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A SCANA COMPANY

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

Gentlemen:

Subject: VIRGIL C. SUMMER NUCLEAR STATION
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12
LICENSEE EVENT REPORT (LER 2001-001)
FAILED DIODES IN DIESEL FIELD FLASH CIRCUIT RENDER DIESEL INOPERABLE

Attached is Licensee Event Report (LER) No. 2001-001-00, for the Virgil C. Summer Nuclear Station (VCSNS). The report describes a failure of diodes in the exciter/voltage control circuit of one emergency diesel generator, which caused loss of field flash during testing. During this event, the second emergency diesel generator was functional but not fully operable due to lack of completed surveillance testing following resolution of a governor problem.

Should you have any questions, please call Mr. Mel Browne at (803) 345-4141.

Very truly yours,

BCWilliams for

Stephen A. Byrne

PAR/SAB
Attachment

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NRC FORM 366 (1-2001) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 6-30-2001

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

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TITLE (4)

Failed diodes in diesel generator field flash circuit render diesel inoperable with other diesel not fully operable

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
01	26	01	2001	- 001	- 00	03	27	01	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	N/A	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply) (11)							
POWER LEVEL (10)	000	20.2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)		50.73(a)(2)(ix)(A)	
		20.2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)		50.73(a)(2)(x)	
		20.2203(a)(1)		50.36(c)(1)(i)(A)		50.73(a)(2)(iv)(A)		73.71(a)(4)	
		20.2203(a)(2)(i)		50.36(c)(1)(ii)(A)	X	50.73(a)(2)(v)(A)		73.71(a)(5)	
		20.2203(a)(2)(ii)		50.36(c)(2)	X	50.73(a)(2)(v)(B)		OTHER	
		20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)		Specify in Abstract below or in NRC Form 366A	
		20.2203(a)(2)(iv)		50.73(a)(2)(i)(A)	X	50.73(a)(2)(v)(D)			
		20.2203(a)(2)(v)		50.73(a)(2)(i)(B)		50.73(a)(2)(vii)			
		20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)			
		20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)			

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
M. N. Browne, Mgr., Nuclear Licensing & Operating Experience	(803) 345-4141

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
X	EK								

YES (If yes, complete EXPECTED SUBMISSION DATE).	NO	EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On 01/10/2001 at approximately 03:00 during surveillance testing of "B" emergency Diesel Generator (EDG), the engine came up to speed but no voltage or frequency was observed. Trouble shooting determined that the cause was a short circuit in two diodes of a diode rectifier bridge, which caused a protective fuse to open. This prevented the generator field from flashing. At this same time, the "A" EDG was inoperable due to testing. The plant was shutdown with all fuel removed from the reactor vessel and a time to boil of greater than 25 hours for the Spent Fuel Pool.

The same problem was discovered previously on the "A" EDG on 12/24/00 but was thought to be a random failure and the other train of ESF power was still operable. At that time the diodes and fuse were replaced.

The rectifier bridge is a generator component that assured DC power was supplied as input power for the manual voltage regulator motor operated potentiometer (MOC-2). The rectifier provided DC output regardless of whether AC or DC input power was supplied. After their failure, these diodes were removed and sent off for analysis. The cause of failure was determined to be an over-voltage condition that could not be replicated either on the EDG or in the Electric Shop.

The diode rectifier bridges have been removed from these circuits on both EDGs since they are not necessary. V. C. Summer uses only DC power as the input to the MOC.

NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

PLANT IDENTIFICATION

Westinghouse - Pressurized Water Reactor

EQUIPMENT IDENTIFICATION

XEG0001A and 1B, Emergency Diesel Generators (EIIS - EK)

IDENTIFICATION OF EVENT

This report is based on the initiation and evaluation of Non-Conformance Notice (NCN) 01-0033. Due to an engineering review of the identified fuse failure, it was determined that the condition brought about by the failure of the diode rectifier bridges resulted in the loss of field flash power to the EDG, and could have prevented the fulfillment of a safety function if it had occurred while the reactor was in operation.

SCE&G believes that the redundant systems are not vulnerable to credible single failures or events: however, without knowing the origin of the apparent voltage spike that produced the diode failure, reasonable doubt exists. Statements of consideration posted with the revised rule require reporting if reasonable doubt exists.

EVENT DATE

01/26/01 This is the date that the root cause report was issued by the vendor, Pentas Controls, Inc..

REPORT DATE

03/27/01

CONDITIONS PRIOR TO EVENT

Defueled

DESCRIPTION OF EVENT

On 01/10/2001, at approximately 0300, after a successful engine start, during surveillance testing (STP-125.002B), Emergency Diesel Generator (EDG) "B" was observed to not be indicating voltage or frequency, which indicated the field did not flash. This happened when the "A" EDG was functional, but not operable because one other surveillance test, required to satisfy operability requirements, was not yet performed. The same type of failure occurred to the "A" EDG on 12/24/00 during surveillance testing. Due to the similarities in failures, a root cause investigation was initiated.

Initial troubleshooting discovered a blown fuse (FU4A) as the reason that DC power was not present at the exciter

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input. Subsequent troubleshooting identified two short circuited diodes in a bridge rectifier circuit as the cause of the failed fuse. The rectifier circuit is on the input to the motor operated potentiometer MOC-2, which provides the manual voltage regulator adjustment. The diodes were replaced and tested satisfactorily and then later removed after determination that they were not required due to plant configuration.

