

ACCELERATED DISTRIBUTION DEMONSTRATION SYSTEM

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR: 9006270282 DOC. DATE: 90/06/25 NOTARIZED: NO DOCKET #
 FACIL: 50-400 Shearon Harris Nuclear Power Plant, Unit 1, Carolina 05000400
 AUTH. NAME: AUTHOR AFFILIATION
 HOWE, A.J. Carolina Power & Light Co.
 RICHEY, R.B. Carolina Power & Light Co.
 RECIP. NAME RECIPIENT AFFILIATION

SUBJECT: LER 90-015-00: on 900524, both emergency load sequences
 subj to common mode failure.

DISTRIBUTION CODE: IE22T COPIES RECEIVED: LTR 1 ENCL 1 SIZE: 6 ltr.
 TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

NOTES: Application for permit renewal filed. 05000400

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CP&L

Carolina Power & Light Company

P. O. Box 165 • New Hill, N. C. 27562

R. B. RICHEY
Manager
Harris Nuclear Project

JUN 25 1990

Letter Number: HO-900112 (0)

U.S. Nuclear Regulatory Commission
ATTN: NRC Document Control Desk
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SHEARON HARRIS NUCLEAR POWER PLANT UNIT 1
DOCKET NO. 50-400
LICENSE NO. NPF-63
LICENSEE EVENT REPORT 90-015-00

Gentlemen:

In accordance with Title 10 to the Code of Federal Regulations, the enclosed Licensee Event Report is submitted. This report fulfills the requirement for a written report within thirty (30) days of a reportable occurrence and is in accordance with the format set forth in NUREG-1022, September 1983.

Very truly yours,



R. B. Richey, Manager
Harris Nuclear Project

RBR:gcm

Enclosure

cc: Mr. R. A. Becker (NRR)
Mr. S. D. Ebnetter (NRC - RII)
Mr. J. E. Tedrow (NRC - SHNPP)

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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 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.

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| FACILITY NAME (1) SHEARON HARRIS NUCLEAR POWER PLANT | DOCKET NUMBER (2) 0 5 0 0 0 4 0 1 0 | PAGE (3) 1 OF 0 5 |
|--|---|-----------------------------|

TITLE (4) **BOTH EMERGENCY LOAD SEQUENCERS SUBJECT TO COMMON MODE FAILURE DUE TO IMPROPER APPLICATION OF RELAYS NOT ACCOUNTING FOR DC INDUCTIVE LOAD RATING.**

| 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) |
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| OPERATING MODE (9) 4 | THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11) | | | | | | | | | | | | | | | | | | | | | |
| POWER LEVEL (10) 0 0 0 | 20.402(b) | 20.406(a)(1)(i) | 20.406(a)(1)(ii) | 20.406(a)(1)(iii) | 20.406(a)(1)(iv) | 20.406(a)(1)(v) | 20.406(c) | 60.38(c)(1) | 60.38(c)(2) | 60.73(a)(2)(i) | 60.73(a)(2)(ii) | 60.73(a)(2)(iii) | 60.73(a)(2)(iv) | 60.73(a)(2)(v) | 60.73(a)(2)(vii) | 60.73(a)(2)(viii)(A) | 60.73(a)(2)(viii)(B) | 60.73(a)(2)(ix) | 73.71(b) | 73.71(c) | <input checked="" type="checkbox"/> OTHER (Specify in Abstract below and in Text, NRC Form 366A) | |
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LICENSEE CONTACT FOR THIS LER (12)

| | |
|---|---|
| NAME Andrew J. Howe, Sr. Specialist | TELEPHONE NUMBER |
| | AREA CODE 9 1 9 3 6 2 - 2 7 1 9 |

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 |
|-------|--------|-----------|---------------|---------------------|-------|--------|-----------|--------------|---------------------|
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| SUPPLEMENTAL REPORT EXPECTED (14) | EXPECTED SUBMISSION DATE (15) | MONTH | DAY | YEAR |
| <input type="checkbox"/> YES (If yes, complete EXPECTED SUBMISSION DATE) <input checked="" type="checkbox"/> NO | | | | |

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

On May 24, 1990, with the plant in a scheduled outage conducting repairs on valves inside containment to ensure continuous availability during the summer months, it was concluded that several Agastat microswitch and Potter-Brumfield relay contacts used in the Emergency Load Sequencers would be subjected to excessive inductive loads during certain emergency scenarios. The actual inductive currents were demonstrated by testing to cause early failure of the contacts. An evaluation concluded that the failure of the microswitch contacts could inhibit proper sequencer response to Safety Injection and Loss of Offsite Power signals, if these occurred at different times. The plant declared the sequencers inoperable at 1130 and brought the unit from hot shutdown into cold shutdown at 1738 on May 24.

