

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

September 19, 1991

NRC INFORMATION NOTICE 91-57: OPERATIONAL EXPERIENCE ON BUS TRANSFERS

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 findings contained in Engineering Evaluation Report AEOD/E90-05, "Operational Experience on Bus Transfer," June 1990, on medium-voltage (2 kV to 15 kV) bus transfer failures at 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 are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

In 1988 and 1989, Northeast Utilities issued licensee event reports (LERs) 50-422/88-026 and 50-422/89-030 indicating that at the Millstone Nuclear Power Station, Unit 3, under certain scenarios, the existing bus transfer scheme could result in common-mode failure of Class 1E loads of both trains, and repeated bus transfers could damage the safety-related motors. This information prompted the NRC to conduct an in-depth study of the bus transfer practices and operational experience at U.S. nuclear plants. The results of this study are delineated in NRC Engineering Evaluation Report AEOD/E90-05, "Operational Experience on Bus Transfer," June 1990. The report indicates that between 1985 and 1989 bus transfers either failed to take place on demand or were accompanied by some equipment malfunction on more than 50 occasions.

Discussion

The problems associated with the bus transfer process raise two basic safety concerns:

- (1) Damage to the equipment connected to the auxiliary buses.
- (2) Failures of bus transfers to take place on demand.

The first safety concern relates to an excessive difference in voltage between the auxiliary load bus and the incoming power source. An excessive voltage

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difference will cause transient current flows in the system that can damage the transformers, the buses, and the connected loads.

There is a difference of opinion within the industry about criteria that assure safe bus transfer. In 1977, the American National Standards Institute (ANSI) introduced the recommendation for limiting resultant voltage to 1.33 per unit volts per hertz by issuing ANSI standard C50.41, "Polyphase Induction Motors for Power Generating Stations." The National Electrical Manufacturers Association (NEMA) accepted this as a safe criterion in NEMA MG-1-1978, "Motors and Generators." However, further research showed that limiting the resultant voltage to 1.33 per unit volts per hertz does not ensure that motor shaft torques will be within acceptable limits. In 1987, NEMA withdrew the criterion from MG-1.

The NRC staff is not aware of equipment failures at nuclear plants that can be directly attributed to excessive difference in voltage between an auxiliary load bus and the incoming power source, although some equipment could be stressed in this process. Such stresses experienced by connected equipment would be cumulative, and, unless specific action is taken to limit these stresses, they can remain undetected until failure occurs.

The second safety concern covers cases in which the transfer does not take place on demand, resulting in a loss of power to buses. In most nuclear plants, such a failure leads to the loss of offsite power to plant auxiliary loads, which in some cases, include the Class 1E loads. Hence, with this type of bus transfer failure, the Class 1E loads will be powered by the emergency diesel generators, and reactor system cooling will be accomplished by natural circulation. Although nuclear plants are designed to safely shut down on a loss of offsite power, it is desirable that such failures be kept to a minimum to minimize challenges to the emergency diesel generators.

Analysis

The data from AEOD/E90-05 indicates that the root causes for the most significant events (those that involved an actual failure to transfer or a significant design deficiency) can be broken down as follows:

- 42 percent were caused by design deficiencies,
- 25 percent were caused by equipment failures,
- 18 percent were caused by personnel errors, and
- 15 percent were caused by protective relays that blocked the bus transfer.

The major design deficiencies included slow bus transfer (35 percent of all design deficiency events), low bus voltage (24 percent of all design deficiency events), and inadequate setting and speed of operation of sync-check relays (17 percent of all design deficiency events).

In addition, the report includes a discussion of various design modifications that can reduce the probability of bus transfer failures, including modifying the power distribution scheme, using static sync-check relays and devices, and incorporating faster bus transfer practices. The report also indicates that many of the bus transfer failures resulting from equipment malfunction and personnel errors can be avoided by improving equipment maintenance and personnel vigilance.

Related Generic Communications

The staff has issued the following information notices on this and related topics: Information Notices 85-28, "Partial Loss of AC Power and Diesel Generator Degradation," 86-87, "Loss of Offsite Power Upon an Automatic Bus Transfer," 86-100, "Loss of Offsite Power to Vital Buses at Salem 2," and 88-50, "Effect of Circuit Breaker Capacitance on Availability of Emergency Power."

NRC Engineering Evaluation Report AEOD/E90-05 is available in the Public Document Room, Washington, D.C. (Accession Number 9007310012).

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 project manager.

U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20542-0001
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Charles E. Rossi, Director
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Office of Nuclear Reactor Regulation

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LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
91-56	Potential Radioactive Leakage to Tank Vented to Atmosphere	09/19/91	All holders of OLs or CPs for nuclear power reactors.
91-55	Failures Caused by An Improperly Adjusted Test Link In 4.15 KV General Electric Switchgear	09/16/91	All holders of OLs or CPs for nuclear power reactors.
85-18, Supp. 1	Failures of Undervoltage Output Circuit Boards In the Westinghouse-Designed Solid State Protection System	09/10/91	All holders of OLs or CPs for Westinghouse (W)-designed nuclear power reactors.
91-54	Foreign Experience Regarding Boron Dilution	09/06/91	All holders of OLs or CPs for pressurized water reactors (PWRs).
89-90, Supp. 2	Pressurizer Safety Valve Lift Setpoint Shift	09/05/91	All holders of OLs or CPs for nuclear power reactors.
91-53	Failure of Remote Shutdown System Instrumentation Because of Incorrectly Installed Components	09/04/91	All holders of OLs or CPs for nuclear power reactors.
91-52	Nonconservative Errors In Overtemperature Delta-Temperature (OT&T) Setpoint Caused by Improper Gain Settings	08/29/91	All holders of OLs or CPs for Westinghouse (W)-designed nuclear power reactors.
86-14, Supp. 2	Overspeed Trips of APW, 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.

OL = Operating License
CP = Construction Permit

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References:

1. NRC Engineering Evaluation Report, AEOD/E90-05, "Operational Experience On Bus Transfers," June 1990. Available in the Public Document Room, Washington, D.C., Accession Number 9007310012

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AJKugler	SMazumdar	EJBrown
08/08/91	08/09/91	08/13/91
		JERosenthal
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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 NRR project manager.

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No specific action is required by the notice. However, if you have any questions on this issue, please contact the technical staff listed below or the regional administrator of the appropriate regional office.

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