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SUBJECT: LER 91-017-01: on 910708, Auto start of emergency diesel generators occurred while on backfeed. Undervoltage initiated by a 500KV grid disturbance caused by personnel error & equipment design. Shutdown cooling restored. W/930609 ltr.

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WASHINGTON PUBLIC POWER SUPPLY SYSTEM

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June 9, 1993
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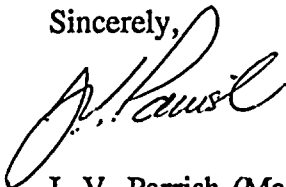
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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: **NUCLEAR PLANT WNP-2, OPERATING LICENSE NPF-21
LICENSEE EVENT REPORT NO. 91-017-01**

Transmitted herewith is Licensee Event Report No. 91-017-01 for the WNP-2 Plant. This revision is submitted in response to the report requirements of 10CFR50.73 and modifies the discussion of the electrical transfer logic previously submitted.

Sincerely,



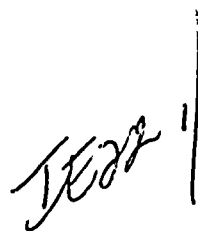
J. V. Parrish (Mail Drop 1023)
Assistant Managing Director, Operations

JVP/CDM/cgeh
Enclosure

cc: Mr. B. H. Faulkenberry, NRC - Region V
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Mr. D. L. Williams, BPA (Mail Drop 399)

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LICENSEE EVENT REPORT (LER)																			
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Washington Nuclear Plant - Unit 2										05000397					1 OF 7				
TITLE (4)																			
AUTO START OF EMERGENCY DIESEL GENERATORS WHILE ON BACKFEED. UNDervOLTAGE WAS INITIATED BY A 500 KV GRID DISTURBANCE. ROOT CAUSES ARE PERSONNEL ERROR AND EQUIPMENT DESIGN																			
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	7	08	91	01	7	0	6	09				050000							
OPERATING MODE (9)			THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)																
POWER LEVEL (10)			20.402(b) 20.405(a)(1)(i) 20.405(a)(1)(ii) 20.405(a)(1)(iii) 20.405(a)(1)(iv) 20.405(a)(1)(v)				20.405(C) 50.36(c)(1) 50.36(c)(2) 50.73(a)(2)(i) 50.73(a)(2)(ii) 50.73(a)(2)(iii)				50.73(a)(2)(iv) 50.73(a)(2)(v) 50.73(a)(2)(vii) 50.73(a)(2)(viii)(A) 50.73(a)(2)(viii)(B) 50.73(a)(2)(x)				77.71(b) 73.73(c) X OTHER (Specify in Abstract below and in Text, NRC Form 366A)				
			Voluntary LER																
LICENSEE CONTACT FOR THIS LER (12)																			
NAME										TELEPHONE NUMBER									
C. D. Mackaman, Licensing Engineer										509377-4451									
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										
SUPPLEMENTAL REPORT EXPECTED (14)										EXPECTED SUBMISSION DATE (15)									
YES (If yes, complete EXPECTED SUBMISSION DATE) X NO																			
ABSTRACT (16)																			
<p>On July 8, 1991, at 0113 hours, Operations personnel responded to the automatic start of the Division 1 and 2 Emergency Diesel Generators. The Diesels started due to undervoltage conditions on their respective vital power buses. The undervoltage condition resulted when a ground fault occurred in the off-site 500KV system. Misalignment of protective relay selector switches at a Bonneville Power Administration (BPA) substation precluded primary protective relays from immediately isolating the faulted line. Backup relaying action to isolate the fault also de-energized the WNP-2 backfeed power source and plant buses. Transfer to the Startup power source did not occur since the transfer logic was not satisfied. WNP-2 undervoltage relays acted to transfer critical bus power to the Backup transformer.</p> <p>Operations personnel restored station power to the Startup source at 0136 and reestablished Shutdown Cooling at 0156.</p> <p>The root causes are personnel error on the part of substation operations personnel and substation equipment design deficiencies. Substation personnel are not WNP-2 employees. Personnel and hardware related corrective actions are being pursued by substation management. WNP-2 will monitor the completion of BPA corrective actions. Further, WNP-2 will perform engineering review to confirm existing relaying is sufficient to protect the unit if a similar event had occurred while at power.</p>																			

