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SUBJECT: Provides addl info concerning mod testing & completed failure modes & effects analysis re EDG protection circuitry.

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CP&L

Carolina Power & Light Company
PO Box 165
New Hill NC 27562

William R. Robinson
Vice President
Harris Nuclear Plant

SERIAL: HNP-97-095
10 CFR 50.59(c)
10 CFR 50.90

APR 2 9 1997

United States Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NO. 50-400/LICENSE NO. NPF-63
ADDITIONAL INFORMATION CONCERNING EMERGENCY
DIESEL GENERATOR PROTECTION DURING TESTING

Dear Sir or Madam:

By letter dated April 18, 1997, Carolina Power & Light Company (CP&L) requested NRC review of a proposed modification related to Emergency Diesel Generator (EDG) Protection During Testing for the Harris Nuclear Plant (HNP). In addition, a meeting with the NRC staff was held on April 7, 1997, to discuss the proposed modification to the EDG protection circuitry and formally notify the NRC staff of the unreviewed safety question. In response to NRC staff questions during review of the proposed change, CP&L provides the following additional information concerning modification testing and the completed Failure Modes and Effects Analysis (Enclosure 1).

Initial acceptance testing for the installed modification was previously discussed in the April 18, 1997 letter; however, the following additional description is provided. Acceptance testing on the "A" train will consist of verifying that the loss of offsite power (LOOP) logic, Breakers 101 AND 102 OPEN or Breaker 101 OPEN AND either main generator lockout, will result in CR1/1748 contact closure. Once the modification is installed, CR1/1748 relay (which will have been previously demonstrated to function as designed) will be actuated to verify that the installed circuitry functions as designed up to and including trip signals to the Emergency Diesel Generator (EDG) output Breaker 106 and the non-safety bus to Engineered Safety Feature (ESF) bus tie Breaker 105. Similar acceptance testing of the "B" train will verify design functions for the corresponding "B" train circuitry.

The following is a description of integrated testing to be performed in the future. An integrated test of the LOOP logic will be performed every other refueling outage on each train. This test will include simulating a loss of offsite power to verify the circuitry functions as designed up to and including trip signals to the EDG output breaker and the non-safety bus to ESF bus tie breaker.

A001

As described in the enclosed Failure Modes and Effects Analysis, if the EDG protection circuitry added by the proposed modification does not function as designed, operator actions are available as a backup. Operating Procedure OP-155, "Diesel Generator Emergency Power System" will be revised to describe the required backup operator actions. In addition, operator training for these backup operator actions will be conducted. The following precaution (or similar wording) will be added to OP-155:

> "If a loss of offsite power (LOOP) occurs while an EDG is paralleled to the grid, breakers 105 (125) and 106 (126) should automatically trip open, which will leave the diesel running unloaded. Breaker 106 (126) should then automatically reclose and the sequencer start to load. If breaker 106 (126) fails to open, operator action is required to manually open the breaker.
>
> The LOOP signal to open breakers 105 (125) and 106 (126) is generated by:
>
> - Both breakers 101 (121) and 102 (122) open,
>
> OR
>
> - Breaker 101 (121) open and either main generator lockout tripped
>
> Indications that this circuit has actuated properly include proper sequencer operation, or indication that the EDG is running in the emergency mode.
>
> If these conditions occur while the EDG is paralleled to the grid, and breaker 106 (126) fails to open, (i.e., no indication of proper actuation as described above exists), the breaker must be manually tripped from the Main Control Board (MCB) or, if control is transferred to the local Generator Control Panel (GCP), from the GCP. Since occurrence of a LOOP may not be obvious at the GCP, action to trip Breaker 106 (126) from the GCP must be directed from the Main Control Room."

This additional information supplements the April 18, 1997 submittal and does not change the conclusions of the previously submitted No Significant Hazards Evaluation or Environmental Considerations discussions.

Please refer any questions regarding this submittal to Ms. D. B. Alexander at (919) 362-3190.

Sincerely,

W. R. Robinson

W. R. Robinson

JHE/jhe
Enclosure

W. R. Robinson, having been first duly sworn, did depose and say that the information contained herein is true and correct to the best of his information, knowledge and belief; and the sources of his information are employees, contractors, and agents of Carolina Power & Light Company.

