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

August 5, 1996

NRC INFORMATION NOTICE 96-42: UNEXPECTED OPENING OF MULTIPLE SAFETY RELIEF VALVES

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 a recent event in which indication was received that multiple safety relief valves (SRVs) had opened during steady-state reactor operation without any apparent initiating cause. 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 June 6, 1996, Grand Gulf Nuclear Station was being operated at about 100-percent power when alarms sounded and the control room operators noticed that the reactor vessel water level was decreasing, the suppression pool temperature was increasing, and six SRVs were open. No maintenance or test activities related to SRV operation were being performed. Because the suppression pool temperature was increasing rapidly, operators scrammed the plant to prevent exceeding the maximum temperature limit of 43 °C [110 °F].

Neither the emergency core cooling system nor the reactor core isolation cooling system was challenged by this event. However, both the "A" and "B" residual heat removal systems were placed in the suppression pool cooling mode of operation to reduce the suppression pool temperature. The main steam isolation valves remained open, and steam continued to go to the main condenser. There was no appreciable cooldown of the reactor vessel during this transient until after the reactor was scrammed.

The six open SRVs automatically closed after the scram when reactor pressure decreased. The six SRVs were open for approximately 2.5 minutes. Reactor pressure was subsequently controlled with the main turbine bypass valves. The reactor water level was restored to the normal range through use of the feedwater control system. The rest of the reactor shutdown was routine, and there were no further complications.

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Discussion

Grand Gulf uses a BWR-6 reactor having four steam lines, each with either four or six SRVs. All SRVs have the same design and each has a relief capacity of approximately 6 percent of the full steam flow. The SRVs have both spring safety operation and a power-operated (relief) mode. SRV power actuation may be accomplished either automatically at a predetermined relief set pressure or manually at any desired pressure. Actuation is achieved by positioning solenoid-operated valves that either admit compressed air into an operating cylinder or vent compressed air from the cylinder. Two of the SRVs on each steam line are also actuated by the automatic depressurization system logic.

Six of the SRVs are provided with a low-low set relief logic that minimizes the number of valves that reopen following a reactor isolation event. The low-low set relief logic provides all six SRVs with lower closing setpoints and two of these valves with lower opening setpoints that are below the normal operating reactor pressure of 7.1 Megapascals [1025 psig]. These setpoints override the normal set points following initial opening of the SRVs and act to hold these valves open longer and prevent simultaneous reopening of multiple SRVs. This low-low set relief logic seals in when the SRVs receive an opening signal. The function of this logic is to prevent hydrodynamic loads during subsequent SRV actuations from exceeding the containment design basis.

The control logic for the relief mode of operation consists of two divisional trains (safety groups), with two logic channels per division. Both logic channels must be satisfied in order to operate the respective divisional solenoid valves on the SRV air actuators. Logic cards for both channels of each respective division are located in the same card file. The SRV logic card files are one of four card files supplied from the 24-Vdc power supply.

The licensee identified a transient in the 24-Vdc power supply circuit of the Division II SRV logic as the root cause for the lifting of the SRVs. All 20 SRVs can be actuated by either Division I or Division II logic, and the 20 SRVs received an unanticipated 200-millisecond open signal. This open signal was sufficient to actuate the "seal-in" for the six SRVs that have the low-low set relief feature. However, the signal duration was too short to sustain opening of the other 14 SRVs. The SRV logic card file is one of four card files supplied from the Division II 24-Vdc power supply. Each card file contains several trip unit cards that have logic circuits for safety-related components. Licensee personnel found a blown fuse to one of the other circuit card files and determined that a trip unit card in the card file associated with the failed fuse had a failed capacitor.

The licensee determined that this event was bounded by the safety analysis, which includes opening of all 20 SRVs. The component loading effects were determined to be within the piping design capabilities for the SRV transients, as well as for the containment. In addition, the design of the SRV and the low-low set logic was verified as meeting the single-failure criterion for initiation of a safety system and that inadvertent system actuations were analyzed for acceptable safety consequences. However, to prevent future occurrence of a similar event, the licensee is pursuing the following corrective actions:

1. Evaluation of design modifications to minimize the vulnerability to a single failure actuating several SRVs.

2. Evaluation of the consequences of failures in similar logic cards in other safety systems that are also subject to a similar initiating event (high-voltage spike) to verify that the design-basis accident analyses are bounding.

In addition, the licensee plans to revise of the final safety analysis report description to clarify the application of the single-failure criterion.

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

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LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
96-41	Effects of a Decrease in Feedwater Temperature on Nuclear Instrumentation	07/26/96	All holders of OLs or Cps for pressurized water reactors
96-40	Deficiencies in Material Dedication and Procurement Practices and in Audits of Vendors	07/25/96	All holders of OLs or CPs for nuclear power reactors
96-09, Supp. 1	Damage in Foreign Steam Generator Internals	07/10/96	All holders of OLs or CPs for pressurized-water reactors
96-39	Estimates of Decay Heat Using ANS 5.1 Decay Heat Standard May Vary Significantly	07/05/96	All holders of OLs or CPs for nuclear power reactors
96-38	Results of Steam Generator Tube Examinations	06/21/96	All holders of OLs or CPs for pressurized water reactors
96-37	Inaccurate Reactor Water Level Indication and Inadvertent Draindown During Shutdown	06/18/96	All pressurized water reactor facilities holding an operating license or a construction permit
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

OL = Operating License
CP = Construction Permit

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Tech Editor reviewed & concurred on 07/11/96

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