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New York Power Authority

John C. Brons
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June 10 1988
JPN-88-030

U. S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, D.C. 20555

ATTN: Document Control Desk

Subject: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
Anticipated Transient Without Scram (ATWS) Rule

References:
1. NRC letter, H. I. Abelson to J. C. Brons, dated January 8, 1987.
2. NYPA letter, J. C. Brons to NRC dated April 15, 1987, (JPN-87-020).
3. NRC letter, H. I. Abelson to J. C. Brons, dated March 18, 1988.
4. BWROG letter, R.F. Janecek to J. C. Baha (NRC), dated June 12, 1987, (BWROG-8727).

Dear Sir:

Reference 1 requested information concerning the FitzPatrick alternate rod insertion (ARI) and recirculation pump trip (RPT) designs. The Authority provided ARI and RPT information in Reference 2. In Reference 3, the NRC identified additional information needed to complete the Staff's review of the RPT and ARI system. This information is provided in Attachment I.

The FitzPatrick plant uses Rosemount 510 DU analog trip units for the ARI System. These are the same type and model as the units used for the reactor protection system (RPS). The ARI and RPS are completely separate systems and comply with the ATWS Rule concerning diversity. The staff has raised questions concerning components of common type and manufacture used in these systems. It is the Authority's position that the ARI System design meets the diversity requirement of the ATWS rule and is consistent with the Boiling Water Reactors Owners Group licensing topical report approved by the NRC staff. The Authority plans installation of the ARI system in the Reload 8/Cycle 9 refueling outage (currently scheduled to begin August 27, 1988). If the ARI System design is considered unacceptable,

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with regard to diversity, an extension of at least one additional cycle to complete this modification will be required. Reply concerning this issue is requested by July 1, 1988.

The NRC requested that the Authority either demonstrate that the FitzPatrick RPT design is as reliable as approved designs or upgrade the design. Attachment II provides reliability assessments of the FitzPatrick and proposed designs. This attachment shows that:

- The single trip coil and its trip mechanism contribute very little to RPT unavailability. Therefore, installing redundant trip coils would not improve reliability significantly.

- Based upon JAF historical breaker failure data and breaker-failure data developed by EG&G from the licensee event report database, the existing JAF design is more reliable than the proposed designs utilizing two trip coils.

Based on these analyses, and pending resolution of the issue, no modifications to the FitzPatrick RPT system are planned.

The Authority has endorsed the Boiling Water Reactor Owners' Group (BWROG) position that the redundant trip coils in each recirculation system motor generator set field breaker are not required to comply with the ATWS Rule. Reference 3 stated that the NRC has not received a submittal from the BWROG concerning the RPT issue. The BWROG submitted the "GE Licensing Topical Reports NEDE-31096-P-A and NEDE-31096-A, Anticipated Transients without Scram Response to NRC ATWS Rule 10 CFR 50.62, dated February 1987" on June 12, 1987 (Reference 4).

Should you or your staff have any questions regarding this matter, please contact Mr. J. A. Gray, Jr. of my staff.

Very truly yours,

John C. Brons
Executive Vice President
Nuclear Generation

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ATTACHMENT I

New York Power Authority
James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333

RESPONSE TO USNRC MARCH 18, 1988 REQUEST FOR ADDITIONAL INFORMATION CONCERNING ALTERNATE ROD INSERTION

NRC Question 1:

"Provide electrical functional diagrams for the ARI and RPT systems from sensors to the final actuated devices. Is the ARI system separate from the existing RPT system? Is any portion common to both systems?"

NYPA Response 1:

The attached logic diagrams (11825-LSK-28-6.1D, E&F) and the corresponding elementary diagrams (11825-ESK-7FA through 7FF) depict the ARI system. Elementary diagrams 11825-1.60-20, 11825-1.60-21, 11825-1.60-23, 11825-1.60-24, 11825-ESK-5C and 11825-ESK-5F depict the ATWS RPT system from sensors to final actuating devices.

Also attached are the following Analog Transmitter Trip System loop diagrams showing the originating sensor.

LP-023-2A	Rev. 3A
LP-023-2C	Rev. 3A
LP-023-2C	Rev. 3B
LP-023-2B	Rev. 3A
LP-023-2D	Rev. 3A
LP-023-2D	Rev. 3B
LP-023-3C	Rev. 3A
LP-023-3A	Rev. 3A
LP-023-3A	Rev. 4A
LP-023-3B	Rev. 3B
LP-023-3D	Rev. 3B
LP-023-3B	Rev. 4A

The ARI System and the existing RPT System use the same initiating signals for actuation. These signals originate in the Analog Transmitter Trip System (ATTS) slave relays for reactor vessel low low water level (Level 2) trip and reactor vessel high pressure trip. These signals energize output relays in the Emergency Core Cooling System (ECCS) Division I ATTS Cabinet 09-95 and output relays in ECCS Division II ATTS Cabinet 09-96.

The following equipment is common to both systems:

A. Transmitters:

02-3LT-72A, B, C & D
02-3PT-102A, B, C & D

B. ATTS Trip Units:

02-3-272A, B, C & D
02-3-273A, B, C & D
02-3-202A, B, C & D

C. ECCS Output Relays:

02-3A-K102A, B
02-3A-K105A, B
02-3A-K109A, B
02-3A-K110A, B

NRC Question 2:

"Provide the analysis results and test plans which verify that the ARI system design meets the requirements for timely completion. Also identify the ARI reset capabilities including the time delay to ensure ARI function has completed its operation."

NYPA Response 2:

As required to meet plant licensing commitments, control rod insertion motion begins within 15 seconds after ARI system actuation, and all rods are inserted within 25 seconds after actuation. Once initiated, the actuation signal is electrically "sealed-in" for 25 seconds to assure full control rod insertion regardless of other plant conditions. After 25 seconds the plant operators may manually "reset" the ARI system if warranted by plant conditions.

The analysis results show that all sections of the pilot valve header depressurize below 16 psig (the pressure at which the hydraulic control unit inlet and outlet valves move into wide open position and control rod motion begins) in less than 1.5 seconds, and that the complete system depressurizes to 0 psig in approximately 4 seconds. It also shows that the maximum time differential between the east and west banks' depressurization is approximately 0.2 seconds.

The air header depressurization test acceptance criterion is that the pilot air header's most remote point should depressurize below 16 psig in less than 15 seconds. This will be verified by monitoring and recording the pilot air header pressure versus time in nine (9) selected locations as the ARI system is actuated and the pilot air header depressurizes through the newly installed ARI valves during the preoperational test.

Upon depressurizing the air header below 16 psig, the control rods are fully inserted into the reactor vessel in less than 7 seconds. This ensures that maximum total time for complete control rod insertion after actuation of the ARI System is 22 seconds. This is less than the 25 seconds required to meet the plant licensing commitments.

NRC Question 3:

"Describe the ARI system manual initiation capabilities and the means provided to protect the system from inadvertent operation."

NYPA Response 3:

The ARI system can be manually initiated by a manual control switch provided on panel 09-5 in the Control Room.

The potential for inadvertent operation is limited by the spring return design of the control switch and the human factored engineered arrangement of the ARI indication and control devices in Control Room Panel 09-5 which are in accordance with the requirements of NUREG-0700, Sections 6.4 and 6.5. The control switch is located adjacent to the ARI System reset push button and indicating lights for the ARI valves. This location of the control switch further reduces the potential for inadvertent operation of this system.

NRC Question 4:

"Identify the ARI/RPT information readout and indications provided in the Control Room. Will the ARI valve have a positive position indication?"

NYPA Response 4:

ARI valve position indicating lights are provided on the ARI logic panel in the relay room as well as on panel 09-5 in the Control Room. An ARI test light is also located on panel 09-5 which lights up when the test switch on the ARI logic panel is placed in the test position. These lights provide the Control Room operators with an indication of the status of the ARI system.

As part of the ARI system addition, a scram valve pilot air header pressure transmitter was added. This transmitter provides scram header air pressure indication on panel 09-5 in the Control Room. The indicator is adjacent to the ARI control switch and valve status lights. The ARI valves have position limit switches (used to operate the position indicating lights) magnetically coupled to the valve stem. This design provides positive indication of valve operation. Reactor water recirculation M-G drive motor breaker position lights are provided on panel 09-4 in the Control Room. Also the following alarms are provided on panel 09-4 in the Control Room:

"Recirc A Hi Pressure Lo Level Trip."
"Recirc B Hi Pressure Lo Level Trip."

NRC Question 5:

"Identify the interface between the ARI system and the safety related systems. Describe the Class 1E isolators which are used for this interface."

NYPA Response 5:

Normally open contacts of the ATTS relays are wired to the coils of the new ARI isolation relays in the new ARI isolation panels. These isolation relays provide electrical separation between the electrical class 1E ATTS and the non-class 1E ARI system. These ETRD002, 125 VDC are relays manufactured by Agastat. These relays will be type qualified to the requirements of Appendix B of Reference 1.

NRC Question 6:

"Describe the system design which permits maintenance and the test of the system logic while the plant is in power operation."

NYPA Response 6:

The logic up to the ARI valve actuating relay is testable during plant operation. The design permits maintenance, repairs and test of system logic and instrumentation up to, but not including, this relay. Each individual level and pressure instrument is testable during plant operation without initiating the ARI system, since two pressure or level signals must be present to complete the signal path. To test the ARI circuitry, the test switch on the ARI logic/test panel located in the relay room is placed in the test position. This electrically isolates the ARI system actuating relay, enables the four ARI test lights on the panel so that all illuminate, and lights up the ARI test light on Control Room panel 09-5. To test level channel A, the slave relay in ATTS cabinet 09-95 is energized, closing the level A input contacts. If the circuitry is working correctly, the Channel A/C Level light will go out and the Channel B/D Level light will double in brightness. The two pressure test lights will not change in brightness. If the level Channel C slave relay is energized, the results should be exactly the same. Likewise, if a level Channel B or D slave relay is energized, the Channel B/D Level light should go out and the Channel A/C level light double in brightness. The pressure circuitry is tested in the same way.

NRC Question 7:

"Describe the power source arrangement for the ARI and RPT systems, and the capability to function during the loss-of-offsite-power event."

NYPA Response 7:

ARI system controls, instrumentation and solenoid valves are powered from DC power, independent of RPS power. This power source allows the ARI system to perform its function during loss of offsite power.

RPT breakers are powered from the plant 125 VDC system. The 125 VDC controls Power System is designed in accordance with criteria for class 1E electric systems. It supplies power to all DC loads for normal operating conditions and for safe shutdown of the plant following abnormal operating transients and postulated accidents, including loss of offsite power.

References

1. NRC letter, H. I. Abelson to J. C. Brons, dated January 8, 1987.

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ATTACHMENT II

New York Power Authority
James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333

JAMES A FITZPATRICK NUCLEAR POWER PLANT
RELIABILITY ASSESSMENT OF THE EXISTING & PROPOSED ATWS RECIRCULATION PUMP TRIP DESIGNS

1. SUMMARY

This report evaluates of the existing Anticipated Transient Without Scram (ATWS) Recirculation Pump Trip (RPT) single trip coil design and the proposed redundant trip coil design at the James A. Fitzpatrick Nuclear Power Plant (JAF). This evaluation was prompted by Carolina Power & Light Company (CP&L) submitting their Probabilistic Risk Assessment (PRA) analysis to the NRC to demonstrate that their RPT single trip coil design at the Brunswick Steam Electric Plant (BSEP) Units 1 and 2 complies with the requirements of 10CFR50.62. Furthermore, the BSEP analysis demonstrates that the NRC-endorsed redundant trip coils used in the Monticello RPT design do not appreciably improve reliability.

This evaluation entailed:

1) Reviewing the history file of maintenance work request data for any evidence of failure in the existing JAF RPT single trip coil design.

2) Performing fault tree analyses, using a) WASH-1400/IEEE-500 component failure data, and b) specific breaker failure data from the LER data search conducted by EG&G, to determine the causes and probability of a loss of function of the existing and proposed JAF ATWS RPT designs.

3) Comparing the existing JAF RPT fault tree analysis results with results of the proposed JAF RPT and the Monticello redundant trip coils; assessing the adequacy of the existing JAF ATWS RPT design; and demonstrating that the redundant trip coil design does not appreciably improve reliability.

The conclusions reached in this evaluation are:

1) There were no failures for the recirculation pump 4.16 kV motor generator feeder breakers and motor generator field breakers in the equipment history file over the last 14 years. However, one failure had occurred on the main generator field breaker, which is GE Model No. AKF-2-25. This main generator field breaker is the same model as the recirculation pump motor generator field breaker.

2) Because of built-in redundancies overall RPT system unavailability is not sensitive to the trip signal initiation logic.

3) The single trip coil and its trip mechanism failures contribute twelve percent of RPT unavailability. Therefore, addressing this single trip coil failure cause by installing redundancy is not advisable, as it will not improve the reliability of the existing JAF ATWS RPT design significantly.

4) The dominant single failures are: those associated with the motor generator field breakers for both the proposed JAF RPT and Monticello RPT designs, and the 4.16 kV motor generator feeder breakers for the existing JAF RPT design. However, the BSEP, Pilgrim, JAF plant data, and the LER data base search conducted by EG&G, indicate that the 4.16 kV motor generator feeder breakers have lower failure frequencies than the low voltage motor generator field breakers. Thus, the resulting unavailability of the RPT is dominated by the circuit breaker failure data selected for the analysis.

5) Using breaker-specific failure data, the existing JAF ATWS RPT system is clearly more reliable than both the proposed JAF RPT and the Monticello system as endorsed by the NRC. This comparison indicates that modification of the existing JAF ATWS RPT system is unnecessary.

2) Because of built-in redundancies overall RPT system unavailability is not sensitive to the trip signal initiation logic.

3) The single trip coil and its trip mechanism failures contribute twelve percent of RPT unavailability. Therefore, addressing this single trip coil failure cause by installing redundancy is not advisable, as it will not improve the reliability of the existing JAF ATWS RPT design significantly.

4) The dominant single failures are: those associated with the motor generator field breakers for both the proposed JAF RPT and Monticello RPT designs, and the 4.16 kV motor generator feeder breakers for the existing JAF RPT design. However, the BSEP, Pilgrim, JAF plant data, and the LER data base search conducted by EG&G, indicate that the 4.16 kV motor generator feeder breakers have lower failure frequencies than the low voltage motor generator field breakers. Thus, the resulting unavailability of the RPT is dominated by the circuit breaker failure data selected for the analysis.

5) Using breaker-specific failure data, the existing JAF ATWS RPT system is clearly more reliable than both the proposed JAF RPT and the Monticello system as endorsed by the NRC. This comparison indicates that modification of the existing JAF ATWS RPT system is unnecessary.

2. INTRODUCTION

This report describes the system configurations, analyses, assumptions, methodology and results of a reliability evaluation of the existing ATWS RPT single trip coil and proposed redundant trip coil designs at JAF. This evaluation assesses the adequacy of the existing RPT single trip coil design, compares the existing design to the proposed design and the NRC-endorsed Monticello RPT redundant trip coil design from a reliability perspective, and examines whether a redundant trip coil design appreciably improves reliability.

A list of documents used in the evaluation is presented in Appendix A.

3. SYSTEM CONFIGURATIONS

During normal operation, the recirculation pumps are used to vary reactor power over a portion of the power range by varying pump flow. During transient conditions which cause a sharp increase in reactor pressure or drop in reactor water level, the recirculation pumps are tripped in order to reduce flow through the core rapidly and, consequently, to reduce reactor power level.

3.1 JAF EXISTING CONFIGURATION

JAF ATWS RPT is accomplished by energizing the single trip coil of the 4.16 kV motor generator feeder breaker, thus opening the breaker for each recirculation pump M-G set drive motor. Each recirculation system M-G set is tripped independently of the other M-G set.

The trip logic is arranged in a "one-out-of-two" logic scheme. The trip signal is initiated by either one of two level sensors (sensing reactor vessel low water level) or either one of two pressure sensors (sensing high reactor vessel pressure). Each level and pressure sensor is connected to an analog trip module which provides a trip signal output when either a predetermined low water level or high pressure is reached. A simplified schematic of the JAF RPT trip logic is presented in Figure 1.

3.2 JAF PROPOSED CONFIGURATION

The proposed JAF ATWS RPT modification is installation of two redundant trip coils in each motor generator field breaker (GE Model No. AKF-2-25) of the recirculation pump motor-generator (M-G) sets.

The trip logic scheme will be arranged in a "one-out-of-two-taken-twice" logic. Under this logic, each motor generator field breaker trip is initiated by either one-out-of-two-taken-twice low reactor level sensors or one-out-of-two-taken -twice high reactor pressure sensors. Each trip logic train will trip both recirculation pumps upon signals from two pressure sensors or two level sensors. A simplified schematic of the proposed modification of the JAF RPT trip logic is presented in Figure 2.

3.3 MONTICELLO DESIGN

Monticello ATWS RPT is accomplished by energizing the redundant trip coils of the 480 V motor generator field breaker (GE Model No. AKF-2-25) thus opening the 480 V motor generator field breakers for each recirculation pump.

The trip logic scheme is arranged in a "two-out-of-two" logic. Each 480 V motor generator field breaker trip is initiated by two level sensors (sensing reactor vessel low water level) or two pressure sensors (sensing high reactor vessel pressure). The level and pressure sensors are again connected to analog trip modules. A simplified schematic of the Monticello RPT trip logic is presented in Figure 3.

4. ANALYSES & RESULTS

4.1 JAF MAINTENANCE WORK REQUEST DATA

The entire maintenance work request data files of the recirculation pump motor generator feeder breakers and motor generator field breakers were reviewed. This review revealed no failures for the recirculation pump 4.16 kV motor generator feeder breakers and motor generator field breakers over the last 14 years. However, one failure had occurred on the main generator field breaker, which is GE Model No. AKF-2-25. This breaker failure, a failure to trip which occurred on March 3, 1984, was attributed to cracking of the eccentric bushing. NRC Inspection Report No. 50-333/86-18 (dated 1/12/87) also supports this finding.

4.2 JAF RPT FAULT TREE ANALYSES

Fault trees were constructed for the existing and the proposed JAF ATWS RPT design configurations. These fault trees account for the trip coil(s), breakers, fuses, breaker and test switches, and trip signal initiation logic paths (i.e., relays, trip units, level and pressure transmitters). The trees have as their top event: "Recirculation Pump Trip Unsuccessful." Failure of either pump to trip constitutes failure of the RPT. The tree then cascades down through various hardware failure modes until the basic failure events are reached. The existing and proposed JAF ATWS RPT design configuration fault trees are presented in Appendix B and Appendix C, respectively.

The following assumptions were made in modeling these design configurations:

1) The fault tree models only the trip circuit which sets upon receipt of ATWS signals.

2) Operation of the RPT circuitry is automatic. No credit is taken for operator action as a means of achieving successful operation.

3) Failure to supply 125 VDC control power for feeder breakers 1A and 1B of the M-G set, generator field breakers, Alternate Rod Insertion (ARI) cabinets and the Analog Transient Trip System (ATTS) are beyond the scope of the analysis. This means that the probability for the unavailabilities of these power sources is assumed to be zero.

4) Cable failure is not considered to be a significant contributor to RPT unavailability. Thus, it is not included in the model.

5) Human errors in calibrating the trip units, level and pressure transmitters are not included in the model.

6) Human error resulting in the breaker test switches being left in the wrong position after test is not included in the model.

Each of the above assumptions tends to eliminate failure events extraneous to the present point of interest. We have, therefore, focused attention more strongly and directly on the effect of installing redundant trip coils.

Both failure modes of the trip coil, "Trip coil does not energize" and "Trip coil fails open," were incorporated into the fault tree model for analysis. However, the trip coil in the motor generator feeder breakers and motor generator field breakers has an indicator light connected in series with it. The indicator light continuously monitors the breaker and trip coil status. Therefore, an open circuit within the trip coil would be effectively indicated in the control room, and corrective action could be taken by the operator during the shift.

Various sources of the breaker failure data presented in EG&G-REQ-7766 (Ref.17) were examined. Most of these data sources indicate a history of generic problems with the GE Model No. AKF-2-25 recirculation pump motor generator field breaker. Higher failure frequencies of the motor generator field breaker were recorded in the Brunswick and Pilgrim plant data bases and in the LER data base as well. The Brunswick and Pilgrim plant data base covered three plants over a period of ten years. The LER data base was derived from EG&G's search of 34 plants over a period of seven and a half years, constituting over 240 plant-years of data. This data base clearly represents a statistically significant foundation for providing the best available operating experience of the circuit breaker failure data.

Two fault tree analyses were performed for both the existing and proposed designs by using the generic WASH-1400/IEEE-500 component failure data. By replacing the generic breaker failure data with the specific breaker failure data derived from the LER data search conducted by EG&G, two more fault tree analyses were performed for both designs. These component failure data are presented in Tables 1 & 2.

4.3 RESULTS

a) WASH-1400/IEEE-500 Component Failure Data

Using generic data, the unavailability computed for the existing JAF ATWS RPT design is 2.83 E-3, as compared to 2.62 E-3 for the proposed JAF design and 2.5 E-3 for the Monticello design. These analyses indicate that the proposed JAF RPT redundant trip coil design is about 8 percent more reliable than the existing single trip coil design while the Monticello redundant trip coils are 13 percent more reliable than the single trip coil.

This result is misleading, since a single generic breaker failure rate is arbitrarily assigned to the 4.16 kV motor generator feeder breakers and motor generator field breakers. The proposed JAF and Monticello designs then appear to be inherently more reliable than the single trip coil design.

b) Specific Breaker Failure Data from LER Data Search Conducted by EG&G

The unavailability computed for the existing JAF ATWS RPT design is 2.3 E-3, as compared to 7.3 E-3 for the proposed design and 7.2 E-3 for the Monticello design. The existing JAF design is more reliable when analyzed using the LER data.

The dominant single failures are: those associated with the motor generator field breakers for both the proposed JAF and Monticello designs, and the 4.16 kV motor generator feeder breakers for the existing JAF design. The different failure rates developed by EG&G's search of the LER data base and used by EG&G for the Brunwick evaluation were assigned to the 4.16 kV motor generator feeder breakers and motor generator field breakers, respectively. Accordingly, the existing JAF design, given these further consideration, is inherently more reliable.

5. CONCLUSIONS

The conclusions reached in this evaluation are:

1) There were no failures for the recirculation pump 4.16 kV motor generator feeder breakers and GE AKF-2-25 motor generator field breakers in the equipment history file over the last 14 years. However, one failure had occurred on the main generator field breaker, which is GE Model No. AKF-2-25.

2) Because of built-in redundancies overall RPT system unavailability is not sensitive to the trip signal initiation logic.

3) The single trip coil and its trip mechanism failures contribute twelve percent of RPT unavailability. Therefore, addressing this single trip coil failure cause by installing redundancy is not advisable, as it will not significantly improve the reliability of the existing JAF ATWS RPT design.

4) The dominant single failures are: those associated with the motor generator field breakers for both the proposed JAF RPT and Monticello RPT designs, and the 4.16 kV motor generator feeder breakers for the existing JAF RPT design. However, the BSEP, Pilgrim, JAF plant data, and the IER data base search conducted by EG&G, indicate that the 4.16 kV motor generator feeder breakers have lower failure frequencies than the low voltage motor generator field breakers. Thus, the resulting unavailability of the RPT is dominated by the circuit breaker failure data selected for the analysis.

5) Using breaker-specific failure data, the existing JAF ATWS RPT system is clearly more reliable than both the proposed JAF RPT and the Monticello system as endorsed by the NRC. This comparison indicates that modification of the existing JAF ATWS RPT system is unnecessary.

TABLE 1
COMPONENT FAILURE DATA OF THE RPT SYSTEM
(WASH-1400/IEEE-500 DATA SOURCE)

COMPONENT	FAILURE MODE	FAILURE RATE
Circuit Breaker	Fails to open on demand	1.25×10^{-3}/Demand
Circuit Breaker* (low voltage)	Fails to remain closed	3.80×10^{-8}/Hour
Relay Coil	Does not energize	1.25×10^{-4}/Demand
Relay Coil	Fails open	2.66×10^{-7}/Hour
Relay Contact	Does not close	3.75×10^{-7}/Hour
Level Transmitter	Does not operate	2.66×10^{-6}/Hour
Pressure Transmitter	Does not operate	2.66×10^{-6}/Hour
Trip Units	Does not function	2.66×10^{-6}/Hour
Fuse	Fails open	1.25×10^{-6}/Hour
Fuse* (5 Amp DC fuse)	Fails open	3.0×10^{-8}/Hour
Switch Contact	Failure of NC by opening, given no switch operation	7.98×10^{-8}/Hour

* IEEE-500 Data Source.