Lisa M. Randall
Notary (Seal)

My commission expires: 6-7-98

LISA RANDALL NOTARY PUBLIC WAKE COUNTY, N.C.

c: Mr. J. B. Brady, NRC Sr. Resident Inspector
Mr. Mel Fry, N.C. DEHNR
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ENCLOSURE TO SERIAL: HNP-97-095

ENCLOSURE 1

SHEARON HARRIS NUCLEAR POWER PLANT
NRC DOCKET NO. 50-400/LICENSE NO. NPF-63
EMERGENCY DIESEL GENERATOR PROTECTION DURING TESTING

FAILURE MODES AND EFFECTS ANALYSIS

Failure Modes and Effect Analysis

This Failure Modes and Effects Analysis (FMEA) per EGR-NGGC-0154 examined the credible ways in which components used or affected by the implementation of ESR 97-00005, EDG Protection During Load Test, can fail, the effect of those failures on the Safety Bus and the EDG, and the mitigating functions or actions in place or planned. The questions examined include:

1. Which components are to be analyzed?
2. What are the critical functions of these components?
3. What are the component failure modes?
4. What mechanisms might produce these modes of failure?
5. What are the effects of the failures on the Safety Bus and EDG?
6. Is the failure in the safe or unsafe direction?
7. What mitigating functions or actions are in place to compensate for the failures?

The key rules and assumptions made for this FMEA are:

- One EDG is in test and paralleled to offsite power with the other EDG operable and in standby (excluding Modes 5 and 6 where only one EDG is required to be operable).
- EDGs A and B are not paralleled to offsite power concurrently.
- Cascading failures resulting from the effects of a single failure are considered as a single failure.
- The effects of failures with and without offsite power available are addressed.
- Critical operator error upon a loss of offsite power and failure of the LOOP detection relay logic is considered as a failure mode.
- Non-1E circuit failures are assumed to occur in addition to a single failure of Safety Related equipment.
- Safety Injection signal logic is outside of the scope of this analysis.
- Station Blackout procedures are outside of the scope of this analysis.

FMEA Conclusion:

In a LOOP scenario (without LOCA) occurring while one EDG is paralleled to offsite power for testing, a single failure of the other train EDG could result in a Station Blackout if a failure in the LOOP detection relay logic (portions of which are Non-1E) and critical operator error both occur.

Since Non-1E circuitry and operator action are not currently credited for safety bus integrity upon a loss of offsite power event, the analyzed sequence of events and equipment failures does not meet the single failure criterion. However, the LOOP detection relay logic is considered to be reliable, will be subjected to periodic testing, and provides the best method of protection for the EDG and Safety Bus while paralleled to offsite power for testing. The current design is based upon assumptions (i.e. EDG overload on a LOOP) which have proved to be invalid.

In addition, the EDG will only be paralleled to offsite power for short periods of time during testing and will not be paralleled to offsite power during expected adverse weather conditions. If the EDG output breaker for the division in test does not automatically trip due to the LOOP detection relay logic upon loss of offsite power, operator action will be taken to trip the breaker. The EDG output breaker can be operated from the main control room or, if control is transferred to the EDG local control panel, from the EDG local control panel. These compensatory measures provide reasonable assurance that electrical power will be made available to one of the redundant safety buses in a timely manner following a LOOP coincident with EDG testing in parallel with offsite power, should a single failure of safety related equipment also occur.

