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SUBJECT: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51
Licensee Event Report 50-313/91-010-01

Gentlemen:

In accordance with 10CFR50.73(a)(2)(ii)(B), enclosed is a supplemental report concerning the capability of the offsite power source to meet the requirements of General Design Criterion 17. This supplement is being submitted to report the results of the root cause analysis and plans for long term corrective actions.

Very truly yours,

James J. Fisicaro

James J. Fisicaro
Director, Licensing

JJF/RHS/mmg
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IE22

NRC Form 366
(6-89)

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

LICENSEE EVENT REPORT (LER)

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TITLE (4) Offsite Power Source Potentially Unable to Maintain Adequate Voltage to Safety Loads During Specific Accident Conditions Due to Increased Offsite Grid Loading

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
1 0	0 5	9 1	9 1	-- 0 1 0	-- 0 1	0 3	2 7	9 2		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)	50.73(a)(2)(v)	73.71(c)		
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X	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
	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		0 3	3 0	9 2

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

On October 5, 1991, an ANO Engineering evaluation identified specific conditions which could jeopardize the capability of an offsite power source to meet the requirements of General Design Criterion 17 for ANO-1 and ANO-2. It was determined that during peak summertime load conditions the 161KV offsite power source (Startup Transformer 2) might not be able to maintain adequate voltage to ANO loads during accident conditions with both units off line and the 500KV power source (autotransformer) unavailable. The impact of increased 161KV grid loading with time was not identified due to the failure to incorporate Millstone Degraded Grid Voltage requirements into Entergy transmission system review criteria. Short term corrective actions included placing the feeder breakers from Startup Transformer 2 in the "Pull to Lock" position, which prevents it from automatically picking up ANO loads due to loss of power to the 6.9KV or 4.16KV buses. Procedural guidance was also implemented to restrict the loading of Startup Transformer 2 when the 500KV source is unavailable to ensure its capability to supply adequate voltage to safety loads. Long term corrective actions will include the installation of capacitor banks near ANO and voltage tap changes on transmission system and ANO transformers. This report is also intended to meet the special reporting requirements of ANO-1 Technical Specification 3.7.2.H.

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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 October 5, 1991, an ANO Engineering evaluation identified specific conditions which could jeopardize the capability of an offsite power source to meet the requirements of General Design Criterion 17 (GDC-17) for ANO-1 and ANO-2.

Electric power is supplied to the ANO switchyard by five separate transmission lines. Three lines, one from the Mabelvale substation, one from the Ft. Smith substation, and one from the Mayflower substation, feed the 500KV ring bus. The remaining two lines, one from the Russellville East substation and the other from the Morrilton East substation, feed the 161KV ring bus. Two physically independent circuits with startup transformers sized to carry full plant essential loads are provided from the station switchyard to the onsite electrical distribution system. Startup Transformer 1 (S/U-1) and Startup Transformer 3 (S/U-3) are supplied by the autotransformer bank from the 500KV bus. Startup Transformer 2 (S/U-2), which is supplied by the 161KV ring bus, serves as a second source of power for both units. This transformer has an auto transfer feature which enables it to pick up loads automatically from Startup Transformer 1 or 3 if power is lost to either unit's 6.9KV or 4.16KV buses. During normal plant operation, onsite power is supplied by each unit's main generator via its respective auxiliary transformer. If a plant trip occurs, the unit's loads are "fast transferred" to its respective startup transformer (S/U-1 for ANO-1, S/U-3 for ANO-2). If the 500KV autotransformer were to become unavailable, offsite power could still be supplied by S/U-2 either automatically, if auto transfer is selected, or manually.

While investigating the implications of NRC Information Notice 89-83, ANO Engineering personnel identified that offsite grid loading on the Arkansas Power and Light (AP&L) 161KV system had increased to the point that reanalysis of the ability of the system to carry ANO loads on S/U-2 was necessary. Early indications of the analysis were that, with the ANO 500KV autotransformer out of service and minimal or no credit taken for support from local hydro generation, unacceptably low voltages could result at the primary connection to S/U-2. Since a review of NRC correspondence indicated that ANO's commitments regarding minimum contingencies to be analyzed implied that credit for local hydro generation was taken during licensing of the Millstone degraded grid issues, additional research was initiated to establish what design basis assumptions should be applied to more accurately reflect the current condition. Also, loads required to be assumed in the scenarios dictated by ANO's commitments regarding compliance with GDC-17 and degraded grid conditions were reviewed.