CAUSE OF EVENT

The cause of the short circuited diodes in the rectifier bridge has been determined to be (greater than 80% probability) from a high voltage transient condition, called an electrical overstress, of at least 1000 volts. This value was chosen as the diodes are rated for 1000 volts. This determination was the result of offsite investigation by a failure analysis laboratory (Pentas Controls, Inc.) of the failed diodes. Laboratory tests indicate that the diode failure occurred instantaneously and was due to a high voltage transient. Cracks in the semi-conductor material were filled with solder. Since there were very few voids in the solder, this indicated a one time event. Additional testing, on functional diodes that were also in the bridge circuit, is being performed by Pentas Controls to confirm this analysis. The source of the voltage transient could not be determined.

This rectifying bridge was not required for this application since DC current is supplied to the MOC and therefore, provided an unnecessary component in the circuitry that could fail.

A lack of indication of availability on field flashing power contributed to the event by creating uncertainty as to the timing of the failure.

ANALYSIS OF EVENT

Testing was performed both in the field and in the on site electrical shop to duplicate this failure. The intent was to identify the source of any current or voltage transient anomalies in the exciter or field flash circuitry that may have led to this failure. The field testing was designed to simulate the conditions under which the "A" EDG failed. Five cycles of start up and shut down were performed without observing any high voltage transients.

As a result of not detecting any high voltage transients, new diodes, good diodes from the bridge circuit, and the failed diodes were sent off for failure analysis and inspection. The initial hypothesis was that an aging mechanism was involved since both EDGs had almost identical usage since the MOCs were installed. The results indicated that the diodes failed from a high voltage transient. No age related failure mechanisms were detected.

Once the failure analysis results were obtained, additional testing was performed to identify the cause of the high voltage transient. The testing simulated all evolutions at VCSNS including known outage activities that could induce a transient onto the circuit. This included: circuit breaker cycling, relay operation, MOC operation, contact bounce, and field flashing. Neither bench testing nor testing at the EDGs revealed any evidence of high voltage transients.

A review of industry operating experience resulted in two instances of rectifier bridge diodes failing in MOC circuits. No specific detail of these failures is available other than one plant removed the diodes and the other replaced them. The causes for the diode failures have not been identified.

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ANALYSIS OF EVENT(continued)

SCE&G does not believe the probability of this failure mechanism re-occurring is very high due to the following:

- Each EDG is hard wired to a safety related electrical bus (train) which is normally tied to an independent offsite source of power. Each onsite distribution system is electrically independent and maintained physically separated from each other.

- This condition was most likely caused by a high voltage transient on either the EDG, safety related train or offsite power source. Therefore, the possibility of one transient affecting both EDGs at the same time is very small.

- The MOCs with the diode rectifier bridge installed have been installed on the EDGs for 13 years. During this time, there has not been one occasion of a failure to field flash resulting from the diode rectifier bridge. Surveillance testing has been performed at the required frequency and no significant testing methodology changes have occurred. Based on this equipment history, there was a low probability of the EDGs being unavailable due to diode failure.

SCE&G suspects that this event was most likely caused by some maintenance or modification activity near the time of failure. Welding activities were reported in the vicinity but records were not detailed sufficiently to establish cause and effect, and no ground path, through which such a transient of sufficient magnitude to short the diodes, could be identified. Testing was performed on the EDG shortly after the time of discovery without reproducing the failure.

The event in which the "B" EDG would not field flash while the "A" EDG was not operable per Technical Specifications was not significant. The reactor was defueled with all fuel in the Spent Fuel Storage Pool. The only critical safety system in operation was the Spent Fuel Cooling pump "B". Had all cooling to the Spent Fuel Pool been lost during that time period, there was greater than 25 hours to boil in the pool due to the reduced heat load. This time was more than adequate to restore one source of cooling to the pool. Although all of the required surveillance testing had not been completed for the "A" EDG, it was functional and could have satisfied the emergency power requirements.

INTERIM CORRECTIVE ACTIONS

- Research into this issue concluded that there was no need for these diode rectifier bridges since DC current was supplied to the MOCs. The diode rectifier bridges on both EDGs were removed from the circuits.

- The EDG field flashing circuitry was reviewed for other semi-conductor components susceptible to high voltage transients. No other components susceptible to high voltages were detected.

- Maintenance procedures were revised to assure that MOCs with diode rectifier bridges would not be installed.

- Maintenance procedures were revised to assure that MOC-2 potentiometer is left in mid-position to assure any residual energy in the MOC coil has a dissipation path.

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ADDITIONAL CORRECTIVE ACTIONS

- A device to provide verification of the field flashing power availability was installed and tested under ECR 50388. The modification was completed prior to plant start-up from RF-12.
- Normal operator rounds and Technical Specification Logs will verify that the indication of power availability exists at least twice per day. Immediate notification to the control room is required if the indicating lights are not illuminated is required.
- A test plan is being developed by Plant Support Engineering that will identify components to be checked for operability immediately, should this type of component failure (i.e. fuse failure) occur again. This plan is expected to be complete by March 31, 2001.

PRIOR OCCURRENCES

None