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SUBJECT: LER 90-005-00:on 900424,design deficiency/unanticipated interaction of sys results.

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DUKE POWER

May 24, 1990

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

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
LER 269/90-05

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report (LER) 269/90-05 concerning design deficiency/unanticipated interaction of systems resulting in the potential closure of the startup transformer "E" breaker on to a degraded (low voltage) switchyard.

This report is being submitted in accordance with 10 CFR 50.73 (a)(2)(vii). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

H. B. Barron
Station Manager

RSM/ftr

Attachment

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NRC FORM 366 (6-89) | U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

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)
Oconee Nuclear Station, Unit 1	0 5 0 0 0 2 6 9	1 OF 1 0

TITLE (4) Design Deficiency/Unanticipated Interaction of Systems Results in the Potential Closure of the Startup Transformer "E" Breaker on to a Degraded (Low Voltage) Switchyard

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 4	2 4	9 0	9 0	0 0 5	0 0	0 5	2 4	9 0	Oconee, Unit 2	0 5 0 0 0 2 7 0
									Oconee, Unit 3	0 5 0 0 0 2 8 7

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
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)	X 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)	50.72(b)(2)(iii)(D)
		20.405(a)(1)(iv)	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)

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

ABSTRACT

On April 24, 1990, with all three Oconee Nuclear Station (ONS) Units at 100% full power, it was discovered that the Startup Feeder (E) breakers could potentially close on the 230KV switchyard while switchyard voltage is degraded. Degraded grid protection was not provided due to the non-conservative setpoints of the undervoltage relays serving the E breaker logic. This event could have led to a degradation of Engineered Safeguards equipment under certain accident scenarios. This discovery was identified as the result of an earlier Licensee Event Report (LER) and further Design Basis Documentation studies of the 230KV Switchyard. Corrective Action initiated by LER 269/90-04 is adequate to allow continued operation of all ONS units. The root cause is classified Design Deficiency with a contributing cause of Management Deficiency.

BACKGROUND

During normal plant power operation, auxiliary power is supplied from the turbine generator (G)[EIIS:TB] via the Unit Auxiliary (T) Transformer [EIIS:XFMR] and the Normal Feeder (N) breakers (EIIS:BRK). During startup and shutdown, auxiliary power is supplied from the Oconee Nuclear Station (ONS) 230KV switchyard via the Startup (CT) Transformer and the Startup Feeder (E) breakers. On a unit trip, an automatic fast transfer occurs of the auxiliary loads from the T transformer to the CT transformer. In the event of a loss of power situation, an emergency power switching logic (EIIS:EK) automatically establishes a reliable power source, reduces unit/station load to a level within the capacity of the emergency power source, and transfers essential loads on the affected unit(s) to the emergency power source. The emergency power source is from either of two automatic sources, the Keowee Overhead (one Keowee hydroelectric generator through an isolated bus in the ONS switchyard and the CT transformer) or the Keowee Underground (the other Keowee hydroelectric generator through the CT4 transformer, the Standby buses, and the Standby (S) breakers). Emergency and shutdown loads can also be supplied manually from the Lee gas turbine generator via the CT5 transformer, the Standby buses, and the S breakers. (Refer to Attachment 1)

The E breakers provide power to the Main Feeder Bus (EIIS:EA) from the CT transformer when the normal source is not available during unit shutdowns or accident situations. In order to close the E breakers in either the manual or the automatic mode, a number of permissive signals must be present. One of these, the undervoltage permissive signal, is sensed on all three phases of the startup source via a potential transformer and the 27E relay (EIIS:RLY)(Refer to Attachment 1). The permissive signal prevents manual or automatic closing of the E breakers when the voltage for the CT transformer (startup source) is inadequate on 2 out of 3 phases. If the E breakers are closed, the 27E relays provide a signal to trip the E breakers should an undervoltage condition exist on the startup source. This is provided to disconnect the startup source and utilize power from the Standby bus to energize the Main Feeder Bus.

The 27E relay is a Westinghouse Type CV-7 Short Time Overvoltage or Undervoltage relay. The CV-7 relay, a voltage fault detector, is used as a timing device for various automatic operations. This relay can provide for actuation at any of the following Tap setpoints: 55, 64, 70, 82, 93, 105, 120, and 140 volts. The 27E relay operates as an inverse-time relay. The response time of the relay becomes shorter as the difference between the applied voltage and the Tap voltage setpoint increases. A routine test procedure, PT/0/A/4980/27A, is performed every refueling outage to verify the proper operation of the 27E relays.