TABLE 2
BREAKER FAILURE DATA FROM THE LER
DATA SEARCH CONDUCTED BY EG&G

COMPONENT	FAILURE MODE	FAILURE PROBABILITY JAF(EXISTING)	JAF(PROPOSED) & MONTICELLO
Motor Generator Feeder Breaker A	Fails to open on demand	$9.8x10^{-4}$	----
Motor Generator Feeder Breaker B	Fails to open on demand	$9.8x10^{-4}$	----
Motor Generator Field Breaker A	Fails to open on demand	----	$3.6x10^{-3}$
Motor Generator Field Breaker B	Fails to open on demand	----	$3.6x10^{-3}$

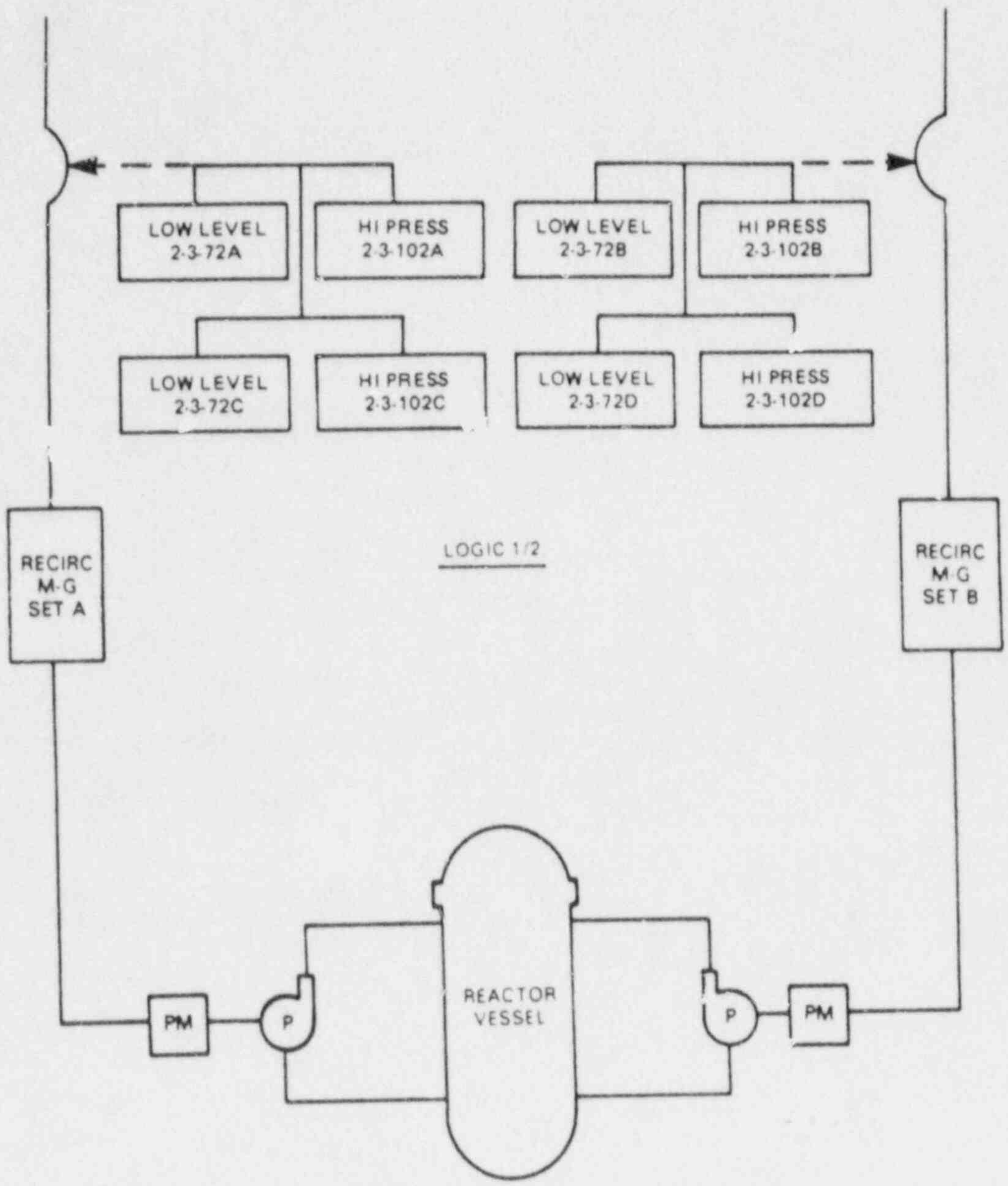


Figure —1 FitzPatrick Current RPT Design

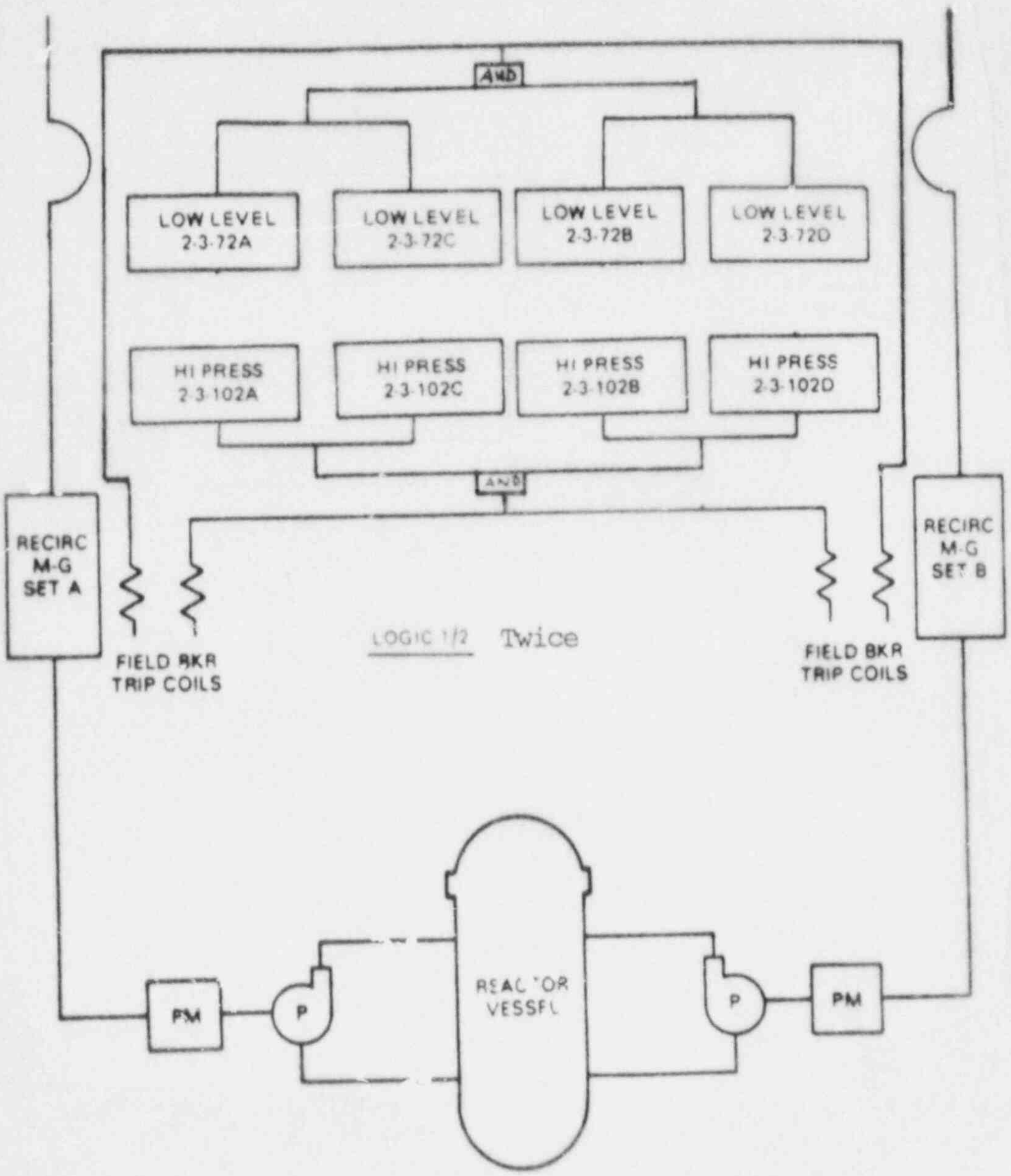


Figure 2 Proposed JAF ATWS RPT Design

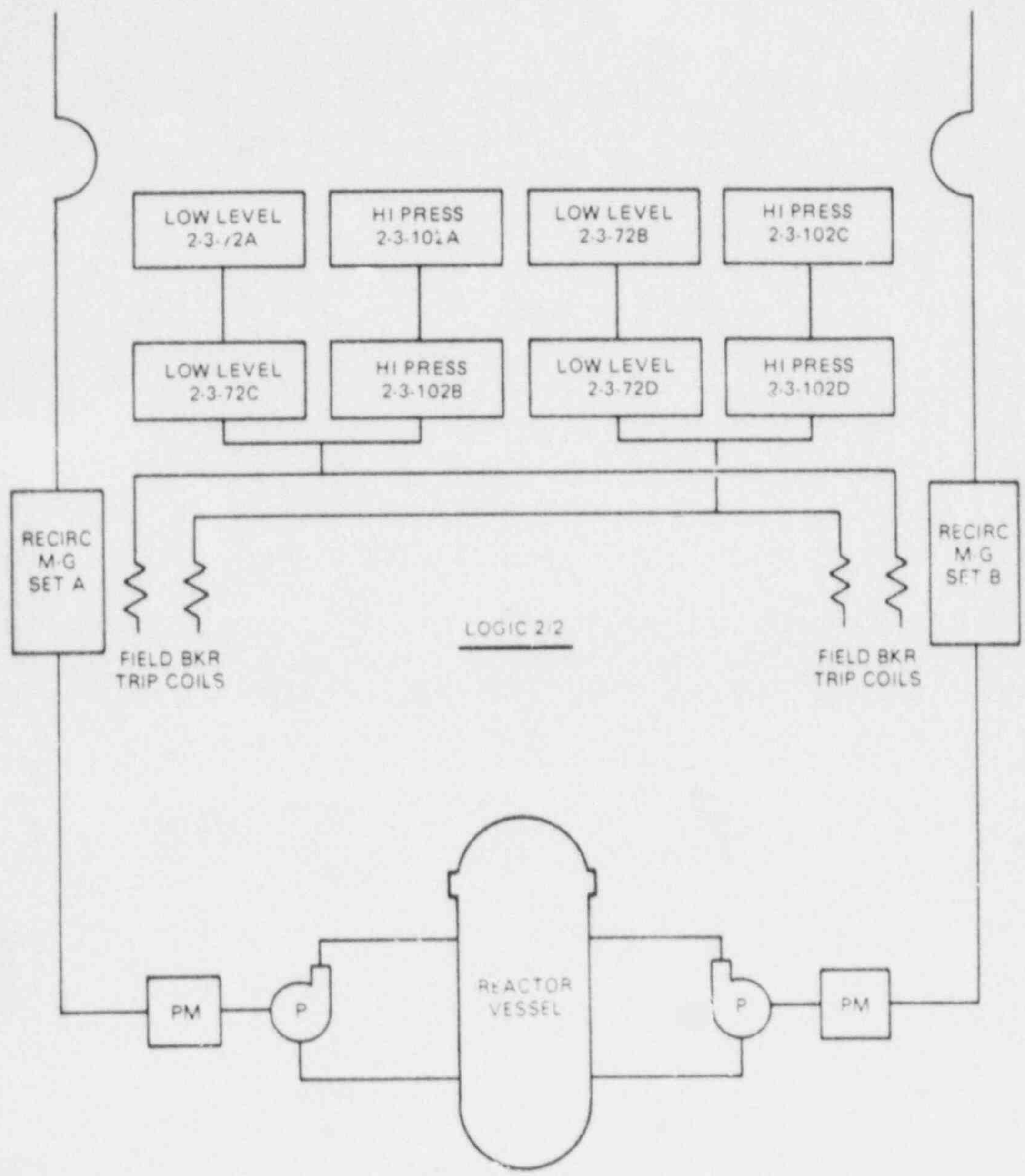


FIGURE 2 Monticello Design

APPENDIX A

LIST OF DOCUMENTS FOR RELIABILITY ASSESSMENT OF THE EXISTING & PROPOSED JAF ATWS RPT DESIGNS

1) Drawing 11825-1.62-144 Elementary Diagram Variable Speed Recirculation Pump and M-G Set - Sheet 2.

2) Drawing 11825-1.62-148C Elementary Diagram Variable Speed Recirculation Pump and M-G Set - Sheet 1.

3) Drawing 11825-1.62-132D Elementary Diagram Variable Speed Recirculation Pump and M-G Set - Sheet 3.

4) Drawing 11825-1.60-20 Elementary Diagram Analog Trip System.

5) Drawing 11825-1.60-21 Elementary Diagram Analog Trip System.

6) Drawing 11825-1.60-23 Elementary Diagram Analog Trip System.

7) Drawing 11825-1.60-24 Elementary Diagram Analog Trip System.

8) Drawing 11825-ESK-7FA Elementary Diagram ARI System, Rev A.

9) Drawing 11825-ESK-7FB Elementary Diagram ARI System, Rev A.

10) F-ST-27 JAF Recirculation Pump Trip Logic System Functional / Auto Actuation Test.

11) GE NEDC-31017-1, Rev 1 JAF Nuclear Power Plant ATWS Assessment.

12) JAF Nuclear Power Plant ATWS RPT Modification No. F1-83-054 Conceptual Design Package, March 18, 1988.

13) WASH-1400 Reactor Safety Study, USNRC, October, 1975.

14) IEEE Std. 500, 1977 Guide to the Collection and Presentation of Electrical, Electronic and Sensing Component Reliability Data for Nuclear Power Generating Stations.

15) IE Information Notice 87-12 Potential Problems with Metal Clad Circuit Breakers, General Electric Type AKF-2-25.

16) CP & L letter from S.R.Zimmerman to USNRC, dated November 13, 1987, Serial NLS-87-244 ATWS-RPT System.

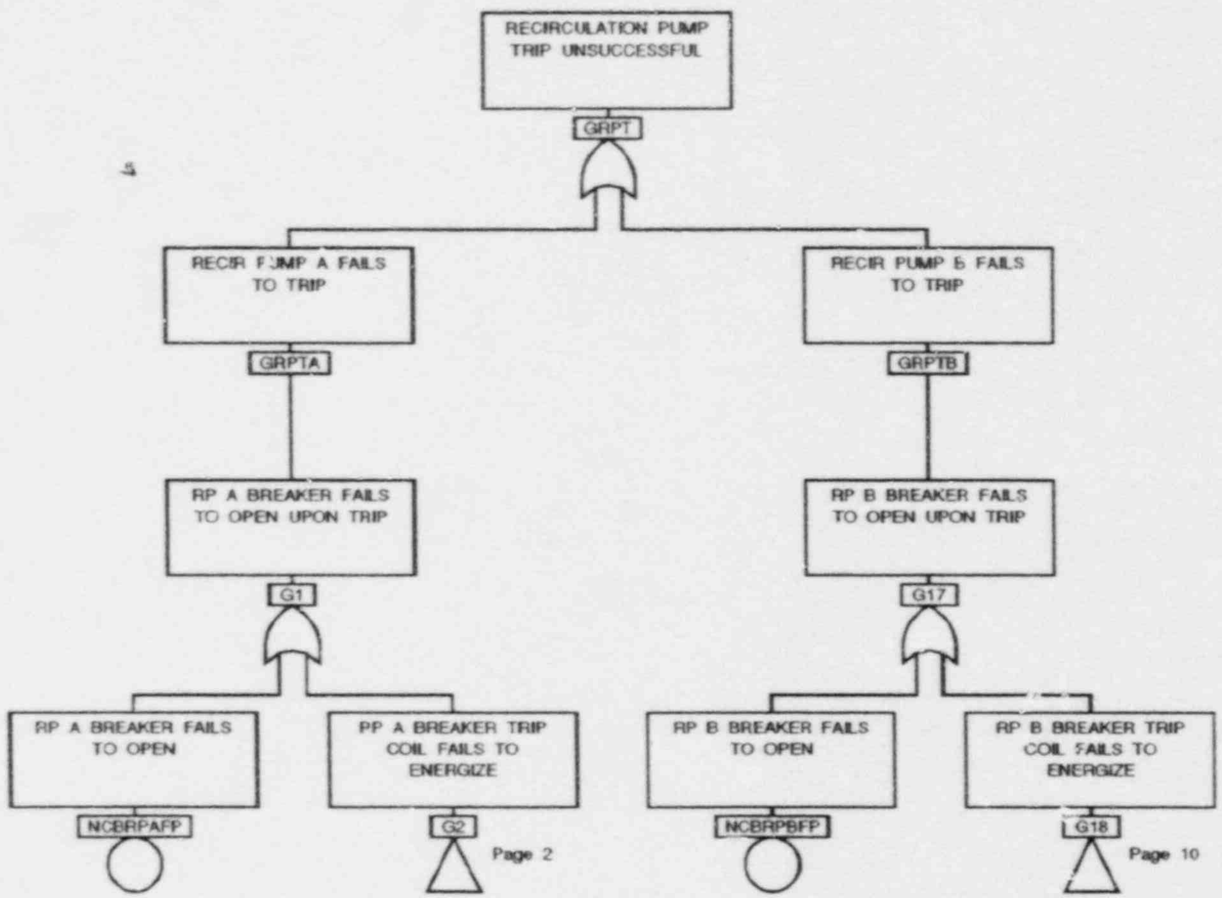
17) EG&G-REQ-7766 Review of the Recirculation Pump Trip Design for the Brunswick Steam Electric Plants, Attachments 1 & 2.

18) NUREG/CR-4126 Data Summaries of LERs of Protective Relays and Circuit Breakers at US Commercial Nuclear Power Plants January 1, 1976 to December 31, 1983 (Draft).

19) NRC Inspection Report 50-333/86-18, JAFNPP, January 12, 1987.

APPENDIX B

FAULT TREES DEPICTING THE FAILURE OF THE EXISTING JAF ATWS RPT DESIGN (SINGLE TRIP COIL DESIGN)



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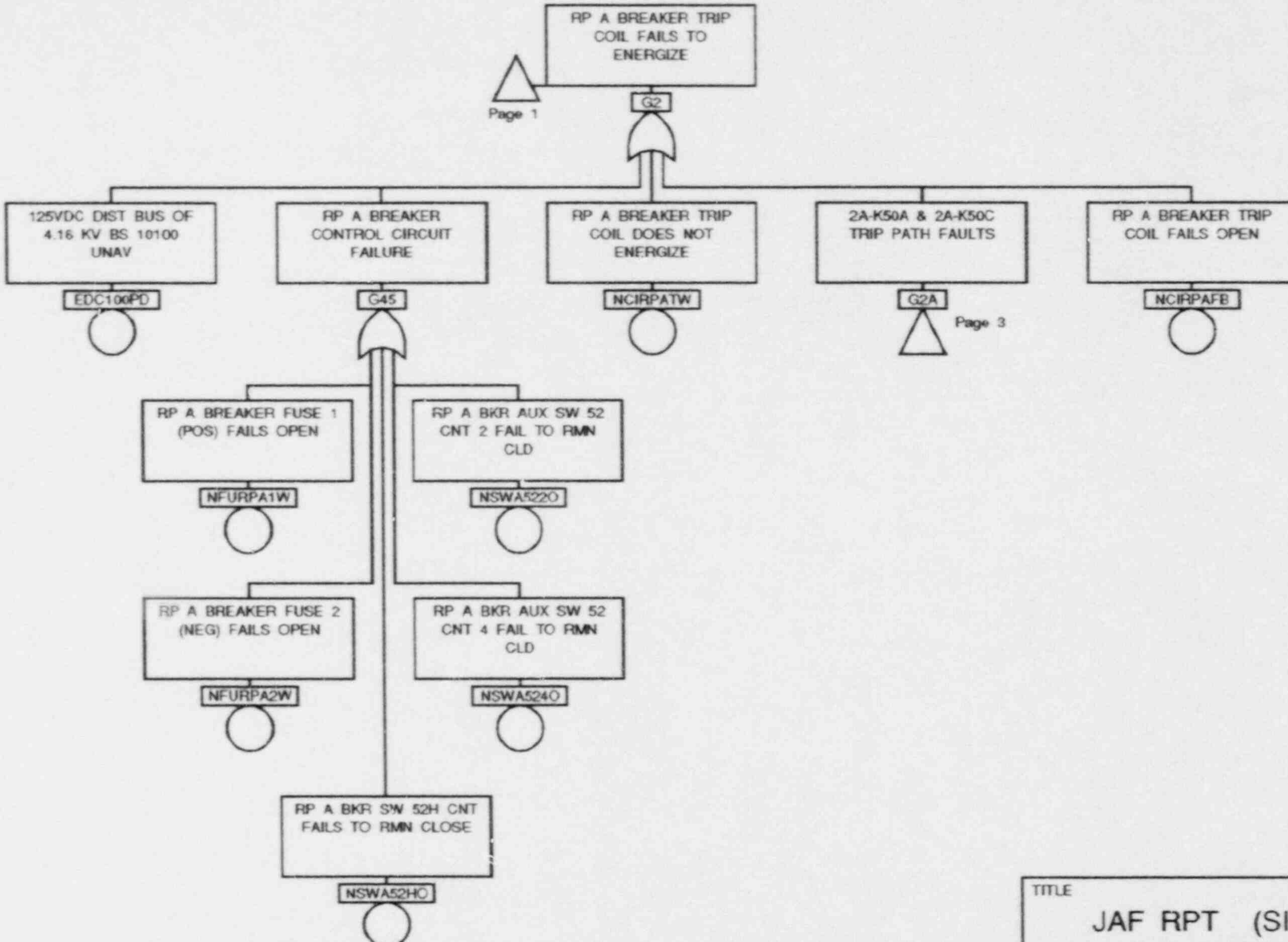
JAF RPT (SINGLE TRIP COIL)	
DRAWING NUMBER	DATE
Page 1	5/31/88



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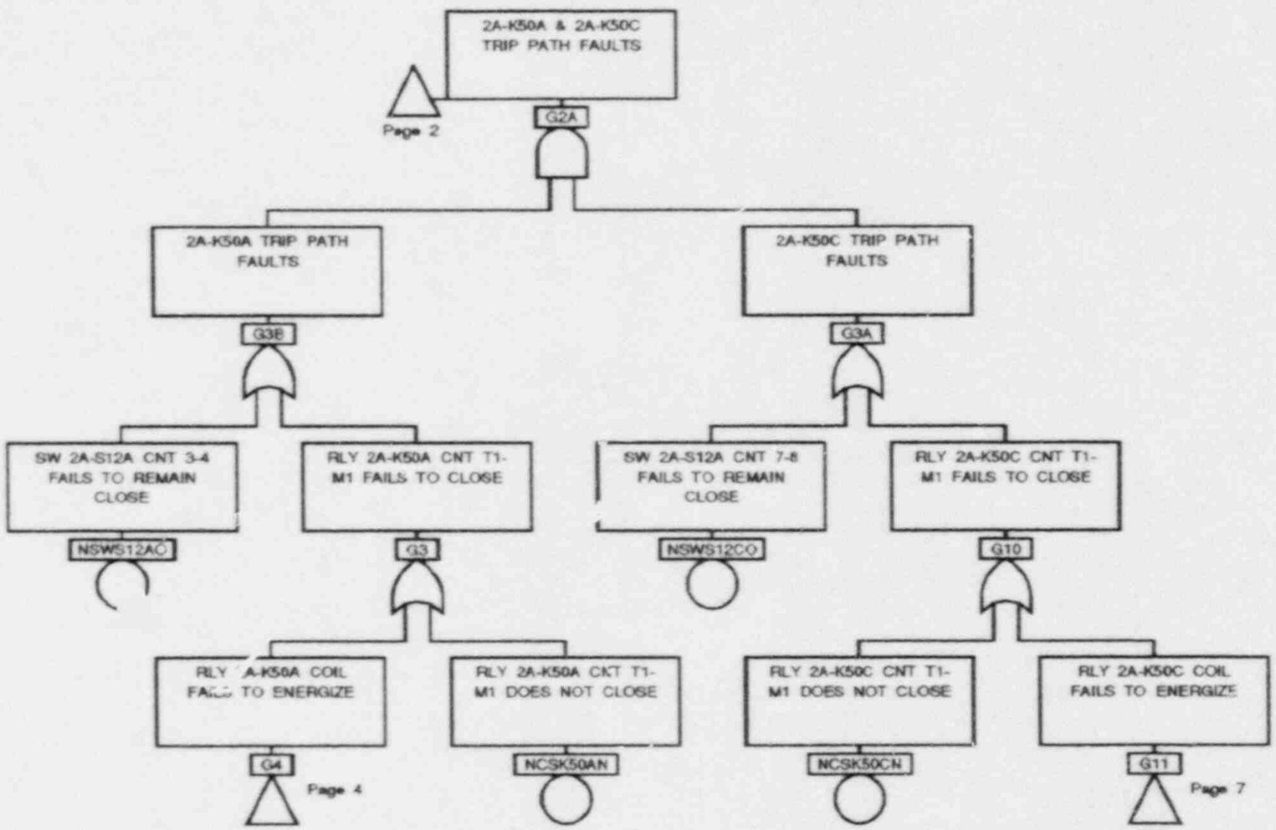
JAF RPT (SINGLE TRIP COIL)	
DRAWING NUMBER	DATE
Page 2	5/31/88



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JAF RPT (SINGLE TRIP COIL)