Further qualification testing of these contacts demonstrated acceptable operation by modifying the circuit to place two contacts in series, reducing the inductive load on each individual contact. The affected circuits were modified and testing was completed on May 29, and the sequencers were then declared operable. The plant was returned to service on May 31.

A deficiency in the sequencer design is the cause of this condition. The contact rating specified by the microswitch manufacturer was exceeded in the design. Other applications of these relays and microswitches in DC safety-related circuits were reviewed, and no other problems were found. This item is considered reportable under 10CFR21.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH 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.

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| FACILITY NAME (1) SHEARON HARRIS NUCLEAR POWER PLANT | DOCKET NUMBER (2) 0 5 0 0 0 4 0 0 | LER NUMBER (6) | | | PAGE (3) | | |
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | | | |
| | | 9 0 | 0 1 5 | 0 0 | 0 2 | OF | 0 5 |

TEXT (If more space is required, use additional NRC Form 366A's) (17)

INITIAL CONDITIONS:

On May 24, 1990, the plant was in hot shutdown conducting a scheduled outage to repair valves inside containment to ensure continuous plant availability during the summer months.

EVENT DESCRIPTION:

On September 11, 1989, relay contact failures occurred in the B train Emergency Load Sequencer during routine testing, resulting in actuation of the B train Emergency Service Water Pump. The cause of the failure was determined to be overloading of the contacts when they open, resulting in eventual damage to the contacts, causing them to remain closed. The contacts were determined to be overloaded due to their application in an inductive DC circuit, and the inductive load experienced in a DC application compared to an AC application had not been accounted for in the circuit design. This event is discussed in LER 89-016-00, and the corrective action for this LER included further evaluation of the sequencer circuits for similar problems.

On November 22, 1989, Ebasco Services, which was the architect/engineer for the plant, and the sequencer designer, completed this evaluation. The report identified a concern for the DC inductive capability of relay contacts used in the sequencer circuits. The relay manufacturer (Potter-Brumfield) did not supply a DC rating since it was not required in the relay specification. Testing of the relays was recommended by Ebasco in their November 22 report to verify the actual DC capability of the contacts. In the affected relays' application in the sequencers, the possible failure effect would not inhibit the sequencer from properly functioning.

Following the plant refueling outage, on January 5, 1990, preparations to conduct the recommended testing of the relay contacts were begun. Due to difficulties encountered in obtaining the particular relay model, actual testing did not begin until May 3. On May 4, the first failure occurred on a relay (Manufacturer: Potter-Brumfield, rotary relay model MDR-138) at 201 cycles, compared with a manufacturer rating of 100,000 cycles. The failure mechanism observed was the melting of the contact tabs into the cam as a result of DC currents in excess of the contact capability. Ebasco and plant personnel were notified of the failure, and redesign of the circuit to correct the overloading condition was initiated. Additional testing was conducted on May 7 to ensure the failure was repeatable and not due to a defective relay. The second relay failed at 124 cycles due to the same failure mechanism.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH 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.

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TEXT (If more space is required, use additional NRC Form 365A's) (17)

EVENT DESCRIPTION: CONTINUED

On May 10, further evaluations by Ebasco identified a new concern involving the DC inductive current rating of microswitches used in the sequencer. The microswitches are mounted on Agastat time delay relays and are used to provide an instantaneous response contact for these relays. The microswitch contact is rated for 0.5 amps at 125 volts DC assuming a resistive load. The testing of the Potter-Brumfield relay contacts had demonstrated that the DC inductive rating should be approximately one half of the resistive rating, which would equate to 0.25 amps for the microswitch contact. The current in the actual application of the microswitch in the sequencer circuit was 0.9 amps, which exceeded both the resistive and inductive capabilities of the contact.

On May 18, during testing on the microswitch contact, sticking was experienced at approximately 75 cycles. At 300 cycles, testing was suspended because the microswitch (Supplier: Agastat, Manufacturer: Microswitch, model 7024PB7) was obviously operating in a degraded mode. The contact response, which is designed for instantaneous operation, exhibited arcing and noticeable time delay in opening. The failure mechanism was the effect of high currents on the contact.

