

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

January 31, 1991

NRC INFORMATION NOTICE NO. 91-06: LOCK-UP OF EMERGENCY DIESEL GENERATOR
AND LOAD SEQUENCER CONTROL CIRCUITS
PREVENTING RESTART OF TRIPPED EMERGENCY
DIESEL GENERATOR

Addressees:

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose:

The information in this notice is intended to alert addressees of potential problems involving the restart of a tripped emergency diesel generator (EDG) because of "lock-up" of EDG or load sequencer control circuits. 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 March 20, 1990, operations personnel at the Alvin W. Vogtle Plant, Unit 1, experienced difficulties when attempting to restart the in-service EDG. In response to a valid bus undervoltage condition, the EDG had automatically started and energized its associated 4.16 kV ac safety bus per design. The EDG tripped after approximately one minute of operation. A spurious jacket water high temperature signal is believed to have caused the trip. The load sequencer had completed its cycle before the trip. The EDG could not be restarted following the trip even though the condition that had caused the trip had cleared and a valid undervoltage condition and automatic start signal existed. The EDG control circuits had functioned as designed but had locked-up such that subsequent restart attempts were prevented. Although the EDG could have been started in the "emergency" mode by using the emergency start switch at the local panel, the local and remote control switches used for "normal" EDG start were ineffective. No equipment failures or malfunctions were involved.

The design of the load sequencer circuits that provide an automatic start signal upon sensing bus undervoltage and the interface between these circuits and the interlocks in the EDG air start system are such that the circuits will lock-up whenever a trip results in an undervoltage condition on the associated

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safety bus. During the March 1990 event at the Vogtle Plant, the initial attempts to reset the lock-up were unsuccessful, and the EDG was not restarted for approximately 18 minutes. Had proper action been taken to reset the locked-up circuits, the EDG could have been restarted promptly. However, the operations personnel involved were not trained concerning the lock-up condition, and procedures providing guidance concerning actions required for restart did not exist. A detailed explanation of the design of the Vogtle Unit 1 load sequencer and EDG air start system is presented in NUREG 1410, "Loss of Vital AC Power and the Residual Heat Removal System During Mid-Loop Operations at Vogtle Unit 1 on March 20, 1990."

On November 14, 1990, the 1A EDG at the Kewaunee Nuclear Power Plant was being tested following replacement of the governor. Because of an improper governor setting, the EDG tripped on overspeed before the load sequencer completed its cycle. This trip caused the sequencer control circuits to lock-up in a condition that would have prevented loading of the EDG following a valid start. Maintenance technicians present during the testing had to lift leads in the sequencer cabinet to clear the lock-up condition. The first attempt to clear the lock-up condition was unsuccessful because the leads were only removed momentarily, which resulted in remote indications that led the operators to believe that the sequencer had been reset. However, the leads were relanded before time delay relays could time out and reset (approximately 90 seconds is required). Approximately two hours were required for the plant personnel to troubleshoot the load sequencer and complete successful testing of the EDG. Apparently, the plant staff were not adequately trained to recognize and reset the lock-up condition, and plant procedures were not appropriately detailed to allow operators to cope with a situation where the EDG trips before the load sequencer completes its cycle. The licensee is considering a modification to the sequencer to install a conveniently located reset switch to allow reset to be accomplished without having to lift leads.

Discussion:

These incidents have raised concerns regarding the understanding of EDG and load sequencer control circuits and their interfaces, and the adequacy of procedures for restarting EDGs following unexpected trips. EDG and load sequencer control systems are often complex. As the result of either a valid or spurious trip signal, an EDG can shut down at any time before, during, or after cycling of the load sequencer. Successful mitigation of the effects of accidents or transients and maintenance of the overall reliability of EDGs depends upon operations personnel having (1) sufficient knowledge of the associated instrumentation and controls; and (2) the ability to recognize and reset a lock-up condition.

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

Charles E. Rossi
Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contact: E. Nick Fields
(301) 492-1173

Attachment: List of Recently Issued NRC Information Notices

Attachment 1
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LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
91-05	Intergranular Stress Corrosion Cracking in Pressurized Water Reactor Safety Injection Accumulator Nozzles	1/30/91	All holders of OLs or CPs for pressurized water reactors (PWRs).
91-04	Reactor Scram Following Control Rod Withdrawal Associated with Low Power Turbine Testing	01/28/91	All holders of OLs or CPs for nuclear power reactors.
91-03	Management of Wastes Contaminated with Radioactive Materials ("Red Bag" Waste and Ordinary Trash)	01/07/91	All medical licensees.
91-02	Brachytherapy Source Management	01/07/91	All Nuclear Regulatory Commission (NRC) medical licensees authorized to use byproduct material for medical purposes.
91-01	Supplier of Misrepresented Resistors	01/04/91	All holders of OLs or CPs for nuclear power reactors.
90-82	Requirements for Use of Nuclear Regulatory Commission-(NRC-)Approved Transport Packages for Shipment of Type A Quantities of Radioactive Materials.	12/31/90	All registered users of NRC-approved packages.
90-81	Fitness for Duty	12/24/90	All U.S. Nuclear Regulatory Commission (NRC) material and non-power reactor licensees.
90-80	Sand Intrusion Resulting in Two Diesel Generators Becoming Inoperable	12/21/90	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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Attachment: List of Recently Issued NRC Information Notices

*See previous concurrence

OFC	:DOEA:EAB:	:SC:DOEA:EAB	:C:DST:SELB	:C:DOEA:EAB	:C:DOEA:OGCB	:D:DOEA	:TechEd
NAME	:ENFields*	:DCFischer*	:FRosa*	:AEChaffee*	:CHBerlinger*	:CERossi	:JMain*
DATE	:12/19/90	:12/24/90	:1/3/91	:1/9/91	:1/17/91	:01/28/91	:01/22/91

Successful mitigation of the effects of accidents or transients and maintenance of the overall reliability of emergency diesel generators depends upon operations personnel having (1) sufficient knowledge of the associated instrumentation and controls; and (2) the ability to quickly recognize and reset a lock-up condition, especially in cases where the cause for the trip is known and easily corrected. When functioning as designed, the emergency diesel generator and load sequencer control systems should only present situations to operations personnel for which the best recovery method is understood and for which the method for recovery is uncomplicated.

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OFC	:DOEA:EAB:	:SC:DOEA:EAB	:C:DST:SELB	:C:DOEA:EAB	:C:DOEA:OGCB	:D:DOEA	: TechEd
NAME	:ENFields*	:DCFischer*	:FRosa*	:AECChaffee*	:CHBerlinger	:CERossi ^{ll}	: JMain
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OFC	:DOEA:EAB:	:SC:DOEA:EAB	:C:DST:SELB	:C:DOEA:EAB	:C:DOEA:OGCB	:D:DOEA	:
	<i>ENT</i>	<i>DC</i>	<i>SXF</i>	<i>Roll</i>			
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