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SUBJECT: LER 93-003-00:on 930121,determined that under certain ac electrical distribution sys alignments,fault could result in unavailability of both offsite power sources.Caused by inadequate sys analysis.Delay times revised.W/930222 ltr.

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February 22, 1993
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Docket No. 50-397

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Washington, D.C. 20555

SUBJECT: NUCLEAR PLANT WNP-2, OPERATING LICENSE NPF-21
LICENSEE EVENT REPORT NO. 93-003

Transmitted herewith is Licensee Event Report No. 93-003 for the WNP-2 Plant. This report is submitted in response to the report requirements of 10CFR50.73 and discusses the items of reportability, corrective action taken, and action taken to preclude recurrence.

Sincerely,

J. W. Baker
WNP-2 Plant Manager (Mail Drop 927M)

JWB/RJP/cgeh
Enclosure

cc: Mr. J. B. Martin, NRC - Region V
Mr. R. Barr, NRC Resident Inspector (Mail Drop 901A, 2 Copies)
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LICENSEE EVENT REPORT (LER)

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TITLE (4)

INADEQUATE COORDINATION OF PRIMARY UNDERVOLTAGE BUS TRANSFER LOGIC AND OVERCURRENT PROTECTION RESULTS IN POTENTIAL LOSS OF OFFSITE POWER AND DELAYED EMERGENCY POWER SOURCE AVAILABILITY

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 NUMBERS(S)
0 1	2 1	9 3	9 3	-- 0 0 3	-- 0 0	0 2	2 2	9 3		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9)	3	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 0 0	20.402(b)	20.405(C)	50.73(a)(2)(iv)	77.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.73(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)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	X 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
R. J. Poché, Licensing Engineer	AREA CODE 5 0 9 3 7 7 - 4 1 4 5

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) X NO				

ABSTRACT (16)

At approximately 1215 hours on January 21, 1993, it was determined that a deficiency involving coordination of protective relays associated with the AC electrical distribution system could result in plant operation that was not within the plant design bases. Under certain AC electrical distribution system alignments a fault on either 4.16 KV vital bus could have resulted in unavailability of both offsite power sources and delayed powering of the nonfaulted 4.16 KV vital bus from its associated Emergency Diesel Generator (EDG). WNP-2 has not experienced a bus fault that resulted in a loss of offsite power and/or delayed synchronization of the EDGs due to inadequate breaker coordination. Consequently, the conditions described in this report did not have an adverse affect on safe operation of the plant, or the health and safety of plant personnel or the general public.

The root cause of this condition was a deficiency involving inadequate analysis of undervoltage and overcurrent protective features on the vital 4.16 KV AC electrical distribution system. As corrective action, delay times associated with this breaker coordination problem were revised. Additionally, the Bus Short Circuit Current Calculation and the Relay Coordination Calculation will be reviewed and updated.

TITLE (4)
INADEQUATE COORDINATION OF PRIMARY UNDERVOLTAGE BUS TRANSFER LOGIC AND OVERCURRENT PROTECTION RESULTS IN POTENTIAL LOSS OF OFFSITE POWER AND DELAYED EMERGENCY POWER SOURCE AVAILABILITY

Plant Conditions

Power Level - 0%
Plant Mode - 3 (Hot Shutdown)

Event Description

At approximately 1215 hours on January 21, 1993, it was determined that a deficiency in the medium voltage (4.16 KV) vital AC electrical distribution system could result in plant operation that was not within the plant design bases. This deficiency involved coordination of overcurrent protection relays and undervoltage bus transfer logic. Under certain electrical distribution system alignments, a persistent fault on either 4.16 KV vital bus could have resulted in unavailability of both offsite power sources and delayed powering of the nonfaulted 4.16 KV vital bus from its associated Emergency Diesel Generator (EDG) .

The medium voltage AC electrical distribution system has two divisionally separate and redundant vital busses, SM-7 and SM-8 (see attached sketch), that supply 4.16 KV power to safety-related plant loads. These busses are typically aligned to the main generator via the normal station transformer (TR-N1) when the main generator is on-line; however they can also be, and occasionally are, aligned to either the startup transformer (TR-S) or backup transformer (TR-B) during power operations. Busses SM-7 and SM-8 are typically aligned to receive power from TR-S during plant startups and periods when the plant is shut down, with backup power available from TR-B.

