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

November 22, 1995

NRC INFORMATION NOTICE 95-13, SUPPLEMENT 1: POTENTIAL FOR DATA COLLECTION EQUIPMENT TO AFFECT PROTECTION SYSTEM PERFORMANCE

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 potential problems that may occur when using data acquisition system (DAS) devices to collect data on protection system performance. These devices have the potential to affect the signals being monitored. 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.

Background

The NRC issued Information Notice (IN) 95-13 to alert addressees to the potential for DAS devices in protection system circuits to affect parameters being monitored. Fermi 2 experienced problems with a decrease in reactor vessel level indication with the DAS unit connected but deenergized. The decrease in indication was a result of the low internal impedance of the (deenergized) DAS unit, whereby the signal was in parallel with both the DAS and the indicator, resulting in a smaller signal to the indicator. NRC has since learned that Quad Cities Station Unit 2 had a very similar experience shortly before the incident at Fermi. A more recent event at Quad Cities Unit 2 demonstrates potential for unplanned interactions of an energized DAS and the circuits being monitored.

Description of Circumstances

Quad Cities 2

During a routine surveillance on December 13, 1994, testing personnel found that the reactor low water level analog trip associated with the reactor protection system (RPS) scram setpoint was apparently reading out-of-tolerance. The testing personnel found that an installed DAS unit was affecting the trip setpoint. The DAS had been installed under a temporary modification and a 10 CFR 50.59 evaluation was performed.

However, no post-installation testing was performed because the licensee believed that the DAS unit was nonintrusive and would not affect the trip function. After the change in reactor water level setpoint was identified, the licensee performed additional troubleshooting and found that with the DAS turned off, the DAS unit became a low internal impedance path. Therefore, the transmitter output signal would divide in parallel with the DAS and the analog trip unit, causing the process parameter to decrease. The DAS was reinstalled to finish the collection of data, with instructions and warnings to prevent the DAS from being turned off. The effects of a potential loss of 120-volt (V) ac power to the DAS unit were not addressed.

On July 19, 1995, the DAS unit was reinstalled to monitor and establish baseline data for redundant channels of reactor vessel level and pressure, core flow, steam flow, and average power range monitor (APRM) flux. The next day, during a startup (at 2 percent power), the nuclear shift operator noted that the B recirculation pump speed had increased from about 32 percent to about 60 percent (causing a slight increase in reactor power), even though the A and B recirculation pumps were in manual mode, and no change in pump speed demand had been made by the operators. The operator was able to return the pump speed to 32 percent. Six hours later, the operator observed an indicated decrease of 20 centimeters(cm) [8 inches] in one reactor water level channel and indicated changes in core flow. It should be noted that neither water level nor core flow actually changed during this last event. The licensee made immediate plans to disconnect the DAS.

The cables that connect to the parameters being monitored were completely shielded except at the terminal block before entering the DAS unit. These cables did not use any type of isolation device to protect the instrumentation from influences of the DAS unit. A 100 conductor, unshielded ribbon cable was connected at one end to the unshielded terminal block external to the DAS, and on the other end to a circuit board within the DAS unit. The licensee had performed some preliminary testing and found that voltages from 0.4 V to 1.7 V ac were present on the dc process parameter signals. The ac voltage is present because the voltage supply to the instruments and control circuits is 120V ac. During normal operation (without the DAS installed), this stray ac voltage did not affect the dc signals. These dc signals are inputs into the GE-MAC analog control and to control room instrumentation. The signals are normally 10-50 milliamp (ma) dc but are converted to millivolt (mV) dc before entering the DAS.

The licensee explained that because the ribbon cable is not shielded, the process parameters were subjected to electromagnetic interference (EMI). This EMI is caused by the ac voltages riding on the ribbon cable, which may cross over to other circuits along the length of the ribbon cable (a length of about 20.5 cm [8 inches]). Testing personnel demonstrated that noise on one circuit can feed back into the original circuit, or to the other circuits. The licensee report of the event stated that the stray ac voltage was carried into the DAS and this ac voltage induced noise on the circuits being monitored, causing the signal problems previously noted. The vendor of the DAS was consulted and verified that such a scenario was possible. The vendor also stated that because of the high ac noise voltage compared to the signal being

monitored (10-50 mV dc), the DAS unit was not capable of completely filtering out the noise. The vendor stated that the DAS unit was capable of filtering out noise that did not exceed 50 percent of the parameter being monitored (about 20 mV for a 10-50 mV signal). The vendor also stated that high ac noise signals can damage the DAS multiplexer.

