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FACIL:50-251 Turkey Point Plant, Unit 4, Florida Power and Light C 05000251
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RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 91-002-00:on 910107 & 0729,permanent magnet generator failed during performance of emergency diesel generator 4A tests.Caused by misalignment of drive shaft & ground in voltage regulator.New drive shaft installed.W/911002 ltr.

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OCT 02 1991

L-91-243
10 CFR 50.73

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

Gentlemen:

Re: Turkey Point Unit 4
Docket No. 50-251
Reportable Event: 91-002-00
Date of Event: January 7, 1991
4A Emergency Diesel Generator Permanent Magnet Generator Failures Due to Design Inadequacy

The attached voluntary Licensee Event Report 251-91-002-00 is being provided for information purposes only following the guidance provided in NUREG 1022, Supplement 1, Item 19.1.

Very truly yours,

T. F. Plunkett
Vice President
Turkey Point Nuclear

TFP/DPS/ds

enclosures

cc: Stewart D. Ebneter, Regional Administrator, Region II, USNRC,
Senior Resident Inspector, USNRC, Turkey Point Plant

JE22 1/1

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
TURKEY POINT UNIT 4	05000251	1 OF 5

TITLE (4) 4A EMERGENCY DIESEL GENERATOR PERMANENT MAGNET GENERATOR FAILURES DUE TO DESIGN INADEQUACY

EVENT DATE (5)				LER NUMBER (6)			RPT DATE (7)				OTHER FACILITIES INV. (8)	
MON	DAY	YR		YR	SEQ #	R#	MON	DAY	YR		NAME	DOCKET # (5)
01	07	91		91	002	00	10	02	91			

OPERATING MODE (9)	N	10 CFR N/A
POWER LEVEL (10)	000	OTHER Voluntary (Specify in Abstract below and in text)

LICENSEE CONTACT FOR THIS LER (12)

	TELEPHONE NUMBER
David R. Powell, Superintendent of Licensing	305-246-6559

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	NPRDS
B	EK	PMG	X999	Y						

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

ABSTRACT (16)

This voluntary LER is being submitted following the guidance provided in NUREG 1022, Supplement 1, Item 19.1.

On January 7, 1991, and on July 29, 1991, with both units defueled and during performance of the 4A Emergency Diesel Generator (EDG) tests, the Permanent Magnet Generator (PMG) failed. The January test was being performed as part of phase 1 of the FPL acceptance testing prior to turnover of two new EDGs to the plant. The July 29 failure occurred during a 24 hour test run required prior to declaring the EDGs operable. EDGs 4A and 4B have been installed as part of the Emergency Power Systems Enhancement Project (EPS). The January event was caused by a drive shaft failure determined to have been caused by misalignment of the shaft. Following the January event, new PMG shafts were installed on both 4A and 4B EDGs. In addition, a new alignment procedure was provided by the vendor. Both events were determined to have been caused by inadequate design in that the drive shaft arrangement was unable to maintain sufficient clearance between the PMG rotor and stator. The PMG was removed from EDGs 4A and 4B and replaced with a system powered from the 125 VDC station battery. Note, the PMG arrangement on EDGs 4A and 4B was a one-of-a-kind addition designed specifically for Turkey Point Unit 4. EDGs 3A and 3B do not have PMGs, therefore this problem was not applicable to Unit 3.

I. EVENT DESCRIPTION

This voluntary LER is being submitted following the guidance provided by NUREG 1022, Supplement 1, Item 19.1.

A. January 7, 1991 Event

On January 7, 1991, with both units defueled, the drive shaft to the 4A Emergency Diesel Generator (EK)(EDG) Permanent Magnet Generator (EK)(PMG) sheared at the drive hub end. Although the PMG was still functioning after the shaft sheared, the evaluation of the event stated that Engineering could not determine how long the PMG would have continued to operate in that condition. The PMG failure could prevent EDG loading.

The failure occurred during phase 1 of the Florida Power And Light (FPL) acceptance testing prior to turnover of the EDG to the plant. Two new EDGs have been installed as part of the Emergency Power Systems Enhancement Project (EPS). The two EDGs were turned over to the plant in July, 1991.

B. July 29, 1991 Event

On July 29, 1991, at approximately 1530 EDT, with both units defueled during the Emergency Power Enhancement Dual Unit Outage, the 24 hour test run on EDG 4A was terminated 6.5 hours into the run due to a DC ground in the voltage regulator circuits. Investigation of the DC ground determined the cause to be a short in the PMG. Before disassembly, a black substance was noted to be flowing from the PMG cover. An examination of the PMG internals discovered that the permanent magnets had completely separated from the shaft and were partially ground up between the shaft and the stator.