FMEA TABLE

No.	Component ID (Train-A)	Function	Failure Mode	Credible Failure Mechanisms	Effect on Safety Bus and EDG	Mitigating Functions / Actions in Place
1	(See Figure 2) Loop detection relay - CR1/1748	(See Figure 1) Actuates on Bkr 101 & 102 open or 101 open and either Main Generator Lockout (86G1A or 86G1B) tripped.	Critical relay contact fails to close in response to a LOOP (EDG in test and paralleled to offsite power)	Loss of non-1E uninterruptible power to relay coil circuit. Open circuit in relay coil. Failure of relay contact to close upon relay actuation.	Breaker 105 and / or Breaker 106 do not trip from LOOP relay logic as designed. This results in the EDG picking up the loads from buses 1A-SA and 1D also preventing a UV trip of Bkr 104. If sufficient loading exists, overload of the EDG will occur (51V relay may actuate and trip Bkr 106 if loading is severe). If sufficient load does not exist to overload the EDG then the EDG would continue to power both buses and automatic actuation of the sequencer would not occur. **This failure is in the unsafe direction.**	If Bkr 106 does not automatically trip due to the LOOP relay logic upon loss of offsite power, operator action will be taken to trip Bkr 106. (The breaker can be operated from the main control room or, if control is transferred to the EDG local control panel, from the EDG local control panel.) When Bkr 106 opens, a UV on Bus 1A-SA will trip Bkr 105 and a UV on Bus 1D trips Bkr 104. A Trip for Bkr 105 would also be generated from CR1/1727 when Bkr 104 opens. If the manual trip of Bkr 106 is accomplished before significant EDG overload occurs then the engine can be expected to remain running and automatic reclosing of Bkr 106 and loading by the sequencer will take place. Due to the loads typically present on the buses during EDG load testing it is expected that the EDG will not be severely overloaded during this event scenario.
2	(See Figure 2) Loop detection relay - CR1/1748	(See Figure 1) Actuates on Bkr 101 & 102 open or 101 open and either Main Generator Lockout (86G1A or 86G1B) tripped.	False actuation of relay (EDG in test and paralleled to offsite power)	Short circuit across relay contact. Short circuit that causes relay coil to actuate.	Breaker 105 and 106 trip while EDG in test and paralleled to offsite power. The load reject on the EDG is within specifications and the engine continues to run. Breaker 105 can not be reclosed if the condition does not clear. Power is momentarily lost to bus 1A-SA until Bkr 106 automatically recloses and the sequencer actuates. **This failure is in the safe direction.**	(See Figure 3) The Bkr 106 trip results in reset of the SM/SA EDG in test relay contact and a loss of power to bus 1A-SA which in turn causes automatic reclosure of Bkr 106 after 1.5 seconds and automatic actuation of the sequencer. Safety bus loads can be powered from the EDG until the problem is resolved and offsite power restored to bus 1A-SA. No actual LOOP exists so the other safety bus is not effected.

FMEA TABLE

No.	Component ID (Train-A)	Function	Failure Mode	Credible Failure Mechanisms	Effect on Safety Bus and EDG	Mitigating Functions / Actions in Place
3	(See Figure 2) Loop detection relay - CR1/1748	(See Figure 1) Actuates on Bkr 101 & 102 open or 101 open and either Main Generator Lockout (86G1A or 86G1B) tripped.	Critical relay contact fails to close in response to a LOOP (EDG in standby)	Loss of non-1E uninterruptible power to relay coil circuit. Open circuit in relay coil. Failure of relay contact to close upon relay actuation.	Breaker 104 trips due to UV on Bus 1D, Breaker 105 trips from 1A-SA UV and Bkr 104 open logic and Bkr 106 is already open. Power to bus 1A-SA is lost due to loss of offsite power and because the EDG is not operating. Bus 1A-SA UV results in auto start of EDG, auto closure of Bkr 106, and sequencer actuation. **This failure is in the safe direction.**	86UV/SA energizes on LOOP. 1A-SA loads are shed. Bkr 106 closes once EDG is ready to load. Sequencer commences with LOOP program loading. Safety bus responds normally to the LOOP.
4	(See Figure 2) Loop detection relay - CR1/1748	(See Figure 1) Actuates on Bkr 101 & 102 open or 101 open and either Main Generator Lockout (86G1A or 86G1B) tripped.	False actuation of relay (EDG in standby)	Short circuit across relay contact. Short circuit that causes relay coil to actuate.	Breaker 105 trips and Bkr 106 is already open. Power to bus 1A-SA is lost due to tripping of Bkr 105 and because the EDG is not operating. Bus 1A-SA UV results in auto start of EDG, auto closure of Bkr 106, and sequencer actuation. Breaker 105 cannot be reclosed if the condition does not clear. **This failure is in the safe direction.**	86UV/SA energizes on Bkr 105 trip. 1A-SA loads are shed. Bkr 106 closes once EDG is ready to load. Sequencer commences with LOOP program loading. Safety bus loads can be powered from the EDG until the problem is resolved and offsite power restored to bus 1A-SA. No actual LOOP exists so the other safety bus is not effected.

