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AUTH.NAME AUTHOR AFFILIATION
NORTH,P.J. Duke Power Co.
TUCKER,H.B. Duke Power Co.
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 88-001-00:on 880215,seismic inoperability of power inverter due to design deficiency.

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NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

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TITLE (4)

SEISMIC INOPERABILITY OF A VITAL POWER INVERTER DUE TO A DESIGN DEFICIENCY

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 2	2 2	8 8	8 8	— 0 0 1	— 0 0	0 3	2 3	8 8		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	XX 50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	XX 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
PHILIP J. NORTH - LICENSING	AREA CODE 7 0 4 3 7 3 - 7 4 5 6

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	XX NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On February 15, 1988 a brace used to help secure printed circuit boards in Vital Power Inverter 2DIB, was discovered missing during performance of a preventive maintenance procedure. On February 22, 1988 it was determined by Design Engineering that the inverter had been seismically tested and qualified with the brace installed. Therefore the brace was required to be installed for seismic qualification and operability.

Because Unit 2 operated with 2DIB Inverter seismically inoperable, it operated outside its design basis. Additionally Technical Specification 3.7.2(h) was violated. At the time of discovery, Unit 2 was in a refueling outage.

The root cause of this event was determined to be a design deficiency since no documentation existed or was originally provided regarding the need for the brace. A contributing cause was the failure of the maintenance procedure to specify the removal and restoration of the brace.

Since the missing brace could not be found, a new one was fabricated and installed, using the design of the braces in the other inverters. All three unit's inverters were inspected to verify their braces were installed.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

Background:

Vital inverter 2DIB is a component of the Unit 2 DC Power System. The four vital inverters are components of the 125 volt DC System, which provides a source of reliable continuous power (125 volt DC) for control and instrumentation during normal operation and for an orderly shutdown of the unit. Each inverter supplies one of four redundant 120 volt AC vital instrument power buses. The buses supply power in a predetermined arrangement to vital instrumentation and control loads.

The four vital AC Power Panelboards and their associated inverters, such as 2DIB, are required to be operable when the reactor is above 200 degrees-F. Technical Specification 3.7.2(h) allows the DIB inverter of a unit to be inoperable with no compensating actions, for no more than four hours. If compensatory actions are taken, the inverter may remain inoperable for a total period not to exceed seven days.

The inverters must be seismically qualified for them to be considered operable. This requirement is part of the overall requirement that Oconee Nuclear Station be designed to withstand the maximum hypothetical earthquake for its location. These requirements are listed in the FSAR Chapter 3.0. Table 3.10-1 states that 2DIB is seismically qualified, and is thus part of the design basis.

Sequence of Events:

1970

- o Inverter was seismically qualified by Exide by using a brace and modifying the door latching system.

Date Unknown

- o The brace was not replaced after maintenance making the inverter seismically inoperable.
- o The inverter was placed in service without the brace installed.
- o Unit 2 was subsequently operated outside its design basis.
- o Technical Specification 3.7.2(h) was violated.

February 4, 1988

- o Unit 2 Shutdown for Refueling

February 15

- o An Instrumentation and Electrical (I&E) Technician noted that the brace was missing.
- o The I&E Technician reported the missing brace to his management.

February 16

- o A work request was initiated to fabricate and install a new bracket.

February 22

- o Design Engineering determined the inverter was seismically inoperable.

February 23

- o I&E verified that the other Vital Inverters on all three units had braces installed where required.

February 25

- o A new brace was installed on 2DIB Inverter making it seismically operable.

Description Of Occurrence:

On February 15, 1988 at 1615, an I&E Technician began a preventive maintenance task on 2DIB vital power inverter for Unit 2, which was in a refueling outage. Preventive maintenance is performed each refueling outage on all four vital inverters. This is done using the Preventive Maintenance Procedure for Exide Inverters.

As a part of preventive maintenance, printed circuit boards, which are mounted on a rack inside the inverter, are removed and inspected. Upon reaching the step in the procedure which required this, the I&E Technician noticed the absence of a brace that should have been secured against the backs of the boards. Although he had not previously worked on Unit 2's vital inverters, the I&E Technician was familiar with their layout from working on the Unit 1 inverters.

The procedure does not include any information regarding the brace. Step 10.9 simply states, "Remove circuit boards one at a time, make the following checks and replace the boards." However, because there was a deviation from what he expected to see, the I&E Technician consulted his management concerning the missing brace.