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TITLE (4) AUTO START OF EMERGENCY DIESEL GENERATORS WHILE ON BACKFEED. UNDERVOLTAGE WAS INITIATED BY A 500 KV GRID DISTURBANCE. ROOT CAUSES ARE PERSONNEL ERROR AND EQUIPMENT DESIGN							

Plant Conditions

Power Level - 0%

Plant Mode - 4 - Cold Shutdown

Event Description

On July 8, 1991, at 0113 hours, Operations personnel responded to an automatic start of the Division 1 and 2 Emergency Diesel Generators. The Diesels started due to undervoltage conditions on their respective vital power buses. The undervoltage was caused by a disturbance in the off-site 500KV system which resulted in total de-energization of the 500KV portion of the Bonneville Power Administration (BPA) Ashe substation from which the plant was backfeeding.

The disturbance was a ground fault on the Marion line feeding the substation. (See Figure 1 for schematic drawing of Ashe substation. The numbers in circles indicate the opening sequence for the substation breakers.) Misalignment of two protective relay selector switches at the substation precluded the BPA primary relays from immediately isolating the faulted line. The switches allowed breaker 4937 to open but not breaker 4940. Backup relaying (line relays) isolated the Hanford line (by opening breakers 4898 and 4901) and then the Slatt line (via breakers 4888 and 4891). Finally the fault was cleared when a neutral overcurrent relay timed out and opened breaker 4940. The fault was completely isolated in less than one second.

WNP-2 backfeed de-energized when the Slatt line isolated by opening breakers 4891 and 4888. Since the Hanford, Slatt and Marion line relays are not designed to trip breaker 4885, WNP-2 was left connected to the de-energized South bus through 4885. Breaker 4885 was not required to open to isolate the fault and did not open. Plant design includes logic for automatic transfer of station power from the off-site 500KV system to the 230 KV Startup transformer (TRS) in the event of a Main Generator trip. However, when the plant is in the 500 KV backfeed configuration, the Main Generator is out of service, and the logic is only actuated by faults on the power distribution system between WNP-2 and the Ashe substation. Since the electrical fault was isolated at the substation, auto-transfer to the Startup source did not occur by design. The resultant loss of power to critical plant buses was detected by undervoltage protective relays. The loss of voltage relay scheme then transferred Division 1 and 2 critical bus power to the Backup transformer (TRB) within four seconds. Concurrently, the loss of voltage relays started the Division 1 and 2 Diesel Generators. The High Pressure Core Spray (HPCS) Diesel Generator was out of service for maintenance at the time of the event.

Since transfer to TRB was successful, the diesels did not pick up load. The operating Shutdown Cooling pump, RHR-P-1A, tripped as part of the load shed sequence associated with transfer to TRB.

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Immediate Corrective Actions

WNP-2 plant operators returned the unit to the Startup power source by 0136 hours, restored Shutdown Cooling by 0156 hours and secured the Diesel Generators by 0149 hours.

Further Evaluation and Corrective Action

A. Further Evaluation

Start of the Diesel Generators due to undervoltage is not considered to be an Engineered Safeguards Feature actuation, according to the WNP-2 FSAR. Therefore, this LER is voluntarily submitted. Nevertheless the NRC was notified of this event, via ENS, within the four hours allowed by 10CFR50.72(b)(2)(ii). The WNP-2 Resident NRC Inspector was also notified.

The HPCS Diesel Generator was out of service for maintenance during this event. The HPCS system is not designed to transfer to the Backup transformer upon loss of bus voltage. If the Startup transformer is not available, the HPCS diesel is the only other source of power to the system. Hence HPCS was unavailable during the event. However HPCS was not being relied upon to satisfy any ECCS requirements.

The Root Causes of this event are personnel error on the part of substation operations personnel and equipment design deficiency. These root causes are confirmed by both substation operator (BPA) and Supply System investigations. It is believed the selector switches remained misaligned after planned breaker work. Substation personnel failed to use procedurally prescribed methods for changing component status and logging such actions. Since the relay selector switches had been out of service for approximately 19 days, the BPA investigation specifically addressed their procedural controls over substation activities and log keeping. The controls were found to be satisfactory.