DRAWING NUMBER	DATE
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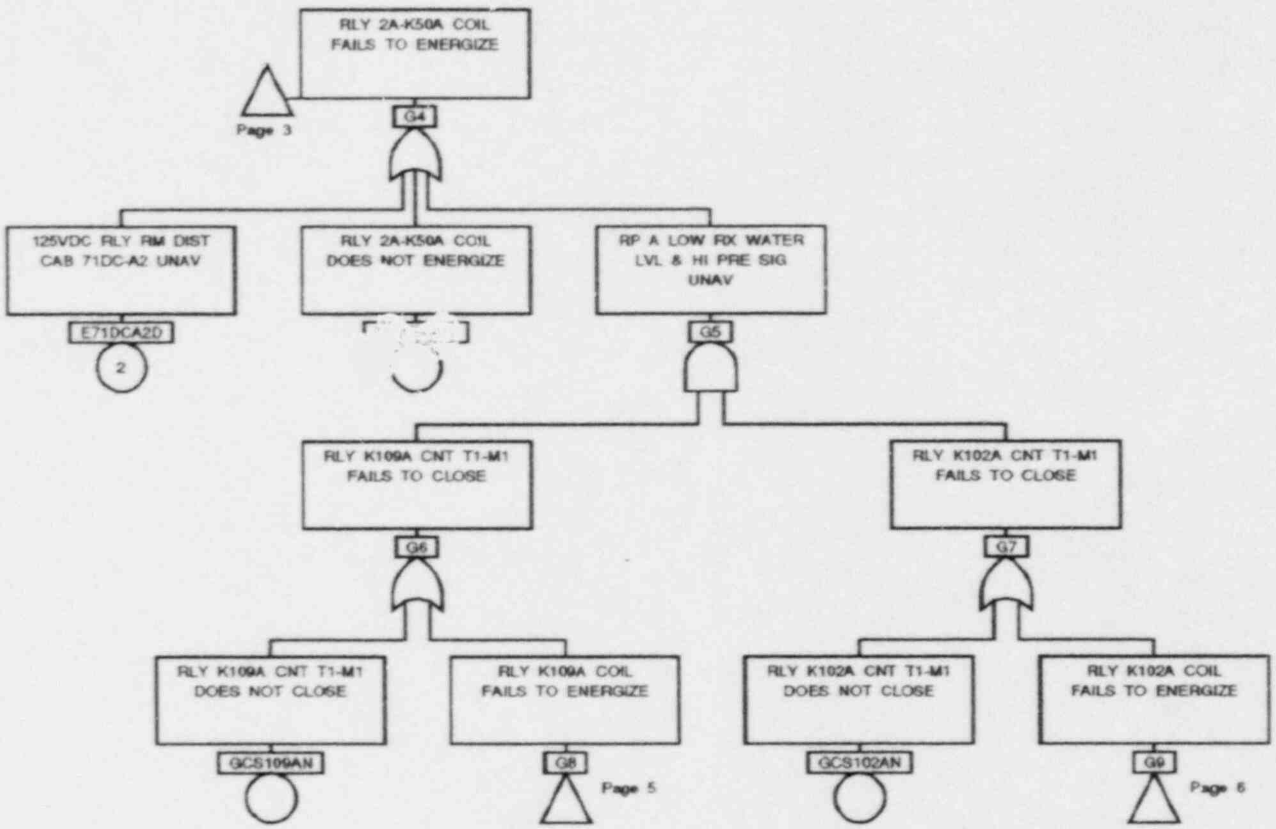

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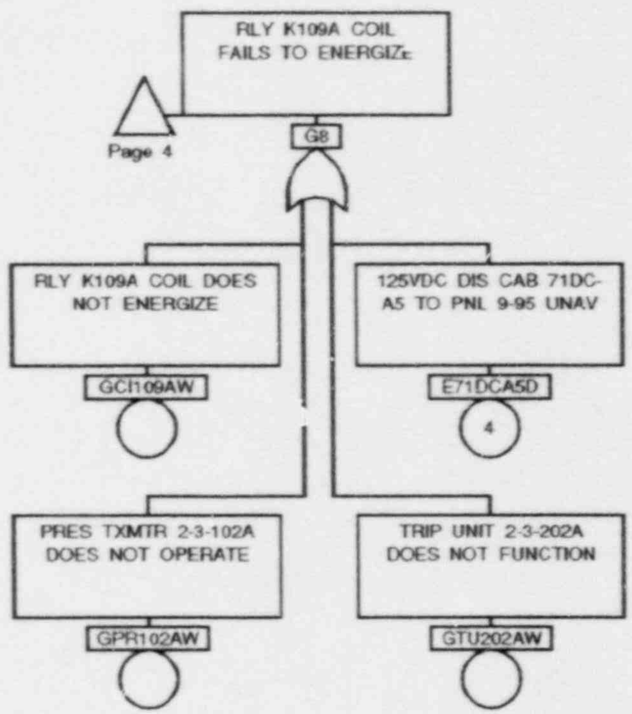
JAF RPT (SINGLE TRIP COIL)

DRAWING NUMBER	DATE
Page 4	5/31/88



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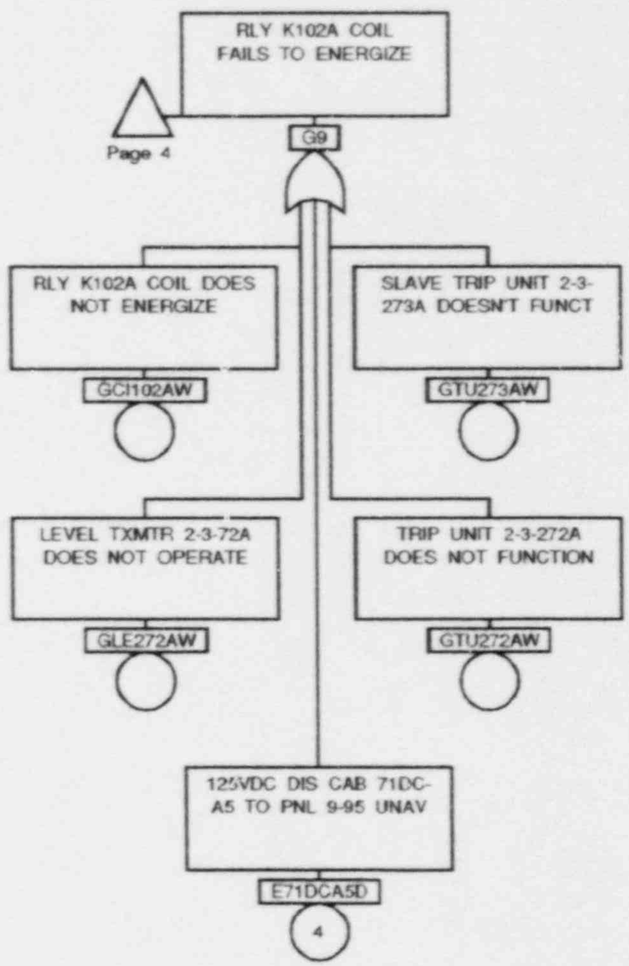
JAF RPT (SINGLE TRIP COIL)	
DRAWING NUMBER	DATE
Page 5	5/31/88



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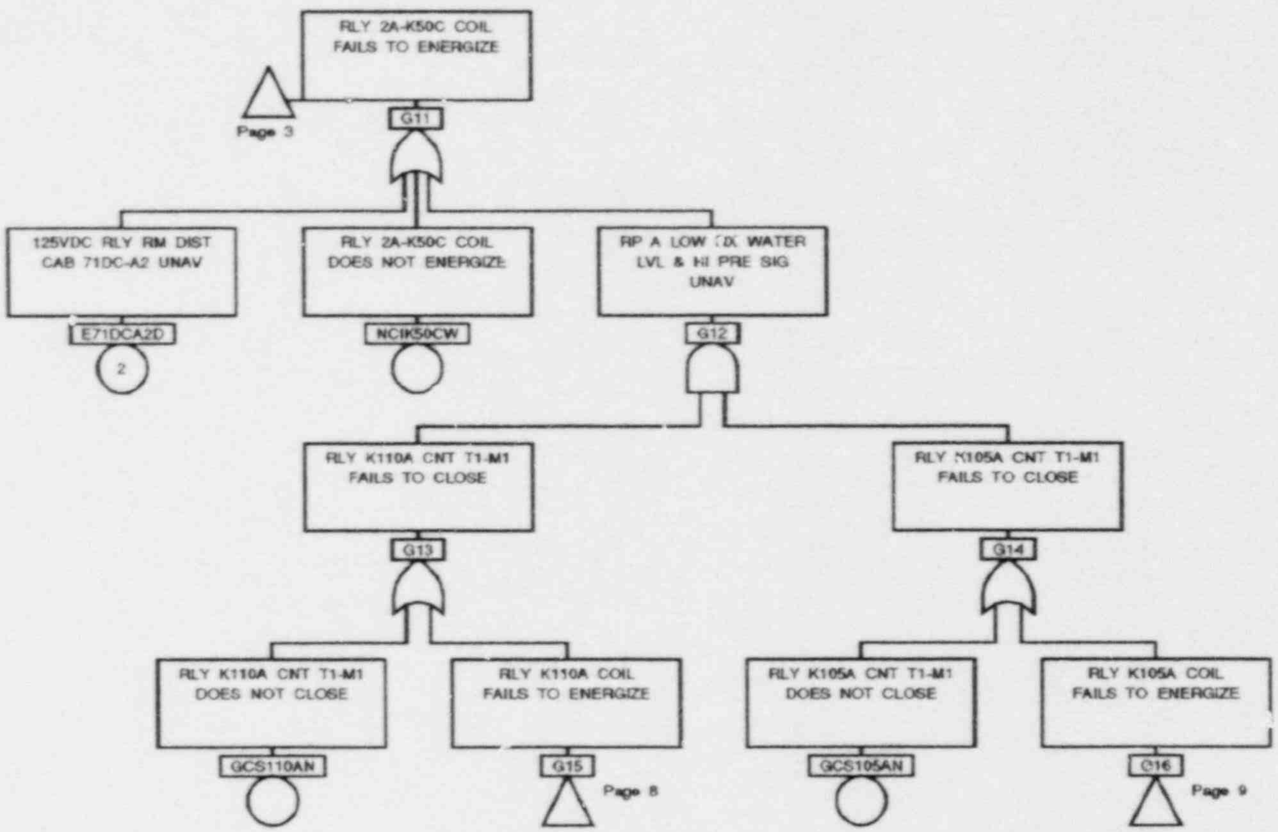
Page 6	5/31/88



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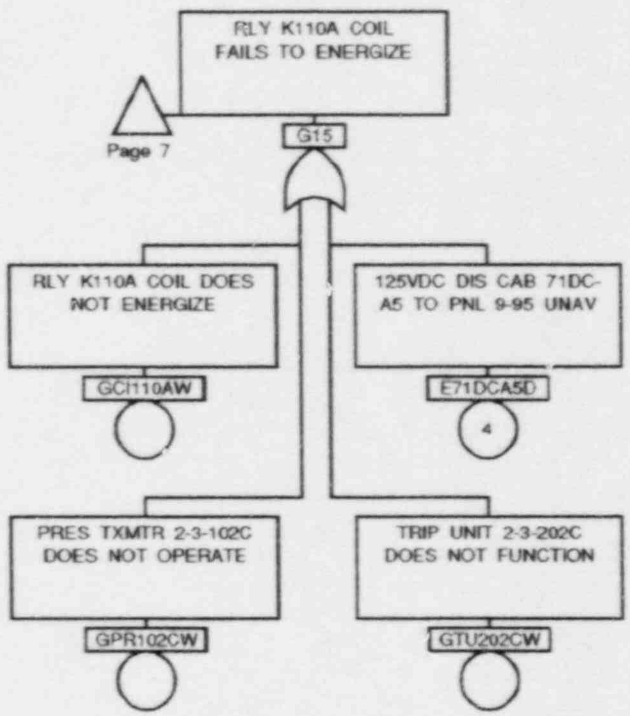

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DRAWING NUMBER	DATE
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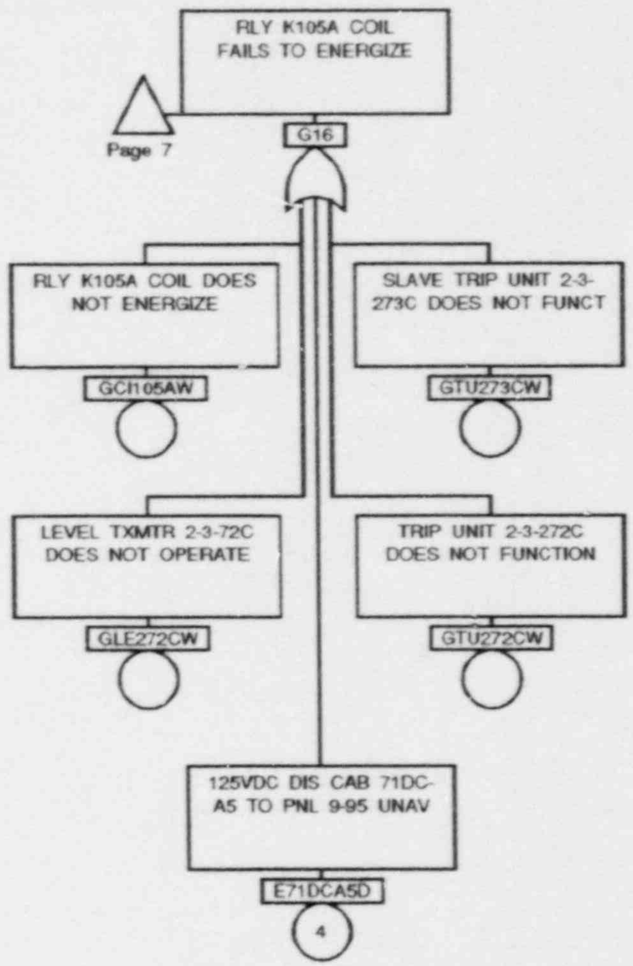

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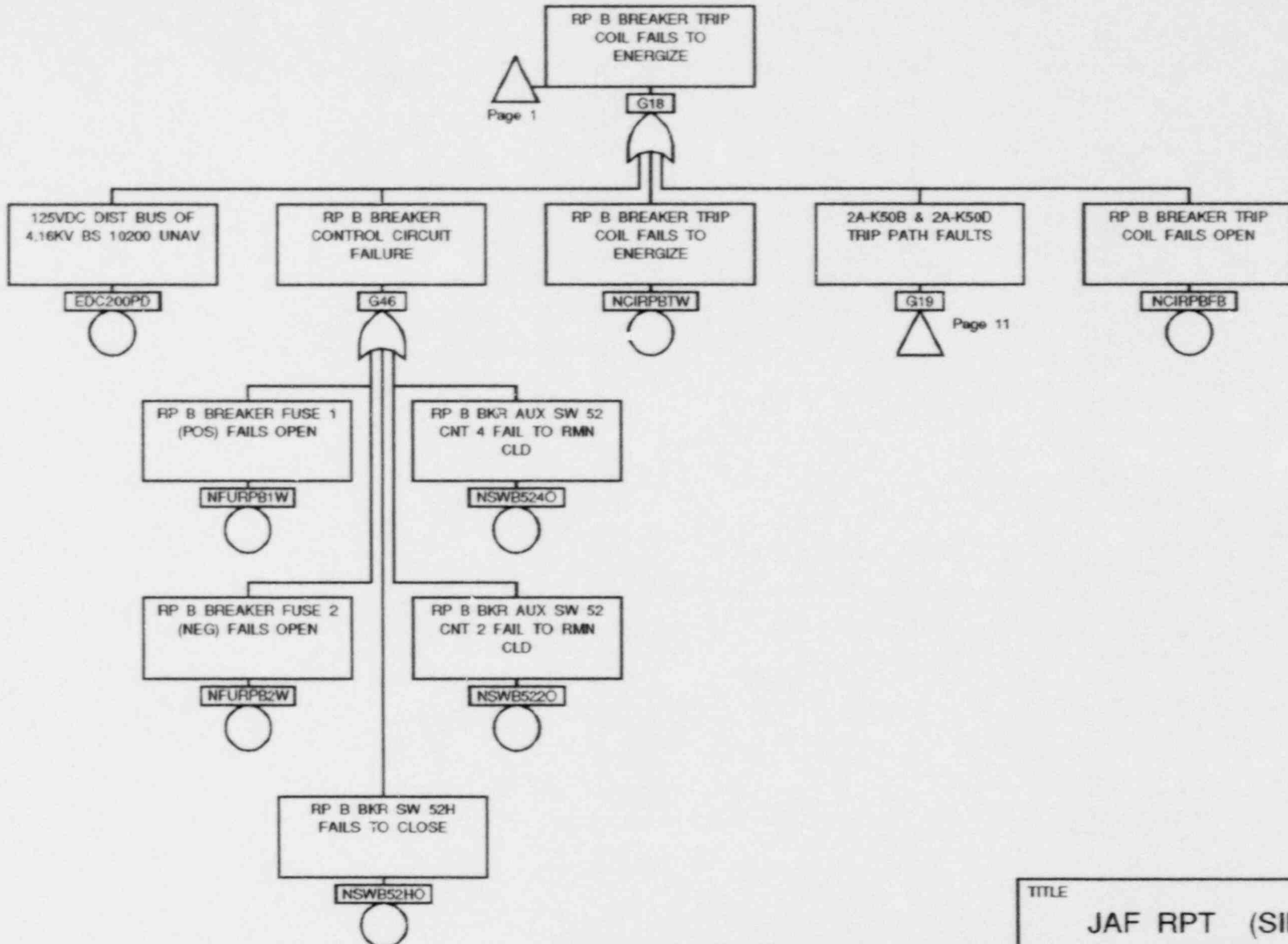
DRAWING NUMBER Page 9	DATE 5/31/88



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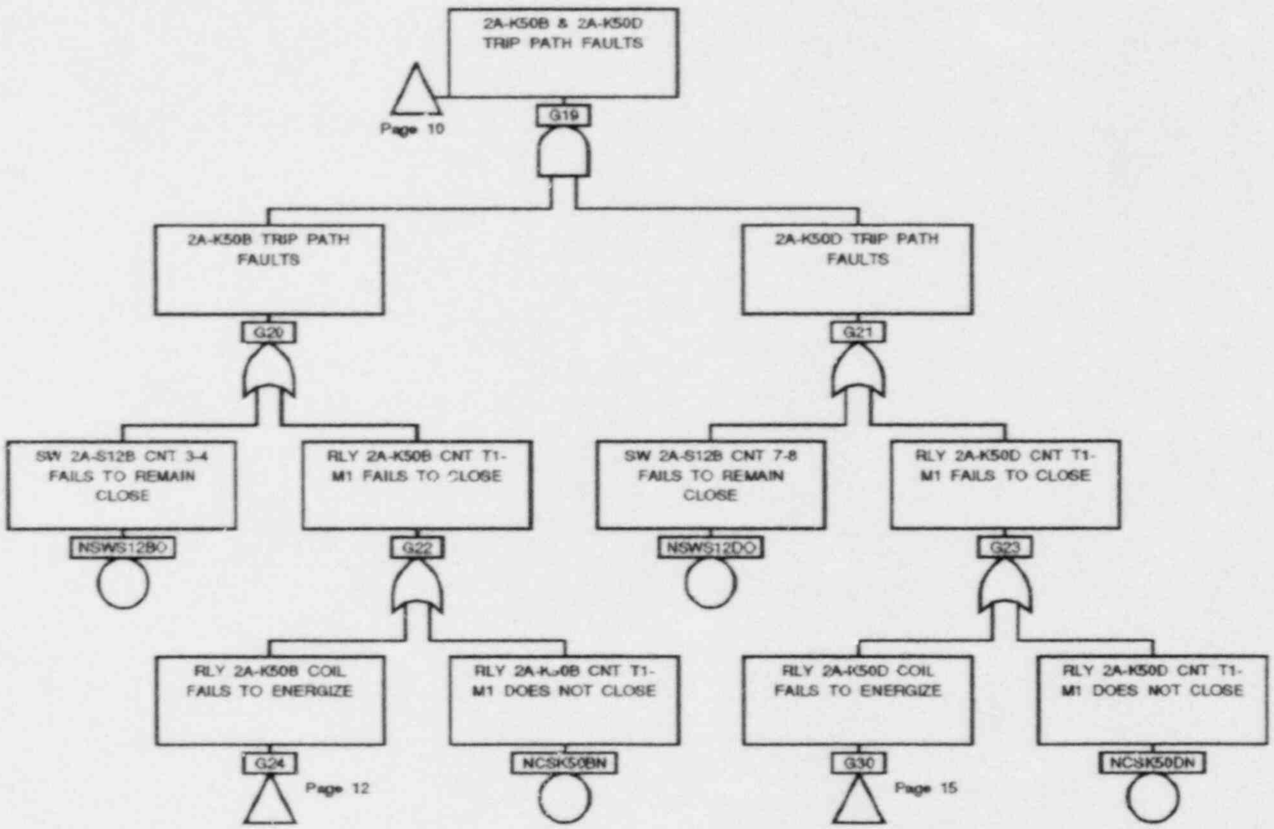

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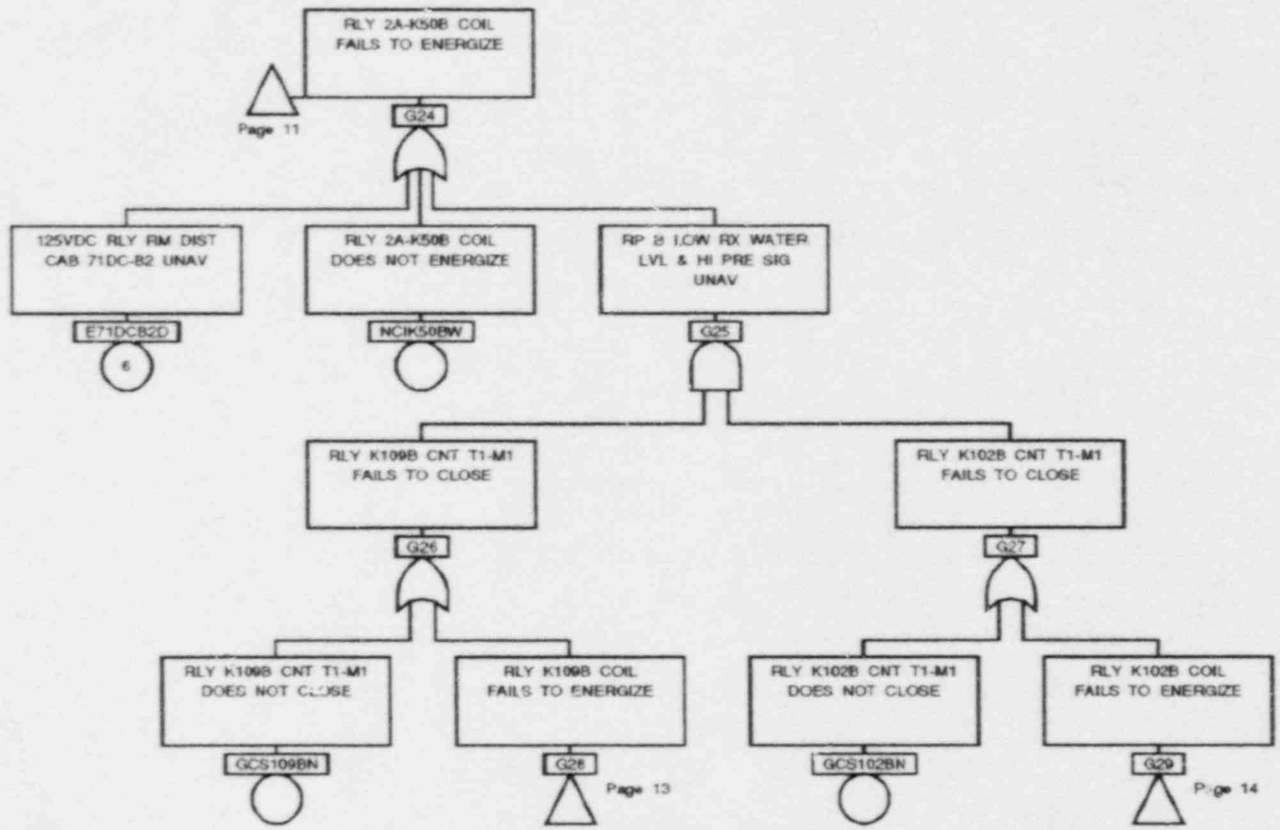
DRAWING NUMBER	DATE
Page 11	5/31/88



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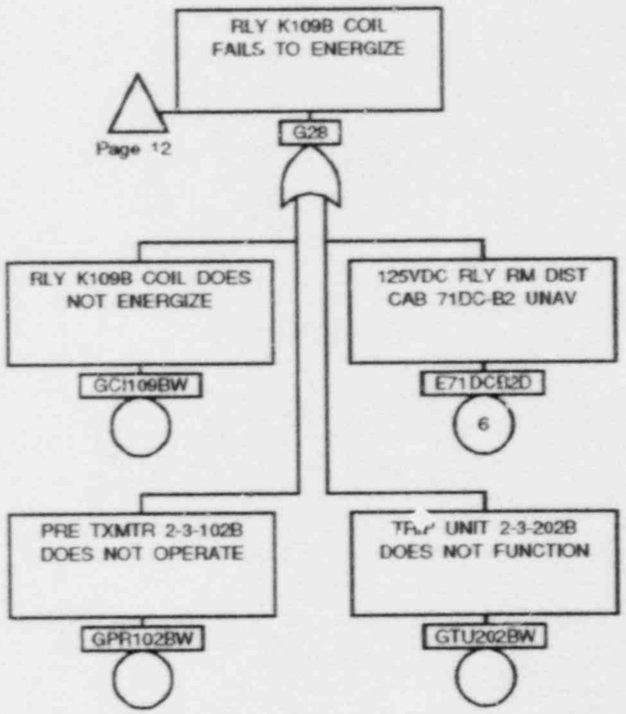
Page 12	5/31/88



