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July 15, 1991

1CAN079103

U. S. Nuclear Regulatory Commission
Document Control Desk
Mail Station P1-137
Washington, D. C. 20555

SUBJECT: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51
Licensee Event Report 50-313/91-007-00

Gentlemen:

In accordance with 10CFR50.73(a)(2)(i)(B) and 10CFR50.73 (a)(2)(v), enclosed is the subject report concerning fuse/circuit breaker coordination within the Emergency DC Power System.

Very truly yours,

James J. Fisicaro

James J. Fisicaro
Director, Licensing

JJF/RHS/mmg
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cc: Regional Administrator
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NRC Form 366.
(6-89)

U.S. Nuclear Regulatory Commission
Approved OMB No. 3150-0104
Expires: 4/30/92

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
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TITLE (4) Inadequate Fuse/Circuit Breaker Coordination Which Resulted From Design Inadequacies Related To Emergency Battery Replacement Created The Possibility Of A Loss Of Both Emergency DC Busses During A Design Basis Fire

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)
									ANO-2	0 5 0 0 0 3 6 8
0 6	1 4	9 1	9 1	-- 0 0 7	-- 0 0	0 7	1 5	9 1		0 5 0 0 0

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)							
	N								
POWER LEVEL (10)	1 0 0	20.402(b)		20.405(c)		50.73(a)(2)(iv)		73.71(b)	
		20.405(a)(1)(i)		50.36(c)(1)	X	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)	X	50.73(a)(2)(i)		50.73(a)(2)(viii)(A)			
		20.405(a)(1)(iv)		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 (Area Code)
Richard H. Scheide, Nuclear Safety and Licensing Specialist	5 0 1 9 6 4 - 5 0 0 0

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	

SUPPLEMENT REPORT EXPECTED (14)	EXPECTED SUBMISSION DATE (15)	Month	Day	Year
[ ] Yes (If yes, complete Expected Submission Date) [X] No				

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

On June 14, 1991, during an internal inspection, it was identified that the fuses between the emergency batteries of both ANO-1 and ANO-2 and their associated DC control centers were not fully coordinated with the control center's load circuit breakers. This condition occurs at the upper range of available fault current and could, under certain fault conditions, result in the melting of the fuse and loss of the entire control center before the affected load circuit breaker could trip. This event, although unlikely, is postulated to occur if a very low resistance "pole to pole" or "both poles to ground" short circuit is created in close proximity to the affected DC bus such that the fault resistance is low enough to allow the high current necessary to cause fuse melt before or coincident with breaker trip. Several areas of common vulnerability were identified in both units where a fire in a single fire area could result in loss of both emergency DC busses. The root cause of this condition was determined to be design inadequacies related to the Design Change Packages which documented replacement of the emergency batteries for both units. Firewatches were posted in the areas of common vulnerability. The fuses for the emergency batteries of both units will be replaced with higher rated fuses during the next outage of sufficient duration.

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

A. Plant Status

At the time this condition was identified, Arkansas Nuclear One, Unit One (ANO-1) and Unit Two (ANO-2) were operating at approximately 100 percent of rated power.

B. Event Description

On June 14, 1991, during an internal Electrical Distribution System Functional Inspection, it was identified that the fuses between ANO-2 emergency batteries [EJ] 2D11 and 2D12 and their associated DC control centers (2D01, 2D02) were not fully coordinated with the control center's load circuit breakers. This inadequate coordination occurs at the upper range of available fault current (>9000 amps) and could, under certain fault conditions, result in the melting of the fuse and loss of the control center before the affected load circuit breaker could trip. A review of ANO-1 DC systems revealed that a similar problem exists for emergency batteries D06 and D07 for fault currents in excess of about 7000 amps.

Although a fault resulting in current of a magnitude sufficient to result in melting of a fuse and loss of a DC control center is theoretically possible, it is very unlikely to occur. Short circuits that could result in fault current great enough to cause the battery fuse to clear prior to a load circuit breaker tripping has been determined not to exist at locations that are significantly remote from the DC control centers due to increased cable resistance and the corresponding reduction in maximum fault current. A review was conducted which determined that most of the non-Q loads which are fed by the emergency DC control centers were of sufficient distance from their respective busses for the cable supply cable resistance to limit the maximum fault current to below critical values if the load shorted internally. For ANO-1, the exceptions to this are the plant computer inverter (Y25) and the air side seal oil backup pump (P25). For ANO-2, the exception is the plant computer inverter (2Y25).

In addition, faults on the ungrounded DC systems must involve both poles and likely would have a significant fault resistance, thereby limiting maximum current to less than that required to melt the fuse prior to tripping the breaker. However, if such a fault did occur, the battery fuses could either partially or completely melt before the control center breaker could clear the fault. Partial melting of the fuses makes the time characteristics unpredictable and thus, the fuses could melt later under heavy load demand or another fault condition. For a fault relatively close to the main DC bus, it is possible that the fuse would melt before or coincident with the tripping of the load circuit breaker. Either of these actions could result in the loss of an entire safety related DC bus.