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During the week of September 30, 1991, after validation of the loads on the 161KV system and the associated load flow analyses were completed, it appeared that there was a problem with maintenance of design basis loading of S/U-2 assuming the loss of the 500KV autotransformer with both units off line unless credit could be taken for dispatcher action within the time limits allowed by GDC-17. On October 4, 1991, ANO was notified by the Entergy System Operations Center that following loss of the 500KV autotransformer with both units off line during load conditions at or below those expected to occur prior to the summer of 1992, the dispatcher could respond as necessary to maintain the 161KV system voltage at acceptable levels until the autotransformer was returned to service or both ANO units were safely shutdown. On October 5, 1991, ANO received communication from the System Operations Center stating that expected summertime peak loads would render them unable to maintain the required 161KV at the S/U-2 primary windings if the 500KV autotransformer were to become unavailable while both ANO units were off line.

C. Root Cause

The root cause evaluation of this condition identified several contributory causal factors. A review of ANO's Millstone Degraded Grid Voltage Analysis, which was accepted by the NRC in December, 1979, and the associated correspondence with the NRC indicated that no attempt was made to quantify how many years into the future the required minimum offsite voltage levels could be maintained before additional improvements to the transmission system would become necessary. In addition, there was no formal procedure established between ANO Engineering and Transmission System Planning which required periodic review of the transmission network to assure that the offsite voltage levels required by ANO were being maintained. The transmission planning engineers at AP&L performed annual studies and recommended necessary improvements to assure that adequate voltages, as defined by Entergy criteria, were maintained on the transmission system. However, since the Millstone offsite voltage requirements are considerably more restrictive than Entergy criteria, these reviews were not effective in preventing the identified degraded voltage condition.

D. Corrective Actions

Although the current Entergy System conditions as well as the projected loads through the winter months are sufficiently low to ensure acceptable voltage to the units via S/U-2 if the postulated event were to occur, ANO has implemented procedural and operational guidance to guarantee that acceptable loading of S/U-2 will not be exceeded. This guidance includes the stipulation that the control switches for the feeder breakers from S/U-2 to both units shall be maintained in the"Pull to Lock" position except under carefully analyzed conditions. This position disables the auto transfer function of S/U-2 and allows selective manual loading of the transformer. The auto transfer function is not a design requirement and is not required to be operable by either unit's

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Technical Specifications. Procedural guidance was also implemented to restrict the loading of S/U-2 when the autotransformer is unavailable to ensure its capability to supply safety loads.

Additionally, directives have been developed and issued to Entergy System dispatchers regarding restoration of 161KV to the ANO switchyard should the 500KV autotransformer become unavailable. These directives provide details for implementing the following actions:

1. Request the Southwestern Power Administration to provide maximum watt and var support from Dardanelle hydro generation located near the site. This generation is expected to be on-line in less than ten minutes.

2. If the hydro generation is unavailable and ANO operators request that safety loads be energized from S/U-2, the dispatchers will take actions to shed load at predetermined substations to restore the 161KV yard to the required voltage.

The long term plans for corrective actions related to operation during summer loading conditions include the following:

1. Voltage tap changes were completed on the 4160/480 VAC load center transformers serving the 1E safety loads of both ANO-1 and ANO-2 to increase voltage on the 480 VAC safety buses. The tap changes for ANO-1 were completed during refueling outage 1R10, which is currently in progress. The tap changes for ANO-2 were completed on March 10, 1992.

2. A 161KV transmission capacitor bank will be installed near ANO by May 1, 1992. This capacitor bank is adequate to address projected summer peak conditions in conjunction with administrative procedures which have been provided to the transmission system dispatcher. The installation of a second capacitor bank which would eliminate the need for procedural control of load shedding is also being considered.

3. Additional voltage tap changes on the transmission system 500/115KV autotransformers at the Mayflower substation will be completed, as necessary. These changes are expected to be completed by May 1, 1992.

These actions allow the deliverance of acceptable voltages to the 1E safety loads so they could perform their required safety functions when the offsite voltages are at their minimum expected level (upon loss of the 500/161KV autotransformer during summer peak load conditions). Performance of these actions will maintain adequate voltage levels to the 1E safety buses for an estimated 3-5 years. As transmission area loads continue to grow, a periodic reevaluation of the resultant offsite voltages will be required to determine when additional actions will be required to maintain adequate offsite voltages.

