line failures in the AMF system for the charging/safety injection pumps (CSIPs) which would have diverted a significant amount of safety injection (SI) flow away from the reactor coolant system (RCS). The root cause of the degradations appears to be water hammer due to air left in the AMF system piping following system maintenance and testing activities.

The AMF system (Attachment 1) is designed to prevent a deadhead condition on the CSIPs by providing a flow path for these pumps to the refueling water storage tank if the reactor repressurizes following a main steam line break or feedwater line break accident. The AMF system is designed only to pass flow when the CSIP discharge pressure is above the lift setpoint of 2300 +/- 69 psig for relief valves 1CS-744 and 1CS-755. The AMF system was a modification to the original design in response to a Westinghouse 10 CFR Part 21 report. This report identified the potential for deadheading the CSIPs during repressurization of the RCS following secondary side breaks.

The licensee identified the following damage to the alternate minimum flow system:

1) Relief valve 1CS-744 had a broken bellows and a cracked spring and was found to have a reduced relief setpoint of 1100 psig.

2) Relief valve 1CS-755 had a broken bellows. Its relief setpoint could not be determined due to valve seat leakage.

3) The piping connection upstream of 1CS-754 failed due to a water hammer during engineered safety feature (ESF) testing. A small leak had previously existed in this weld and was scheduled for repair during the 1991 refueling outage.

Discussion

The physical layout of the AMF system piping at the Shearon Harris Nuclear Power Plant results in air being trapped upstream and downstream of the relief valves when they are removed and reinstalled in the system. The upstream isolation valves 1CS-746 and 1CS-752 remain closed until an SI signal is received. This prevents water from refilling this piping. Also, piping upstream of the relief valves does not have high point vents to remove the trapped air.

The licensee has taken corrective actions by revising plant procedures to require the piping upstream of the relief valves to be refilled prior to installation of the relief valves and vented through the relief valves by hydraulic pressure to eliminate the air. The licensee has also repaired the damage identified above. The licensee reported this event to the NRC in LER 050-400/91-008-01 in May of 1991. The licensee is currently evaluating the potential for water hammer downstream of the relief valves.

The NRC Office for Analysis and Evaluation of Operational Data (AEOD) included this event in their Accident Sequence Precursor Program. A preliminary evaluation estimated the conditional core damage probability to be approximately 6 x 10E-3. The estimate is based on the unavailability of the HHSI system for a year prior to discovery. The NRC staff considers this to be a significant operational event.

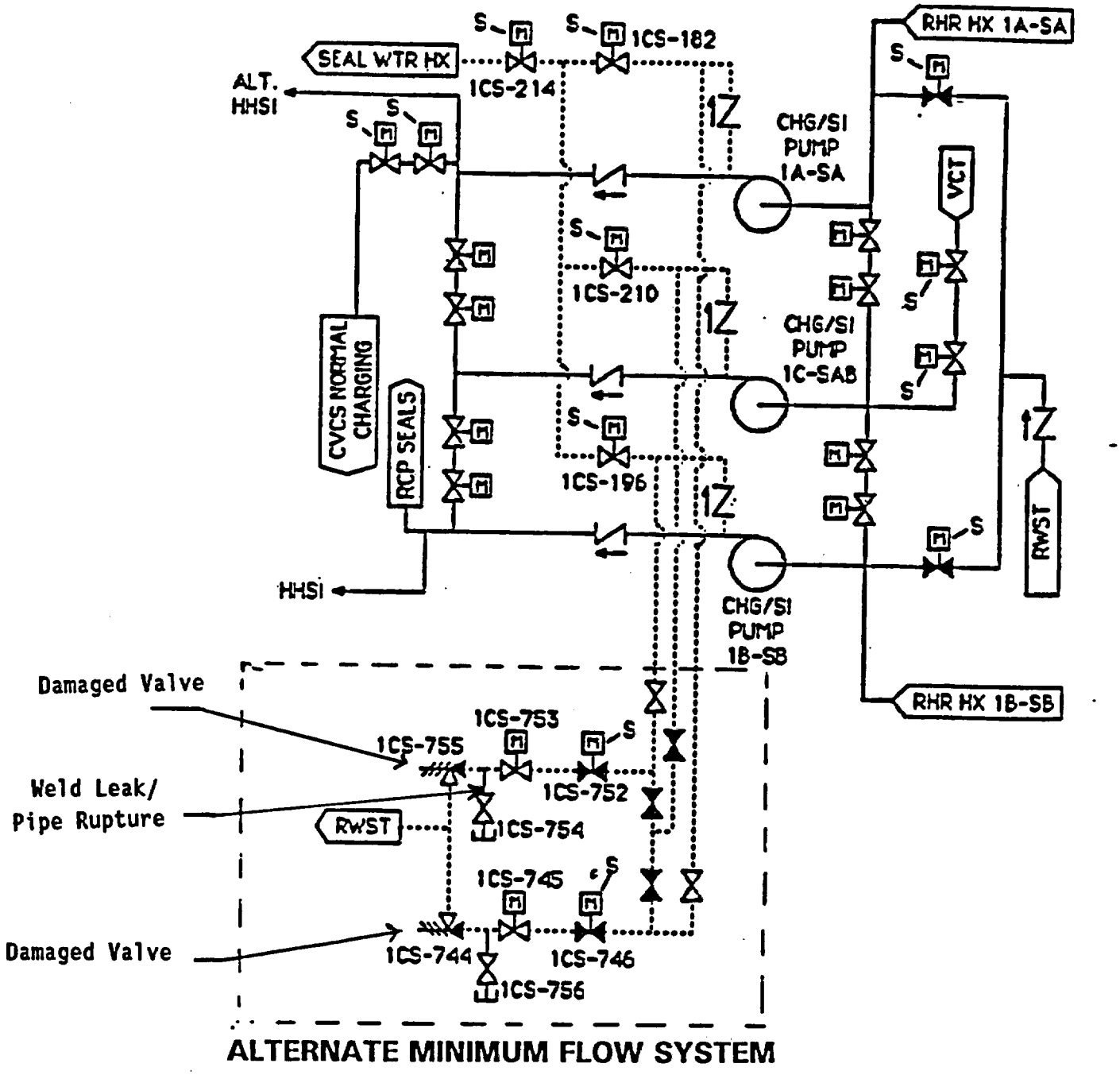
The NRC sent a special inspection team to the Shearon Harris site to review the event circumstances. The team determined that several water hammer events could have occurred in the AMF system over the past 6 years. They concluded that the water hammer events likely occurred when the CSIP pressurized the AMF system piping which contained air during ESF testing and during ESF system actuations.

