

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

March 4, 1991

**NRC INFORMATION NOTICE NO. 91-13: INADEQUATE TESTING OF EMERGENCY  
DIESEL GENERATORS (EDGs)**

Addressees:

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

Purpose:

This information notice is intended to alert addressees to inadequacies in the testing of emergency diesel generators at nuclear power plants. Specifically, some EDG testing has not adequately verified the capability of the EDG to carry its maximum expected loads and other tests have failed to properly verify the operation of the load shedding logic for the EDG. These testing deficiencies indicate that other licensees may have similar deficiencies that have not yet been detected. 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:

Yankee Atomic Electric Company, the licensee for the Yankee Nuclear Power Station (Yankee Rowe), recently identified that the EDGs at the Yankee Rowe plant were undersized for their maximum accident electrical load demand. The EDGs failed to reach their technical specification (TS) required loading of 400 kilowatts (kW) while connected in parallel to the electrical grid. The licensee then retested the EDGs using a resistor bank in place of the grid. Using this test configuration, Yankee Atomic determined that the frequency of the generator dropped to 58 hertz with a maximum electrical output of 385 kW. The licensee attributed the reduction in power output, in part, to high ambient air temperatures that reduced engine power and cooling. The licensee had not considered the effect of ambient air temperature during previous testing. The existing air temperature was within design basis limits. Although high ambient air temperature was the immediate cause of the failure to attain 400 kW, the root cause was the fact that the engines were undersized. The manufacturer's rating of 400 kW also failed to consider the effects of ambient air temperature. The licensee calculated that the dependable capacity of these EDGs was between 359 kW and 399kW. Yankee Atomic eventually replaced all 3 EDGs with models capable of producing 600 kW (450 kW continuous) because the

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estimated electrical load on the EDGs is very close to 400 kW and modifications to the original EDGs failed to raise their output capabilities. The Omaha Public Power District, the licensee for Fort Calhoun Station, Unit 1, reported a similar problem with their EDGs. At Fort Calhoun, the EDGs could temporarily achieve their design rating at high ambient temperatures, but they could not maintain this power level for an extended period of time.

At the Vermont Yankee Generating Station, during a safety system functional inspection, the U.S. Nuclear Regulatory Commission (NRC) staff determined that the surveillance testing of the station EDGs was inadequate. The staff found that there was insufficient electrical loading during testing as well as insufficient compensation for the expected electrical power factor (pf). Specifically, the plant surveillance test for the EDGs required that the EDGs maintain a load of 2500 to 2750 kW, which is equivalent to 2500 to 2750 kilovolt-amperes (kVA) at pf=1.0. The licensee considered this limit sufficient to meet the maximum load of 2471 kW specified in the final safety analysis report (FSAR). However, during subsequent analysis, the licensee determined that the worst-case EDG loading could actually reach 2751 kW. In addition, the EDG would realistically experience an electrical power factor of 0.85 lagging, causing the actual generator output current to be significantly higher (i.e., assuming generator output voltage is maintained roughly constant, generator output current and kVA at pf=0.85 are approximately 1.18 times the generator output current and kVA at pf= 1.0.) Therefore, the existing surveillance did not adequately demonstrate the capability of the EDG to carry its accident kW and current loading. As a result, the licensee is modifying its EDG testing requirements to ensure that both the engine and the generator will be appropriately tested to demonstrate their capability to produce the accident electrical load.

At Millstone Nuclear Power Station, Unit 3, the Northeast Nuclear Energy Company (the licensee) determined that its testing of the EDG load shedding circuitry was inadequate. In particular, the surveillance tests did not verify the load shedding of five nonsafety-related loads and two safety-related loads. This condition was a violation of TS requirements and had existed from initial plant operation in April 1986 until January 1990. Subsequent testing verified that the load shedding circuits operated properly.

#### Discussion:

The events at Yankee Rowe, Fort Calhoun, and Vermont Yankee illustrate the failure of EDG testing to demonstrate properly the capability of the EDGs to assume the design-basis electrical loading during an accident. The intent of the required surveillance testing is to assure that the EDG can dependably carry its accident loads. It is important that the worst-case conditions (frequency, voltage, electrical power factor, and environment) be considered when the EDG is tested. In particular, the effects of the electrical power factor and the environment may have been overlooked. It is important that procedures give personnel performing the test sufficient information to allow them to load the EDG to simulate worst-case conditions. Since the simulation of environmental conditions is generally impractical, it may be necessary to use analysis to correct for environmental conditions or to show that the effect

of such conditions is negligible for the EDG. Information from the vendor may help in determining what changes, if any, may be necessary. It is also important for procedures to give adequate guidance to ensure that the EDG is not inadvertently overloaded during the test.