FMEA TABLE

No.	Component ID (Train-A)	Function	Failure Mode	Credible Failure Mechanisms	Effect on Safety Bus and EDG	Mitigating Functions / Actions in Place
5	(See Figure 2) CR2/1727	(See Figure 2 & 3) Actuates on closure of contact 10-11 of relay CR1/1748. Trips breaker 105, picks up CR2/1702 to trip Bkr 106 if EDG is in test.	Critical relay contacts fail to close in response to a LOOP (EDG in test and paralleled to offsite power)	Loss of power to relay circuit. Open circuit in relay coil. Failure of relay contact to close upon relay actuation. Failure of CR1/1748 to actuate.	**Same as item No. 1 if both Bkr 105 and 106 fail to trip.** Bkr 105 and Bkr 106 trip circuits are controlled by two separate sets of contacts from CR2/1727. If Bkr 106 tripped and Bkr 105 didn't, power would be lost to Bus 1A-SA because of the LOOP and Bkr 106 trip. The EDG would continue to run. The Bkr 106 trip would reset the EDG in test SM/SA relay contact and actuate a UV on bus 1A-SA and 1D. The UV on bus 1D would trip Bkr 104, which inturn trips Bkr 105. Bkr 106 would automatically reclose after 1.5 seconds, and the sequencer would actuate. If Bkr 105 tripped and 106 didn't, the load from bus 1D would be shed from the EDG and it would continue to run supplying power to bus 1A-SA, however, the sequencer would not actuate as required in response to the LOOP. **This failure is in the unsafe direction unless Bkr 106 trips as described.**	**Same as item No. 1 if both Bkr 105 and 106 fail to trip.** If Bkr 106 trips, a normal LOOP response would occur. If Bkr 105 trips and Bkr 106 doesn't, bus 1A-SA would not respond to the LOOP but would remain powered by the EDG. Operator action is required to trip Bkr 106 in order for the sequencer to detect a loss of offsite power.

FMEA TABLE

No.	Component ID (Train-A)	Function	Failure Mode	Credible Failure Mechanisms	Effect on Safety Bus and EDG	Mitigating Functions / Actions in Place
6	(See Figure 2) CR2/1727	(See Figure 2 & 3) Actuates on closure of contact 10-11 of relay CR1/1748. Trips breaker 105, picks up CR2/1702 to trip Bkr 106 if EDG is in test.	False actuation of relay (EDG in test and paralleled to offsite power)	Short circuit across relay contact. Short circuit that causes relay coil to actuate.	Same as item No. 2 Breaker 105 and 106 trip while EDG in test and paralleled to offsite power. The EDG continues to run. Breaker 105 cannot be reclosed if the condition does not clear. Power is momentarily lost to bus 1A-SA until Bkr 106 automatically recloses and the sequencer actuates. This failure is in the safe direction.	Same as item No. 2 (See Figure 3) The Bkr 106 trip results in reset of the SM/SA EDG in test relay contact and a loss of power to bus 1A-SA which in turn causes automatic reclosure of Bkr 106 after 1.5 seconds and automatic actuation of the sequencer. Safety bus loads can be powered from the EDG until the problem is resolved and offsite power restored to bus 1A-SA. No actual LOOP exists so the other safety bus is not effected.
7	(See Figure 2) CR2/1727	(See Figure 2 & 3) Actuates on closure of contact 10-11 of relay CR1/1748. Trips breaker 105, picks up CR2/1702 to trip Bkr 106 if EDG is in test.	Relay fails to actuate or critical relay contacts fail to close in response to a LOOP(EDG in standby).	Loss of power to relay circuit. Open circuit in relay coil. Failure of relay contact to close upon relay actuation. Failure of CR1/1748 to actuate.	Same as item 3. Breaker 104 trips due to UV on Bus 1D. Breaker 105 trips from 1A-SA UV and Bkr 104 open logic. Bkr 106 is already open. Power to bus 1A-SA is lost due to loss of offsite power and because the EDG is not operating. Bus 1A-SA UV results in auto start of EDG, auto closure of Bkr 106, and sequencer actuation. This failure is in the safe direction.	Same as item 3. 86UV/SA energizes on LOOP. 1A-SA loads are shed. Bkr 106 closes once EDG is ready to load. Sequencer commences with LOOP program loading. Safety bus responds normally to the LOOP.