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Appendix R to 10CFR50 requires that protection shall be provided so that a fire within a single fire area will not damage both safe shutdown trains. Since the emergency DC busses of ANO-1 and ANO-2 supply both safety and non-safety loads, a review was conducted to determine common area vulnerability by identifying all room locations containing cables from both battery busses with cable lengths from the load centers and distribution panels short enough to be subject to the fuse/circuit breaker coordination concern. The review indicated that common area vulnerability does exist in some fire areas for both ANO-1 and ANO-2 such that the required separation is not assured. For ANO-1, the affected areas include the Emergency Diesel Generator (EDG) corridor, the south DC equipment room, and both 4160 VAC switchgear rooms. For ANO-2, the affected areas include the EDG corridor, both DC equipment rooms and the south 4160 VAC switchgear room. A fire in any of the identified common areas could cause short circuits which might ultimately result in the loss of both emergency DC busses.

C. Root Cause

The root cause for this condition was determined to be design inadequacies related to the Design Change Packages (DCPs) which documented replacement of the emergency batteries for ANO-1 and ANO-2 in 1984 and 1986, respectively. The calculations associated with these DCPs noted the miscoordination of the fuses and circuit breakers, but used qualitative arguments based on conservatisms used in the calculations to deem the coordination acceptable. These conservatisms included; assuming a zero resistance fault, assuming that the battery discharges to zero volts during the fault, and that termination, circuit breaker and contact resistances are negligible. These conservatisms logically provide bases for engineering judgement to state that the available fault currents were less than the calculations indicated. However, in light of today's industry and NRC positions, it is clear that such qualitative assessments cannot be substituted for quantitative design basis evaluations.

D. Corrective Actions

Immediate corrective actions which were taken with respect to this condition included:

- Firewatches were established in the identified areas of common vulnerability in ANO-1 and ANO-2.
- The circuit breaker for the ANO-1 air side seal oil back up pump (P25) was tagged open. A temporary modification was subsequently installed which provided fuses on the load side of the breaker to allow reclosing the breaker.
- The ANO-2 plant computer inverter (2Y25) circuit breaker was tagged open.

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

- A Continued Safe Operation (CSO) determination was developed by engineering to document, in further detail, the technical justification for operability.

Considering that the ANO-1 plant computer inverter (Y25) was purchased and installed to the same Q specifications as the Reactor Protection [JC] and Engineered Safeguards System [JE] inverters, it was not considered necessary to open its circuit breaker.

Change packages have been prepared to replace the existing emergency battery fuses on both units with higher rated fuses to eliminate the present fuse/circuit breaker coordination concern. However, in consideration of the plant and personnel safety aspects of replacing these fuses during power operation, ANO has elected to perform the installation during the next outage of sufficient duration for each unit.

E. Safety Significance

The existence of inadequate fuse/circuit breaker coordination which could result in the loss of both emergency DC busses if a fire were to occur in one of the identified areas of common vulnerability is considered to be of safety significance. However, this significance is reduced by several factors. First, the area of miscoordination exists only at the upper range of available fault current and this maximum fault current is a theoretical value assuming cell discharge to zero volts rather than actual capabilities. Also, the occurrence of a pole to pole or both pole to ground short circuit of low enough resistance to allow fault currents to reach sufficient values to cause fuse melt prior to breaker trip is very unlikely, especially considering that this specific type of fault must occur in close proximity to the affected buss.

10CFR50 Appendix R requires that a loss-of-offsite power (LOOP) be assumed when assessing plant safe shutdown capability. A fire in one of the identified common vulnerability areas causing short circuits which result in the loss of both batteries, if combined with a LOOP, would result in the loss of all AC and DC power. However, as shown in ANO calculations, no initial protective action needs to be completed to protect the core following a plant trip caused by the fire for at least 30 minutes for ANO-1 and 50 minutes for ANO-2. During this time, the EDGs could be manually started following guidance in existing plant procedures, thus restoring AC and DC power and completely mitigating the effects of the battery loss. Therefore, the postulated fire would not result in damage to either shutdown train and Appendix R criteria would not be violated.

It should also be noted that all of the fire zones affected by this condition are equipped with smoke detectors with Control Room annunciation. Additionally, the EDG corridors are equipped with "line type" fire detection and a deluge suppression system.

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F. Basis For Reportability

The existence of inadequate fuse/circuit breaker coordination which could result in the loss of both emergency DC busses if a fire were to occur in one of the identified areas of common vulnerability is considered to be a condition outside the plant's design basis and is reportable pursuant to 10CFR50.73(a)(2)(i)(B). This condition is also reportable pursuant to 10CFR50.73(a)(2)(v) since a fire in one of the areas of common vulnerability could result in the loss of both emergency batteries.

G. Additional Information

There have been no previous similar events reported by ANO regarding inadequate fuse/circuit breaker coordination.

Energy Industry Identification System (EIIS) codes are identified in the text as [XX].