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

August 29, 1991

NRC INFORMATION NOTICE NO. 91-52: NONCONSERVATIVE ERRORS IN OVERTEMPERATURE DELTA-TEMPERATURE (OTΔT) SETPOINT CAUSED BY IMPROPER GAIN SETTINGS

Addressees:

All holders of operating licenses or construction permits for Westinghouse (W)-designed nuclear power reactors.

Purpose:

This information notice is intended to alert addressees to potential problems resulting from improper voltage gain settings applied to components in the overtemperature delta-temperature (OTΔT) reactor protection system trip circuitry at Westinghouse (W)-designed nuclear power reactors. 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:

On July 17, 1991, Duke Power Company notified the NRC of a problem with the OTΔT reactor trip circuit at McGuire and Catawba Nuclear Stations which may have prevented the system from operating correctly over its entire operating range for reactor coolant loop average temperature (T-avg). Engineers discovered the problem at McGuire while attempting to rescale their OTΔT setpoints for the upcoming new fuel load. The engineers found that the gain applied to the lead/lag amplifier for the T-avg portion of the OTΔT circuit was set too high (Westinghouse 7300 series process equipment card TY412A), based on the current scaling of the hardware. This caused the T-avg input to "saturate" at approximately 597°F for McGuire and 592°F for Catawba which prevented the OTΔT circuit from reducing the OTΔT setpoint as the T-avg increased above these temperatures. The required input temperature range for T-avg is 530°F to 630°F. Therefore, the OTΔT setpoint calculation was in error above these "saturation" temperatures since the lead/lag amplifiers would not produce a proportional output.

Following discussions with Westinghouse Electric Corporation, the licensee corrected the problem at both McGuire and Catawba by redistributing the gain associated with the T-avg term of the OTΔT setpoint. This was accomplished by replacing resistors in the lead/lag circuit to ensure that the gain was not so high that it could cause "saturation" of its output over the entire input

range. On July 19, 1991, the licensee modified the OTΔT instrumentation at both facilities.

On July 31, 1991, the Commonwealth Edison Company informed the NRC that it had reviewed the gain settings for the OTΔT circuits at its Braidwood and Byron Stations and had discovered conditions similar to those at McGuire and Catawba.

Discussion:

The OTΔT reactor trip protects against departure from nucleate boiling (DNB). The trip function operates by comparing indicated loop delta-temperature (ΔT) to the calculated setpoint, causing a reactor trip when two or more ΔT channels exceed their setpoint. Analog circuitry for each reactor coolant loop continuously calculates the setpoint for this trip according to the temperature in the loop, the neutron flux distribution in the reactor, and reactor coolant system (pressurizer) pressure. The principal concern for the function of the OTΔT trip is for certain rod withdrawal events in which OTΔT could be the primary safety-related trip mitigating the event. It also functions as a safety-related backup for several other transients.

The problem involves the scaling used in the OTΔT hardware. If the hardware is scaled such that the output gain on the T-avg lead/lag amplifier is greater than unity (1.0), the amplifier will saturate at some T-avg and prevent further adjustment of the OTΔT setpoint. The equation for the OTΔT setpoint at McGuire and Catawba includes as parameters lead-lag and lag constants, a bias (K1), and gains (K2 and K3). Gains K2 and K3 are the adjustments for the effects of temperature and pressure, respectively, on DNB limits.

The licensee indicated that the OTΔT hardware had operated in the degraded condition since 1983 for McGuire and since startup for Catawba. The original K2 value, provided by Westinghouse, was 0.0133/°F for McGuire. The hardware was scaled by Westinghouse such that the lead/lag amplifier gain corresponding to this K2 was less than 1.0. With a gain setting of less than 1.0, the amplifier does not overrange since the gain output voltage cannot exceed 10 volts. The degraded condition was introduced at McGuire when the licensee rescaled the OTΔT trip hardware as a function of performing a core reload analysis to allow for the use of Westinghouse "optimized" fuel. As part of this change to the OTΔT parameters, K2 was increased to its current value of 0.0222/°F. Using the Westinghouse scaling methodology, however, the licensee scaled the OTΔT hardware such that the output gain on the T-avg lead/lag amplifier was greater than 1.0, which introduced the problem.

Preliminary information concerning Catawba indicated that the original K2 value, supplied by Westinghouse, was also 0.0133/°F. Sometime in 1983 or 1984, following a McGuire transient which indicated the need to modify the OTΔT and overpower delta-temperature (OPΔT) setpoints, K2 was increased to its current value of 0.02401/°F. It was then that the licensee incorrectly scaled the OTΔT hardware such that the output gain on the T-avg lead/lag amplifier was greater than 1.0.

At some plants licensees have avoided the problem by using different scaling methodologies or have identified the problem during the scaling process and

modified the hardware (redistributing the gain) similar to the corrective measures performed by Duke Power Company.

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

Charles E. Rossi, Director
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Technical Contacts: William Orders, RII
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Attachment: List of Recently Issued NRC Information Notices



LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

| Information Notice No. | Subject | Date of Issuance | Issued to |
|---|---|---|---|
| 86-14, Supp. 2 | Overspeed Trips of AFW, HPCI and RCIC Turbines | 08/26/91 | All holders of OLs or CPs for nuclear power reactors. |
| 91-51 | Inadequate Fuse Control Programs | 08/20/91 | All holders of OLs or CPs for nuclear power reactors. |
| 91-50 | A Review of Water Hammer Events After 1985 | 08/20/91 | All holders of OLs or CPs for nuclear power reactors. |
| 91-49 | Enforcement of Safety Requirements for Radiographers | 08/15/91 | All Nuclear Regulatory Commission (NRC) licensees authorized to use sealed sources for industrial radiography. |
| 91-48 | False Certificates of Conformance Provided by Westinghouse Electric Supply Company for Refurbished Commercial-Grade Circuit Breakers | 08/09/91 | All holders of OLs or CPs for nuclear power reactors. |
| 91-47 | Failure of Thermo-Lag Fire Barrier Material to Pass Fire Endurance Test | 08/06/91 | All holders of OLs or CPs for nuclear power reactors. |
| 89-56, Supp. 2 | Questionable Certification of Material Supplied to the Defense Department by Nuclear Suppliers | 07/19/91 | All holders of OLs or CPs for nuclear power reactors. |
| 91-46 | Degradation of Emergency Diesel Generator Fuel Oil Delivery Systems | 07/18/91 | All holders of OLs or CPs for nuclear power reactors. |
| 91-45 | Possible Malfunction of Westinghouse ARD, BFD, and NBFD Relays, and A200 DC and DPC 250 Magnetic Contactors | 07/05/91 | All holders of OLs or CPs for nuclear power reactors. |

OL = Operating License
CP = Construction Permit