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JAF RPT (SINGLE TRIP COIL)	
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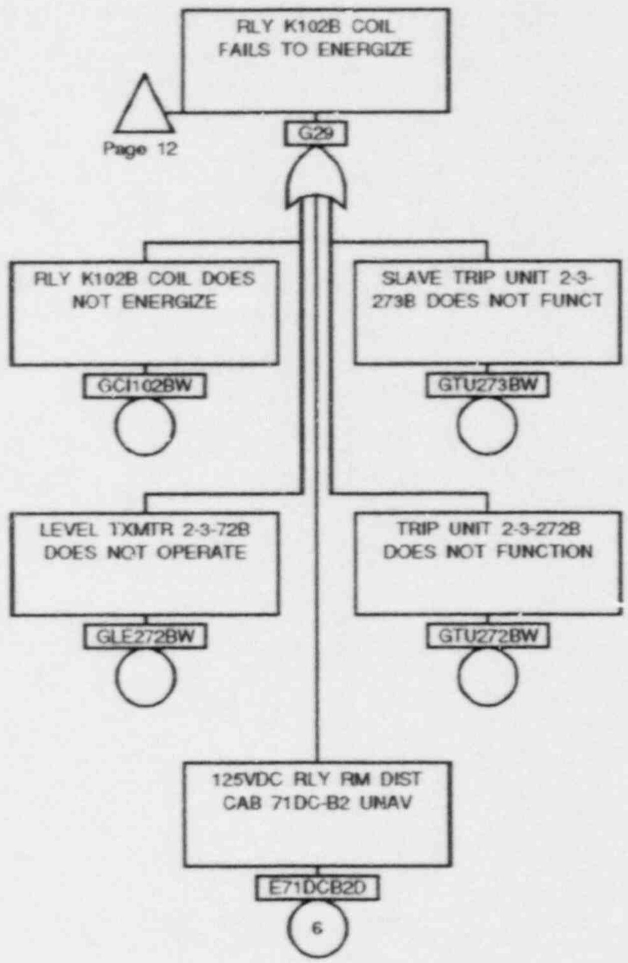
Page 13	5/31/88



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JAF RPT (SINGLE TRIP COIL)

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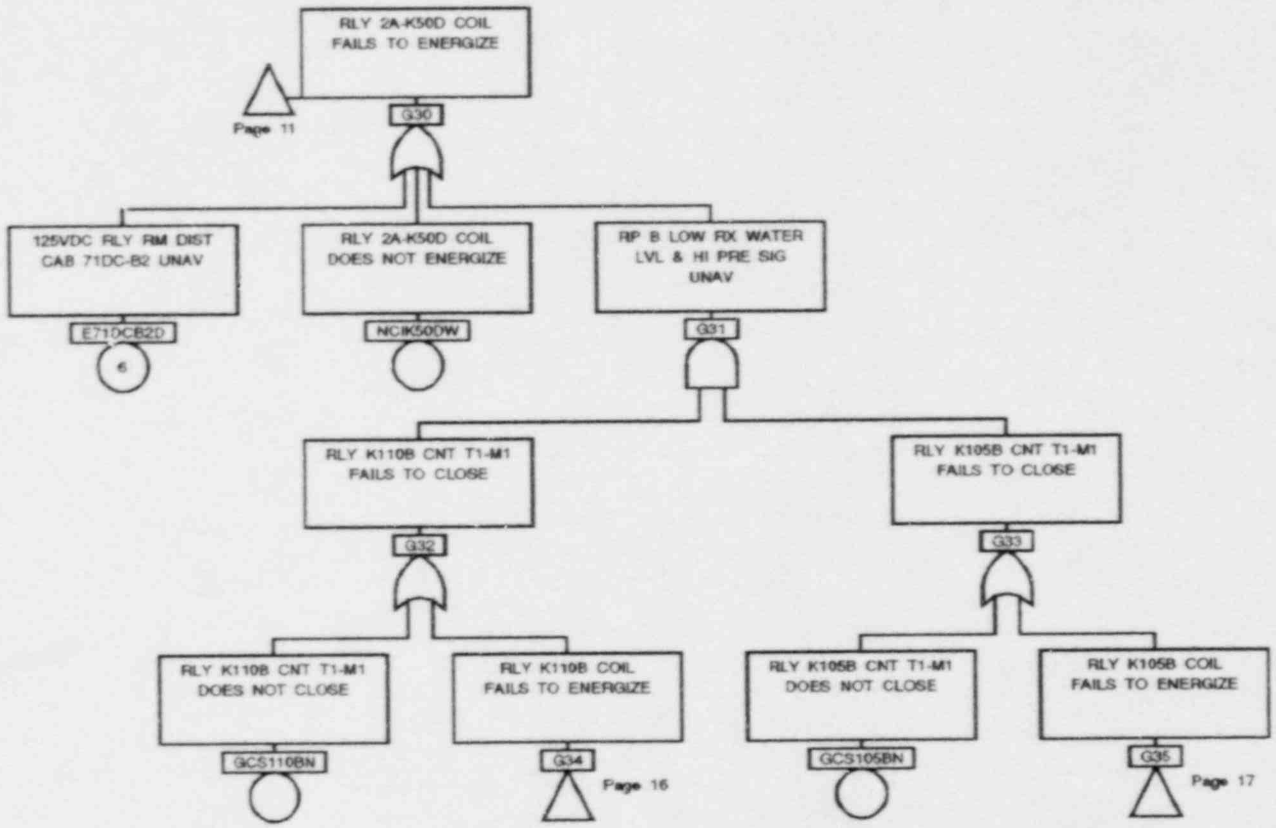

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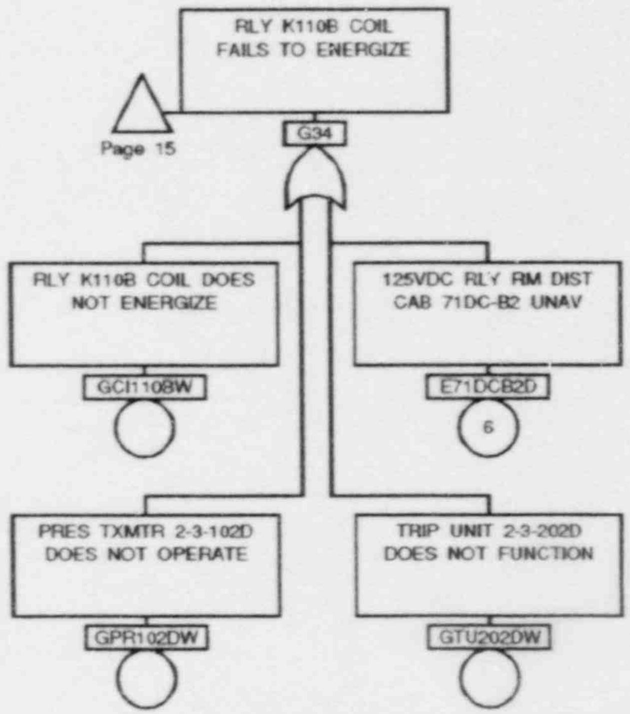

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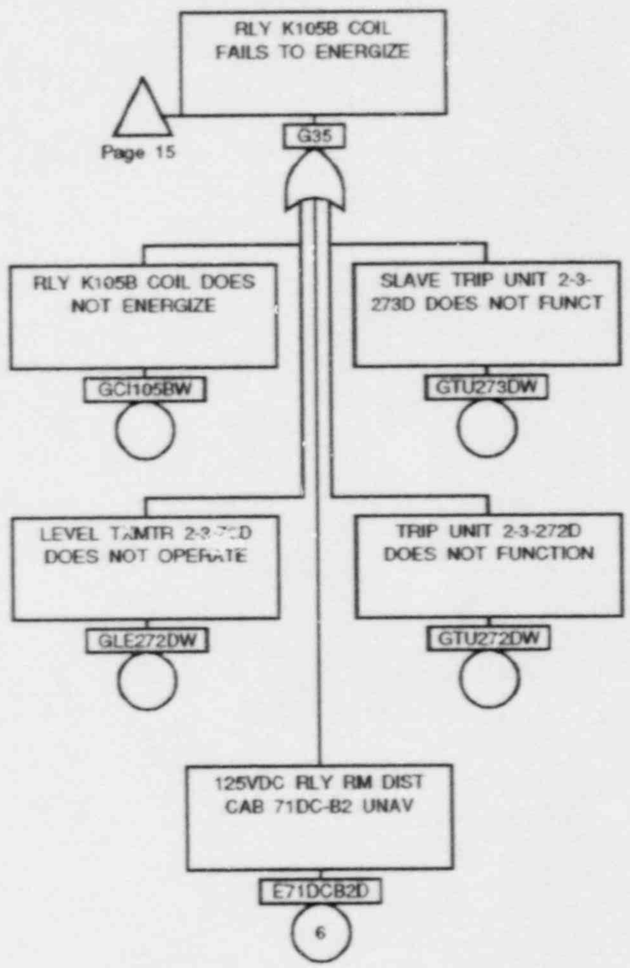

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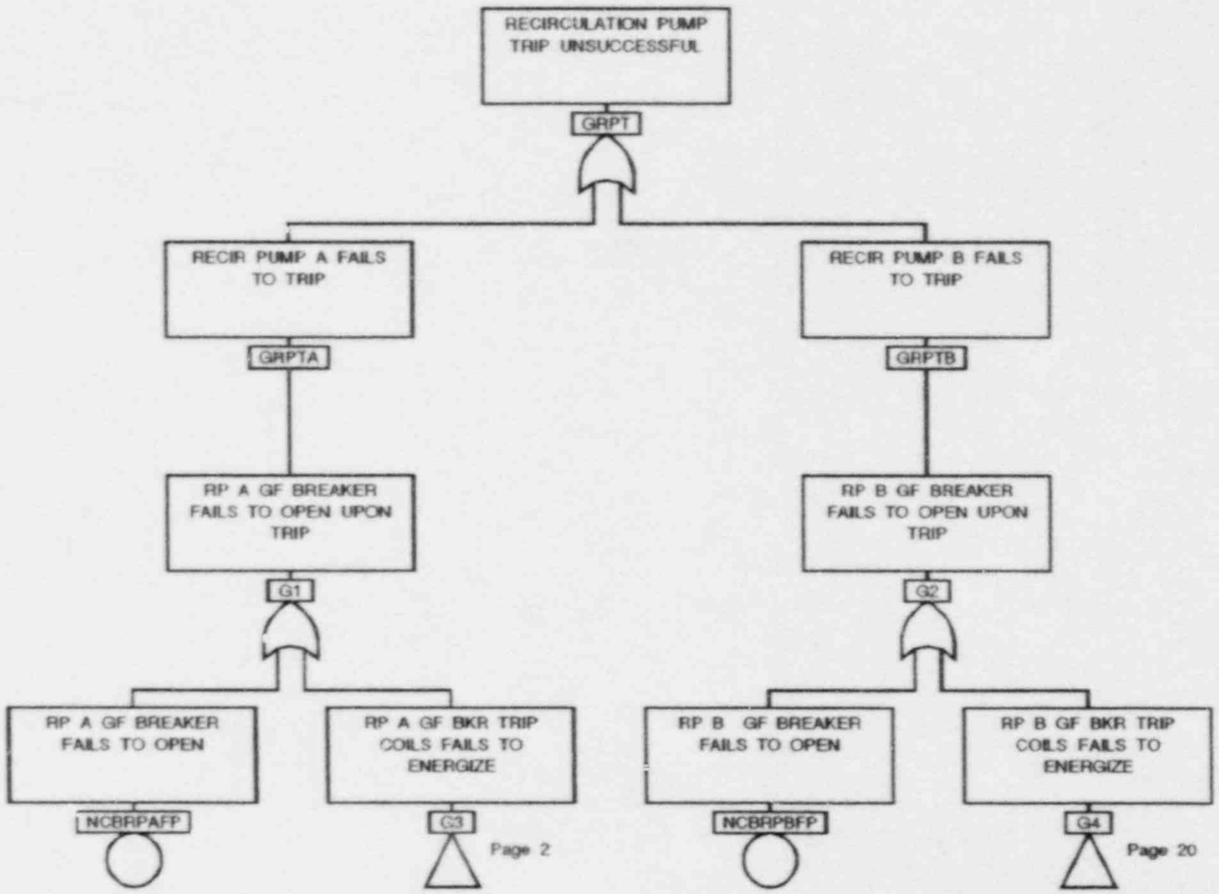
DRAWING NUMBER	DATE
Page 17	5/31/88

APPENDIX C

FAULT TREES DEPICTING THE FAILURE OF THE PROPOSED JAF ATWS RPT DESIGN (REDUNDANT TRIP COIL DESIGN)



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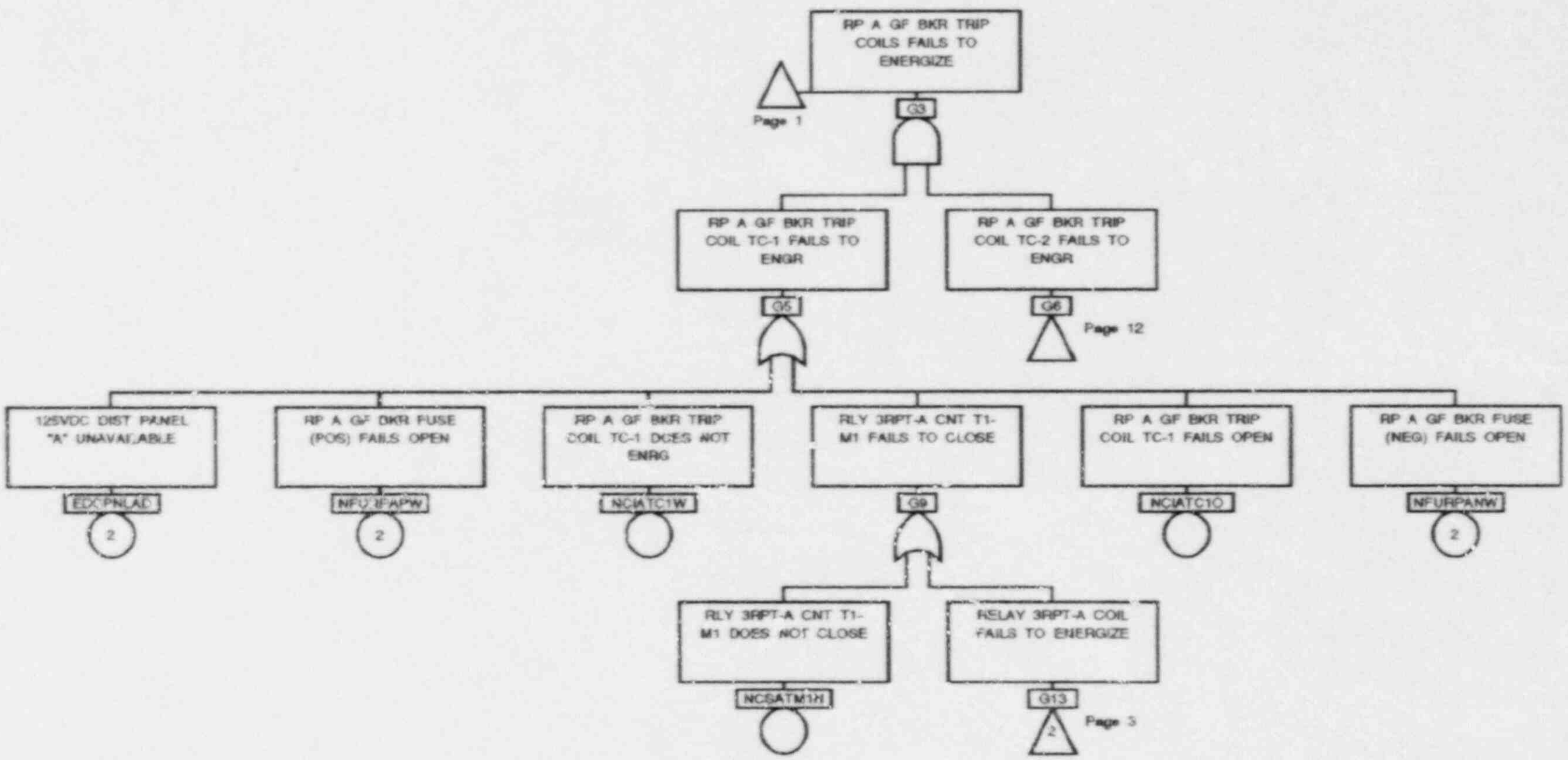

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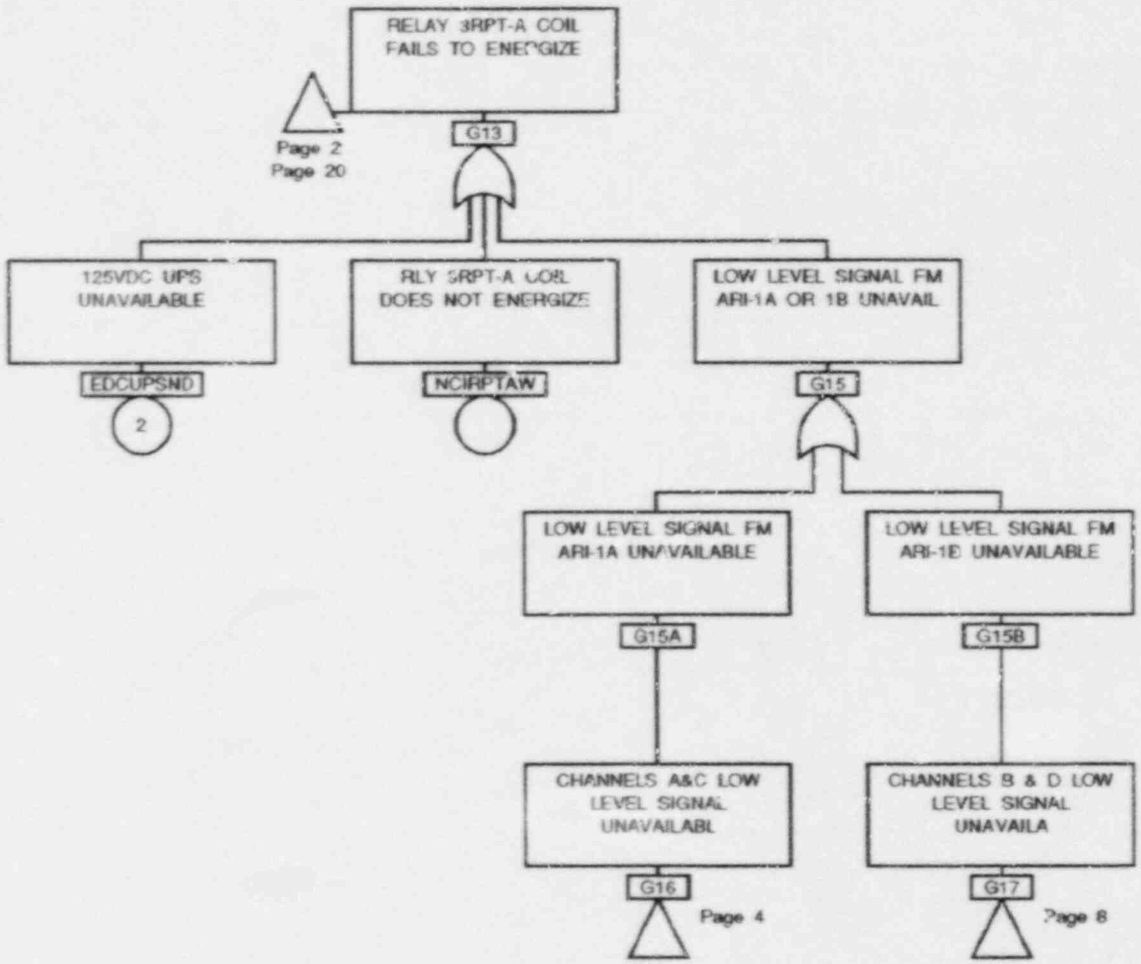

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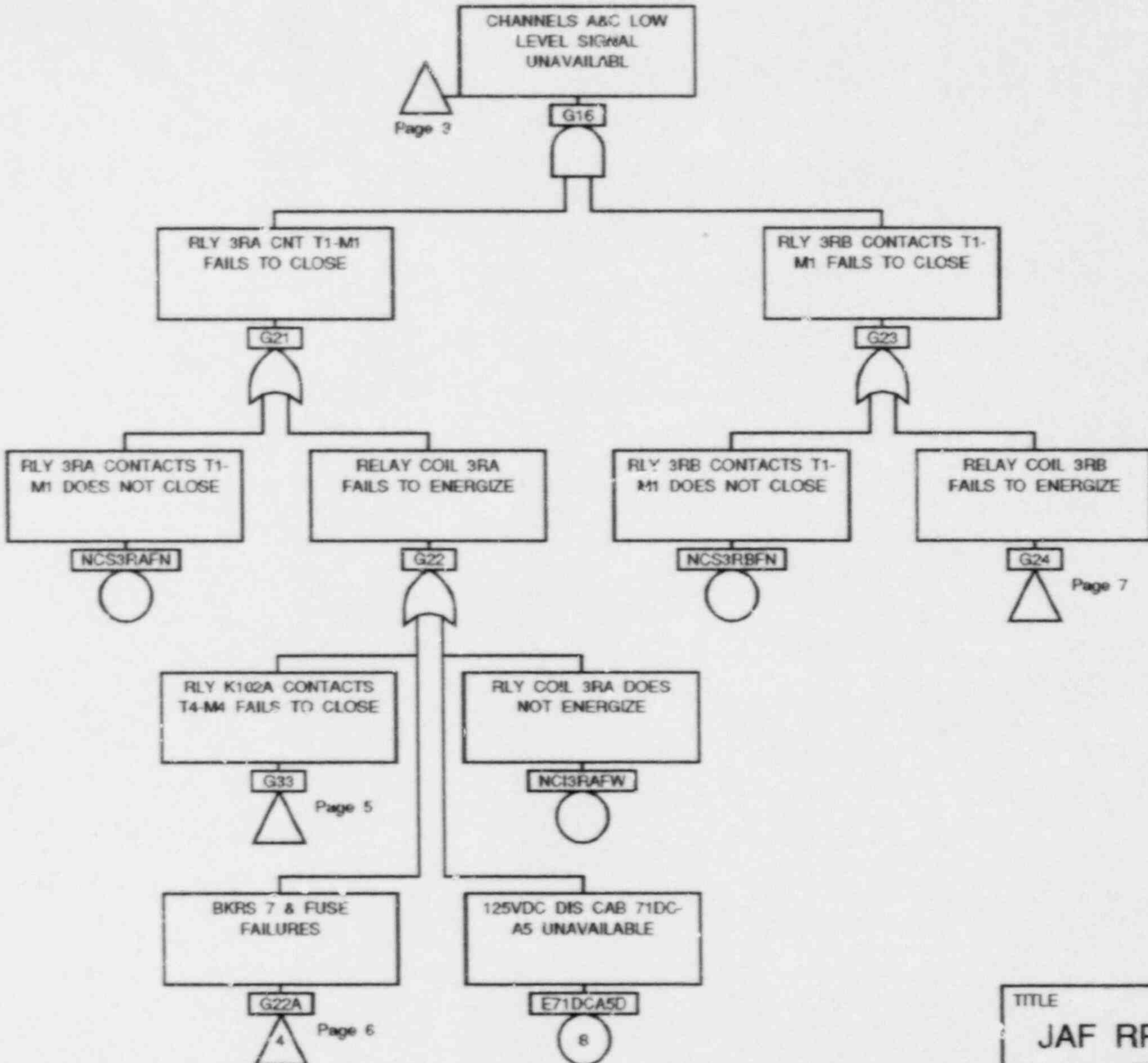
DRAWING NUMBER	DATE
Page 3	5/31/88