EVENT DESCRIPTION

On March 1, 1990, Design Engineering (DE) discovered that during certain 230KV switchyard degraded voltage conditions, both the 230KV switchyard and the Keowee Overhead emergency power path could be unavailable to the ONS Units. These conditions were possible because the 230 KV switchyard voltage must be at least 219KV in order to adequately supply Engineered Safeguards (EIIS:JE)(ES) loads, but while the automatic actuation voltage setpoint for aligning the Keowee Overhead emergency power path is less than 160KV. If a degraded switchyard voltage exists between these relative setpoints (219KV and 160KV), then adequate power to the ES buses may not be automatically available from either source. This problem was detected while conducting a program (Design Basis Documentation (DBD)) established within Duke Power Company (DPC), to review/analyze certain plant systems and to document their design basis. This problem was reported under Licensee Event Report (LER) 269/90-04. Since March 29, 1990, guidance has been provided to the Oconee Nuclear Station (ONS) Operations Group to take specific actions should the 230KV switchyard yellow bus voltage be degraded.

On April 17, review of the LER 269/90-04 draft prompted discussions between DE and ONS about the possibility of closing on the Startup Feeder (E) breakers on a degraded bus.

On April 18, 1990, the need for a second LER to report the potential problem relating to the undervoltage relay setpoints for the E breakers was questioned. After further DE evaluations of the problem and with station management and Compliance review, this finding was determined reportable under 10CFR50.72 and 10CFR50.73 on April 24, 1990. It was determined that the interim corrective action as well as the long-term corrective action reported in LER 269/90-04 were adequate to resolve the tolerance problem.

The potential problem relating to the non-conservative undervoltage relay setpoints considers the fact that the undervoltage relays, as set, could allow the E breakers to automatically close at 4160V equivalent to a switchyard voltage as low as 203KV. This possibility was due to the relay setpoints and their susceptibility to calibration tolerance (+/-3%). It was discovered that the original setpoint was established at a 4160V equivalent to an approximate switchyard voltage of 212KV to prevent an undesired blocking of the E breakers (caused by instrument setpoint drift) at near normal switchyard voltage of 226KV. This condition presents a situation under a Loss of Coolant Accident that ES equipment could be supplied from a source with a voltage less than previously analyzed (219KV). The possibility existed for ES equipment to be damaged as a result of a degraded power supply less than 219KV. The problem of the non-conservative relay setpoints has existed since ONS began operation. All ONS units have operated in all modes under this potential condition.

On May 2, 1990, a meeting was held between ONS management, DPC Design Engineering (DE), and the NRC to discuss the problem of the E breakers closing in on a degraded (low voltage) 230KV switchyard. The following is a summary of the discussion:

1. Minimum Analyzed 4160V bus voltage for LOCA is 91.76% which translates to 219KV in the 230KV switchyard. This is limited by the post-LOCA 208V MOVs, which are not analyzed to operate below 80% voltage which is equivalent to 219KV in the switchyard.
2. With the CV-7 relay TAP setting at 105, 87.5% of rated 4160KV bus voltage, calculations show that all post-trip equipment (with the exception of the post-LOCA 208V MOVs) will operate at 84.875% (87.5% - 3.0%).
3. The effect of 4160V bus voltage as low as 80% of rated bus voltage on 4160V pump motor life is insignificant.
4. The undervoltage relay setpoint, 87.5%, and lowest analyzed voltage of 90.4% (recalculated in 1985 to 91.76%) has been reviewed and accepted by the NRC.
5. The plant is protected from a rapidly degrading grid by the Normal Feeder (N) breakers having the same set point and opening at as low as 84.875% which will not damage the running equipment. In this event, the E breakers would also be blocked and Keowee would automatically supply the Main Feeder Buses through the underground and via CT4.
6. Some questions have been raised concerning control of relay setpoints due to the delay between 1982 and 1984 in resetting the relay Tap voltage from 93 volts (77%) to 105 volts (87.5%). A meeting between DE and Transmission Department is planned to discuss the control of relay setpoints.
7. The LER 269/90-04 planned corrective action, an urgent modification, NSM 52850, will fix these design setpoint problems.