Design basis concerns involving loss of offsite power supplies and delayed powering of the nonfaulted vital bus existed under the previous design when vital busses SM-7 and SM-8 were aligned to either TR-S or TR-B. Due to the cumulative effect of protective feature time delays associated with the transfer of loads from TR-S to TR-B, the most limiting condition with respect to delayed EDG output breaker closure resulted when the plant was initially aligned to TR-S. However, the design basis effect was essentially unchanged regardless of whether the vital busses were aligned to TR-S or TR-B at the start of the event.

Vital busses SM-7 and SM-8 are both supplied from the same (Y) winding on TR-S. As a result, a fault on either vital bus when they are aligned to this transformer would cause an undervoltage condition on the 4.16 KV (Y) transformer winding that would be evidenced as an undervoltage condition on both vital busses. A bus fault cannot affect both vital busses when they are aligned to TR-N1 because each vital bus is powered from a separate winding when it is aligned to this transformer.

After sensing an undervoltage condition on SM-7 and SM-8, primary undervoltage protective devices (27) associated with these busses would have immediately initiated an automatic start of their respective EDG. With the previous undervoltage logic, vial bus source breakers aligned to TR-S would have tripped after approximately 2.0 seconds, initiating automatic transfer of the vital bus source from TR-S to TR-B. Due to

inadequate coordination of the overcurrent and undervoltage protective relay time delays, this transfer would have occurred before the overcurrent device on the incoming line to the faulted bus, which had an approximate 2.2 second delay time, could energize its lock-out feature. This lock-out feature is designed to open the breaker on the incoming line to the faulted bus and prevent other source breakers from closing onto the faulted bus. As a result, the faulted vital bus would not have been isolated, and would have transferred to the backup source, TR-B, instead. At this point, the safety bus source transfer logic (timing) would proceed as if the bus fault condition was a loss of power source event.

There are two undervoltage relays on each of the incoming lines to backup source breakers B-7 and B-8. One relay senses bus undervoltage and trips its breaker at 69% or less of rated voltage. The other relay provides a permissive to allow closure of its source breaker if the secondary of TR-B is 94% or greater of rated voltage. The undervoltage transfer logic would have permitted backup source breakers B-7 and B-8 to close onto the vital busses approximately 4.0 seconds after fault initiation. Vital busses SM-7 and SM-8 share a common winding on TR-B. Consequently, if the bus fault had not cleared by this time, breakers B-7 and B-8 would have tripped open almost immediately due to the fault related undervoltage condition that would exist on both SM-7 and SM-8.

This breaker trip occurs immediately because undervoltage protective relays on the incoming lines from TR-B that are set to operate at 69% of rated voltage did not have a time delay. Again, because of a coordination deficiency involving time delays for undervoltage and overcurrent relays on the incoming line from TR-B, the overcurrent lock-out feature would not have prevented the TR-B supply breaker from closing onto the faulted bus. Instead, the undervoltage logic would have allowed the supply breaker from TR-B to repeatedly and unsuccessfully cycle onto the faulted bus until either the fault cleared or the supply breaker to the faulted bus failed, and could have resulted in the inability to successfully sequence the vital busses between TR-S to TR-B.

Subsequently, if the SM-7 and SM-8 undervoltage time delay permissives to close the EDG output breakers were satisfied, and the EDGs were at rated speed and voltage (which normally occurs 8 seconds after start signal), transfer of the safety busses to their respective EDG would have been enabled approximately 5.0 seconds after automatic transfer of both busses from TR-S to TR-B (7.0 seconds after fault initiation) if the undervoltage logic had not reset. However, transfer of the EDGs to SM-7 and SM-8 may not occur simultaneously. If the source breaker for the nonfaulted bus closes onto TR-B before the source breaker for the faulted bus, it is possible that the undervoltage logic for the nonfaulted bus will reset. Resetting the undervoltage logic would extend the time delay permissive for transferring the EDG on the nonfaulted bus beyond design basis limits.

For the faulted bus, if the primary undervoltage logic was not reset, the EDG output breaker would close after the original time delay permissive was satisfied and the EDG had obtained rated speed and voltage. EDG overcurrent relays (51V) would then pick up, provided there was no LOCA signal present, and

energize the EDG lock-out relay. If a LOCA signal was present, the 51V relays are bypassed and the emergency generator would have eventually developed an internal fault due the heavy currents being supplied to the bus fault. The generator differential relays would then pick-up, thereby energizing the lock-out feature, shutting down the affected EDG, and resulting in loss of power to the faulted safety division.

