



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

313-
50-368

NOV 01 1978

MEMORANDUM FOR: J. F. Stolz, Chief, Light Water Reactors Branch 1, DPM

FROM: Faust Rosa, Chief, Power Systems Branch, DSS
Rod Satterfield, Chief, Instrumentation and Control
Systems Branch, DSS

SUBJECT: ARKANSAS NUCLEAR ONE; INCIDENT ON SEPTEMBER 16, 1978;
AUTO TRANSFER OF AUXILIARY LOADS ON BOTH UNITS TO
STARTUP TRANSFORMER NO. 2 WITH CONSEQUENT OVERLOAD;
CONFORMANCE TO GDC-17

The incident at Arkansas Nuclear One (ANO) on September 16, 1978 brought into question the conformance to GDC-17 of the offsite power system design of this station. We have reviewed the ANO design in light of this incident; this review was conducted in close coordination and consultation with cognizant personnel of I&E, DOR, DPM and the Licensee (Arkansas Power and Light Company) and its AE. As a result of this review we conclude that the present offsite power system design is not in conformance with GDC-17 with regard to the independence between the two required offsite power circuits. Our rationale and recommendations are as follows:

A description of the pertinent features of the ANO offsite power system design is provided in the Enclosure. It is clear from this description that under certain conditions Startup Transformer No. 2 (ST2), which is in the "delayed access" offsite power circuit* (for both units) required by GDC-17, will be automatically overloaded due to a failure in the autotransformer which is the common element in the immediate access offsite power circuit which is also required by GDC-17. More specifically, the automatic overload, i.e., disabling, of ST2 will result when a failure of the autotransformer circuit occurs concurrently with any of the following station conditions and events:

- a) both units in either startup or shutdown mode,
- b) trip of one unit while the other is in either the startup or shutdown mode, and

*The design feature of automatic load transfer to ST2 which is provided actually makes this a second immediate access circuit, thus exceeding GDC-17 requirements with regard to access capability; however, the resulting overload of ST2 violates the independence requirements of GDC-17.

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c) simultaneous trip of both units.

GDC-17 requires, in part, that "Electric power from the transmission network to the onsite electric distribution system be supplied by two physically independent circuits (not necessarily on separate rights of way) designed and located so as to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions." Since in the ANO design a failure in the immediate access offsite power circuit results in failure of the delayed access circuit, we conclude that the ANO offsite power system design is not in conformance with GDC-17; however, the Unit 1 situation is being handled by DOR and Unit 2 is presently shutdown. Prior to Mode 2 licensing of Unit 2, this matter will need to be resolved.

We recommend that the licensee be advised of the above cited non-conformance with GDC-17 and requested to modify his design to bring it into conformance before Unit 2 goes into Mode 2 operation. In our opinion, acceptable methods for attaining conformance with GDC-17 include:

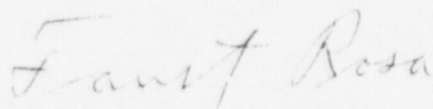
- 1) Replacement of Startup Transformer No. 2 with one capable of carrying the worst case combination of automatically transferred loads.
- 2) Defeat of all capability for automatic transfer of loads to Startup Transformer No. 2.
- 3) Defeat of capability for automatic transfer of selected loads such that Startup Transformer No. 2 will never experience an overload condition (including excess voltage drop resulting in unacceptable voltage at the safety buses) due to the worst case combination of the retained automatic load transfer capability.

Development is underway of a PSB Technical Position addressing the detailed application of GDC-17 to offsite power system designs involving similar automatic switching schemes. Pending completion of this position (and its approval by the R3C if required), acceptable means of implementing option 3 above include: (1) defeat of automatic load transfer in one unit while retaining it in the other, or (2) partial defeat of automatic load transfer in either or both units.

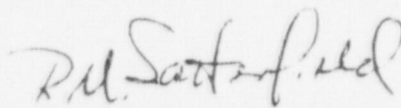
Also, procedural implementation of option 2 or 3 utilizing existing switching capabilities (as opposed to a design change) would be acceptable pending completion of the above cited PSB position. Such procedural implementation should include written procedures for (1) defeat of the required automatic switching capability, (2) manual load shedding and switching including manual loading required to make use of ST2 as the delayed access offsite power circuit for either or both units, and (3) daily logging of the status of automatic load switching. Unrestricted operation of Unit 2 (and Unit 1 insofar as automatic load transfer to ST2 is concerned) would be permissible provided the above procedural requirements are approved by I&E and incorporated in the Technical Specifications.

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Implementation of the above position regarding automatic load transfer to Startup Transformer No. 2 involves the offsite power system for both units. The permissible operational status of Unit 1 is being reviewed separately by DOR (see memorandum from G. Lainas to R. Reid dated October 27, 1978, Voltage Degradation At Class 1E 480 Volt Buses). This review will include consideration of the proposed Millstone fix for degraded grid voltage conditions which includes design changes as well as administrative controls. (An approved Millstone fix has already been installed in Unit 2).