When an I&E Engineer was informed of the missing brace, he realized that it could affect the seismic qualification of the inverter. He generated a Problem Investigation Report in which he stated the need for determining the significance of the missing brace. In his judgement, the brace was required for seismic

qualification, so he took the following actions: 1) On February 16, 1988 a work request was initiated to fabricate and install a new bracket as the original one could not be found. 2) Operations was informed of the technical inoperability of the inverter. This was not significant at the time because Unit 2 was in a refueling outage. 3) I&E verified that the brace was in place on the other vital inverters for all three units.

Design Engineering was requested by the Oconee Nuclear Station Compliance section to formally review the question of seismic operability. They also could find no specific reference to the brace. A report was found which contained information from the Exide Corporation, the inverter's manufacturer, concerning the seismic qualification testing completed in 1970. While the brace was not specifically mentioned, a problem with printed circuit boards becoming dislodged was mentioned. It was stated that Exide was going to correct the problem by changing how the door was latched in order to secure it more firmly and by better securing the printed circuit boards.

Exide was subsequently contacted for additional information. They determined that the inverter had been tested for seismic qualification with the brace installed. It was also determined that the brace was originally installed to secure the printed circuit boards for shipping. When the testing was performed, the brace was used to further secure the boards and prevent them from becoming dislodged. Based on this information, on February 22, 1988 Design Engineering concluded that the inverter was seismically inoperable.

The new brace was installed on February 25 making the inverter seismically operable. Unit 2 was still in the refueling outage at this time.

Cause of Occurrence:

The root cause of this incident was determined to be a Design Deficiency due to the failure of Design Engineering to ensure adequate information regarding the brace was available. There was no indication as to the significance of the missing brace available to Oconee Nuclear Station personnel. Discussions with personnel in Design Engineering familiar with the seismic qualification program determined it is a Design Engineering function, in regards to seismic qualification, to insure that drawings and manuals associated with a particular component show what is needed to maintain the component in an operable condition.

A contributing cause to the design deficiency was the failure of the manufacturer to supply adequate information to Design Engineering regarding the brace. Had the manufacturer supplied sufficient information to Design, the significance of the brace could have been realized.

A further contributing cause of this event was the fact that the preventive maintenance procedure did not mention the existence of the brace. Had it required verification of the brace, it would have provided a periodic and specific means of assuring the brace was installed, thereby insuring seismic operability of the inverter.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

As to when or how the brace was actually removed from the inverter, no definite answer can be provided. The fact that the braces were routinely installed by the manufacturer for shipping purposes and were present on the other vital inverters indicates that the 2DIB brace was originally installed. Based on this, it is concluded that the brace was removed for either repairs or during preventive maintenance. There are no procedural sign-off steps or other documentation to indicate any historical presence or absence of the brace during plant operation. Interviews with personnel who performed the most recent work on the inverter, (Sept., 1986), which involved the printed circuit boards, found there was no specific recollection concerning the brace's presence or absence. Because of this conclusion, it has to be assumed that Unit 2 operated at power with the inverter seismically inoperable.

A review of previous incidents found several instances where equipment was determined to be seismically inoperable. There have been two reportable incidents within the past three years. A review of two additional years found no reportable incidents regarding equipment being seismically inoperable.

In February 1986, it was determined that portions of the Emergency Feedwater System and Low Pressure Service Water System piping and valves were not seismically qualified. As reported in LER 269/86-02, this was determined to be due to a design deficiency. In this incident it was determined that some valves had been installed during construction prior to the establishment of specific seismic qualification criteria for them. These valves were subsequently qualified as criteria became available. However there were deficiencies in documentation demonstrating this. It was also found that manual boundary valves were found to be normally open instead of closed and, finally that some piping attached to the Upper Surge Tanks was not seismically qualified. Corrective actions addressed the specific piping and valves and would have had no impact on this incident.

In June, 1986 as reported in LER 269/86-09 it was determined that the Keowee Battery Racks were seismically inoperable because spacer material had not been installed between the batteries. The root cause was a design deficiency due to poor communication between the designer and the station involving specifications of the racks. Corrective actions for this event involved evaluating the Nuclear Safety Modification program to insure all drawing specification changes were documented and communicated to the station.