FMEA TABLE

No.	Component ID (Train-A)	Function	Failure Mode	Credible Failure Mechanisms	Effect on Safety Bus and EDG	Mitigating Functions / Actions in Place
8	(See Figure 2) CR2/1727	(See Figure 2 & 3) Actuates on closure of contact 10-11 of relay CR1/1748. Trips breaker 105, picks up CR2/1702 to trip Bkr 106 if EDG is in test.	False actuation of relay (EDG in standby)	Short circuit across relay contact. Short circuit that causes relay coil to actuate.	Same as item No. 4 Breaker 105 trips and Bkr 106 is already open. Power to bus 1A-SA is lost due to tripping of Bkr 105 and because the EDG is not operating. Bus 1A-SA UV results in auto start of EDG, auto closure of Bkr 106, and sequencer actuation. Breaker 105 can not be reclosed if the condition does not clear. **This failure is in the safe direction.**	Same as item No. 4 86UV/SA energizes due to Bkr 105 trip. 1A-SA loads are shed. Bkr 106 closes once EDG is ready to load. Sequencer commences with LOOP program loading. Safety bus loads can be powered from the EDG until the problem is resolved and offsite power restored to bus 1A-SA. No actual LOOP exists so the other safety bus is not effected.
9	(See Figure 3) SM/SA	Permissive for 86UVX, K601 (SIS) or CR2/1727 (LOOP) to trip Bkr 106 when EDG is in test.	Relay fails to actuate when EDG is placed in test and paralleled to offsite power (EDG in test and paralleled to offsite power)	Loss of power to relay circuit. Open circuit in relay coil. Failure of relay contact to close upon relay actuation.	With EDG in test, Bkr 106 would not trip from LOOP, UV or SI. Bkr 105 trips. EDG continues to carry safety bus loads, however, the sequencer does not actuate as required. This failure mode existed prior to the modification under consideration and remains unchanged. **This failure is in the unsafe direction.**	Operator trips Bkr 106 per procedure and 86UV/SA energizes. 1A-SA loads are shed. Bkr 106 closes once EDG is ready to load. Sequencer commences with LOOP program loading. Under present design, Operator could not trip Bkr 106.
10	(See Figure 3) SM/SA	Permissive for 86UVX, K601 (SIS) or CR2/1727 (LOOP) to trip Bkr 106 when EDG in test.	False actuation of relay (EDG in standby)	Short circuit across relay contact. Short circuit that causes relay coil to actuate.	Bkr 106 is already open. If the condition fails to clear and the EDG starts on 86UV/SA, LOOP, or SI Bkr 106 will not stay closed when automatically closed. This will prevent one train of safety bus power from being available. This failure mode existed prior to the modification under consideration and remains unchanged. **This failure is in the unsafe direction.**	Opposite train EDG functions as designed.

FMEA TABLE

No.	Component ID (Train-A)	Function	Failure Mode	Credible Failure Mechanisms	Effect on Safety Bus and EDG	Mitigating Functions / Actions in Place
11	Bus UPP-1A	Provides 120VAC power to relay coil for CR1/1748 and CR3/1748	Loss of power to Bus UPP-1A	Electrical fault on Bus UPP-1A or spurious opening of feeder breaker to bus	CR1/1748 and CR3/1748 will not actuate; therefore, opening of Breaker 101 and 102 or 101 and either main generator lockout will not be detected. Breaker 105 and 106 will not open with the EDG in test and paralleled to grid. Breaker 105 would not trip from 1748 relay whether EDG in test or standby. **This failure is in the unsafe direction.**	Administrative controls are in place to ensure that only one EDG is in test at any given time. Loss of power to the CR1/1748 and CR3/1748 relay affects Breaker 106/126 logic only when EDG in test. (Trip is enabled by SM relay contact). Trip of Breaker 105 from the 1748 relay is not a credited trip. Credited trip of Breaker 105 is from the 86UV relay. UPP-1A is fed from a UPS (60 kVA inverter). Administrative control will be in place to ensure the inverter is fed from its normal source prior to placing EDG in test.
12	Operator	Immediately trip Bkr 106 if it fails to automatically trip due to the LOOP detection relay logic upon loss of offsite power.	Fails to trip Bkr 106 as required by procedure for unforeseen reasons.	Operator Error	EDG picks up the loads from buses 1A-SA and 1D also preventing a UV trip of Bkr 104. If sufficient loading exists, overload of the EDG will occur (51V relay may actuate and trip Bkr 106 if loading is severe). If sufficient load does not exist to overload the EDG then the EDG would continue to power both buses and automatic actuation of the sequencer would not occur. **This failure is in the unsafe direction.**	Opposite train EDG functions as designed.