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To assure that transmission area load growth does not again result in inadequate offsite voltage levels, ANO Design Engineering will require a reevaluation of the offsite voltage levels every two years.

E. Safety Significance

Although this condition is outside the plants' design basis, its safety significance is minimized considering the extremely low probability of the combination of failures that must occur to create the postulated sustained degraded voltage conditions. A loss of the 500KV system or the autotransformer must occur during summer peak load conditions concurrent with the failure of the onsite power systems for both units which include four Emergency Diesel Generators.

The reduced safety significance of this postulated scenario is discussed further in the answers to subsequent NRC questions listed below.

a. What is the acceptability of continued operation of ANO should the 500KV system be lost? Is this adequate and what are the bases for adequacy?

The Entergy Corporation 500KV transmission system is the backbone of the offsite power grid in Arkansas. The complete loss of the 500KV system would require multiple failures or grid stability problems that would be indicative of total loss of the grid. Any single contingency event, including but not limited to the loss of the ANO autotransformer, would not cause a loss of the entire 500KV system. Grid stability analysis work done recently by the Entergy transmission planning department demonstrated that single contingency events such as generating unit trips or faults will not cause widespread grid disturbances or a transmission system blackout. The 500KV system is required to support the 161KV system at other intertie points in order to provide acceptable voltages at the primary of S/U-2 if the ANO autotransformer is out of service. However, the loss of a single 500KV line or a fault in the ANO 500KV switchyard not associated with the autotransformer would not result in the loss of the 500KV feed to the autotransformer. Similarly, the loss of a single 500KV line or a fault in the ANO switchyard not involving a generating unit will not of itself cause an operating unit to trip as long as its auxiliaries are being fed from the unit auxiliary transformer (the normal operating source).

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The loss of the entire 500KV system would require the immediate shutdown of both ANO units since they are connected via their respective main step-up transformers directly to the 500KV switchyard and would have no transmission corridor for their outgoing power. The loss of the 500KV connection to the ANO autotransformer would require both units to enter their respective Technical Specifications action statements associated with loss of one of their two required sources of offsite power. This design is considered adequate in that it meets the requirements of GDC-17 and any conditions which jeopardize this capability are appropriately included in Technical Specifications Limiting Conditions for Operation (LCOs) for both units.

b. Provide assurance that the conditions that could render the 161KV system inoperable have been identified. What are the corrective action plans in place to correct the conditions?

Several conditions have been identified which could affect the operability of the 161KV system as it relates to the requirement to supply power to the primary of S/U-2 at sufficiently high voltage to accomplish its safety function. These conditions can be segregated into two categories, normal and abnormal. Normal conditions are those which are enveloped by previous analysis and administrative measures in place, whose occurrence would not render S/U-2 inoperable and therefore would not require entry into Technical Specifications action statements. Examples are operation of the 161KV system within analyzed limits, including contingencies to allow for normal maintenance outages under selected conditions and anticipated limited impact outages due to equipment failures. Abnormal events include operation of the 161KV system outside analyzed limits of load, network configuration, or equipment outages which would render the system incapable of being configured rapidly to supply necessary power and voltage at S/U-2. Such a situation would require notification of ANO personnel so that the appropriate technical specifications actions may be taken in a manner consistent with applicable LCOs. The capability to supply the safety loads of both units of ANO within the time required to meet the requirements of GDC-17 (discussed in C. below) is the key to operability of S/U-2, since credit is being taken for it as a delayed manual access source to meet GDC-17.

If an abnormal event were to occur or if an LCO had to be entered to perform maintenance that could not be reasonably performed without entering an LCO (such as maintenance of S/U-2 itself) then every effort would be made to exit such a condition prior to expiration of the allowed time.

c. During peak load conditions sufficient voltage would not be available on the 161KV system. Are plans in place to restore the voltage if needed and what are the long term plans for corrective action?