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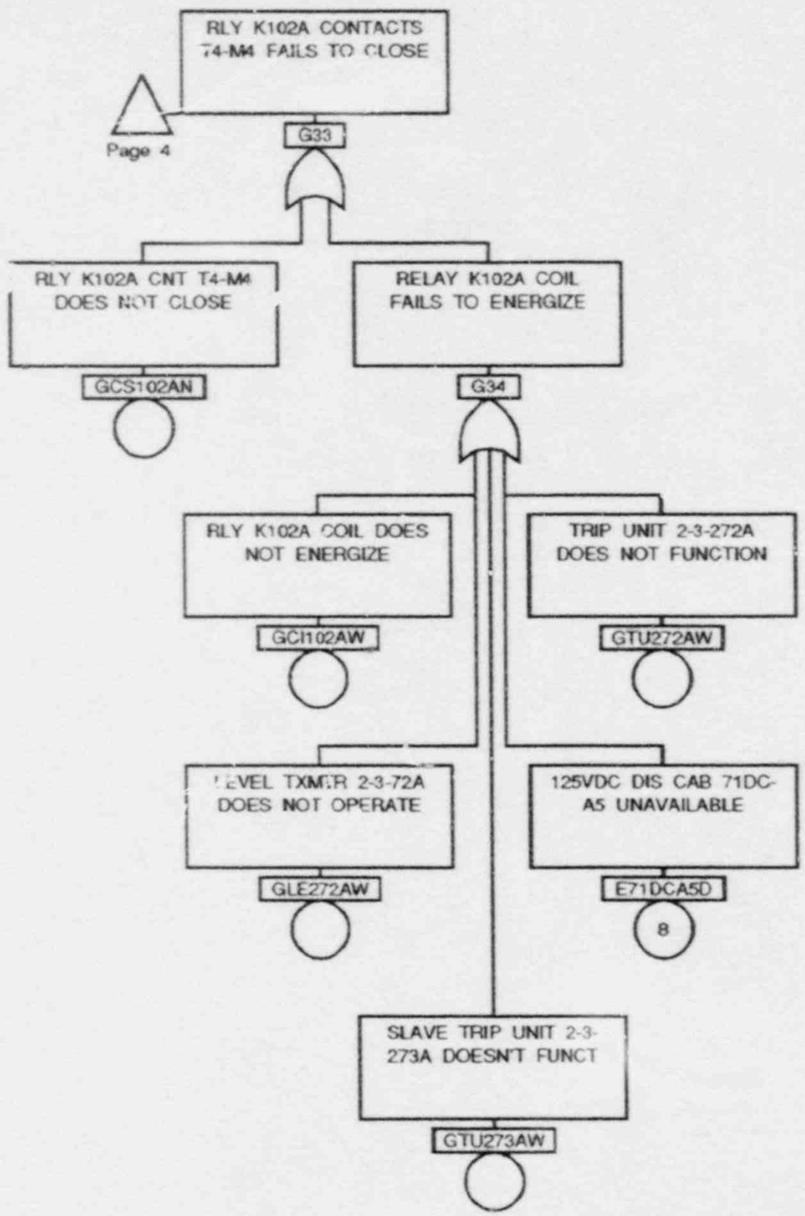

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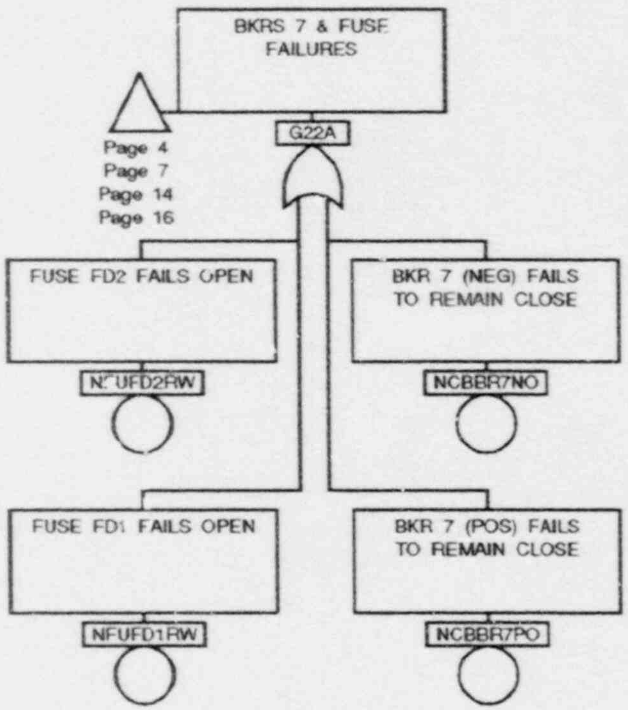

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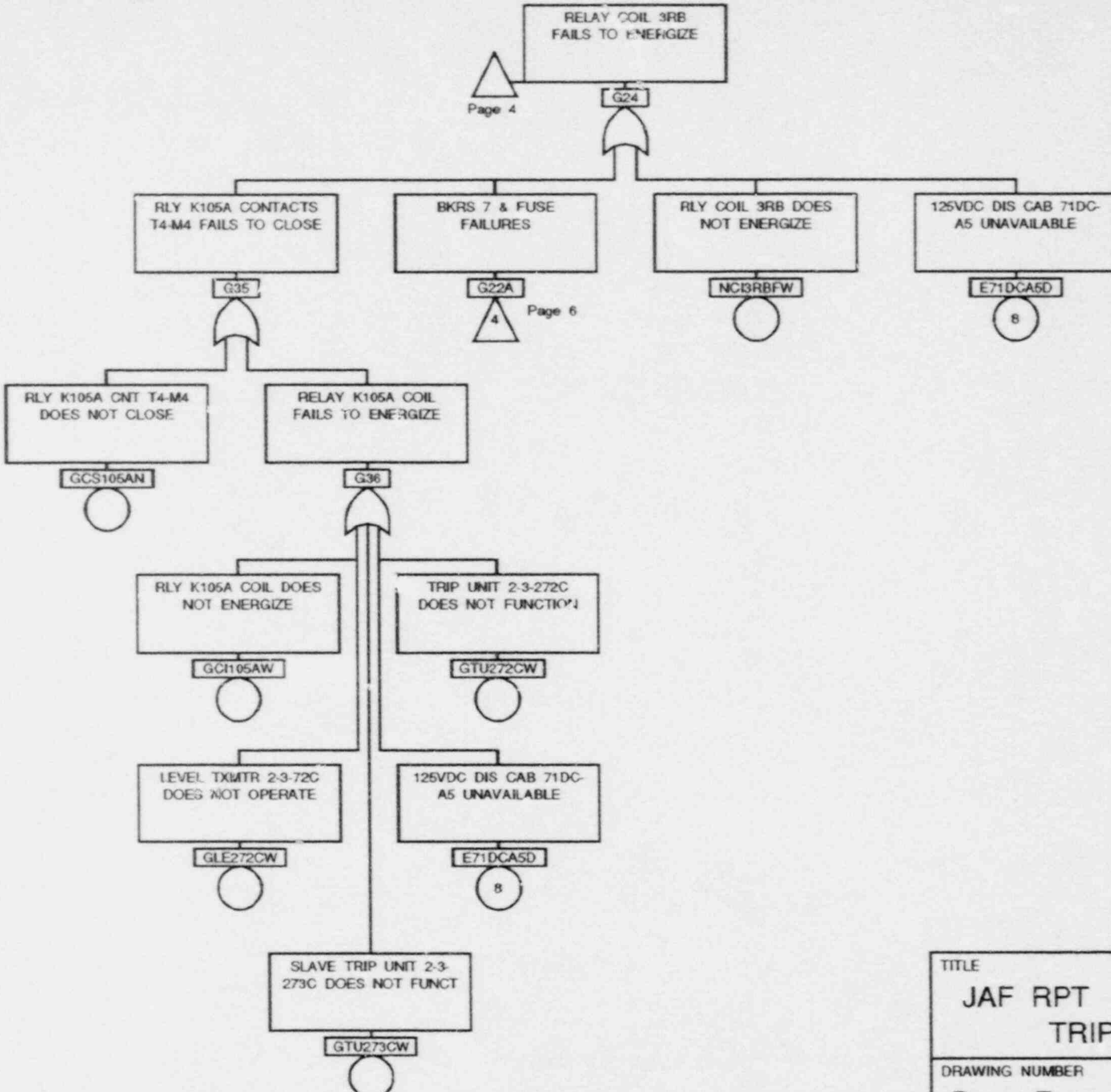

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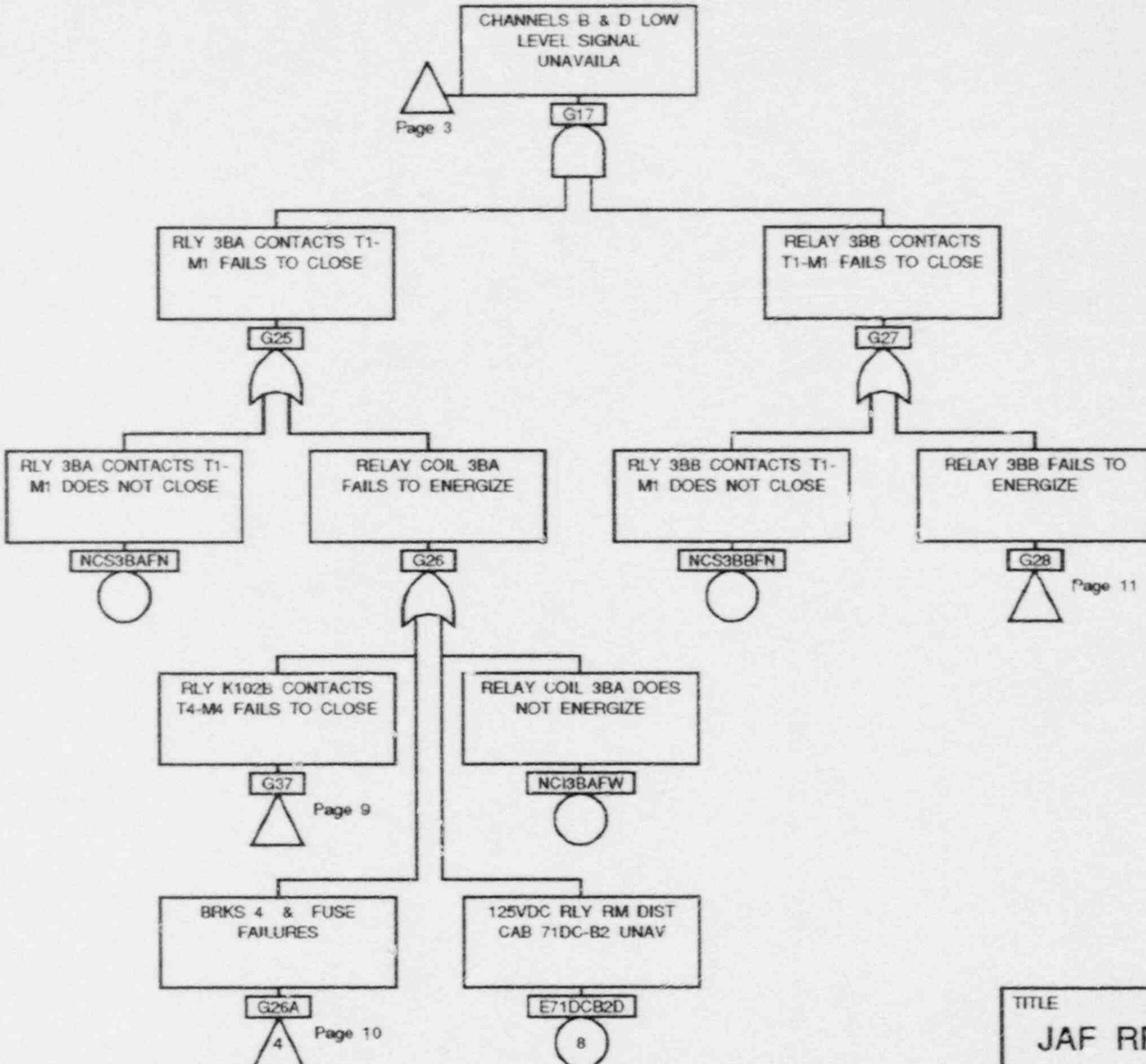

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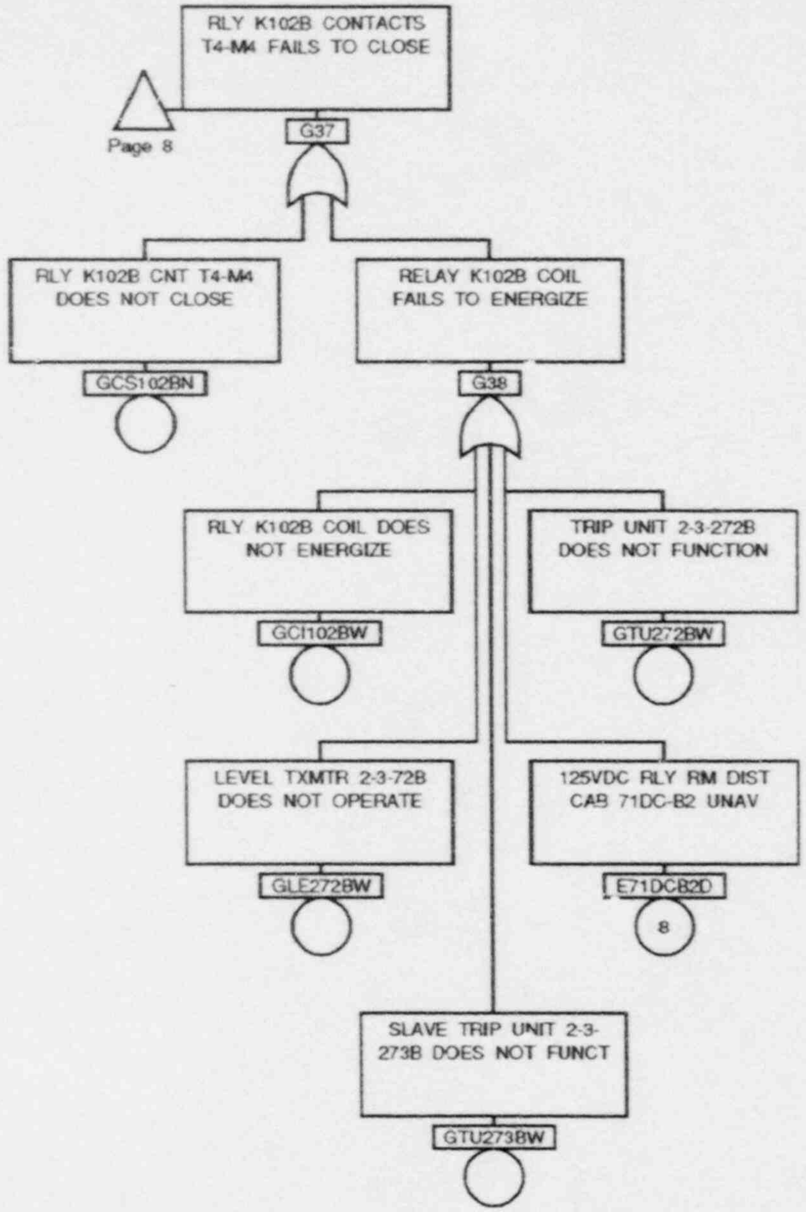

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JAF RPT (REDUNDANT TRIP COILS)

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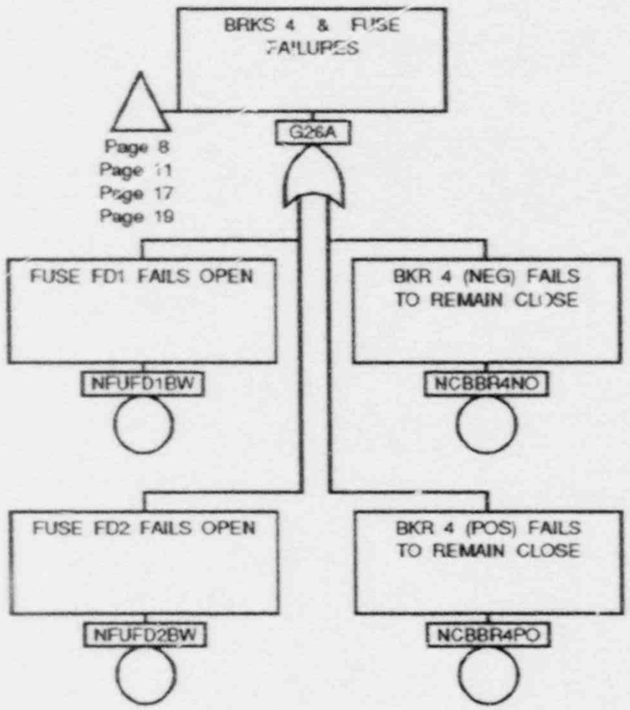
Page 9	5/31/88



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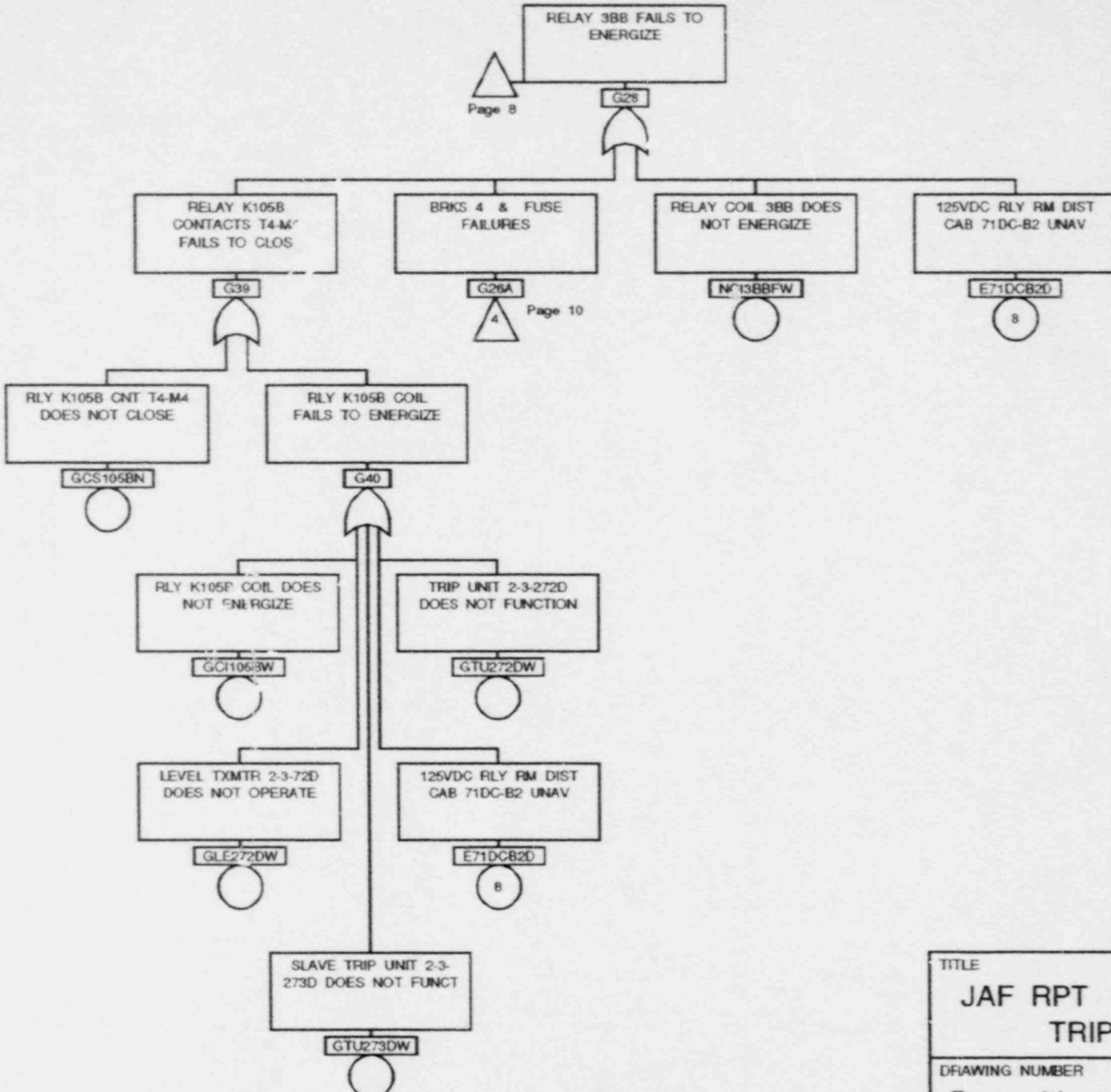

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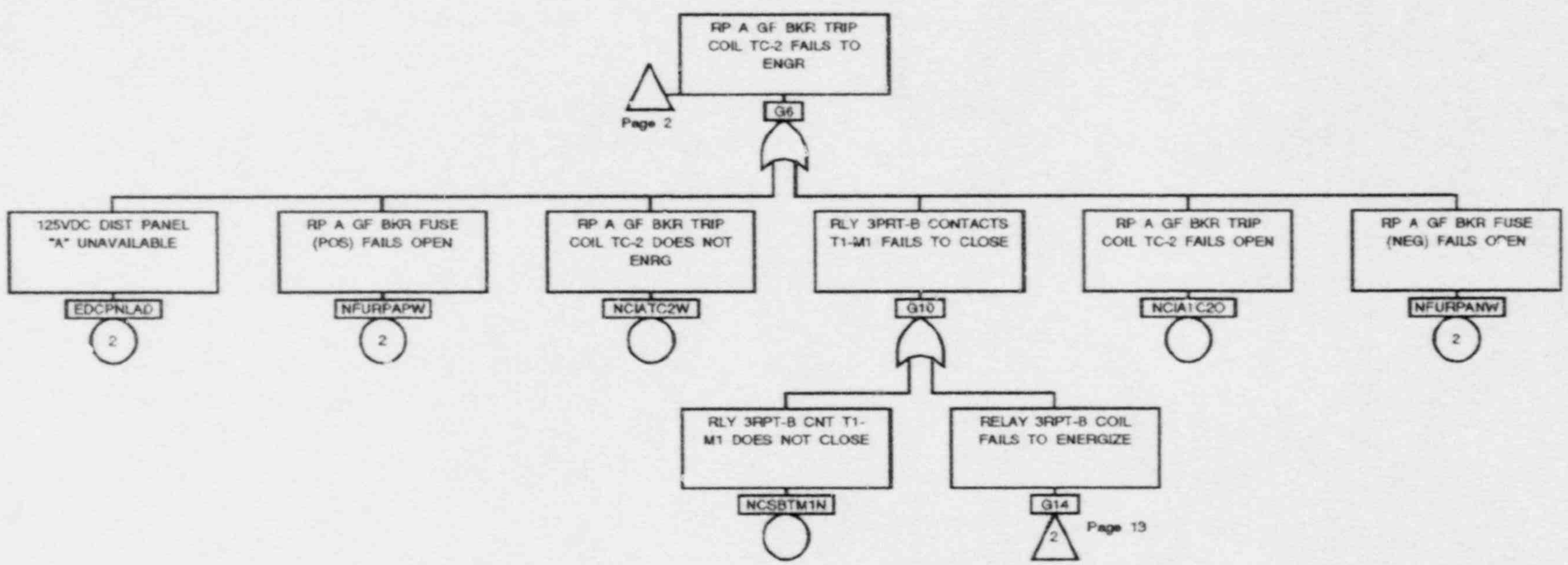

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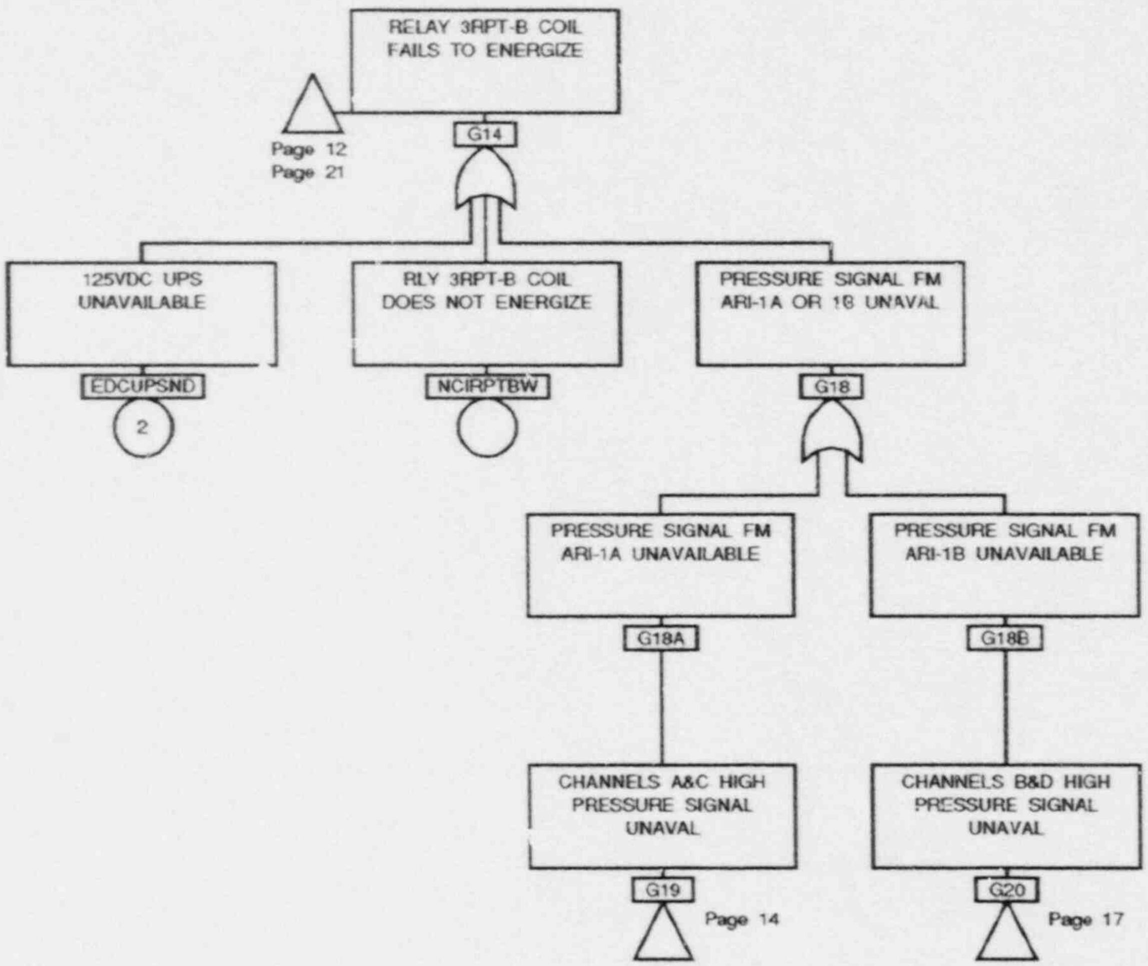

