

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)

Fort Calhoun Station Unit No. 1

DOCKET NUMBER (2)

05000285

PAGE (3)

1 OF 5

TITLE (4)

Potential Common Mode Failure of Emergency Diesel Generator Exciter Circuits

EVENT DATE (5)			LER NUMBER (6)			REPORT NUMBER (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
09	13	90	90	-- 020 --	01	08	31	93		05000
OPERATING MODE (9)			THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 8: (Check one or more) (11)							
1										
POWER LEVEL (10)			20.405(a)(1)(i)							
100			20.405(a)(1)(ii)							
			20.405(a)(1)(iii)							
			20.405(a)(1)(iv)							
			20.405(a)(1)(v)							
			20.405(a)(2)(iv)							
			20.405(a)(2)(v)							
			20.405(a)(2)(vii)							
			20.405(a)(2)(viii)(A)							
			20.405(a)(2)(viii)(B)							
			20.405(a)(2)(ix)							
			OTHER							
			(Specify in Abstract below and in Text, NRC Form 365A)							

LICENSEE CONTACT FOR THIS LER (12)

NAME

David Buell, Shift Technical Advisor

TELEPHONE NUMBER (Include Area Code)

(402) 533-6895

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC
B	EK	RG	G080	Y					

SUPPLEMENTAL REPORT EXPECTED (14)

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

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

On June 25, 1990, the voltage regulator associated with Emergency Diesel Generator No. 1 failed during full load testing due to a partially failed transistor in the static exciter circuit. This was tentatively attributed to high temperature in the control cabinet; the cabinet doors for both diesel generators were removed to provide ventilation and assure operability. On September 13, 1990, the Plant Review Committee reviewed a finalized engineering evaluation of the exciter failure and concluded that a reportable condition had existed. This was reported to NRC at 1402 hours CDT pursuant to 10 CFR 50.72(b)(2)(iii), due to a potential common mode failure which could have prevented the diesel generators from performing their safety function during a design basis accident.

The root cause of this condition was improper design of the exciter cabinets. A contributing factor to the duration of this condition was the failure to identify in previous years the cabinet overheating as the probable cause of a history of static exciter component failures at Fort Calhoun Station.

Corrective actions include installation of a cabinet ventilation system to provide adequate cooling. The cabinet doors were removed under a temporary modification until the ventilation/cooling modifications were completed. Enhanced engineering resources should preclude recurrence of this type condition.

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LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBS 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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		90	-- 020 --	01	

TEXT (If more space is required, use additional copies of NRC Form 365A) (17)

The electrical distribution system at Fort Calhoun Station Unit No. 1 is designed to include four separate 4160 volt buses, two of which supply electrical power to all of the redundant Engineered Safety Feature components required for safe reactor shutdown and removal of decay heat. Each of these engineered safeguards buses has an associated emergency diesel generator capable of supplying all safeguards loads connected to its 4160 volt bus and associated 480 volt buses.

The Plant Review Committee (PRC) requested that full load testing of the Emergency Diesel Generator No. 1 (DG-1) be performed during high ambient air temperatures, to provide information on the hot weather capabilities of the unit. At 1414 CST on June 25, 1990 with the plant operating at 100 percent power, DG-1 was started for the test which was being performed under Maintenance Work Order No. 902171. Approximately 2 hours into the test, the control room received an alarm due to high diesel generator output current of 575 amps versus normal operating current of 385 amps. Operations personnel quickly tried to decrease DG-1 amperage, but were unable to control the generator output. The licensed operator immediately opened DG-1 output breaker 1AD1 after which DG-1 voltage dropped to 2120 volts ac, about one-half the normal voltage of 4200 volts ac. The operator then commenced a shutdown of the diesel engine. At 1819 CST, DG-1 was declared inoperable and the plant entered into Technical Specification Limiting Condition for Operation 2.7 which allows one of the diesel generators to be inoperable for up to seven days during any month, provided the other diesel is proven operable and there are no inoperable safeguards components associated with the other diesel generator. DG-2 was then satisfactorily started and shutdown to prove operability.

Immediate investigation of DG-1 generator voltage regulator circuitry by System Engineering and Electrical Maintenance personnel determined that a blown fuse in the static exciter circuit was caused by a partially failed transistor. It was also noticed by personnel in the diesel generator room at the time of the voltage regulator failure that the local control panels were warm to the touch. A contact thermometer was used to measure panel temperatures of 120 to 140 degrees F with the highest readings on the panel wall adjacent to the diode heat sink assembly. After conversations with the manufacturer, who stated that high temperatures could cause circuit failure, System Engineering attributed the generator output problem to overheating in the local voltage regulator control cabinets.

Results of the surveillance test and circuit troubleshooting were discussed with Plant Management and the conservative decision was made to initiate a controlled plant shutdown due to a possible common mode overheating condition affecting the operability of DG-2. However, until proven otherwise, DG-2 was considered operable. At 0039 on June 26, a plant shutdown commenced. This action was taken to place the plant in a condition that would allow extended full load testing of DG-2 and preclude the necessity of a rapid plant shutdown if DG-2 was found inoperable.

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ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 60.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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Investigation into the overheating of the cabinets continued until the conclusion was reached that the design of the cabinets did not adequately dissipate the heat generated by the electrical circuitry. The cabinets, which share the same design for both diesels, were essentially airtight and were not provided with any ventilation louvers or installed fans for air movement. An emergency temporary modification (TM 90-019) was then implemented, which removed the doors from the voltage regulator control cabinets of both emergency diesel generators to increase the heat dissipation capability for the internal circuitry. The failed circuit components were replaced on DG-1 and the unit was operated fully loaded for approximately 20 minutes. Administrative limits on diesel fuel inventory prevented an extended run of DG-1 at this time, in order to assure Technical Specification fuel requirements were met.