The AMF system design weaknesses identified at Shearon Harris were:

1) The potential for water hammer events upstream and downstream of the relief valves had not been analyzed.

2) The AMF system piping had not been analyzed for transient or water hammer loads.

3) The potential for relief valve chatter and setpoint drift had not been analyzed.




SHEARON HARRIS HIGH HEAD SAFETY INJECTION SYSTEM

Also, it is questionable whether operators would have been able to detect and isolate the flow diversion from the HHSI system in a timely manner due to the lack of flow indication in the AMF system piping and the lack of adequate directions in the Emergency Operating Procedures. Flow diversion could have caused the CSIPs to operate at runout, and they could be potentially damaged prior to diagnosis and corrective action.

Similar damage to AMF system components has previously been identified at other plants.

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

Charles E. Rossi, Director
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Office of Nuclear Reactor Regulation

Technical contacts: J. Jacobson, NRR
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Attachments:
1. Shearon Harris High Head Safety Injection System
2. List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

| Information Notice No. | Subject | Date of Issuance | Issued to |
|---|---|---|---|
| 92-60 | Valve Stem Failure Caused by Embrittlement | 08/20/92 | All holders of OLs or CPs for pressurized water reactors (PWRs). |
| 92-59 | Horizontally-Installed Motor-Operated Gate Valves | 08/18/92 | All holders of OLs or CPs for nuclear power reactors. |
| 92-58 | Uranium Hexafluoride Cylinders - Deviations in Coupling Welds | 08/12/92 | All Fuel Cycle Licensees. |
| 92-57 | Radial Cracking of Shroud Support Access Hole Cover Welds | 08/11/92 | All holders of OLs or CPs for boiling water reactors (BWRs). |
| 92-56 | Counterfeit Valves in the Commercial Grade Supply System | 08/06/92 | All holders of OLs or CPs for nuclear power reactors. |
| 92-55 | Current Fire Endurance Test Results for Thermo-Lag Fire Barrier Material | 07/27/92 | All holders of OLs or CPs for nuclear power reactors. |
| 92-54 | Level Instrumentation Inaccuracies Caused by Rapid Depressurization | 07/24/92 | All holders of OLs or CPs for nuclear power reactors. |
| 92-53 | Potential Failure of Emergency Diesel Generators due to Excessive Rate of Loading | 07/29/92 | All holders of OLs or CPs for nuclear power reactors. |
| 91-52, Supp. 1 | Nonconservative Errors in Overtemperature Delta-Temperature (OT$\Delta$T) Setpoint Caused by Improper Gain Settings | 07/16/92 | All holders of OLs or CPs for Westinghouse (W)-designed nuclear power reactors. |

OL = Operating License
CP = Construction Permit