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AUTH.NAME AUTHOR AFFILIATION
BAKER,J.W. Washington Public Power Supply System
SWANK,D.A. Washington Public Power Supply System
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 91-033-00:on 911120,250 volt DC bus inoperable due to lack of adequate fuse coordination.Caused by less than adequate design analysis.Fuses replaced.W/911120 ltr.

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WASHINGTON PUBLIC POWER SUPPLY SYSTEM

P.O. Box 968 • 3000 George Washington Way • Richland, Washington 99352

December 19, 1991
G02-91-232

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

Subject: NUCLEAR PLANT NO. 2
LICENSEE EVENT REPORT NO. 91-033

Dear Sir:

Transmitted herewith is Licensee Event Report No. 91-033 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.

Very truly yours,

J. W. Baker
WNP-2 Plant Manager

JWB:ac

Enclosure:
Licensee Event Report No. 91-033

cc: Mr. John B. Martin, NRC - Region V
Mr. C. Sorensen, NRC Resident Inspector (M/D 901A)
INPO Records Center - Alanta, GA
Ms. Dottie Sherman, ANI
Mr. D. L. Williams, BPA (M/D 399)
NRC Resident Inspector - walk over copy

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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)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WTH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Washington Nuclear Plant - Unit 2	0 5 0 0 0 3 9 7	1 OF 0 5

TITLE (4)

250 Volt DC Bus Inoperable Due to Lack of Adequate Fuse Coordination

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)
										0 5 0 0 0
1 1	2 0	9 1	9 1	— 0 3 3	— 0 0	1 2	1 9	9 1		0 5 0 0 0

OPERATING MODE (9)	1	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)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	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)	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
	AREA CODE
D. A. Swank, Compliance Engineer	5 0 9 3 7 7 - 4 4 5 1

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

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS	

SUPPLEMENTAL 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)

As part of the Supply System effort to upgrade the design calculations for WNP-2, a fuse coordination calculation is being prepared for the Class 1E Direct Current (DC) power systems, including the 250 volt (250VDC) system. Development of this calculation revealed that the time-current minimum melting curve for the Class 1E 250VDC bus battery main fuse, an 800 amp fuse, crosses over the time-current clearing curve for the downstream branch circuit fuse that supplies non-Class 1E loads, a 400 amp fuse. This means that it was possible, under the postulated fault conditions, that the Class 1E battery main fuse could have melted prior to the downstream branch circuit fuse clearing, isolating the 250VDC battery from the bus. Had this event occurred the 250VDC bus would have been supplied by the battery charger, but this is not considered a stable long-term condition and is not credited in the accident analyses. Because of the lack of selective coordination, the 250VDC system has been technically inoperable since the time of initial Plant startup in 1983. Operation with the 250VDC system inoperable was a condition prohibited by the Plant's Technical Specifications and is reportable pursuant to the requirements of 10CFR50.73(a)(2)(i)(B). This condition, lack of selective coordination on the 250VDC bus, was outside the design basis of the Plant and is reportable in accordance with 10CFR50.73(a)(2)(ii).

Because the Plant was shut down when this condition was discovered, the immediate corrective action for this event was to replace the fuses in question with new fuses that meet the selective coordination and other applicable design requirements. The root cause of this event was a less than adequate design analysis. A coordination calculation was not previously performed, and resulted in selection of improper components.

For this event to have affected the Plant, a line-to-line fault would have had to occur. The more common line-to-ground faults are annunciated on the ungrounded 250VDC system. The loss of the 250VDC system would not, however, significantly impact the Plant since the safety-related equipment served by this bus is either not credited in the WNP-2 design basis accident analyses, or the equipment is backed up by redundant equipment served from a different safety-related bus. Additionally, a fault would have caused the downstream fuse to blow in addition to the upstream fuse, isolating the fault and allowing Plant personnel to replace the main upstream fuse to restore the Class 1E portion of the 250VDC system to service. The main upstream fuse has a blown fuse indicator with annunciation. Therefore, this event is deemed to have minimal safety significance. This event posed no threat to the health and safety of either the public or Plant personnel.