II. EVENT CAUSE

A. January 7, 1991 Event

1. Immediate Cause

The drive shaft to the PMG sheared at the drive hub end at the flange to shaft welded joint.

2. Root Cause

The January 7 PMG failure was caused by a drive shaft failure determined to have been caused by misalignment of the shaft. The design of the PMG with a floating bearing on one side and a long shaft coupled to the diesel auxiliary drive on the other side made alignment difficult. Misalignment of the PMG shaft produced cyclic bending stresses in the shaft at the location of the failure.

3. Contributing Cause

The failure was accelerated by use of the wrong material for the shaft and improper welding on the shaft by the manufacturer.

B. July 29, 1991 Event

1. Immediate Cause

The 24 hour test was terminated due to a DC ground detected in the voltage regulator circuits.

2. Root Cause

The root cause of this event was the inability of the PMG drive shaft arrangement to maintain sufficient clearance between the PMG rotor and stator during all dynamic conditions of operation; i.e., starting, running, and loading vibrations. The design did not prevent exceeding the required tolerances.

III. EVENT SAFETY ANALYSIS

A. January 7, 1991 Event

The Emergency Diesel Generators (EDGs) are necessary to provide on-site power to required safety related loads during a loss of off-site power. An engineering evaluation of this event by FPL engineering concluded that the broken shaft could cause the failure of the PMG. The failure of the PMG could prevent the EDG from loading.

The defect was discovered and corrected prior to the subject EDG being turned over to the plant.

B. July 29, 1991 Event

On July 29, 1991, with both units defueled during the Emergency Power Enhancement Dual Unit Outage, the permanent magnet generator (PMG) attached to emergency diesel generator (EDG) 4A was destroyed. The 24 hour test run had been started at 0847 EDT and secured at approximately 1530 EDT due to a DC ground. Since the test met the RG 1.108 criteria for a successful valid test, no special report to the NRC was required. Since the test did not last the required 24 hours, the EDG was inoperable.

C. Both Events

Pre-operational inspections and tests were developed to locate infantile failure problems similar to the failures discussed above. These tests and inspections are performed before the equipment can be declared operational. Both units 3 and 4 were defueled and EDGs 4A and 4B were not required to support any equipment. The safety evaluation that both units were operating under did not require this EDG to be operable at that time. Therefore no Technical Specification (TS) Limiting Condition for Operation (LCO) was violated.

At the time of both of these events, both units were defueled and the spent fuel pool cooling systems were the only major loads requiring backup power availability. EDGs 3A and 3B were inoperable due to the Emergency Power Systems Enhancement Project and EDGs 4A and 4B were still undergoing pre-operational acceptance testing (January 7 event) and operability testing (July 29 event). If off-site power had been lost to Turkey Point Nuclear Power Plant, at that time, the site had available at least two (non-safety) Blackstart Diesels. The Blackstart Diesels could have been started and connected in approximately 20 minutes via a dedicated line to the emergency buses from the C bus. Thus, the health and safety of the public were not affected by this event.

EDGs 3A and 3B do not have PMGs, therefore these problems were not applicable to Unit 3.

IV. CORRECTIVE ACTIONS

A. January 7, 1991 Event

1. Immediate Corrective Action

a. The defective PMG drive shaft was examined at FPL's Metallurgical Laboratory for cause of failure.

b. New PMG drive shafts were installed. The new shafts incorporated a flexible coupling which eliminated the bending stresses in the shaft. In addition, the dimensions and material composition in the new PMG shafts were verified to be in accordance with the vendor drawings. The new PMG shafts were successfully tested during the remaining EDG acceptance tests.

2. Long Term Corrective Action

To assist in the difficult alignment process, a new alignment procedure was provided by the vendor.

B. July 29, 1991 Event

1. Immediate Corrective Action

An Event Response Team was formed to investigate the event.

2. Long Term Corrective Action

As recommended by the Event Response Team, the PMGs on EDGs 4A and 4B have been removed from the system. The field flashing power supply system has been redesigned. The DC power for field flashing, formerly supplied by the PMGs, is now being supplied from the station batteries.

V. ADDITIONAL INFORMATION

1. Similar LERs:

Voluntary LER 251-90-012-00 issued March 15, 1991, voluntary LER 251-90-013-00 issued April 26, 1991, and voluntary LER 251-90-014-00 issued July 1, 1991, also reported problems with auxiliary systems on the new EDGs.

2. Vendor/Manufacturer:

Florida Power & Light Turkey Point EDGs 4A and 4B were assembled by Morrison-Knudsen Company, Inc. The diesel portion of the EDG was manufactured by the Electro-Motive Division of General Motors. The engine model number is 20-645F4B.

The generator portion of the EDG was manufactured by NEI Peebles-Electric Products.