Immediate Corrective Action

As immediate corrective action, breaker B-7 was opened at 1330 hours on January 21, 1993, in order to provide separation between busses SM-7 and SM-8, and a design change was initiated to resolve breaker coordination deficiencies on SM-7 and SM-8. Bus separation was maintained until the design change could be implemented.

Further Evaluation and Corrective Action

A. Further Evaluation

1. The breaker coordination issue described in this report was determined to be reportable pursuant to the requirements of 10CFR50.72(b)(1)(ii)(B) as a condition that is outside the design basis of the plant because it could have resulted in loss of both offsite power sources and adversely affected the ability of the EDGs to start and synchronize within the time required. Necessary notification were made at 1302 hours on January 21, 1993. This condition is also reportable under 10CFR50.73(a)(2)(ii)(B).

2. Breaker coordination issues associated with current/voltage relaying for SM-7 and SM-8 were identified as an area of potential concern during the WNP-2 Electrical Distribution Safety System Functional Inspection (EDSSFI) that was performed in January of 1992. When this inspection was performed, a review of the relay coordination calculation was already in progress, but had not been completed. Also, update of the fault current calculation, which is necessary for evaluation of breaker coordination, was planned, but had not yet been performed. The breaker coordination deficiency issue was not fully identified during the EDSSFI due to the complexity and scope of reviews necessary to evaluate the existing breaker coordination scheme. The breaker coordination was identified by a plant engineer during a review of electrical distribution system calculations that was being performed as part of an ongoing Electrical Calculation Improvement Program.

3. Coordination of overcurrent protective relaying with the undervoltage transfer logic is required for vital electrical busses, but was not adequately considered in the original AC electrical distribution design. In accordance with 10CFR50, Appendix A, Criterion 17; the design of the offsite power system is required to minimize the likelihood of simultaneous failure under operating and postulated accident and environmental conditions.

B. Root Cause

The root cause identified for this condition was a Plant/Equipment - Design Configuration/Analysis category deficiency involving inadequate analysis. Previous analyses for the AC distribution system did not adequately consider coordination of the undervoltage and overcurrent protective relay schemes. This analysis inadequacy has existed since AC electrical distribution calculations were initially prepared by the architect/engineer.

C. Further Corrective Action

The following corrective actions have already been taken, or are in progress:

1. A design change was implemented under BDC 93-0021-0A to increase the time delay for primary undervoltage relays for SM-7 and SM-8 and resolve breaker coordination issues associated with the supply from TR-S. This change will ensure that overcurrent relays are able to provide breaker trip and lock-out functions necessary to properly isolate a fault on either vital bus. Also, a time delay was provided for the 69 percent undervoltage protective feature associated with TR-B. There was previously no time delay associated with this protective feature. This time delay will provide coordination between undervoltage trips on the backup source breakers, B-7 (B-8); protective features on the associated line; and branch circuit overcurrent protection. These design changes were completed for SM-7 and SM-8 on January 25, 1993, at 0948 hours and 2355 hours, respectively.

2. Electrical distribution system calculations are currently being reviewed and updated on an ongoing basis under the Electrical Calculation Improvement Program. The condition described in this report involved the Bus Short Circuit Current Calculation and the Relay Coordination Calculation. Review and update of these calculations is expected by April 30, 1993.

Safety Significance

WNP-2 has not experienced a bus fault that resulted in a loss of offsite power and/or delayed closure of EDG output breakers due to inadequate breaker coordination. Consequently, the conditions described in this report did not have an adverse affect on safe operation of the plant, or the health and safety of plant personnel or the general public. Additionally, the condition described in this report can only affect both vital power divisions when plant loads are aligned to offsite power sources via TR-S or TR-B. This alignment is typically used only when the main generator is off-line and the plant is not at a substantial power level. Therefore, if a persistent fault condition had existed on SM-7 or SM-8 when the plant was aligned to TR-S or TR-B its significance would have been minimized.

Similar Events

Two previous events involving inadequate coordination of undervoltage protection have been reported in LERs 89-034 and 92-027. These previous events resulted from design deficiencies involving inadequate coordination of protective features for 480 volt Motor Control Centers, and did not involve coordination of protective features for the 4.16 KV vital busses.