Analyses to date indicate that had the autotransformer been lost during summer peak conditions in the past, the 161KV system might not have been capable of supplying the safety loads of both ANO units as required by GDC-17 unless local hydro generation was available and dispatcher actions were taken to shed some 161KV system load. At all other times the system was capable of restoring the 161KV voltage at ANO within a time consistent with the requirements of GDC-17. (See Section D for short and long term corrective actions.)

d. How does ANO comply with Technical Specifications concerning Start-up Transformer #2 and GDCs 5 and 177

Both ANO units have technical specifications requiring the operability of onsite and offsite power sources. These specifications have LCOs which establish allowable operating time with either or both sources of offsite power required to satisfy GDC-17 inoperable. Neither ANO unit is normally connected to these sources when operating at power. Their operability can be considered as their ability to supply necessary safety loads in a time frame consistent with the requirements of GDC-17 for each source. One source is required "to be available within seconds following a loss of coolant accident". For ANO this source is supplied via the 22KV tertiary winding of the ANO autotransformer. A fast transfer from the normal supply to this source typically takes place within a few cycles. A dead bus transfer capability is present that can be accomplished within approximately two seconds should the fast transfer fail. Should the dead bus transfer be unsuccessful or insufficient voltage be present, the safety buses will disconnect from offsite power and be sequenced onto the diesel generators.

The second source is required "to be available in sufficient time following a loss of all onsite ... and the other offsite" source to "assure that specified fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded." This source for both ANO units is S/U-2 fed from the 161KV switchyard bus. ANO has reviewed the station blackout coping capability of both units most recently in its submittal of 1989. This work established that both ANO units had sufficient capability to cope with a loss of all AC power for at least one hour. Therefore, we have concluded that a delay of 30 minutes or less in establishing delayed manual access to S/U-2 is an appropriate time for consideration of the ability of this source to satisfy the requirements of GDC-17. As stated above, ANO estimates that it will be able to complete actions to restore voltage to S/U-2 within 10 minutes of the declaration of the need to do so if the autotransformer were concurrently unavailable. The independence required by GDC-17 between these sources is addressed in the last paragraph of GDC-17. Provisions have been included in the design to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear unit, the loss of the transmission network, or the loss of power from the onsite electric power supplies.

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Whether the nuclear unit auxiliaries are operating on their unit auxiliary transformer or their 22KV-fed startup transformer the trip of the nuclear unit will not cause the 500KV system or the ANO autotransformer to fail. Neither will it affect the diesel generators or the source from S/U-2. ANO's grid stability analysis supports this.

The loss of power from the transmission network will cause operating units to trip and the loss of both offsite supplies. However, the onsite supplies will be unaffected by the loss of offsite and generating unit power by virtue of the design of the loss of voltage and degraded voltage relaying and the separation of the safety buses from the offsite supplies. This capability is assured by the analyzed response of the units to previously evaluated loss of offsite power events. The loss of power from the onsite electric power supplies will require delayed manual access to S/U-2 in the event that the other offsite source is unavailable. Necessary procedures are in place at ANO and the Entergy system dispatch center to accomplish these functions.

GDC-5 requires that systems important to safety cannot be shared if such sharing would significantly impair their ability to perform their safety functions, including an accident in one unit and an orderly shutdown and cooldown of the other. Our analysis of S/U-2 loading demonstrates that sufficient voltage will be available following dispatcher action to power the safety loads of both ANO units assuming an accident on one unit and normal "Loss of Offsite Power" loads of the other. This meets or exceeds the requirements of GDC-5 and is consistent with our previous statements regarding shared loading of S/U-2.

F. Basis For Reportability

The inability of the 161KV system (including S/U-2) to provide adequate voltage during summer peak load conditions is contrary to the requirements of GDC-17 which stipulates that each of the two physically independent offsite power sources shall be capable of providing power sufficient to permit functioning of structures, systems and components important to plant safety considering the loss of all onsite AC power supplies as well as the other offsite source. Therefore, this condition is considered reportable pursuant to 10CFR50.73(a)(2)(ii)(B) as a condition outside the design basis of the plant.

ANO-1 Technical Specification 3.7.1.G requires that load shedding circuitry be operable if S/U-2 is selected for auto transfer. Technical Specification 3.7.2.H stipulates that if 3.7.1.G cannot be met the feeder breakers from S/U-2 must be placed in "Pull to Lock" and, if the load shedding circuitry is not returned to operable status in 30 days, a special report shall be submitted within 30 days discussing plans for repair. On October 3, 1991, ANO-1 conservatively declared the load shedding circuitry inoperable and placed the S/U-2 feeder breakers in "Pull to Lock". This report is also intended to satisfy the special reporting requirements of Technical Specification 3.7.2.H.

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G. Additional Information

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