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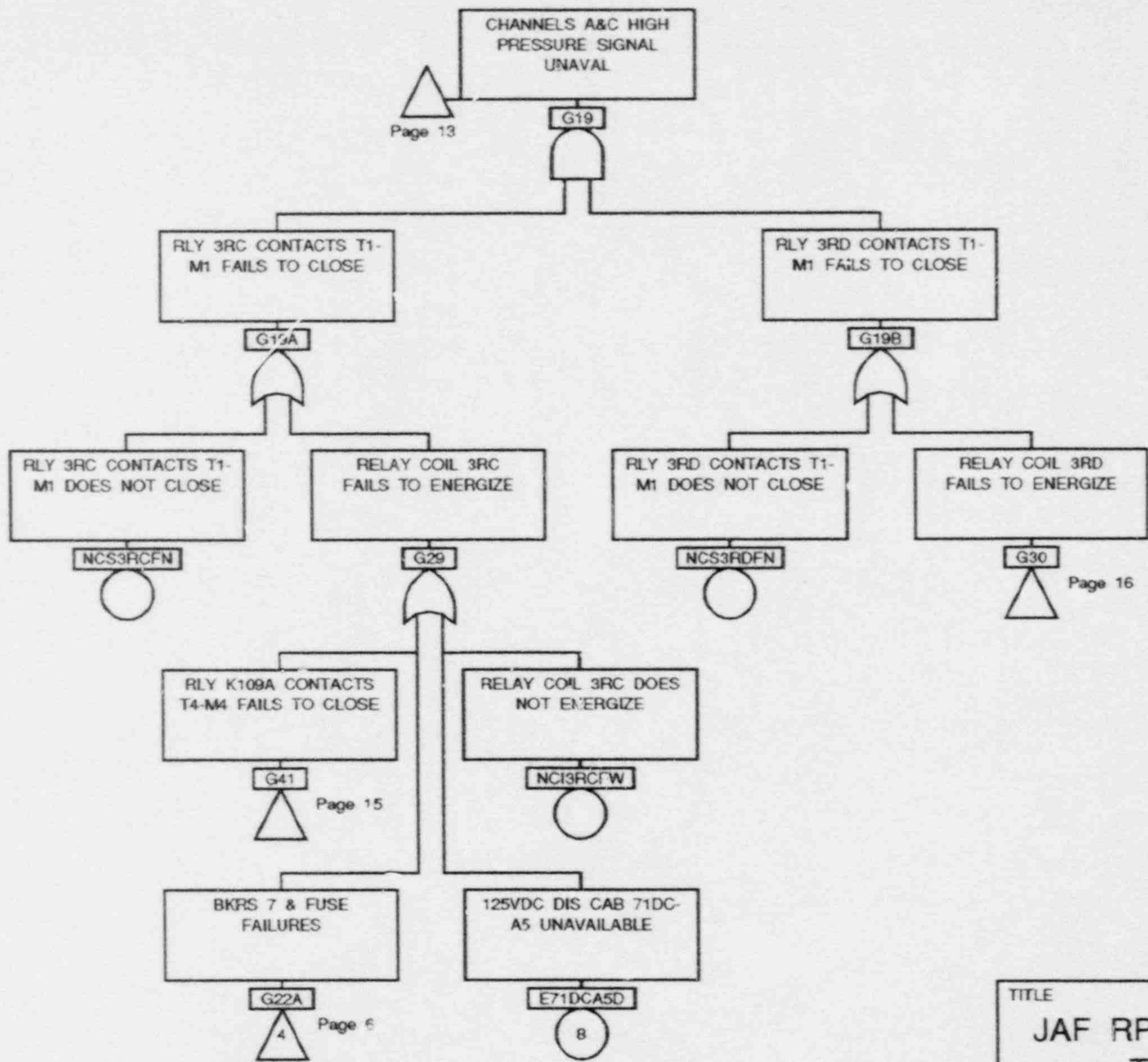

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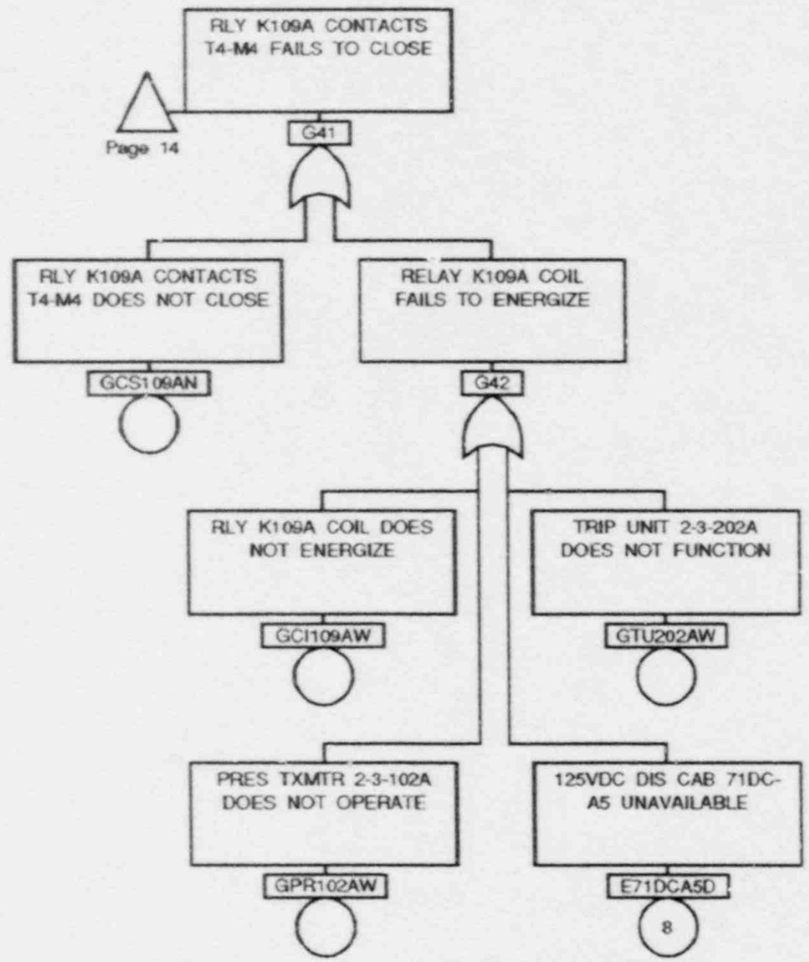

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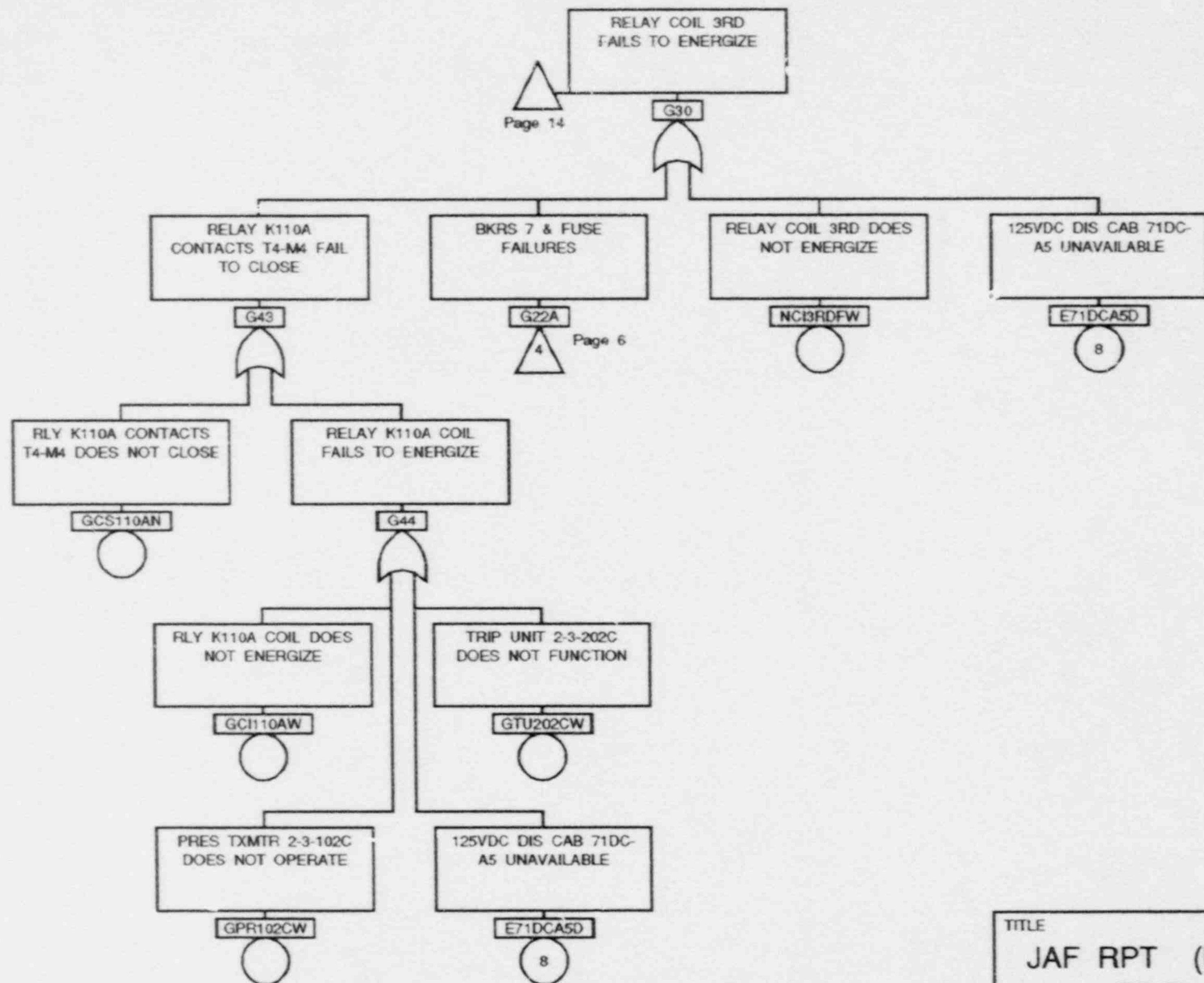

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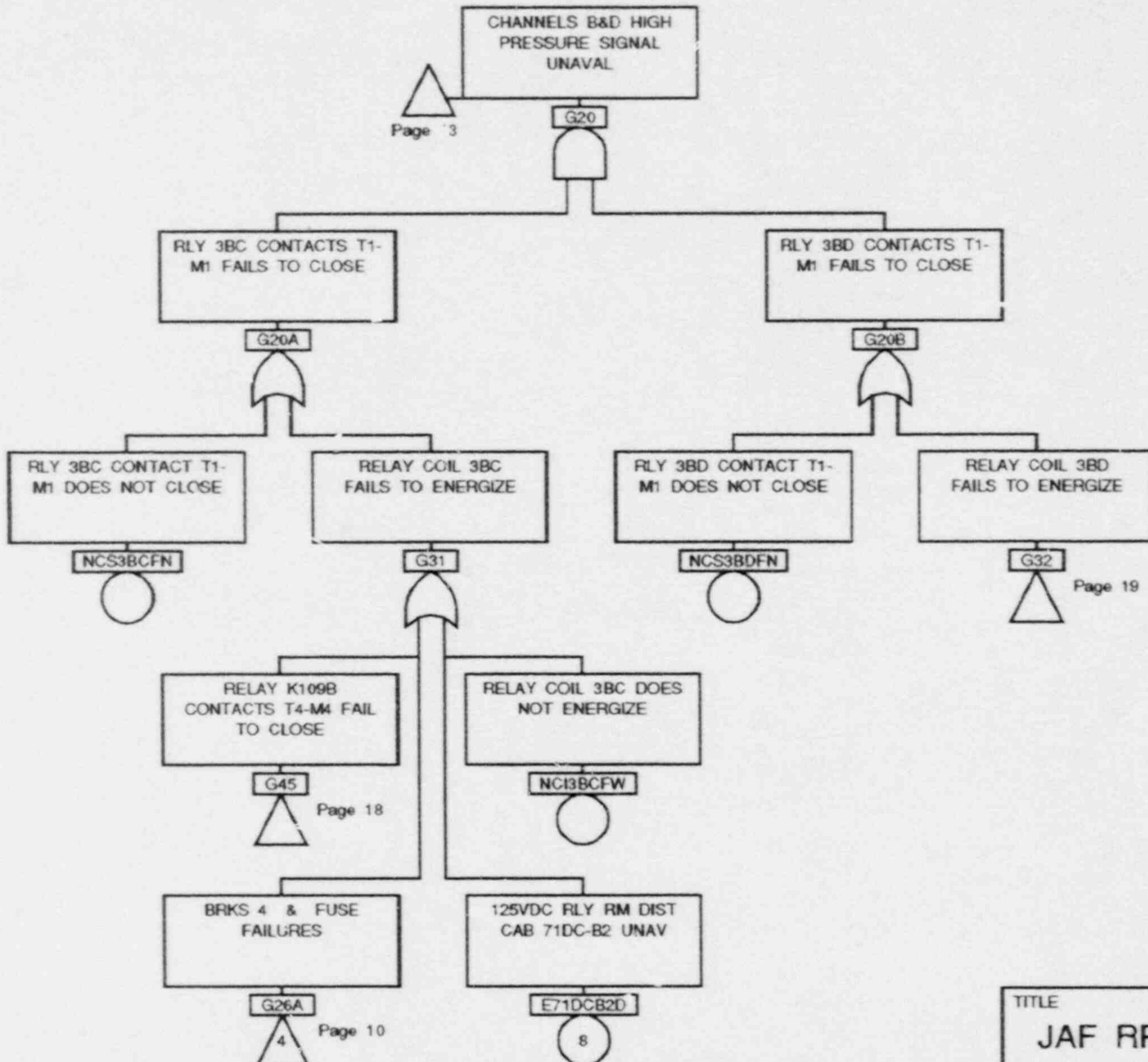

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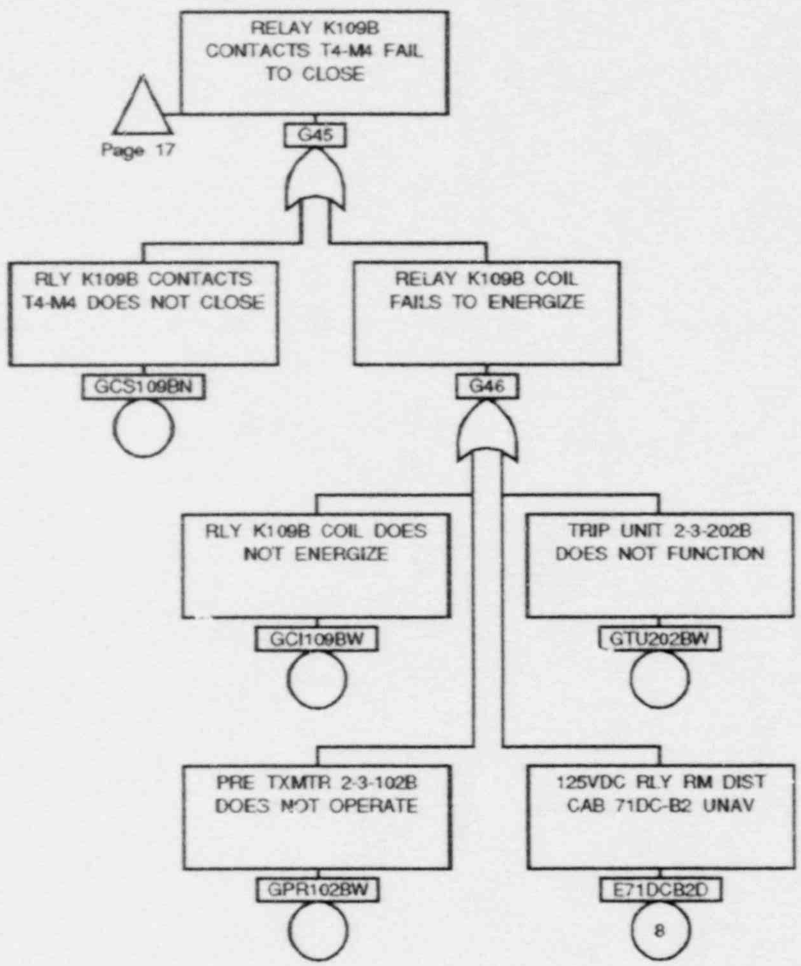

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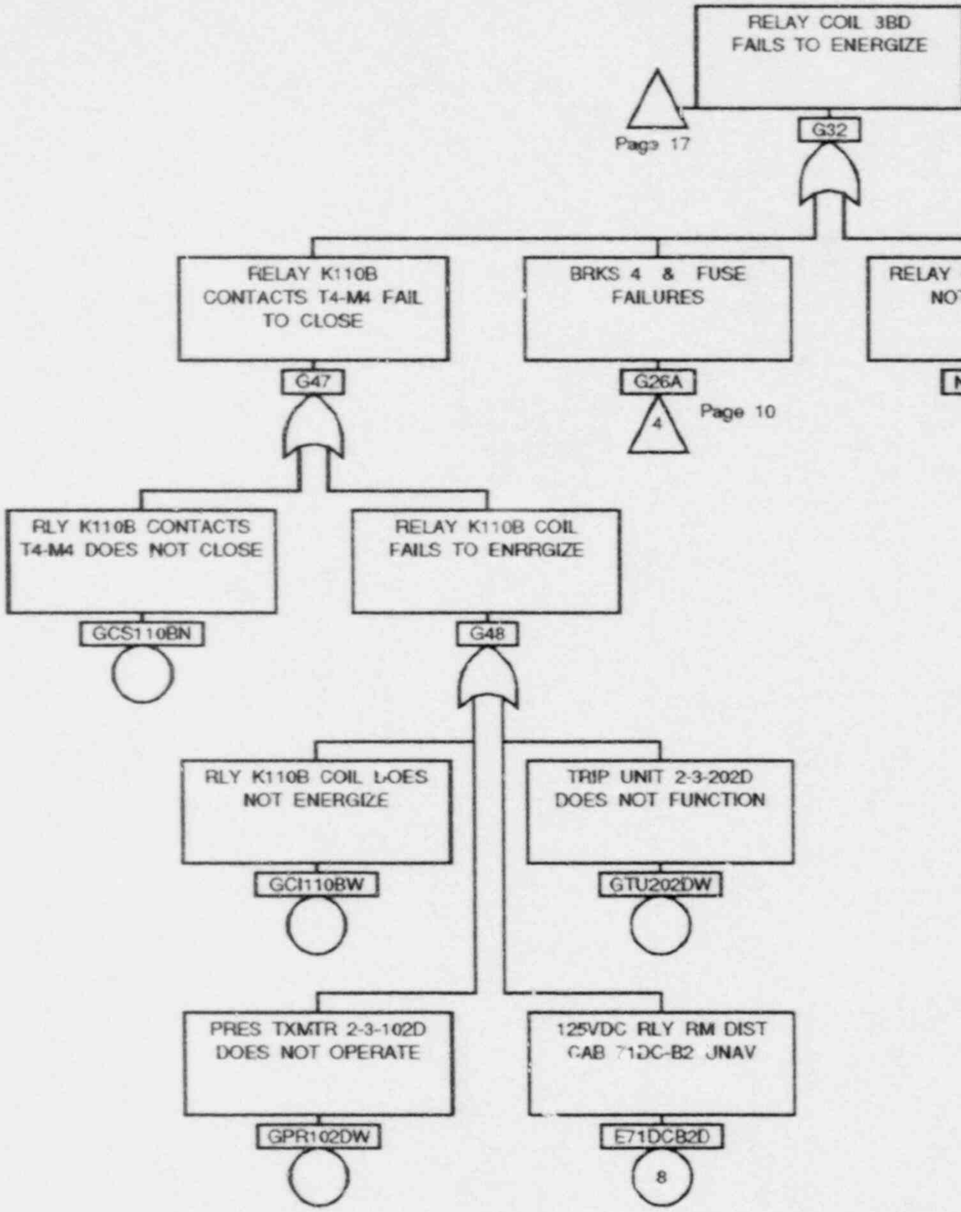

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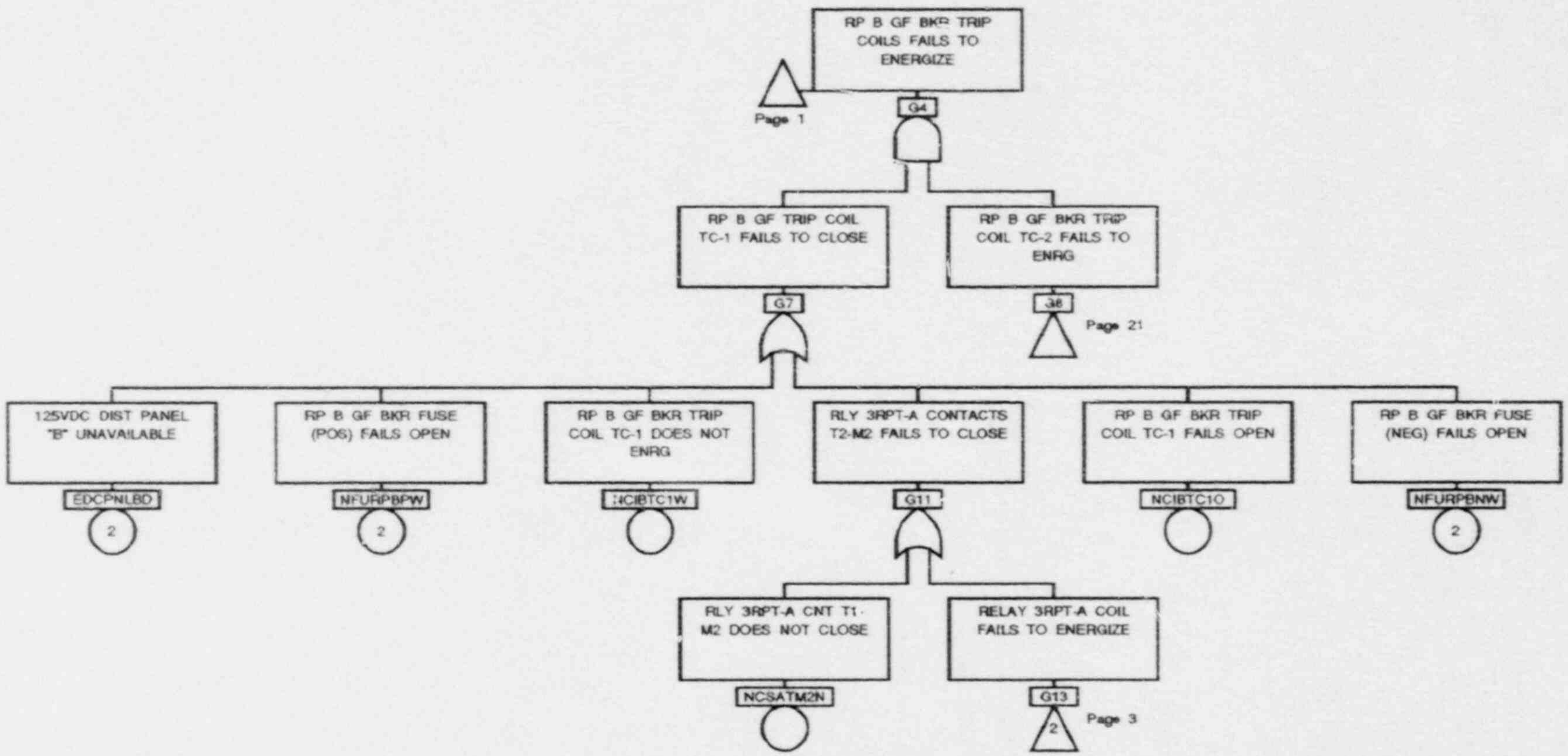