Faust Rosa, Chief
Power Systems Branch
Division of Systems Safety



Rod Satterfield, Chief
Instrumentation and Control
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Enclosure:
As stated

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Also, procedural implementation of option 2 or 3 utilizing existing switching capabilities (as opposed to a design change) would be acceptable pending completion of the above cited PSB position. Such procedural implementation should include written procedures for (1) defeat of the required automatic switching capability, (2) manual load shedding and switching including manual loading required to make use of ST2 as the delayed access offsite power circuit for either or both units, and (3) daily logging of the status of automatic load switching. Unrestricted operation of Unit 2 (and Unit 1 insofar as automatic load transfer to ST2 is concerned) would be permissible provided

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OFFICE
SURNANE
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J. F. Stolz

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DISTRIBUTION:
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NRR READING
PSB READING
ICSB READING
FROSA READING

*Implementation of option
included on page 2, needs to be
reviewed to assure that GDC
35, 38, 41 & 44 are not violated.

See Comments*

DSS:ICSB
MSrinivasan
10/1/78

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Description of the Offsite Power System
Design for Arkansas Nuclear One
Units 1 and 2

The following design features of the Arkansas Nuclear One (ANO) station are pertinent to the evaluation of the design for conformance to GDC-17, in light of the incident which occurred on September 16, 1978.

- 1) Each of the two units has a dedicated unit auxiliary transformer (UAT) and a dedicated startup transformer (ST) each of which can supply all a-c power to all the unit auxiliaries, both safety and non-safety. The UAT's are supplied from their respective unit generator; the two ST's are both supplied through a single auto-transformer which also interconnects the 500 KV and 161 KV sections of the station switchyard.
 - 2) A backup startup transformer, Startup Transformer No. 2 (ST2), is provided which can serve both units. This transformer is supplied directly from the 161 KV section of the switchyard. However, it does not have the capacity for carrying the full auxiliary loads of both units.
 - 3) On unit trip, all the unit auxiliary loads will be transferred automatically from its UAT to its ST. This will occur in both units, independently.
- /

- 4) When unit auxiliary loads are being carried by the respective ST and this source of power is lost for any reason, all the unit auxiliary loads will be transferred automatically to the backup ST 2. This also will occur in both units, independently.
- 5) When both units are being supplied by their respective ST's and the common source of power to the ST's (the autotransformer) is lost, then the auxiliary loads of both units will be automatically transferred to ST2. This will overload ST2 (exceed MVA rating) and also produce excess voltage drop resulting in a degraded voltage condition at the buses (safety and non-safety) of both units.
- 6) With the existing design, the overloading of ST2 will result automatically on failure of the autotransformer circuit feeding the two dedicated startup transformers, when the failure occurs concurrently with the following conditions or events:
 - a) both units in either the startup or shutdown modes of operation,
 - b) trip of one unit while the other is in either the startup or shutdown mode of operation, and
 - c) simultaneous trip of both units.

- 7) The Millstone fix for degraded grid voltage conditions which includes a second level of undervoltage trip (at approximately 92% of nominal) was installed in Unit 2; this fix is scheduled for installation in Unit 1 at the next refueling outage. It should be noted that the Millstone fix is intended to protect the onsite safety related distribution systems from a degraded grid voltage condition not against degraded voltage due to overload of a startup transformer (although it is also effective in this regard). Therefore, the Millstone fix is necessary in order to meet the GDC-17 requirements for independence between the offsite and onsite power systems. However, the Millstone fix is not considered pertinent to the evaluation of the offsite system design for conformance to the GDC-17 requirement for independence between the two required offsite power circuits. In this case, the design feature in question is the automatic overloading of one of the required offsite power circuits to both units on failure of the other offsite circuit.

It is noted that item 6(b) above covers the incident which occurred at ANO on September 16, 1978. Specifically, this incident was

initiated by a spurious trip of Unit 1 while Unit 2 was in the startup mode. This resulted in automatic transfer of the Unit 1 auxiliary loads from its UT to its ST. Since Unit 2 was already on its ST, this transfer loaded the autotransformer with the full auxiliary loads of both units, resulting in trip of an autotransformer overcurrent relay (which had not been adjusted for two unit operation) and consequent opening of the circuit breakers feeding the two ST's. Loss of the ST's automatically transferred the auxiliary loads of both units to ST2 exceeding its MVA rating and producing a degraded voltage at the auxiliary buses (safety and non-safety) of both units. The overcurrent protective relaying for the autotransformer has since been corrected to preclude recurrence of this type of failure.

The above description does not address those aspects of the September 16, 1978 incident or plant design which are not pertinent to the evaluation of the offsite power system for conformance to GDC-17.

SIMPLIFIED LINE
DIAGRAM
AND UNITS 1 & 2