The +/- 3% tolerance of the Tap voltage discussed earlier in this report and in LER 269/90-04 is a characteristic that is assumed for some electrical equipment. The technical manual tests the relay at +/- 3% of the Tap voltage to determine if it operates. At this +/- 3% of the Tap voltage the relay will take a long time for it to actuate. The relay is tested to operate within approximately 3 seconds upon an applied voltage of 84 volts (Tap voltage minus 20%). The TD stated that the time for the relay to operate, if the applied voltage was within 10% of the Tap voltage, would be inconsistent and difficult to determine. Only as the bus voltage decreases below the Tap voltage will the relay operate to send a low voltage signal. Therefore, as the voltage decreases further below

the Tap voltage, the relay will operate with a shorter response time. This time delay characteristic prevents spurious tripping of the breaker on voltage transients and ensures that an undervoltage condition is detected before it can adversely affect safety-related loads.

CONCLUSION

The root cause of this event is classified as Design Deficiency, unanticipated interaction of systems. Design Engineering (DE) did not recognize that if the 4160V bus voltage decreases to 87.5%, with the CV-7 relay Tap voltage set at 87.5%, the CV-7 relay could allow the Engineered Safeguards (ES) motor operated valves to be powered from a switchyard voltage less than the analyzed low voltage of 219KV for an indefinite amount of time. In the case of a -3% drift, the ES equipment could be powered by the 4160V bus at less than 84.875% of rated bus voltage (230KV switchyard at approximately 203KV during an ES condition). This still allows a good margin for the 4KV motors to operate.

The Design Basis Documentation (DBD) program was established in 1989 with the intent to provide readily available documents on the current design basis for certain systems. For inclusion to this document, systems must be evaluated in-depth so that a full understanding is reached and can be documented. The DBD is the principle reference for Problem Investigation Reports (PIR), operability evaluations, 50.59 evaluations, design input to station testing programs, and provides general information on system functions and operations. To maintain the DBD current, revisions may be required because of modifications, changes to Technical Specifications, new NRC requirements, or resolution of PIRs. An accountable engineer will be assigned to be responsible for conducting a coordinated station review of the documents initiating a change and the affected DBD. By providing a controlled central reference document, the DBD's will help prevent reoccurrence of problems arising from uncertainty regarding appropriate operating voltage levels, protective relaying setpoints, etc.

The effect of this problem has varied over Oconee Nuclear Station's (ONS) operating history with the 27E relay set at 68%, 87.5%, 77%, and again at 87.5%. Part of the reason for the low setting of 77% could be attributed to a study of two units on one startup transformer in response to the August 8, 1979 Generic letter, Guidelines for Voltage Drop Calculations. Per the same letter, "Any identified inadequacies in undervoltage relay settings require immediate remedial action and notification of the NRC." Therefore, Duke Power Company's (DPC) sensitivity to this issue may have lead to the action that was taken.

A contributing cause, Management deficiency, was due to a lack of a program for the control of relay setpoints. No program or procedure existed to ensure that when new relay setpoints are determined, that they are properly implemented. Between 1982 and 1984, the Design Engineering (DE) group responsible for maintaining the correct relay setpoints had been notified a number of times with information about DPC's commitment to change and maintain the relay setpoints. During the same time DE contacted the Transmission Department (TD) but failed to follow-up to ensure that the relay setpoints were changed. The TD responsibilities, though they received information to change the relay settings, were unclear.

The health and safety of the public were not compromised as a result of this condition. The Unit Trip/LOCA scenario described in this report as required to present these undervoltage conditions has not occurred at ONS. A review of LERs over the past 24 months reveals that this event is non-recurring. There were no equipment malfunctions or component failures involved in this discovery, therefore no NPRDS reportable conditions exist. There were no radioactive releases, radiation exposures, or personnel injuries resulting from this event.

CORRECTIVE ACTIONS

Immediate

The corrective actions per LER 269/90-04 are adequate to prevent any problems with the Startup Transformer "E" breakers as the 27E relays are now set.

Planned

1. Duke Power Company will develop and implement a program that will assure that proper controls of relays setpoints will be administered.

SAFETY ANALYSIS

This safety analysis addresses the scenarios associated with the possibility of the E breakers closing while the 230 kV switchyard is less than 219 kV. This possibility is due to the non-conservative setting of the 27E undervoltage relay Tap voltage setpoints.