EDS One-Line (Train-A)

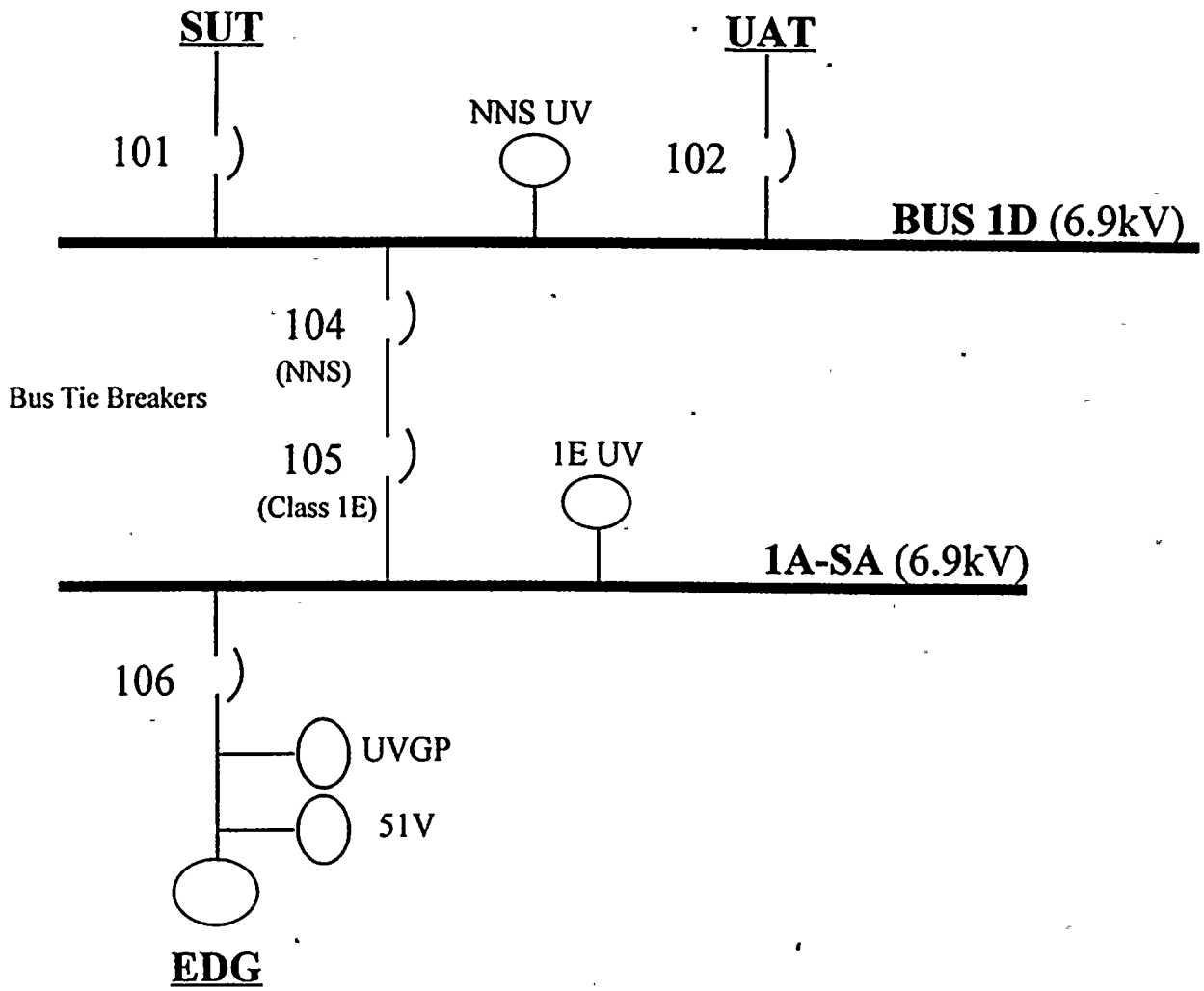

Figure 1