EIIS Information

	EIIS Reference	
Text Reference	System	Component
AC Distribution System	LK	---
Transformers (TR-N1, TR-B, TR-S, TR-M1/2/3/4)	LK	TD
Breakers	LK	BKR
Safety-Related Busses (SM-7 & SM-8)	EB	BU
Emergency Diesel Generators (EDG)	ED	DG
Main Generator	TB	GEN1

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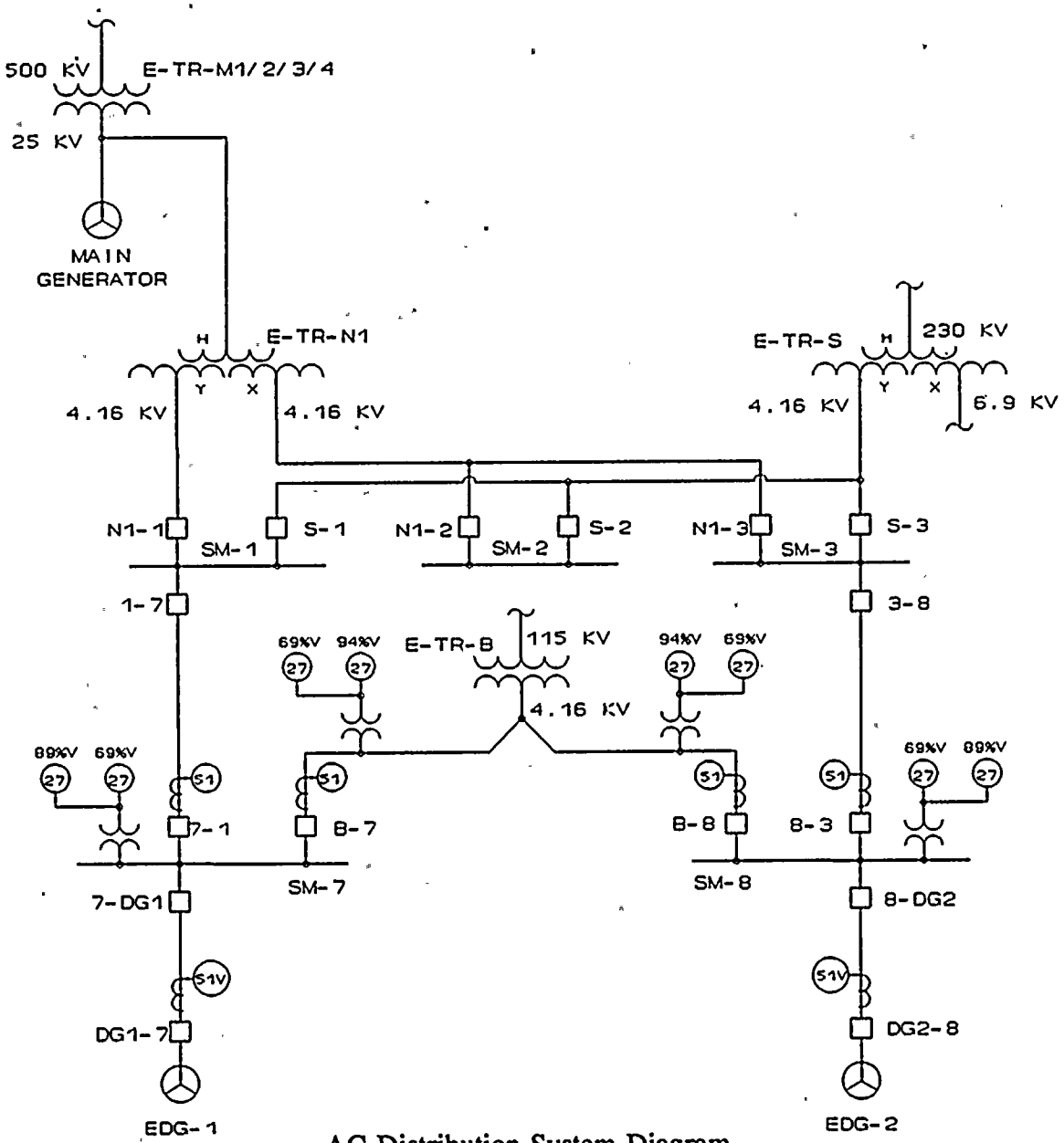

AC Distribution System Diagram

(For Information Only)