The last event illustrates the failure of EDG testing to verify adequately the proper operation of all of the logic necessary to support the EDG in an accident. Millstone Unit 3 was given as an example, but other similar cases have been reported.

Generic Letter 88-15, "Electric Power Systems - Inadequate Control Over Design Processes," discussed problems similar to those in this information notice.

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.

*Charles E. Rossi*

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Office of Nuclear Reactor Regulation

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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
91-12	Potential Loss of Net Positive Suction Head (NPSH) of Standby Liquid Control System Pumps	02/15/91	All holders of OLs or CPs for boiling water reactors (BWRs).
91-11	Inadequate Physical Separation and Electrical Isolation of Non-safety-related Circuits from Reactor Protection System Circuits	02/20/91	All holders of OLs or CPs for H-designed nuclear power reactors.
86-99, Supp. 1	Degradation of Steel Containments	02/14/91	All holders of OLs or CPs for nuclear power reactors.
89-32, Supp. 1	Surveillance Testing of Low-Temperature Overpressure-Protection Systems	02/12/91	All holders of OLs or CPs for nuclear power reactors.
91-10	Summary of Semiannual Program Performance Reports on Fitness-for-Duty (FFD) in the Nuclear Industry	02/12/91	All holders of OLs or CPs for nuclear power reactors.
91-09	Counterfeiting of Crane Valves	02/05/91	All holders of OLs or CPs for nuclear power reactors.
91-08	Medical Examinations for Licensed Operators	02/05/91	All holders of OLs or CPs for nuclear power, test and research reactors.
90-77, Supp. 1	Inadvertent Removal of Fuel Assemblies from the Reactor Core	02/04/91	All holders of OLs or CPs for pressurized-water reactors (PWRs).
91-07	Maintenance Deficiency Associated with General Electric Horizontal Custom 8000 Induction Motors	02/04/91	All holders of OLs or CPs for nuclear power reactors.

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CP = Construction Permit

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Original Signed by

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**\*SEE PREVIOUS CONCURRENCES**

D/DOEA:NRR CERossi 02/12/91	*C/OGCB:DOEA:NRR*RPB:ADM CHBerlinger 02/21/91	TechEd 12/27/90	*RI CWoodard 01/14/91	*RI TKoshy 12/21/90
*OGCB:DOEA:NRR AJKugler 12/20/90	*OTSB:DOEA:NRR EBTomlinson 01/29/91	*SPLB:DST:NRR REArchitzel 01/29/91	*C/SPLB:DST:NRR CEMcCracken 01/30/91	*C/SELB:DST:NRR FRosa 01/31/91

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The last event illustrates the failure of EDG testing to verify adequately the proper operation of all of the logic necessary to support the EDG in an accident. Millstone Unit 3, was given as an example, but other similar cases have been reported. The TS surveillance tests should verify that logic, such as the load shedding logic, which supports the accident response of the EDGs, will perform its intended function.

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Document Name: EDGIN

<b>*SEE PREVIOUS CONCURRENCES</b>				
D/DOEA:NRR	C/OGCB:DOEA:NRR	*RPB:ADM	*RI	*RI
CERossi	CHBerlinger	TechEd	CWoodard	TKoshy
02/ /91	02/01/91	12/27/90	01/14/91	12/21/90
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AJKugler	EBTomlinson	REArchitzel	CEMcCracken	FRosa
12/20/90	01/29/91	01/29/91	01/30/91	01/31/91

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The third event illustrates the failure of EDG testing to adequately verify the proper operation of ~~all~~ of the logic necessary to support the EDG in an accident. Millstone, Unit 3, was given as an example, but other similar cases have been reported. The TS surveillance tests must verify that the logic associated with the various sequences (loss of offsite power, loss-of-coolant accident, load shedding and sequencing, etc.) will perform its intended function.

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(413) 424-5242

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 December XX, 1990  
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