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U. S. Nuclear Regulatory Commission
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Subject: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Licensee Event Report 50-368/96-004-01

Gentlemen:

In accordance with 10CFR50.73(a)(2)(ii)(B), enclosed is a supplement to the subject report concerning the Plant Protective System design. This supplement provides the results of the root cause evaluation and identifies corrective actions.

Very truly yours,

Dwight C. Mims
Director, Nuclear Safety

DCM/tfs

enclosure

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cc: Mr. Leonard J. Callan
Regional Administrator
U. S. Nuclear Regulatory Commission
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LICENSEE EVENT REPORT (LER)

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 (MNB 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.

FACILITY NAME (1)

Arkansas Nuclear One - Unit 2

DOCKET NUMBER (2)

05000368

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TITLE (4) Deficient Failure Modes And Effects Analysis For The DC Electrical System Resulted In Unavailability Of Some Automatic Functions Of The Plant Protective System For Loss Of Power Conditions With A Channel Bypassed And Caused The Potential For Operation Outside The Design Basis Of The Plant

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 NAME	DOCKET NUMBER
10	30	96	96	004	01	01	30	97	FACILITY NAME	DOCKET NUMBER
OPERATING MODE (9)		1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (Check one or more) (11)							
POWER LEVEL (10)		98	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	
			20.405(a)(1)(iii)		50.73(a)(2)(i)		50.73(a)(2)(viii)(A)		Specify in	
			20.405(a)(1)(iv)		X 50.73(a)(2)(ii)		50.73(a)(2)(viii)(B)		Abstract Below	
			20.405(a)(1)(v)		50.73(a)(2)(iii)		50.73(a)(2)(x)		and in Text	

LICENSEE CONTACT FOR THIS LER (12)

NAME

Thomas F. Scott, Nuclear Safety and Licensing Specialist

TELEPHONE NUMBER (Include Area Code)

501-858-4623

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)

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

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

During reviews associated with preparation of a plant modification, Design Engineering personnel discovered a condition that could have placed the plant outside its design basis. The scenarios identified would result in a failure of Containment Isolation Actuation Signal, Containment Spray Actuation Signal, and Emergency Feedwater Actuation Signal to automatically actuate if a loss of offsite power with concurrent failure of a DC bus occurred with a Plant Protective System (PPS) channel in bypass. Prior to a Technical Specification (TS) amendment that was issued in April of 1995, bypass of a PPS channel was limited to 48 hours. Amendment 159 to the ANO-2 TS allowed a PPS channel to remain in bypass until the next cold shutdown based upon an assumption that no safety function would be prevented by a single failure with a channel bypassed. The root cause of this condition was determined to be a deficiency in the original failure modes and effects analysis for the DC electrical system. Administrative controls have been established to prevent a channel from being bypassed for greater than 48 hours until the condition has been resolved. A review of operating records indicated that no PPS channel has actually been bypassed for more than 48 hours since the TS amendment became effective.

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TEXT (if more space is required, use additional copies of NRC Form 366A) (17)

A. Plant Status

At the time this condition was discovered, Arkansas Nuclear One Unit 2 (ANO-2) was operating in normal steady-state conditions at 98 percent power.

B. Event Description

On October 30, 1996, during reviews associated with preparation of a plant modification, Design Engineering personnel discovered a condition that could have placed the plant outside its design basis because some automatic functions of the Plant Protective System (PPS) [JC] would not have been available during loss of power scenarios with a PPS channel in bypass.

At ANO-2, the PPS consists of the Engineered Safety Features Actuation System (ESFAS) [JE] and the Reactor Protective System (RPS) [JC]. The ESFAS monitors Reactor Coolant System (RCS) [AB] pressure, Steam Generator (SG) [AB] pressures and levels, Containment [NH] pressure, and Refueling Water Tank (RWT) [BP] level and initiates a protection response whenever the appropriate monitored parameters deviate from pre-selected actuation setpoints. ESFAS functions include the Containment Isolation Actuation Signal (CIAS) [JM], Containment Spray Actuation Signal (CSAS) [BE], Safety Injection Actuation Signal (SIAS) [BQ], Recirculation Actuation Signal (RAS) [BP], Emergency Feedwater Actuation Signal (EFAS) [BA], Containment Cooling Actuation Signal (CCAS) [BK], and Main Steam Isolation Signal (MSIS) [SB]. The ESFAS Auxiliary Relay Cabinets (ARCs) receive coincident two-out-of-four initiation relay contact signals from the PPS to each ESFAS system and automatically actuate a protective action after satisfying selective two-out-of-four logic in the associated ESFAS actuation circuit.

The ANO-2 vital power design for the PPS consists of one Emergency Diesel Generator (EDG) [EK], one battery, and two inverters for each power division. The PPS is designed such that no single channel failure results in loss of its protective functions. RAS and EFAS are specifically designed not to actuate upon loss of a power division. Power supplies for the RWT level instrument loops for RAS and the Steam Generator level instrumentation loop are auctioneered so that only one instrument loop fails with a power division loss. The remaining ESFAS input instrumentation loops (SG pressure, Pressurizer pressure, Containment pressure, etc.) are not equipped with auctioneered power supplies. The PPS also has internal auctioneered power supplies. Upon a power division failure concurrent with a Loss-Of-Offsite-Power (LOOP), some of the measurement channels do not fail to their safe state. The result of this configuration is that, with a loss of a power division concurrent with a LOOP and a PPS channel bypassed on the operable division, CIAS, CSAS, and EFAS will fail to actuate. The SIAS and CCAS functions will fail to actuate upon Containment pressure signals, but the functions are satisfied by the RCS

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pressure signal input failing low. If a channel is not in bypass, all PPS functions will be available if a power division is lost concurrent with a LOOP except automatic feed water level control to prevent SG over-fill. This EFAS automatic feature is not a required safety function for the postulated loss of power scenario.