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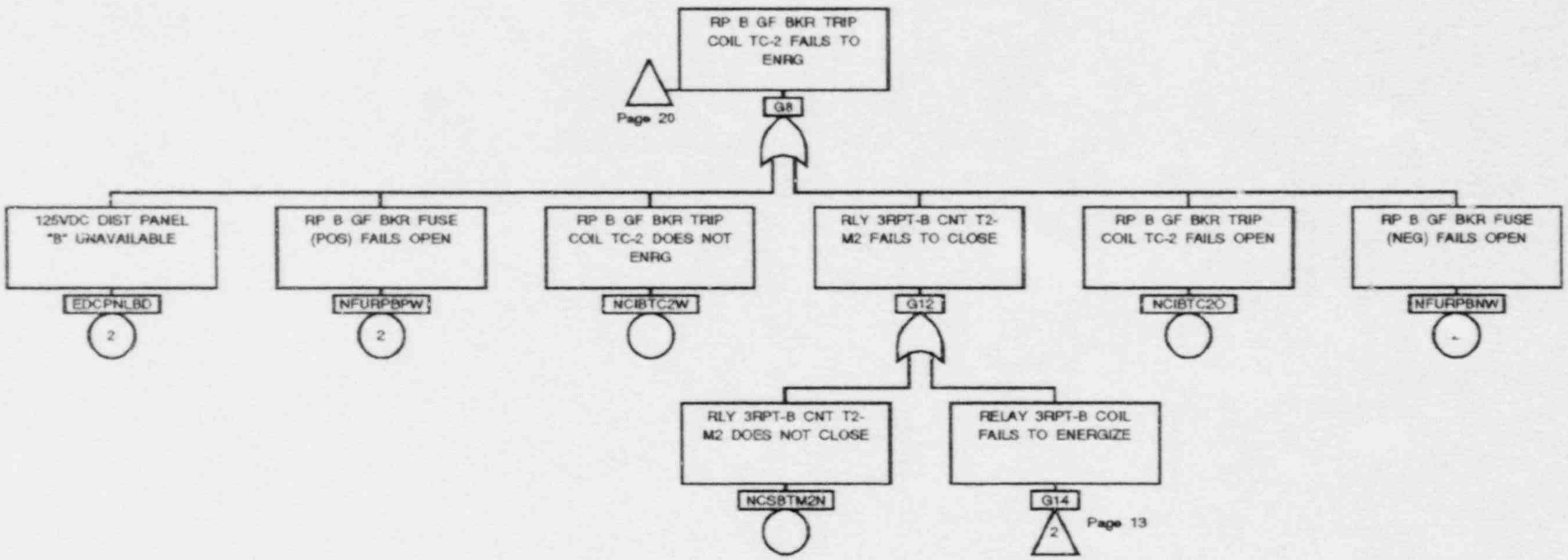

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DRAWING NUMBER Page 21	DATE 5/31/88

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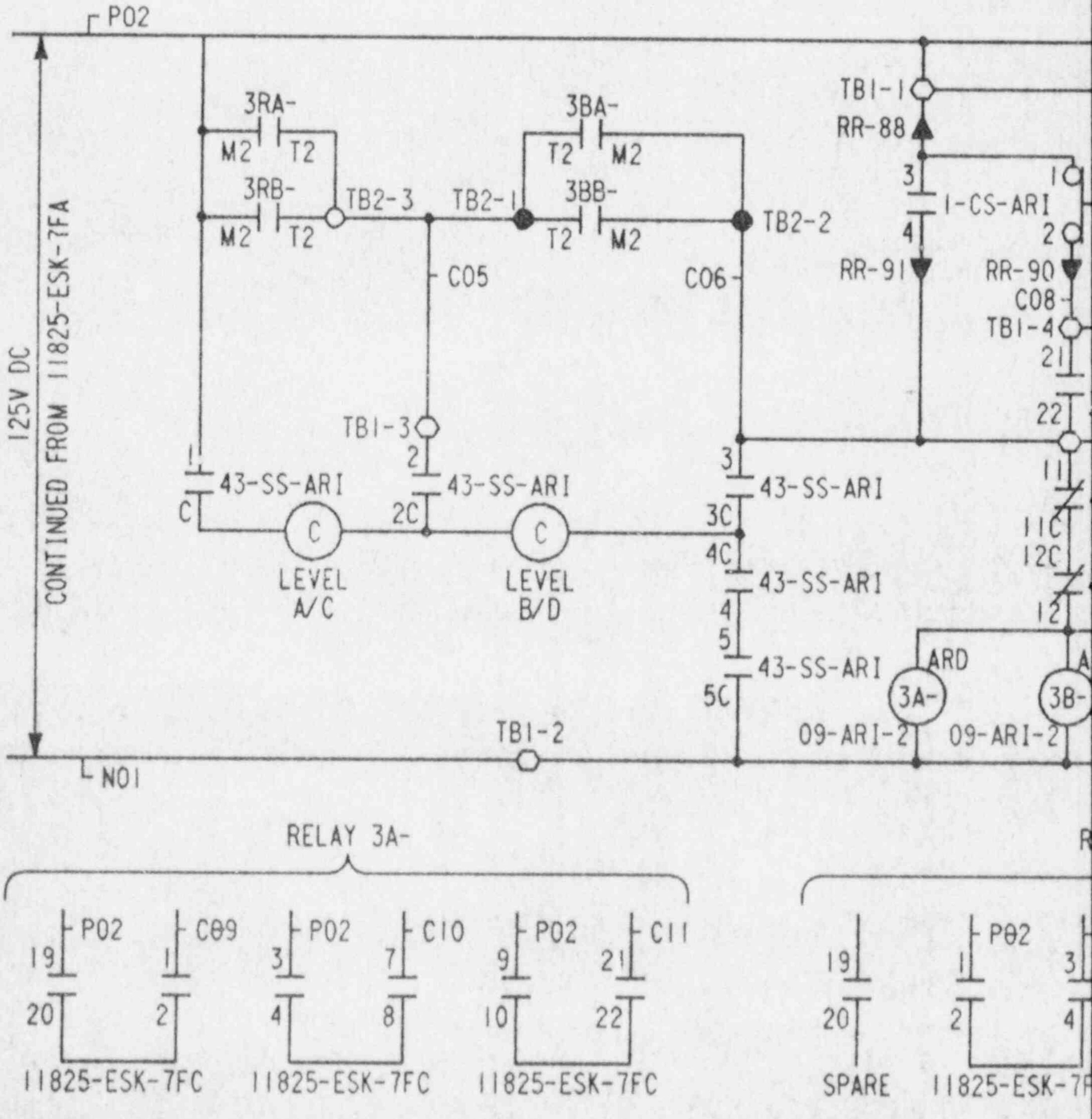
   -●- TERMINAL ON PANEL 09-ARI-1B
   -□- TERMINAL ON PANEL 09-95
   -■- TERMINAL ON PANEL 09-96
   -⬡- TERMINAL ON PANEL 09-ARI-2
   -⬢- TERMINAL IN TERM BOX JB-ARI01
   -△- TERMINAL IN VALVE JUNC BOX
   -▲- TERMINAL ON MN CONT BD 09-5
   -◪- TERMINAL ON 09-DAS-15

RELEASED FOR
BIDDING PURPOSES
CONSTRUCTION

DATE	ENGR.
12-24-87	



ZBO:[146,5]NYPAELEM.DGN

NEW YORK POWER AUTHORITY
MOD F1-85-053
JAMES A FITZPATRICK STATION UNIT 1

ELECTRICAL
ELEMENTARY DIAGRAM
ARI SYSTEM

MADE	CHKD	DRAWING NUMBER	SH. NO.	REV
TW 12/18/87	JJH 12/23/87	11825-ESK-7FB		0

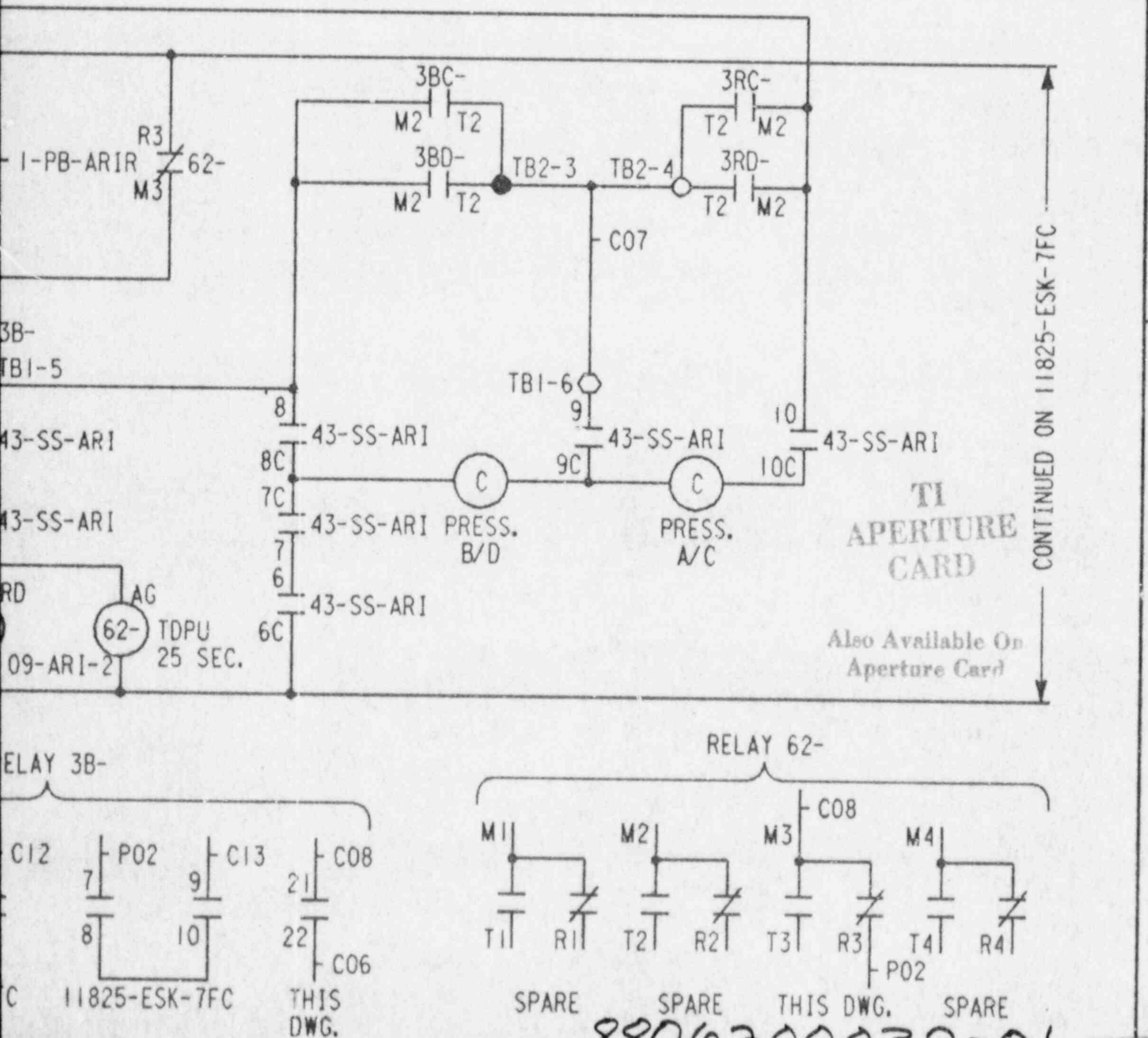
PDS: J.OT 12/24/87 — ENG INTERF: 1. 2.

SCALE: NONE — W.O. 045354000

GILBERT ASSOCIATES, INC
ENGINEERS AND CONSULTANTS
READING PA.

ENGINEER APPROVAL: J.G. Shingler — DEPT 0421 — DATE 12-24-87

REV	MADE	CH	PDS	APP	DATE	REV	MADE	CH	PDS	APP	DATE



8806200032-01

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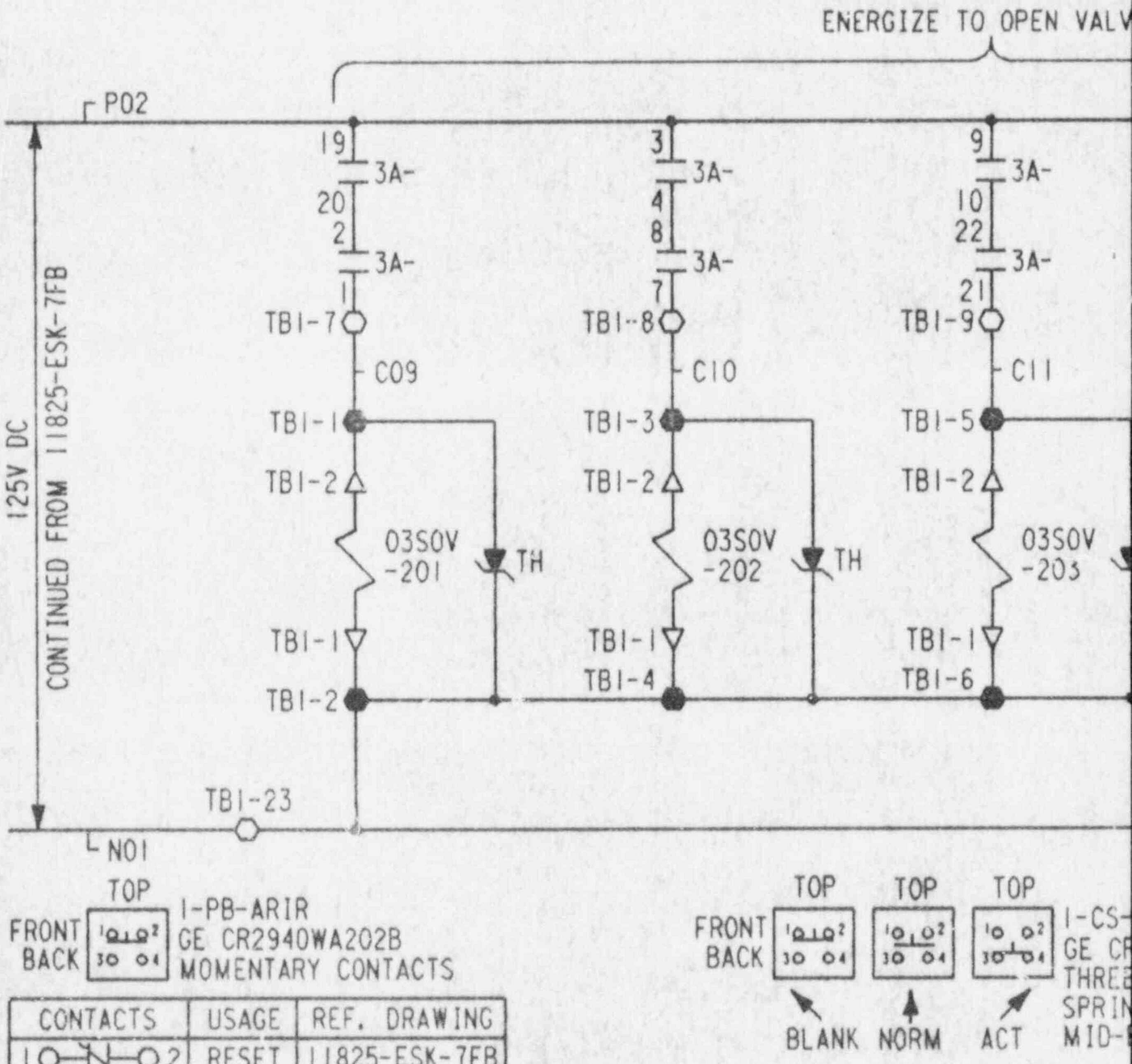
   TERMINAL ON PANEL 09-ARI-1B
   TERMINAL ON PANEL 09-95
   TERMINAL ON PANEL 09-96
   TERMINAL ON PANEL 09-ARI-2
   TERMINAL IN TERM BOX JB-ARI01
   TERMINAL IN VALVE JUNC BOX
   TERMINAL ON MN CONT BD 09-5
   TERMINAL ON 09-DAS-15

2. GE VARISTOR SERIES MA



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3 —||— 4	SPARE	NONE

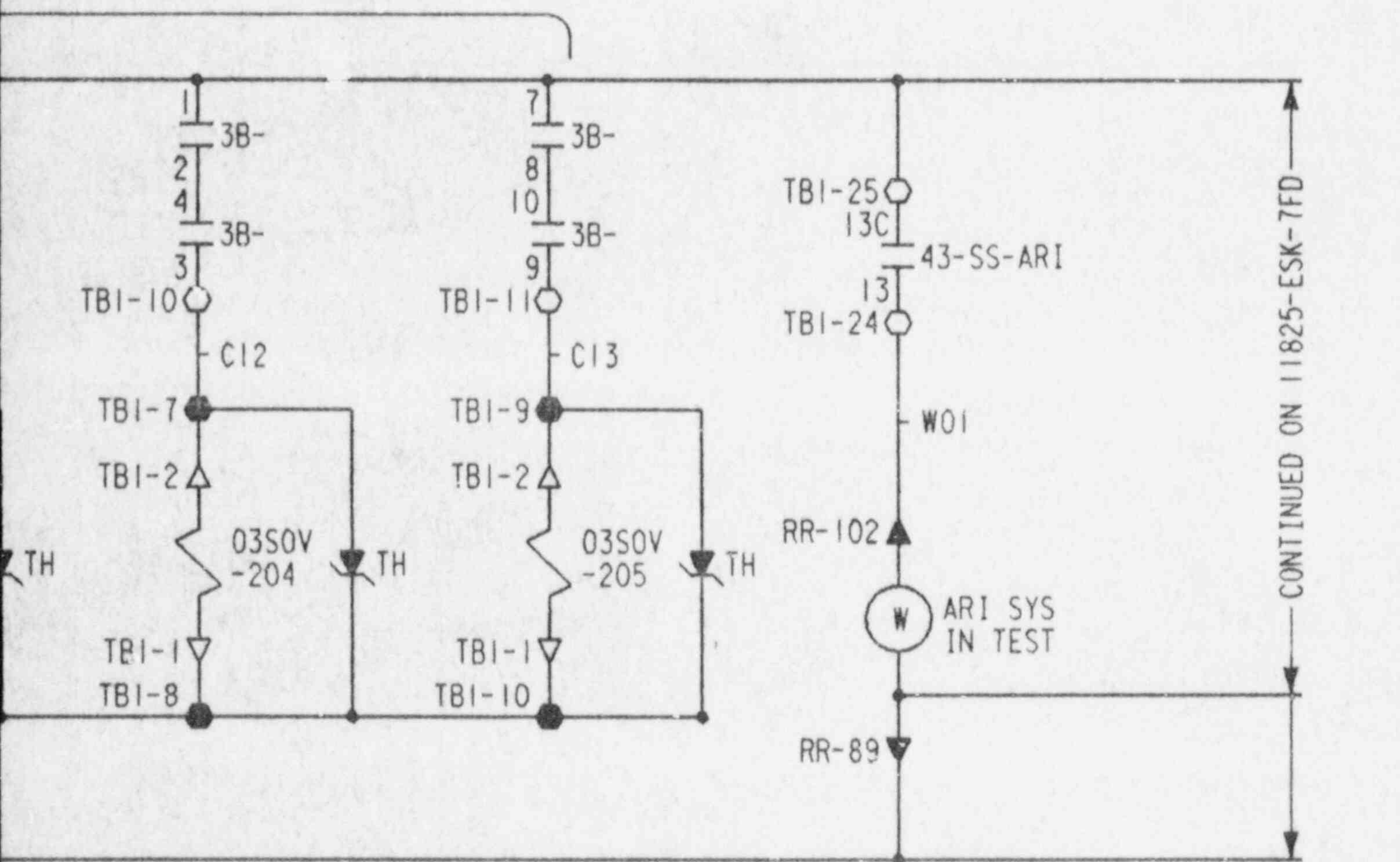
CONSTRUCTION
BIDDING PURPOSES
RELEASED FOR
12-24-87 DATE
ENGR.

ZBO:[146,5]NYPAELEM.DGN

NEW YORK POWER AUTHORITY MOD FI-85-053 JAMES A FITZPATRICK STATION UNIT I	MADE: TWO 10/28/87	CHKD: JJ fh 12/24/87	DRAWING NUMBER: 11825-ESK-7FC	SH. NO.	REV: 0
ELECTRICAL	POS: J. OT 12/24/87	ENG INTERF: 1. 12/23/87 2. —	GILBERT ASSOCIATES, INC ENGINEERS AND CONSULTANTS READING PA.		
ELEMENTARY DIAGRAM	SCALE: NONE		gB Shumyler — ENGINEER APPROVAL	0421 — DEPT	12-24-87 — DATE
ARI SYSTEM	W. O. 045354000				

REV	MADE	CH	PDS	APP	DATE	REV	MADE	CH	PDS	APP	DATE

ES



ARI
2940US202B
POSITION
G RETURN TO
POSITION

CONTACTS	BLANK	NORM	ACT	USAGE	REF. DRAWING
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3○–┤ ├–○4			X	MANUAL ACT	11825-ESK-7FB

TI APERTURE CARD

Also Available On Aperture Card

8806200032-02

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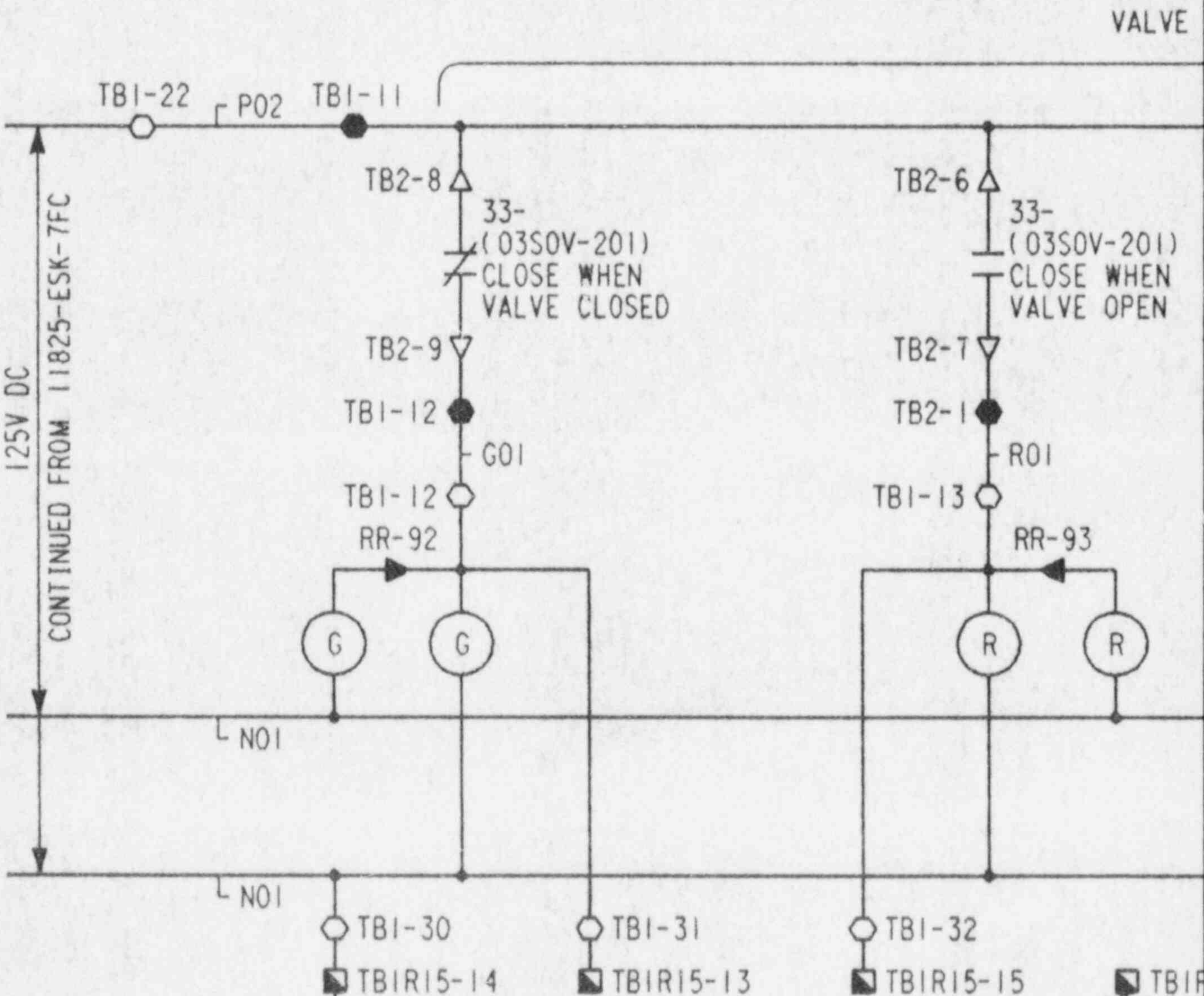
   -●- TERMINAL ON PANEL 09-ARI-1B
   -□- TERMINAL ON PANEL 09-95
   -■- TERMINAL ON PANEL 09-96
   -⬡- TERMINAL ON PANEL 09-ARI-2
   -⬢- TERMINAL IN TERM BOX JB-ARIC1
   -◁- TERMINAL IN VALVE JUNC BOX
   -◀- TERMINAL ON MN CONT BD 09-5
   -◪- TERMINAL ON 09-DAS-15