Discussion

The event on December 13, 1994, at Quad Cities (low internal impedance of a deenergized DAS) was similar to that experienced at Fermi as described in IN 95-13. The second event at Quad Cities involved a problem with the DAS unit turned on. Before putting the DAS unit in service, the licensee had observed ac noise riding on the dc signal. The licensee shielded all the output signals. However, the licensee did not consider induced voltages at the ribbon cable that would affect the parameters being monitored. The induced ac voltage superimposed on the dc signal, combined with the inability of the DAS unit to filter out the large ac noise signals, caused unplanned changes to certain control and indication signals.

Neither the Fermi nor the Quad Cities licensee performed testing adequate to indicate the potential for affecting the instrument signals for indication and control. Testing could have detected the changes to the input impedance to the DAS unit. In addition, possible loss of voltage to the DAS units, combined with the possible effects on redundant channels, was not considered. Furthermore, although the licensee for Quad Cities was aware of the ac noise present on the dc lines, the licensee performed no further investigation or testing to determine whether any adverse effects on the dc signal would occur.

As part of its corrective actions, the licensee for Quad Cities was formulating a policy that would allow use of the DAS with recorders with isolators. The isolation device would prevent the signal from feeding back or interfering with the process parameters. The licensee stated that the LaSalle nuclear station had used this approach with success.

The DAS units used at Fermi 2 are manufactured by Intelligent Instrumentation and utilize a Model No. PCI-20098C multifunction carrier board. The DAS units at Quad Cities are manufactured by Keithly Metrabyte. This equipment may be widely used in the nuclear power industry to collect and monitor plant data for analysis of various input parameters.

The Institute of Electrical and Electronics Engineers (IEEE) Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations," specifies that a single failure in the protection system not cause a loss of function, and redundant channels be independent and physically separated. IEEE Standard 338-1975, "Criteria for the Periodic Testing of Nuclear Power Generating Station Safety Systems," specifies that test equipment not cause loss of independence between redundant channels. The licensing basis of each plant contains the specific applicable commitments for channel independence.

Licensees are required [10 CFR 50.59(b)(1)] to maintain a written safety evaluation which provides the bases for the determination that a change, test or experiment does not involve an unreviewed safety question.

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.

Dennis M. Crutchfield, Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

Technical contacts: Roger Mendez, RIII
(708) 829-9745

Paul Loeser, NRR
(301) 415-2825

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LIST OF RECENTLY ISSUED NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
91-29, Supp. 3	Deficiencies Identified during Electrical Distribution System Functional Inspections	11/22/95	All holders of OLs or CPs for nuclear power reactors.
94-86, Supp. 1	Legal Actions Against Thermal Science, Inc., Manufacturer of Thermo-Lag	11/15/95	All holders of OLs or CPs for nuclear power reactors.
95-52	Fire Endurance Test Results for Electrical Raceway Fire Barrier Systems Constructed from 3M Company Interam Fire Barrier Materials	11/14/95	All holders of OLs or CPs for nuclear power reactors.
95-51	Recent Incidents Involving Potential Loss of Control of Licensed Material	10/27/95	All material and fuel cycle licensees.
95-50	Safety Defect in Gammamed 12i Bronchial Catheter Clamping Adapters	10/30/95	All High Dose Rate Afterloader (HDR) Adapters.
95-49	Seismic Adequacy of Thermo-Lag Panels	10/27/95	All holders of OLs or CPs for nuclear power reactors.
95-48	Results of Shift Staffing Study	10/10/95	All holders of OLs or CPs for nuclear power reactors.
95-47	Unexpected Opening of a Safety/Relief Valve and Complications Involving Suppression Pool Cooling Strainer Blockage	10/04/95	All holders of OLs or CPs for nuclear power reactors.
95-46	Unplanned, Undetected Release of Radioactivity from the Exhaust Ventilation System of a Boiling Water Reactor	10/06/95	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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TechEd reviewed this document 10/13/95.
*See previous concurrences.
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Section 50.59 of 10 CFR requires licensees to provide a basis for the determination that a test or experiment not described in the safety analysis report does not involve an unreviewed safety question.

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