The evaluation concluded that the existing program was sufficient. Design Engineering personnel are required to insure the accuracy of drawings and, operating and maintenance manuals. This would include comparisons with seismic test qualification reports. The programs are described in the Design Engineering Quality Assurance Manual PR-160 and in their Departmental Manual volume II, 4.2. Had this program existed in this form at the time of purchase and installation of the inverter, it would have assured the brace was adequately described. The programmatic changes that have occurred from 1970 through this time should be sufficient corrective action to preclude a recurrence of this incident.

This incident is considered to be recurring in nature. Incidents involving seismic qualification are considered to be occurring at a high frequency due to the fact that these incidents occurred within the past three years.

As there was no component failure involved, this incident is not NPRDS reportable. There were no releases of radioactive materials, radiation exposures or personnel injuries as a result of this incident. This incident was determined to be reportable pursuant to the requirements of 10CFR 50.73(a)(2)(ii)(B) and 50.73(a)(2)(i)(B).

Corrective Actions:

Subsequent to the discovery of this incident:

- o All other vital inverters were verified to have the brace installed;
- o The brace was replaced on 2DIB inverter.

Planned corrective actions are for:

- o The Preventive Maintenance Procedure For Exide Inverters to be changed to require verification of braces being installed;
- o The Controlling Procedure for Troubleshooting and Corrective Maintenance to be changed requiring equipment worked on to be restored to its original configuration;
- o The need for restoring equipment back to its original configuration to be reviewed with I&E personnel;
- o I&E to have the replacement brace design reviewed to assure it is an adequate replacement for the original;
- o Documentation regarding the inverter to be upgraded to show the presence of the brace.

Analysis of Occurrence:

The purpose of the four Vital Power Inverters is to separately supply AC power to each of four Vital AC Power Buses. The Buses in turn supply vital instrumentation and control loads under all operating conditions. The normal operation of Inverter 2DIB was not affected by the missing brace. The purpose of the brace, once the inverter is installed, is to assure the printed circuit boards do not become dislodged during a seismic event. Any other time, it has no effect on inverter operation.

Had a seismic event occurred that was sufficient to dislodge the cards and disrupt the inverter's operation, Control Room Personnel would have been aware of the

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problem. Each inverter is tied into a local statalarm panel. Upon failure of the inverter, statalarms would actuate at this panel. In turn, a statalarm in the Control Room would actuate informing Control Room Operators that an alarm condition existed at the local panel. Upon identifying the failed inverter, the Vital AC Bus fed by an individual Inverter could be manually switched to the AC Regulated Power System.

If for some reason power could not be supplied to the Vital AC Bus by manual action, the unit would still be maintained in a safe condition. Each of the unit's four redundant channels of nuclear instrumentation and reactor protective equipment is supplied from a separate bus of the four redundant AC buses. Each of the three redundant channels of the energized safeguards protective system is also supplied from a separate bus and the two engineered safeguards actuation power buses are supplied from separate vital power buses.

Because of the facts:

- There was no actual malfunction of 2DIB Inverter
- Alarm capability is present to inform Operations of an inverter failure
- Power supply to the Vital AC Buses is redundant
- Nuclear instrumentation, reactor protective and the engineered safeguards protective system are supplied redundantly by separate vital buses.

It is concluded that the health and safety of the public were not adversely affected.

DUKE POWER COMPANY
P.O. BOX 33189
CHARLOTTE, N.C. 28242

HAL B. TUCKER
VICE PRESIDENT
NUCLEAR PRODUCTION

TELEPHONE
(704) 373-4531

March 23, 1988

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
LER 270/88-01

Gentlemen:

Pursuant to 10CFR 50.73 Sections (a) (1) and (d), attached is Licensee Event Report (LER) 270/88-01 concerning the seismic inoperability of a vital power inverter.

This report is submitted in accordance with Part 50.73(a)(2)(i)(B) and 50.73(a)(2)(ii)(B). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

PJN/310/jgc

Attachment

xc: Dr. J. Nelson Grace
Regional Administrator, Region II
U.S. Nuclear Regulatory Commission
101 Marietta St., NW, Suite 2900
Atlanta, Georgia 30323

Ms. Helen Pastis
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. P.H. Skinner
NRC Resident Inspector
Oconee Nuclear Station

American Nuclear Insurers
c/o Dottie Sherman, ANI Library
The Exchange, Suite 245
270 Farmington Avenue
Farmington, CT 06032

INPO Records Center
Suite 1500
1100 Circle 75 Parkway
Atlanta, Georgia 30339

M&M Nuclear Consultants
1221 Avenue of the Americas
New York, NY 10020

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