This safety analysis addresses the scenarios associated with the Startup Feeder (E) breakers closing while the 230KV switchyard is less than 219KV and above the actuation point of the Startup Source relays (27E). These relays are set above 160KV, the setpoint of the external grid trouble protection undervoltage relays. Upon decreasing to 160KV, the switchyard isolates and terminates any concern of supplying lower than analyzed voltage from the 230KV switchyard to the station.

A 230KV switchyard voltage of 219KV is the minimum level analyzed to be adequate to supply all safety-related loads during an Engineered Safeguards (ES) actuation. With the present 27E relay settings of 87.5% of rated bus voltage, the 230KV switchyard could fall below 219KV and not lower the voltage on the low side of the Startup Transformer (CT), 4160V, enough to actuate the relays. Actuation of the relays would open and/or prevent the closing of the E breakers. Due to the possible relay drift of (+/-) 3%. the relay setting could become as low as 84.9% of rated voltage. At this level, the buses are capable of providing a reliable and adequate source of power after a reactor trip, but during an ES actuation (LOCA or main steam line break being the greater concern) the voltage may not be adequate for safety-related 208V motor operated valves (MOV)(e.g., low pressure injection valves, high pressure injection valves, building spray valves, etc.). The safety-related pumps are still available because the motors are designed to start and run at voltages above 80% of rated voltage.

In the above situation, should the operators recognize that the reason for the 208V MOVs not operating is the lowered voltage on the 230KV switchyard, they could take action to align Keowee to supply power. Keowee would already be running since it received a start signal from the ES signal. The operators have the option of opening the E breakers which would allow the Emergency Power Switching Logic to close the Standby (S) breakers and connect the main feeder buses to Keowee via the standby buses.

In case the operators do not immediately recognize the need to find an alternate power source or if the valves become damaged while attempting to open with low voltage, the operators have other options to prevent or mitigate core damage. The most time dependent accident concerning core coverage is the large-break LOCA. For this event, the most important

action is to manually open low pressure injection (LPI) valves LP-17 and LP-18 (only one valve is necessary because a single train is sufficient to cool the core). These valves are on the discharge of the LPI pumps and are the only ones required to be opened for injection flow. On failure of these valves to operate automatically or from the control room (CR), the operators are instructed by the first step of the "Loss of Low Pressure Injection System" procedure to dispatch an operator to manually open the valves.

For a small-break LOCA, more time is available for operator action. The operators could provide two fully operable trains of the High Pressure Injection System by locally opening valves HP-24 and HP-25, and opening valve HP-410 from the CR. Opening HP-410 from the CR is possible because it does not get an ES signal to open and therefore would not become damaged attempting to open during the initial transient. After the attempt to simultaneously load all ES equipment and the associated voltage transient has subsided, voltage would be adequate to operate individual valves.

The building spray valves would not need to operate for peak containment pressure concerns because FSAR Chapter 15.14 shows that even without reactor building cooling the maximum containment pressure (54.6 psig) would not exceed the design pressure of 59.0 psig.

In the past, the 27E relays were set as low as 68% and 77% of rated voltage. At these settings, the switchyard could be lowered enough to degrade the voltage on the low side of the Startup Transformer below 80% of rated voltage without actuating the relays. If an ES actuation were to occur, some 4160V and 600V pumps may not start. It is possible that is such a condition and at such low voltage levels, the operators would recognize the need to immediately align Keowee to provide power before any equipment damage would occur. Because of the severity of the conditions being hypothesized (LOCA or main steam line break, loss of 208 V safety-related valves, loss of safety-related pumps), there is no FSAR analysis that specifically evaluates the consequences of such an accident.

A review of actual data shows that the 230KV switchyard decreased to 207KV on July 29, 1982 for two hours. During this time, Units 1 and 2 had tripped without suffering any adverse post-trip effects. The probability of a LOCA or main steam line break during this and any other two hour period was about 5E-07 which is statistically negligible. Because the events postulated in this safety analysis have never taken place, the health and safety of the public were not affected. There were no

personnel injuries, no releases of radioactive materials, or excessive exposures associated with this event. Corrective actions have been and are being taken to ensure that such a situation will not occur.

ATTACHMENT 1

OCONEE NUCLEAR STATION
Power System