Plant Conditions

Plant Mode - 4 (Cold Shutdown)
Power Level - 0%

Event Description

As part of the Supply System effort to upgrade the design calculations at WNP-2, a calculation is being performed to document fuse coordination for the Class 1E busses, including the 250VDC system. This 250VDC bus is a non-redundant bus serving both Class 1E and non-1E loads. The design criteria for the 250VDC system is described in the WNP-2 FSAR and includes a requirement to provide isolation of non-class 1E equipment from Class 1E equipment using Class 1E isolation devices.

Current limiting fuses are rated at two current squared times time (I^2t) values; total clearing and minimum melting. These values are used for evaluating coordination in the current limiting range. The clearing I^2t value is the value where the fuse interrupts current, while the minimum melting I^2t value is the value where the element begins to melt. For fault currents below the current limiting range, coordination is determined by comparing the clearing time-current curve of the downstream branch fuse with the melting time-current curve of the upstream main fuse. For each fuse model and size, the clearing and melting curves and I^2t values are developed by the manufacturer. The goal of the design, as described above, is to have the downstream fuse clear before the upstream fuse melts. This is commonly termed "selective fuse coordination." Two methods are considered acceptable for fuse coordination work, either the use of the manufacturer provided fuse time-current curves and I^2t data, or use of the manufacturer provided fuse-coordination tables. The fuse-coordination tables from a given manufacturer provide the upstream/downstream fuse size ratio when using various models from that manufacturer. By using the curves and I^2t values, fuses from different manufacturers can be compared and utilized while maintaining proper coordination.

During the performance of the 250VDC bus coordination calculation it was determined that under certain extreme conditions, the clearing characteristics of the fuse serving the non-Class 1E motor control center (MCC), MC-S2-1B, were such that this fuse could fail to clear the MCC circuit prior to melting of the 250VDC main supply fuse from the battery. The conditions which could cause this to occur would be either a line-to-line fault of the ungrounded 250VDC bus or a fault of the backup DC-driven main turbine lube oil pump motor, with a fault current in excess of 8500 amperes. This crossing of the clearing/melting curves for the two fuses, and an I^2t clearing value for the downstream fuse that is higher than the I^2t melting value of the upstream fuse, does not satisfy the WNP-2 design requirements.

Immediate Corrective Action

The non-coordinated fuses were replaced with fuses that satisfied both the coordination and other applicable design requirements.

Further Evaluation and Corrective Action

A. Further Evaluation

Further review identified a lack of coordination existed as part of the original Plant design. Since no selective coordination calculation was previously prepared for the DC systems, it is not possible to determine why the fuses were not properly coordinated. The root cause for this event was a less than adequate design analysis since no DC system coordination calculation had ever been performed, which resulted in the selection of improper components.

The DC coordination calculation has not been completed. Sufficient work has been completed, however, for Supply System Engineering to conclude that the remainder of the Plant DC systems meet the selective coordination requirements.

The lack of fuse coordination between safety-related and non-safety-related loads on the 250VDC system resulted in the system being technically inoperable since initial Plant startup in 1983. This is a condition prohibited by the WNP-2 Technical Specifications and is therefore reportable pursuant to the requirements of 10CFR50.73(a)(2)(i)(B). This condition, lack of selective coordination on the 250VDC bus, was outside the design basis of the Plant and is reportable in accordance with 10CFR50.73(a)(2)(ii).

There were no structures, systems, or components inoperable prior to the start of this event that contributed to the event.

B. Further Corrective Action

Supply System Engineering will complete the DC fuse coordination calculation that uncovered this problem. This calculation will include an analysis of the Class 1E DC busses to document the required coordination.

A formal root cause analysis is currently being prepared to address this event. This analysis will explore the programmatic aspects of this event to determine if the processes in place today require modification.