At 0810 on June 26, with the plant at 40 percent power, the PRC discussed the current status of the diesel generators and resolved that, with the doors removed from the DG-2 voltage regulator cabinet, enough heat could be dissipated to allow the diesel to perform its design function and be considered operable. The PRC decided to terminate the plant power reduction and stabilize power until testing was complete on DG-1 and the diesel was considered operable. System Engineering personnel were prepared to take temperature readings inside the voltage regulator cabinets to develop a temperature profile during the extended run. The temperature profile could then be used to compare the existing condition of the cabinets to the manufacturer's recommended configuration.

The manufacturer of the static exciter was contacted for advice on the maximum recommended operating temperature for the circuitry components and the ventilation design of the cabinets. The manufacturer stated that the exciter components are designed for up to 40 degrees C (104 degrees F) ambient, but that temperatures of up to 50 degrees C (122 degrees F) should not adversely affect the circuit operation. Contact temperature measurements on the panel walls confirmed that with the current cabinet design, excessive overheating was present. It was also noted that the cabinets should be designed with either ventilation ports at the top and bottom of the panels or expanded metal doors to create a natural air flow condition. This cooling effect is necessary to maintain the inside cabinet air temperatures less than 10 degrees C (18 degrees F) above the outside cabinet ambient temperature.

After a shipment of diesel fuel was received, an extended run of the diesel and surveillance test OP-ST-DG-0001 were successfully completed. System Engineering personnel confirmed from temperature measurements that the inside cabinet air temperature was maintained within the acceptable limits and that the diesel could be declared operable. At 0835 on June 27, DG-1 was declared operable and the plant began a power ascension to 95 percent rated power.

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TEXT (If more space is required, use additional copies of NRC Form 386A) (17)

A root cause analysis of the exciter failure was initiated concurrent with a Design Engineering assessment of the high temperature capabilities of the diesel generators. On September 13, 1990, the PRC reviewed a finalized System Engineering evaluation of the exciter failure and concluded that a reportable condition had existed. This was reported to NRC at 1402 hours CDT pursuant to 10 CFR 50.72(b)(2)(iii), due to a potential common mode failure which could have prevented the diesel generators from performing their safety function during a design basis accident. This LER is submitted in accordance with 10 CFR 50.73(a)(2)(v).

Initial investigations into the static exciter circuit failure revealed that the components were subjected to high temperatures in the control cabinets which resulted in thermal failure or degradation. Later conversations with the manufacturers confirmed the diagnosis that the ventilation of the cabinets had been inadequately designed to maintain the proper temperatures required for the circuit components. Original diesel generator vendor documentation shows that the manufacturer of the voltage regulating system did not design or supply the control cabinets for the system. The diesel generator vendor designed and subcontracted the cabinet construction, and apparently did not incorporate the appropriate ventilation requirements into the design. This design deficiency has been present since original plant construction; the root cause of this condition is improper design of the exciter cabinets. A contributing factor to the duration of this condition was the failure to identify in previous years the cabinet overheating as the probable cause of a history of static exciter component failures at Fort Calhoun Station.

The cabinet design deficiency created a common mode failure potential which could have prevented both diesel generators from performing their safety function following a design basis accident. This failure potential was limited to periods of high ambient outside air temperatures. This condition was outside the plant design basis. The Updated Safety Analysis Report (USAR) assumes that at least one emergency diesel generator is available to support engineered safeguard components for safe shutdown of the reactor and removal of decay heat. The USAR assumes that no onsite (345KV) or offsite (161KV) power is available during the accident; if both diesels were inoperable, the operators would be required to re-establish or ensure that an alternate power source be available to supply engineered safeguards components. This action would meet USAR assumptions of 10 CFR 50.46 Emergency Core Cooling Systems criteria, which cannot be ensured until at least one train of engineered safeguards systems are in operation during the design basis accident.

The manufacturer of the diesel generator was consulted on any possible damage to DG-1 which may have occurred during the overcurrent condition. It was the manufacturer's opinion that, if full load testing of the unit had been successfully performed with normal generator field current, then no damage had occurred.

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TEXT (If more space is required, use additional copies of NRC Form 388A) (17)

The following corrective actions have been implemented:

1. Emergency Temporary Modification 90-019 was implemented to require that the cabinet doors remain removed to allow adequate air flow to the circuit components for heat dissipation during diesel generator operation. An engineering evaluation concluded that this configuration was acceptable until implementation of a permanent modification. (See Item 4 below.)
2. During recent years Omaha Public Power District (OPPD) has augmented its engineering staff with personnel having a higher level of expertise and has made provision for acquiring supplemental contract personnel with expertise in engineering areas as required for independent review. These additional resources help provide a more thorough review of contract work.
3. The System Engineering Program has been instituted in the last several years at Fort Calhoun Station. One of the main functions of the System Engineer assigned to the diesel generators is to specifically ensure adequate testing and reliability of the units is maintained through trending and analysis of equipment history.
4. Modification MR-FC-90-040 and Modification MR-FC-90-073 have been completed to address ventilation of both diesel generator voltage regulator control cabinets and provide adequate cooling.

The following LER's relating to Diesel Generator Static Exciter Failures have been previously submitted: 78-017, 78-022, 78-024, 80-003, 83-008, 83-011, 88-014.