ANO-2 Technical Specifications (TS) allowed one PPS channel to be in bypass for up to 48 hours to perform maintenance or testing based upon the low probability of a fault such as loss of a power division affecting more than one channel during that time interval. Amendment 159 to ANO-2 TS was issued by the NRC on April 3, 1995, in response to the ANO submittal dated July 22, 1993. This amendment increased the time allowed during plant operation at full power with one PPS channel bypassed from 48 hours to "until the next cold shutdown." Reviews to support this amendment concluded that the bypass of a specific protective channel combined with a single failure would not prevent required protective actions. The discovery of the potential unavailability of required protective functions under conditions described above indicated that the basis for Amendment 159 allowing greater than 48 hours with a PPS channel in bypass was in error. The result of this condition is that the plant could have been operated outside its original design basis since all required automatic safety functions would not have been available with a PPS channel bypassed.

C. Root Cause

As part of the ANO-2 initial licensing activity, a Failure Modes and Effects Analysis (FMEA) was performed. This FMEA failed to document multiple failures of active electrical power systems that can result from a single passive failure of a DC bus. The consequences of a DC bus failure could include loss of off-site power, loss of on-site power, and loss of two channels of vital AC power affecting the train with the DC bus failure. Power to the redundant train would, however, remain available. The deficiency in the original FMEA has been identified as the root cause of the condition being reported.

Prior to issuance of the indefinite bypass Technical Specification amendment in 1995, the failure of automatic actuation capability of some ESFAS functions is considered to have been an acceptable design condition due to the limited potential for the failure scenario during the 48-hour time period allowed with a channel in bypass.

An evaluation was prepared to support the TS amendment that allowed indefinite bypass of a PPS channel. The PPS FMEA prepared for that evaluation indicated, correctly, that a PPS channel with a decreasing signal will actuate. However, the evaluation failed to recognize that a PPS channel with an increasing signal will not actuate if power is lost to the measurement channel. The evaluation erred in its conclusion that the vital AC power system did not have a single failure mechanism that could cause failure of two vital AC power channel inputs. Although the evaluation referenced failure of two vital AC power

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inputs on process measurement instrumentation that would fail to the tripped state, it failed to address those inputs that would be rendered inoperable. An instrument loop being de-energized causes the process input to the bistable comparator card to fail low. For those bistable comparator cards with a setpoint caused by a decreasing signal, the input failure results in a measurement channel trip. For bistable comparator cards with a setpoint caused by an increasing signal, failure of the input will not result in a measurement channel trip. This measurement channel response is a result of the design features of the auctioneered power supplies for the bistable comparator cards.

D. Corrective Actions

An evaluation of this condition concluded that PPS will continue to perform its design function if a channel is bypassed for no longer than 48 hours. Administrative controls were promptly established to prevent a PPS channel remaining in bypass for greater than 48 hours until the condition is resolved. The Continued Safe Operation evaluation will be reviewed and revised, as appropriate, prior to startup from the refueling outage currently scheduled to begin in April 1997.

A "Night Order" was provided to ANO-2 Operations personnel to remind them of guidance contained in Emergency Operating Procedures regarding actions to mitigate potential SG over-fill events.

Evaluation of this condition to provide recommended actions for resolution will be completed by August 1, 1997. Any plant modifications determined to be necessary will be installed by completion of refueling outage 2R13 in 1999. Changes to the Safety Analysis Report, including the FMEA for DC electrical failures, to reflect those modifications and resolve issues discovered during the root cause evaluation of the condition will be provided in the amendment following that outage.

E. Safety Significance

A review of records confirmed that ANO-2 had not operated with a PPS channel bypassed for greater than 48 hours since TS Amendment 159 became effective. The plant never operated outside the original design and licensing basis that had been previously evaluated to provide an acceptable level of safety. The scenario identified that would result in failure of CIAS, CSAS, and EFAS to perform their functions requires a LOOP while a PPS channel is bypassed with the concurrent failure of a DC bus feeding two of the three channels not in bypass, a situation with a low probability of occurrence. With the same power failure scenario, LOOP concurrent with the loss of a DC power division, if no PPS channel is bypassed the feed water level control to prevent SG over-fill would require manual intervention. The SG fill rate (estimated to be in excess of 60 minutes to over-fill the SGs), availability of level instrumentation, existing procedural guidance, training provided to the Operations personnel, and reminders transmitted by recent

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"Night Orders" provide confidence that this function would be accomplished. All other PPS functions will be available under postulated design basis events and associated single failures. Emergency Operating Procedures were in place to require verification that the protective functions automatically actuate when the appropriate setpoint is reached and to direct manual actuation if necessary. This condition would not have prevented the capability for manual actuation of the affected functions. This condition is therefore judged to have had minimal actual safety significance.

F. Basis for Reportability

The potential for ANO-2 having operated for extended periods with a PPS channel in bypass could have resulted in some automatic PPS functions being unavailable during loss of electrical power conditions. This caused the plant to have been outside its design basis and is being reported in accordance with 10CFR50.73(a)(2)(ii)(B). A report was made to the NRC Operations Center at 1518 on October 31, 1996, in accordance with 10CFR50.72(b)(1)(ii)(B).

G. Additional Information

A similar condition involving inability to provide the EFAS function of PPS during the same postulated electrical failure scenario was reported as LER 2-95-001-00 transmitted via ANO letter 2CAN089502 dated August 18, 1995. The root cause of that condition was attributed to a human error during the development of a system modification installed in 1984.

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