Equipment design is less than adequate since there was no indication in the substation control room that the switches were out of its normal position. Further there were no features of the switch which would obviously indicate, locally, that it was out of position.

The transfer to TRB involves both the four second time delay and load shedding. The time delay is sufficient to cause a start of emergency diesel generators due to critical bus undervoltage. The start is precautionary and allows the diesels to more rapidly connect to the critical bus in the event that the Backup power is not available.

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Load shedding ensures that the inrush current does not exceed transformer ratings when the transformer is initially energized. In this event, Residual Heat Removal loop A, which was supplying shutdown cooling, tripped as part of the load shed sequence.

No isolation or scram occurred since the Reactor Protection System (RPS) flywheel inertia maintained RPS power until the critical buses were re-energized from TRB.

B. Further Corrective Action

Corrective action for BPA personnel performance issues are not within the control of the Supply System. However BPA is applying corrective measures to ensure the problem does not recur.

BPA will implement modifications to: 1) automatically record relay selector switch activity; 2) annunciate and alert the substation operator if a relay selector switch is out of its normal position; and 3) color coding the selector switches to facilitate visual determination of their position.

Supply System Engineering will review the existing WNP-2 electrical protection relaying scheme to ensure adequate protection of unit equipment if a similar event were to occur during operation. Any significant adverse findings will be reported in a supplemental LER.

Safety Significance

There is no safety significance to this event. The unit was already in the cold shutdown mode. Shutdown cooling was lost for 43 minutes, resulting in only a two degree rise in reactor coolant temperature. WNP-2 Technical Specifications allows Shutdown Cooling to be out of service for up to two hours in any eight hour period. There was no threat to the health and safety of the public or plant personnel.

Had the unit been operating when this event transpired, it is most likely that plant response would have been similar to that experienced. Generator protective relaying would probably not have responded quickly enough to trip the unit and initiate fast transfer. Grid relaying would have isolated the faulted grid from the unit, leaving the unit tied (via 4885) to the dead South bus at Ashe. This loss of load would have caused turbine speed to increase. The turbine Overspeed Protection Controller (OPC) would cause a reactor scram and a Recirculation Pump Trip (RPT) by depressurizing the OPC hydraulic header. Most likely the acceleration would be too fast to be caught by the OPC and the turbine would trip on mechanical or electrical overspeed signals. The turbine trip would ultimately trip the unit lock out relays which, in turn, would trip the 500KV breakers and initiate fast transfer.

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If the OPC terminated the acceleration before an overspeed trip occurred, it is possible that the OPC would try to control the turbine at synchronous speed until operator action or anti-motoring initiated the turbine trip/generator trip/fast transfer sequence. (The "anti-motoring" signal is generated by a low differential pressure across the high pressure turbine and has a 60 second time delay.)

In either case if the unit and grid would be disconnected for more than a few cycles and, when fast transfer occurred, rotating loads could be re-energized when out of phase with the Startup transformer, potentially damaging the motors or the transformer. While this presents a commercial risk, critical equipment would not be endangered since such equipment is normally in a standby configuration. Sufficient redundant equipment would be available to protect the health and safety of the public.

Similar Events

Other WNP-2 LERs related to off-site grid disturbances are:

- LER 85-002 Failed Potential Transformer at a BPA Substation Caused a WNP-2 Generator Trip and Reactor Scram.
- LER 85-003 Erroneous 500KV breaker open signal from BPA substation caused by faulty microwave link.
- LER 86-022 Diesel Generator start caused by momentary loss of 230KV power due to a trip at a BPA substation.
- LER 90-024 Diesel Generator #2 start on grid voltage and frequency fluctuation caused by a thunderstorm.

LER 85-002 corrective actions included extending the delay time for ground relays from 0.25 to 0.5 sec. This allows BPA relaying to clear certain substation faults without unnecessarily tripping WNP-2. The relay functioned as designed in this event.

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The corrective actions for LER 85-003 do not relate to this event. The other two LERs did not require corrective action since all equipment responded as expected.