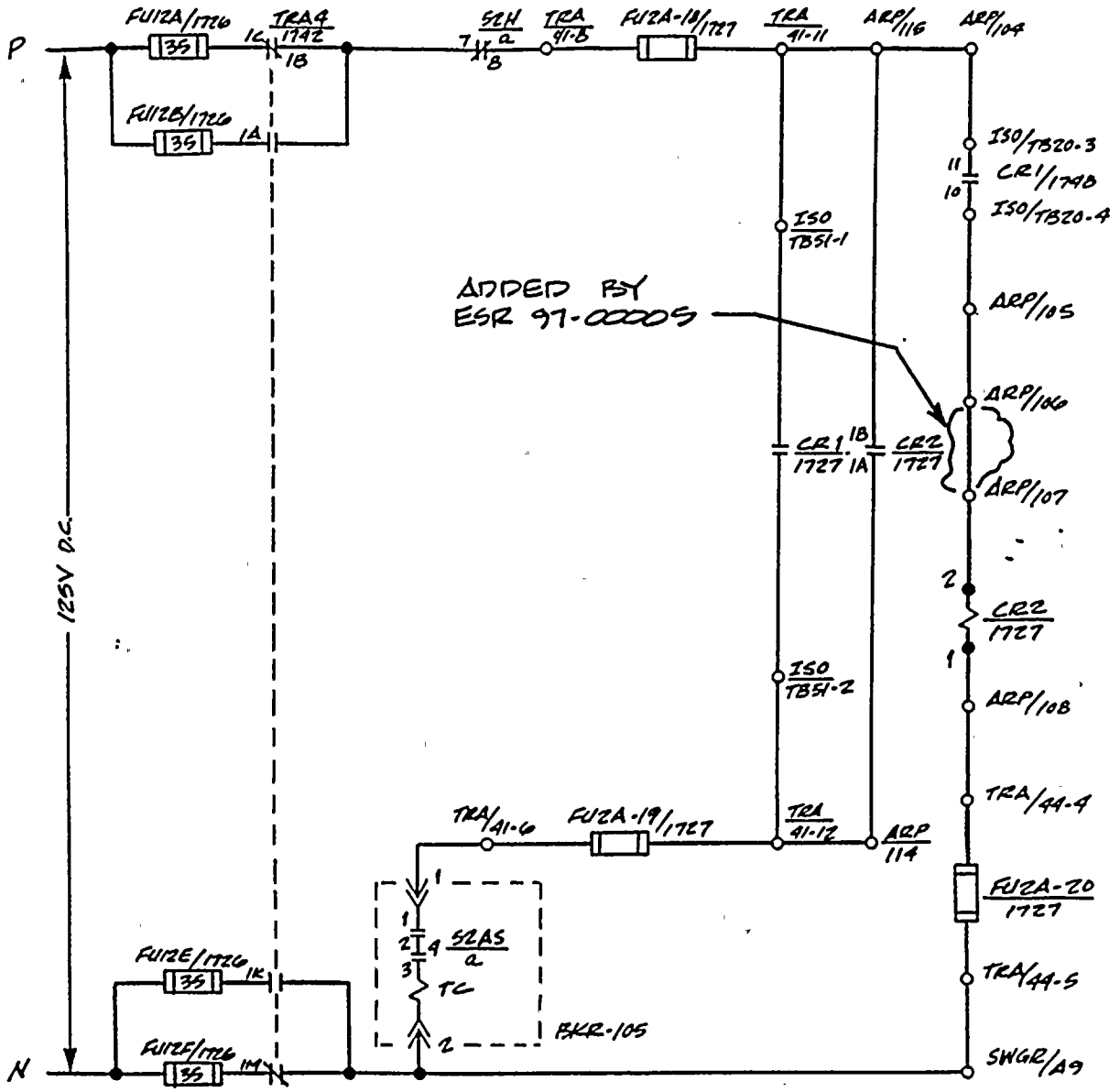

FIGURE # 2
BREAKER # 105
(MODIFIED BREAKER CIRCUIT BY ESR 97-00005)