Ebasco analyzed the impacted circuits to determine the potential consequences of failure of the affected contacts to open on demand. On May 24, plant personnel were notified that the sequencers could be subject to a common mode failure by failing to reset the sequencer program. The failure scenarios involved the sequencer response to non-simultaneous Safety Injection and Loss of Offsite Power signals. Under such scenarios, equipment required to mitigate an accident would not be automatically loaded by the sequencer, and the potential for overloading the diesel generators was also identified.

Both sequencers were declared inoperable based on this potential common mode failure. The plant initiated a cooldown to cold shutdown conditions at 1410 on May 24, and cold shutdown was achieved that evening at 1738. (Per Technical Specification 3.3.2, the signals which actuate the sequencers are not required operable in cold shutdown.)

Modifications to the affected circuits in both sequencers were made to eliminate overloading of the microswitch contact. The function provided by the microswitch contact was relocated to another relay using two in series contacts, which reduces the inductive load seen by each contact. The microswitch is no longer used to provide sequencer control, but is used in a low amperage indication circuit.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH 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.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

CAUSE:

The deficiency in the sequencer circuit design, provided by Ebasco, in failing to properly account for DC inductive loading of contacts, existed since plant startup in 1986.

The contacts of the Potter-Brumfield relays do not have a specified DC rating, and testing was not performed prior to their application in the design of the sequencer by Ebasco. As discussed above, previous failures of these contacts has occurred during sequencer testing, and during the special testing conducted on May 4, 1990.

The Agastat relay microswitches were installed in an inductive application where the DC current was 0.9 amps, while the contact rating was only 0.5 amps resistive. The sequencer circuit design failed to consider these ratings in the actual application.

SAFETY SIGNIFICANCE:

There are two failure mechanisms relevant to DC inductive loading of contacts to be considered in evaluating sequencer performance. The first involves the Potter-Brumfield relays in which the tabs of the contact melt into the cam, and the second involves the microswitch contact mounted on the Agastat relays.

No failures in the first case have been identified which would cause the sequencer to be unable to perform its safety function. The relay contacts which open under excessive DC inductive load are required only to close for the sequencer to function, and open only on sequencer reset or testing.

In the second case, the affected contacts are part of the circuit which suspends sequencer operation on one program in response to a subsequent signal to operate a different program. The sequencer is designed to respond by resetting, and then operating the demanded program. There are two possible cases to consider.

(1) If the sequencer was responding to a Safety Injection Signal when a loss of offsite power occurred, the failure would result in the sequencer continuing to operate as if a loss of offsite power had not occurred. When the diesel generator re-energized the bus, the sequencer would not be reset to allow it to restart the loads which would have tripped on the loss of offsite power, and the operator would be required to manually restart the equipment.

(2) If the sequencer was responding to a Loss of Offsite Power Signal when a Safety Injection signal occurred, then the sequencer would operate both programs simultaneously, and the potential for overloading the diesel generator would exist.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 600 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.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

SAFETY SIGNIFICANCE: CONTINUED

Although the microswitches are exercised during sequencer testing, conducted every 62 days, no failures of the installed switches have been observed.

These scenarios involving non-simultaneous offsite power loss and accident initiation, are not addressed in the plant's Final Safety Analysis Report, which assume the loss of offsite power and the accident initiation to occur simultaneously. However, this condition is being reported in accordance with 10 CFR 50.73(a)(2)(v)(D) and 50.73(a)(2)(vi) as a discovery of a design inadequacy which alone could have prevented the fulfillment of the safety function of the sequencers to mitigate the consequences of an accident, under this postulated sequence of events. In addition, this condition is reportable in accordance with 10 CFR 21 because of a misapplication of these relays and microswitches in a vendor supplied component.

Corrective Action:

1. The relay contacts in the sequencer actuation circuits have been redesigned to provide two in series sets of contacts. This configuration was verified by qualification testing to be adequate to withstand the resulting DC inductive loads. This redesigned actuation circuit no longer uses the microswitches mounted on the Agastat relays. This modification was completed on May 29, 1990.
2. An evaluation of similar circuit applications in the sequencers and other safety-related circuits of these relays was completed with no similar deficiencies discovered.

EIIS Codes:

| | |
|------------------------------|----|
| Emergency Load Sequencer | JE |
| Emergency Service Water Pump | BI |



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