Safety Significance

In order for the lack of fuse coordination to have affected the Plant, numerous failures would have had to occur. A line-to-line fault in the non-Class 1E portion of the 250VDC system would have had to occur. The 250VDC system is an ungrounded system and alarms on the occurrence of a ground. This alarm would have provided the opportunity to locate and isolate the ground, reducing the probability for a line-to-line fault. The only component which could have faulted and taken out the main bus fuse is the backup main turbine lube-oil pump. This pump is normally only used in a loss of off-site power event when the main turbine shaft-driven lube oil pump and the non-safety-related AC-driven backup oil pump are not available.

Loss of the 250VDC battery would result in the safety-related battery charger supplying the loads. The chargers are not designed to carry the design basis loads without the battery in service. The chargers have proven stable, however, when the Plant is shut down and the 250VDC system is not required to be operable, and the battery is taken out of service for maintenance. The battery charger is designed to serve the safety-related loads while recharging the battery in 24-hours from its discharged state.

A significant event at the Plant would have had to occur in the same time frame as the loss of the 250VDC bus which resulted in the need for the safety-related equipment supplied by the 250VDC bus. A review of the safety-related loads supplied from the 250VDC bus revealed that they are not credited for the prevention or mitigation of the required design-basis accidents, or that the components serve a redundant function to components supplied from a different Class 1E bus. The following is a description of the safety-related equipment that would be unavailable due to a loss of the 250VDC bus.

1. Numerous Reactor Core Isolation Cooling (RCIC) components would be unavailable on loss of the 250VDC system, causing the system to be unavailable. RCIC can provide high pressure injection just as the High Pressure Core Spray (HPCS) system can. HPCS, a safety-related, diesel backed high pressure injection source, is not affected by this postulated event. In addition, three of the RCIC valves supplied from the 250VDC bus provide a containment isolation function that is backed up by a check valve providing the same function.

2. Residual Heat Removal (RHR) RHR-V-8, Shutdown Cooling Suction Isolation Valve. Shutdown Cooling is not required to prevent or mitigate the consequences of an accident. Normally closed Residual Heat Removal (RHR) valve RHR-V-23, Reactor Head Spray Isolation Valve. The isolation function for this line is also accomplished by check valve RHR-V-19. The Reactor Head Spray and Shutdown Cooling functions of RHR are not credited in design-basis accident analyses. The Low Pressure Core Injection and Suppression Pool Cooling functions of RHR are not affected by the loss of RHR-V-23 and RHR-V-8.

3. Reactor Water Cleanup (RWCU) valve RWCU-V-4, an outside containment isolation valve. Containment isolation is also provided by inside containment isolation valve RWCU-V-1 which is powered from a different Class 1 source. The reactor water cleanup function is not required for accident prevention or mitigation.

The loss of the 250VDC bus due to a fault in the non-Class 1E portion of the system is considered a very low probability event. Had the postulated loss of the 250VDC system occurred, however, redundant equipment is available for the prevention and mitigation of the design basis accidents. Additionally, Plant personnel could have rapidly restored the Class 1 portion of the 250VDC system to service by replacing the battery main fuse. Therefore, this event is deemed to have had minimal safety significance.

Similar Events

WNP-2 Licensee Event Report (LER) 84-048 reported a problem with improper fuse application on the 250VDC MCCs. The manufacturer recommended that the a new fuse type be used, rated at 600V instead of 250V, to provide an acceptable level of protection for the 250VDC MCCs. The corrective action for that LER was the replacement of the identified fuses with fuses rated at 600V instead of 250V. The downstream fuse in this event was changed out as part of the corrective action for LER 84-048, and resulted in improved coordination.

EIIS Information

Text Reference	EIIS Reference	
	System	Component
250 Volt DC	EI	FU
Main Turbine Lube Oil	TD	P
Reactor Core Isolation Cooling	BN	
High Pressure Core Spray	BG	
Residual Heat Removal	BO	ISV
Reactor Water Clean Up	CE	ISV