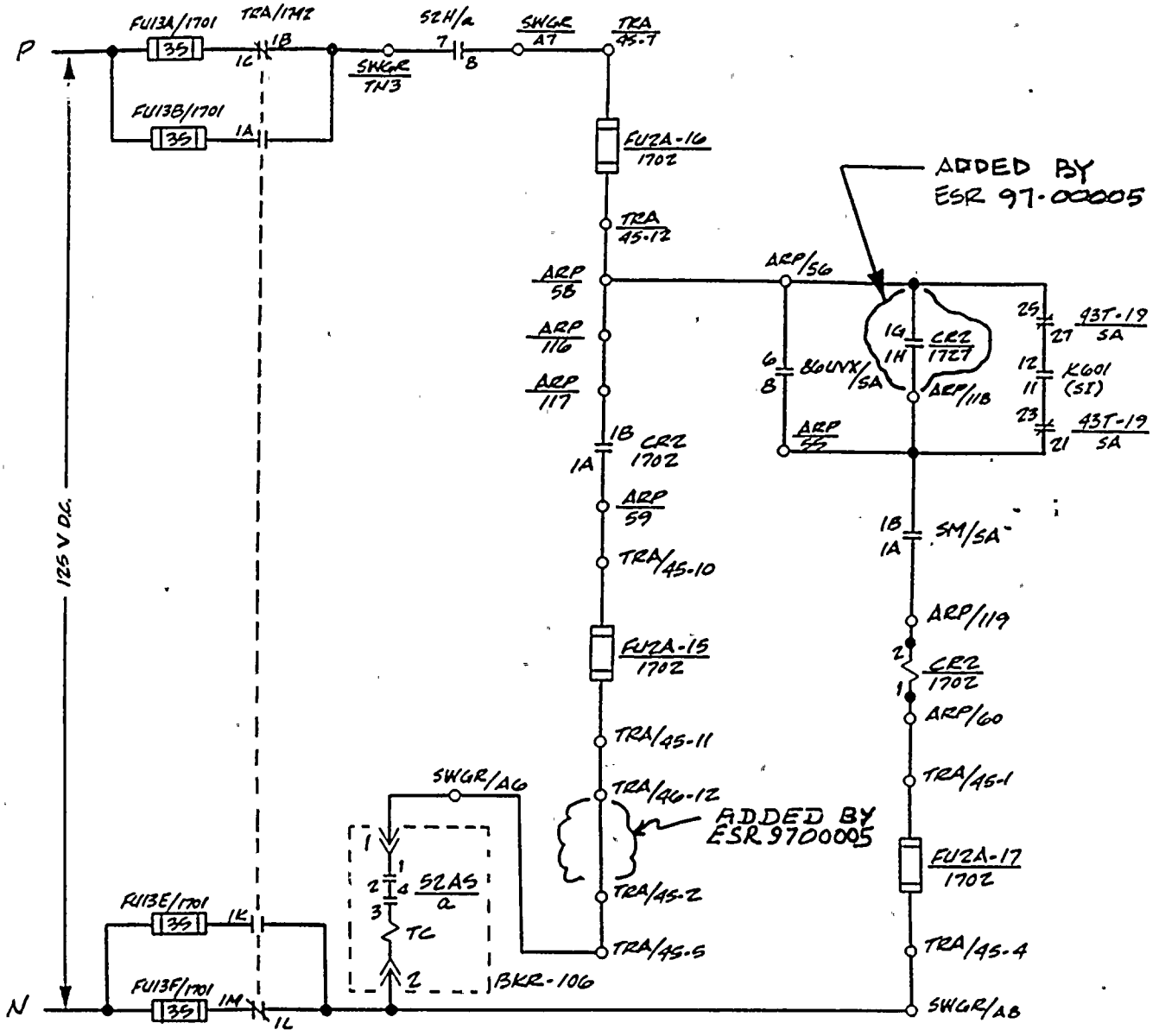

FIGURE 3:
BREAKER # 106
(MODIFIED BREAKER CIRCUIT BY ESR 97-00005)