EIIS Information

Text Reference

EIIS Reference

System Component

Diesel Generator (HPCS)
 Diesel Generator (Div. 1 & 2)
 Relay
 Selector Switches
 Overcurrent Relay
 Transformer
 Bus
 Residual Heat Removal Pump
 High Pressure Core Spray

EK	DG
EB	DG
--	RLY
--	HS
--	67
--	XFMR
--	BU
BO	P
BG	--

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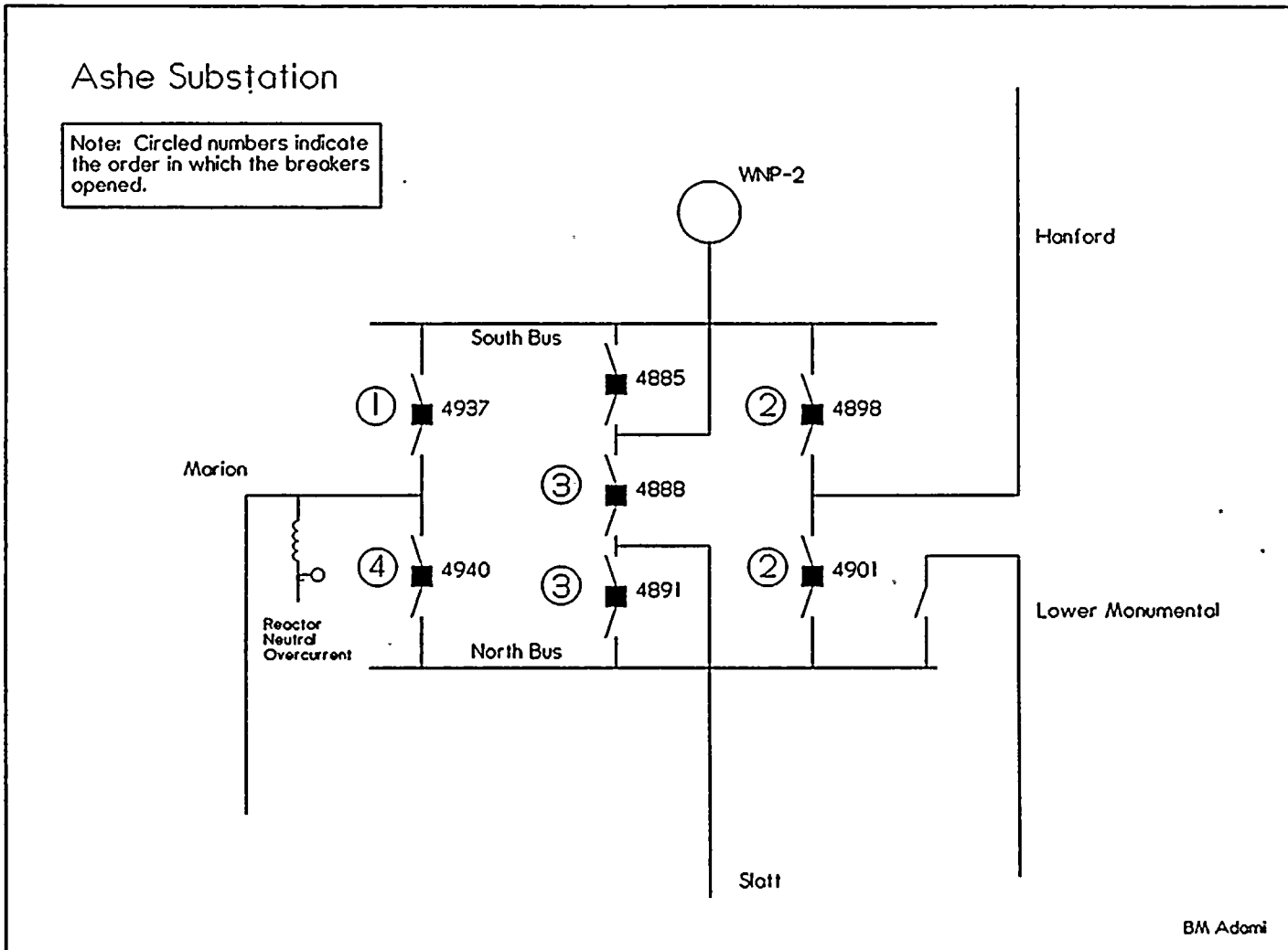
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FIGURE 1