RELEASED FOR	DATE	ENGR.
BIDDING PURPOSES		
CONSTRUCTION	12-24-87	

ZBO:[146,5]NYPAELEM.DGN

NEW YORK POWER AUTHORITY
MOD FI-85-053
JAMES A FITZPATRICK STATION UNIT 1

ELECTRICAL
ELEMENTARY DIAGRAM
ARI SYSTEM

MADE	CHKD	DRAWING NUMBER	SH. NO.	REV
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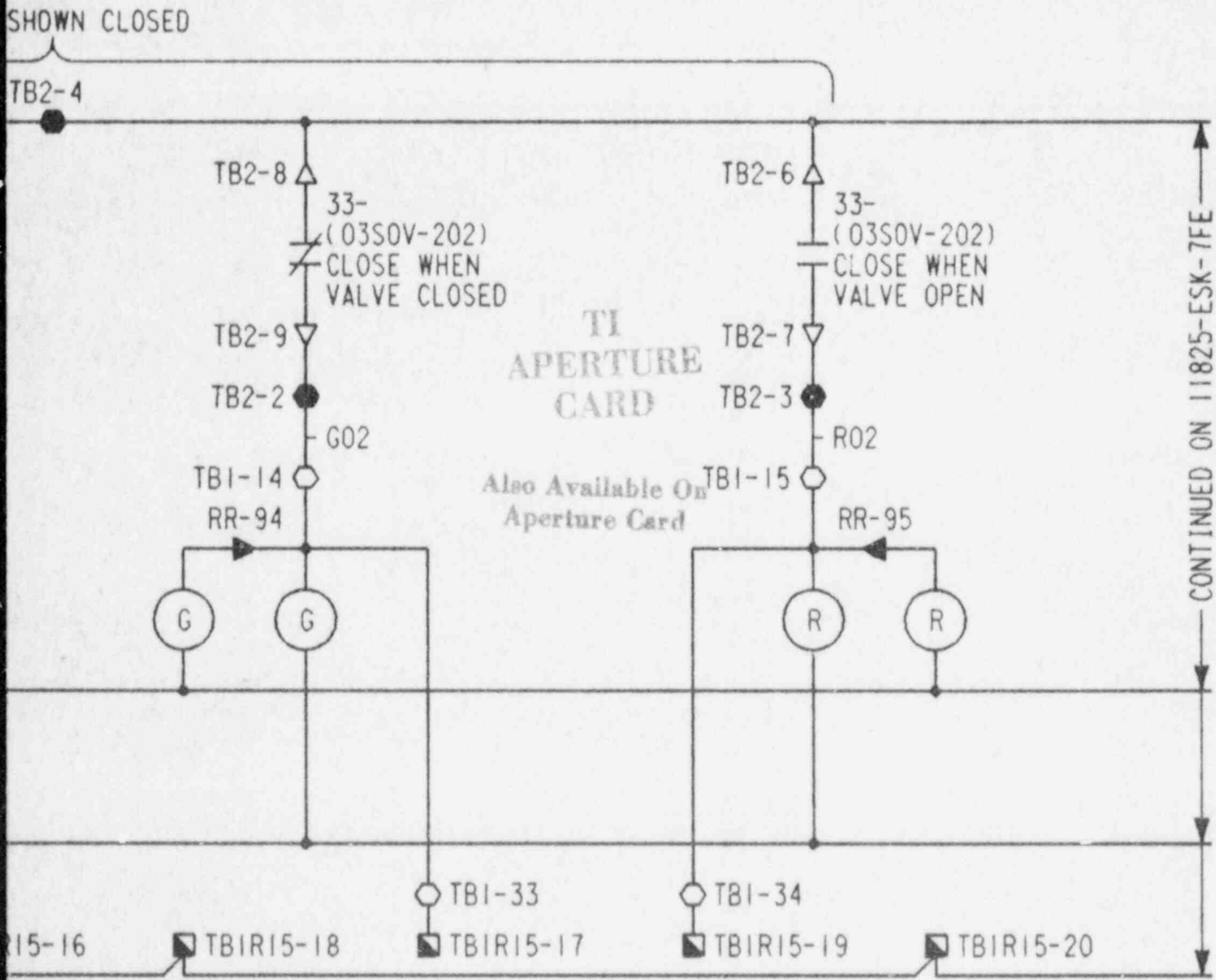
PDS: 12/24/87 — ENG INTERF: 1. 12/24/87 2.

GILBERT ASSOCIATES, INC
ENGINEERS AND CONSULTANTS
READING PA.

SCALE: NONE
W. O. 04535-4000
ENGINEER APPROVAL — DEPT 0421 — DATE 12-24-87

REV	MADE	CH	PDS	APP	DATE	REV	MADE	CH	PDS	APP	DATE



8806200032-03

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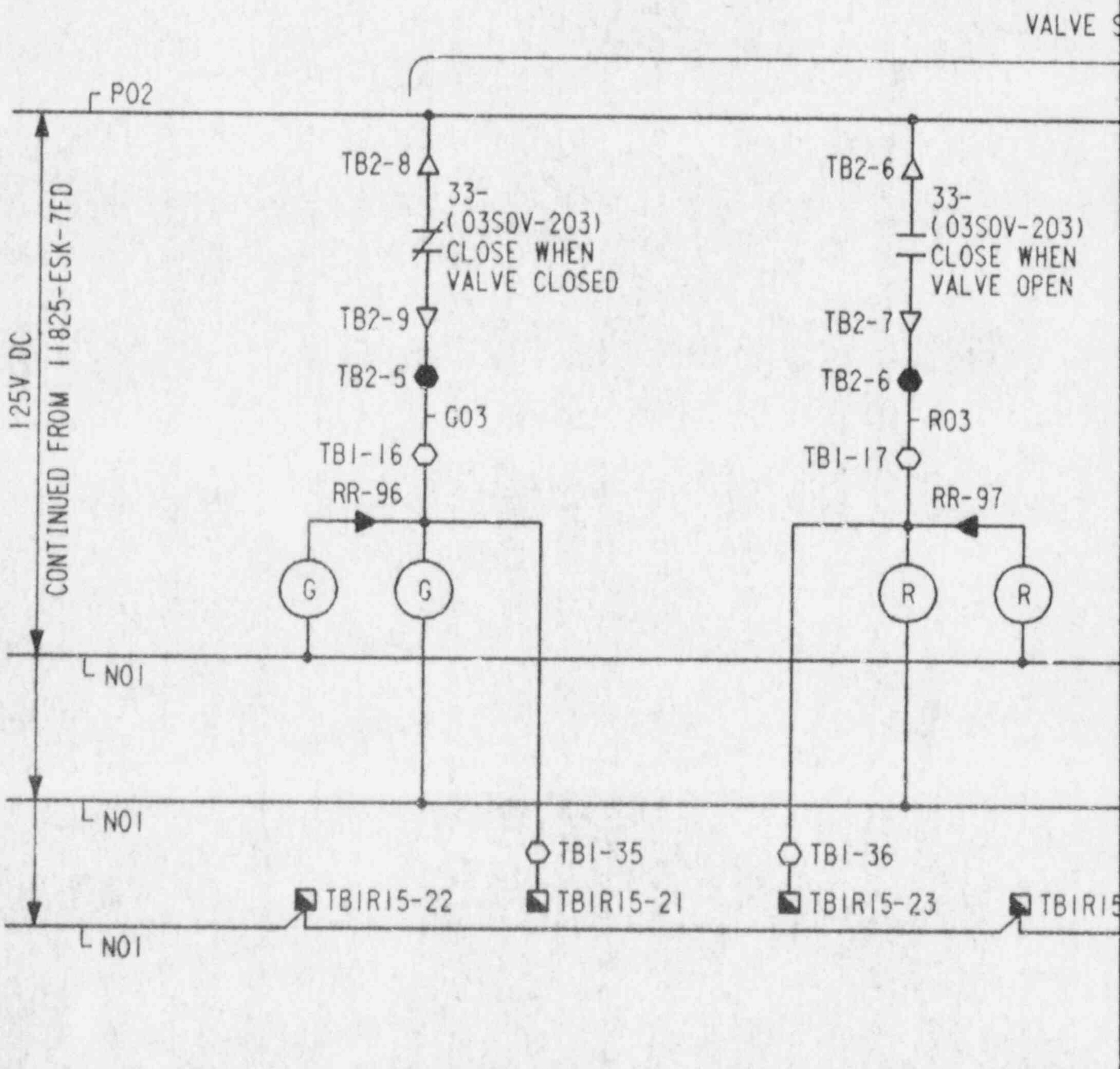
- -□- TERMINAL ON PANEL 09-95
- -■- TERMINAL ON PANEL 09-96
- -⬡- TERMINAL ON PANEL 09-ARI-2
- -⬢- TERMINAL IN TERM BOX JB-ARIC1
- -△- TERMINAL IN VALVE JUNC BOX
- -▲- TERMINAL ON MN CONT BD 09-5
- -◩- TERMINAL ON 09-DAS-15

CONSTRUCTION | BIDDING PURPOSES | RELEASED FOR | DATE | ENGR.



ZBO:[146,5]NYPAELEM.DGN

NEW YORK POWER AUTHORITY
MOD FI-85-053
JAMES A FITZPATRICK STATION UNIT I

ELECTRICAL
ELEMENTARY DIAGRAM
ARI SYSTEM

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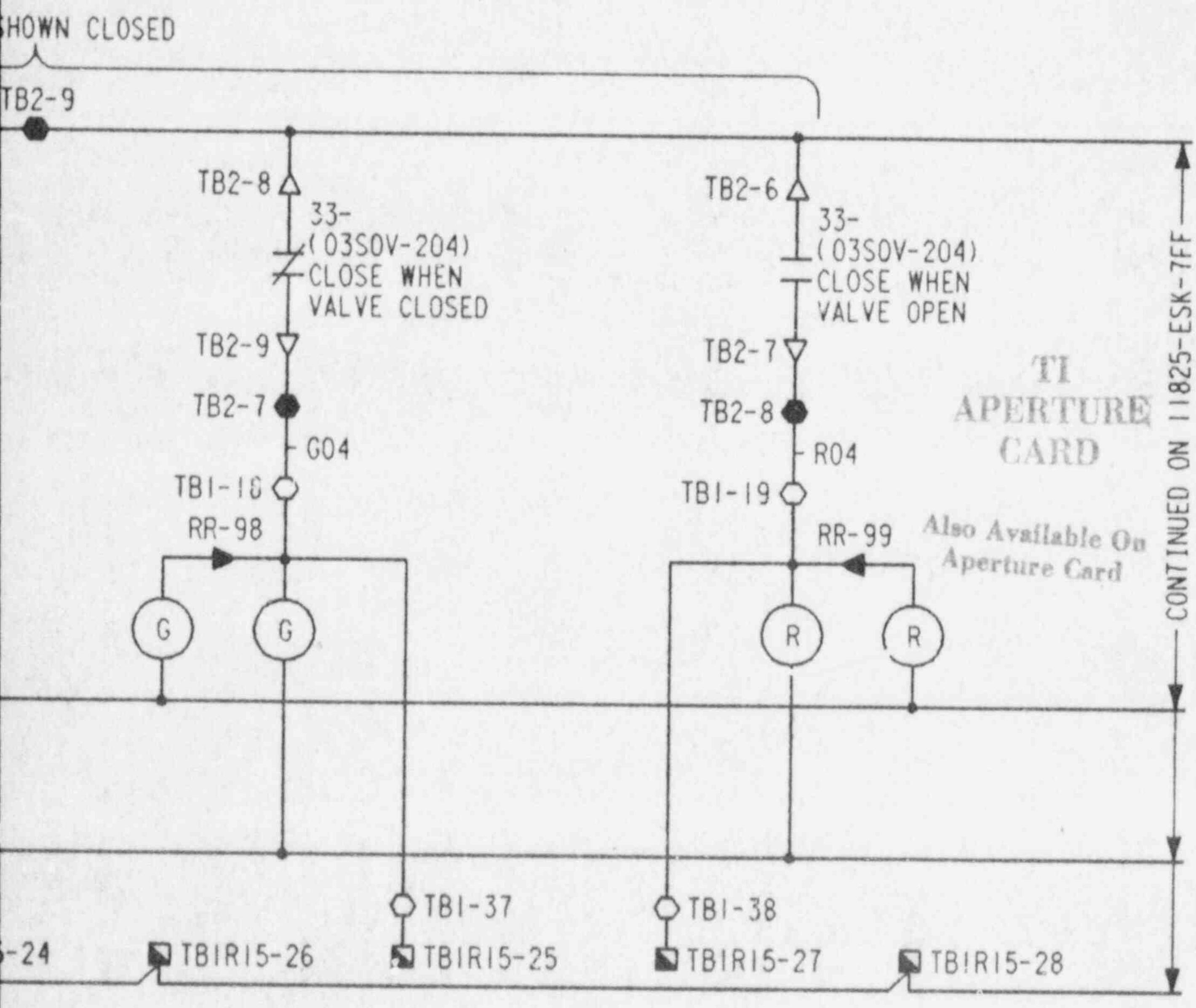
PDS	ENG INTERF	
J OK	1. [illegible] 2.	GILBERT ASSOCIATES, INC ENGINEERS AND CONSULTANTS READING PA.

SCALE NONE
W.O. 045354000

J A Shungler 0421 12-24-87
ENGINEER APPROVAL DEPT DATE

REV	MADE	CH	PDS	APP	DATE	REV	MADE	CH	PDS	APP	DATE



TI
APERTURE
CARD

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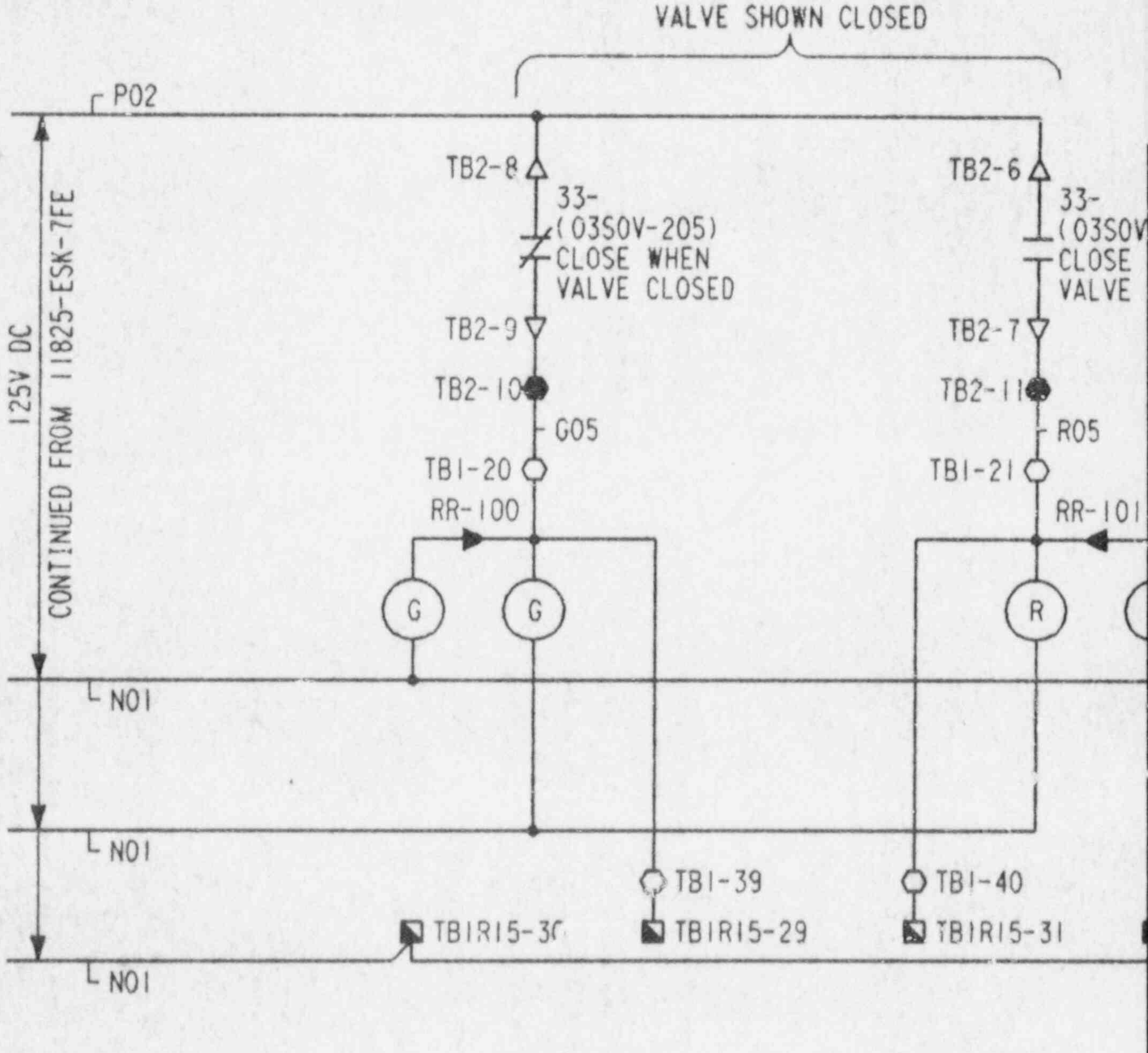
Aperture Card

8806200032-04

NOTES:

1. -○- TERMINAL ON PANEL 09-ARI-1A
   -●- TERMINAL ON PANEL 09-ARI-1B
   -□- TERMINAL ON PANEL 09-95
   -■- TERMINAL ON PANEL 09-96
   -⬡- TERMINAL ON PANEL 09-ARI-2
   -⬢- TERMINAL IN TERM BOX JB-ARI01
   -△- TERMINAL IN VALVE JUNC BOX
   -▲- TERMINAL ON MN CONT BD 09-5
   -◩- TERMINAL ON 09-DAS-15

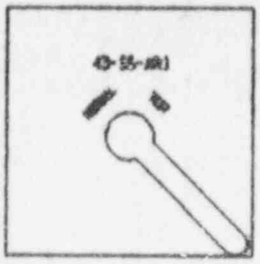


CONSTRUCTION		
BIDDING PURPOSES		
RELEASED FOR	DATE	ENGR.

ZBO:[146,5]NYPAELEM.DGN

NEW YORK POWER AUTHORITY MOD F1-85-053 JAMES A FITZPATRICK STATION UNIT 1	MADE TWO	CHKD	DRAWING NUMBER 11825-ESK-7FF	SH. NO. / REV 0
ELECTRICAL ELEMENTARY DIAGRAM ARI SYSTEM	PDS	ENG INTERF	GILBERT ASSOCIATES, INC ENGINEERS AND CONSULTANTS READING PA.	
	SCALE NONE	W.O. 045354000	ENGINEER APPROVAL	DEPT 0421 DATE 12-24-87

REV	MADE	CH	PDS	APP	DATE	REV	MADE	CH	PDS	APP	DATE



GE TYPE SBM SWITCH
MAINTAINED CONTACTS
PISTOL GRIP HANDLE
STANDARD EXCUTCHEON PLATE

CONTACTS HANDLE END ODD	CONTACTS HANDLE END EVEN	CONTACTS	TEST	NORMAL	USAGE	REFERENCE DRAWING
1 — 1C	2C — 2	1	X		LVL A/C LT	11825-ESK-7FB
		2	X		LVL LTS	11825-ESK-7FB
3 — 3C	4C — 4	3	X		LVL B/D LT	11825-ESK-7FB
		4	X		LVL LTS	11825-ESK-7FB
5 — 5C	6C — 6	5	X		LVL LTS	11825-ESK-7FB
		6	X		PRESS LTS	11825-ESK-7FB
7 — 7C	8C — 8	7	X		PRESS LTS	11825-ESK-7FB
		8	X		PRESS B/D LT	11825-ESK-7FB
9 — 9C	10C — 10	9	X		PRESS LTS	11825-ESK-7FB
		10	X		PRESS A/C LT	11825-ESK-7FB
11 — 11C	12C — 12	11		X	RELAY ACT	11825-ESK-7FB
		12		X	RELAY ACT	11825-ESK-7FB
13 — 13C	14C — 14	13	X		TEST IND LT	11825-ESK-7FC
		14	X		SPARE	THIS DWG

-205)
WHEN
OPEN

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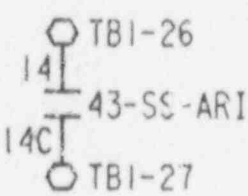
TB1R15-32



SPARE

8806200032-05

NOTES:

1. -O- TERMINAL ON PANEL 09-ARI-1A
-●- TERMINAL ON PANEL 09-ARI-1B
-□- TERMINAL ON PANEL 09-95
-■- TERMINAL ON PANEL 09-96
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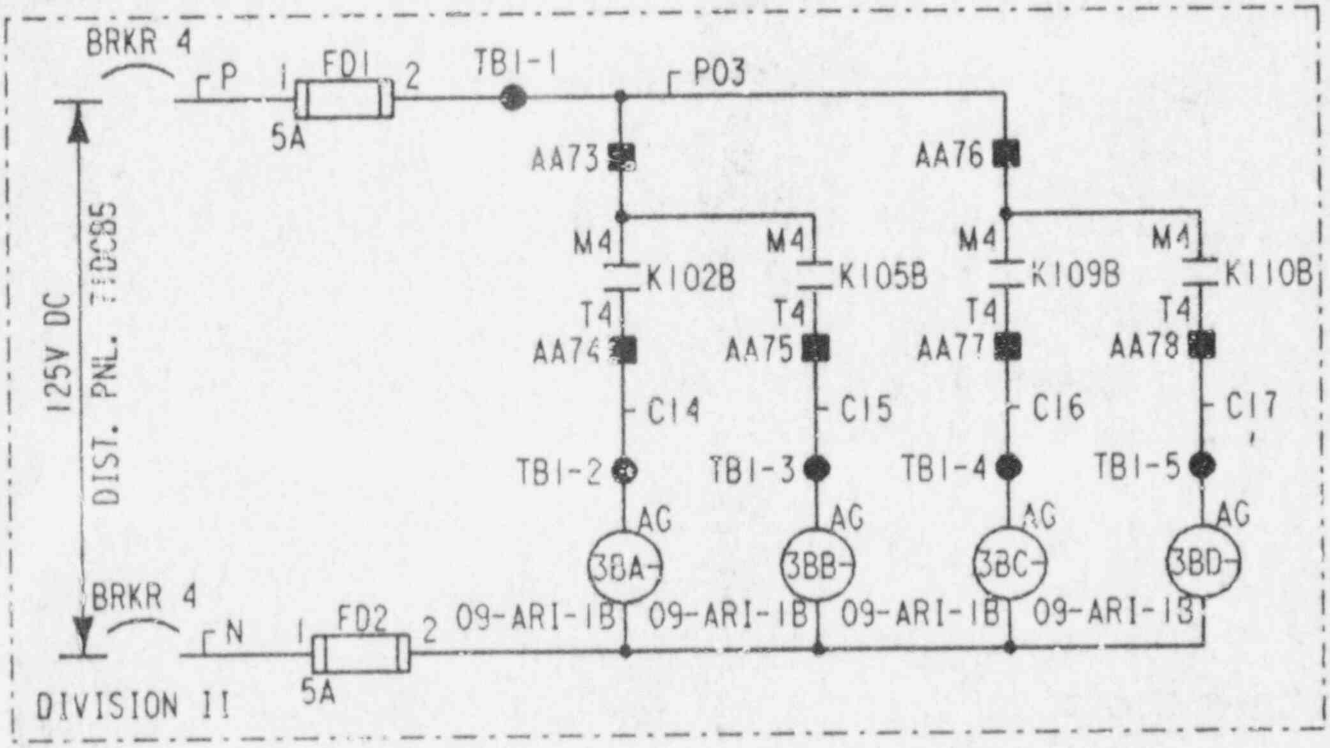
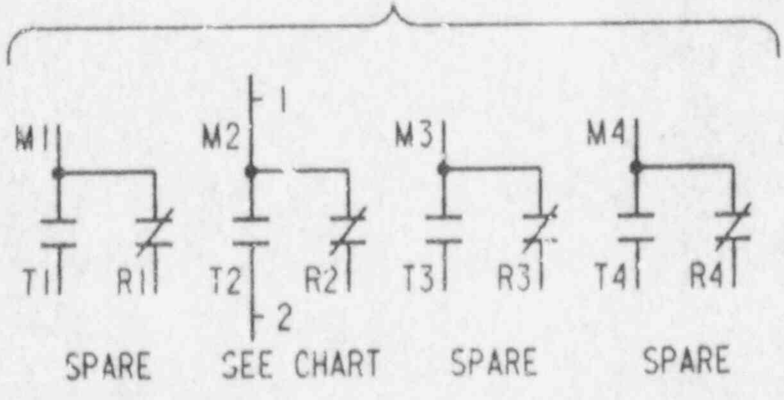


RELAYS 3BA- THRU 3BD-
RELAYS 3RA- THRU 3RD-
SEE CHART FOR WIREMARKS AND DRAWING



RELAY	WIREMARK 1	WIREMAR
3BA-	C06	C05
3BB-	C06	C05
3BC-	C06	C07
3BD-	C06	C07
3RA-	P02	C05
3RB-	P02	C05
3RC-	P02	C07
3RD-	P02	C07

CONSTRUCTION	
BIDDING PURPOSES	
RELEASED FOR	ENGR.
12-24-82	DATE

ZBO:[146,5]NYPAELEM.DGN

NEW YORK POWER AUTHORITY
MOD FI-85-053
JAMES A FITZPATRICK STATION UNIT 1

ELECTRICAL
ELEMENTARY DIAGRAM
ARI SYSTEM

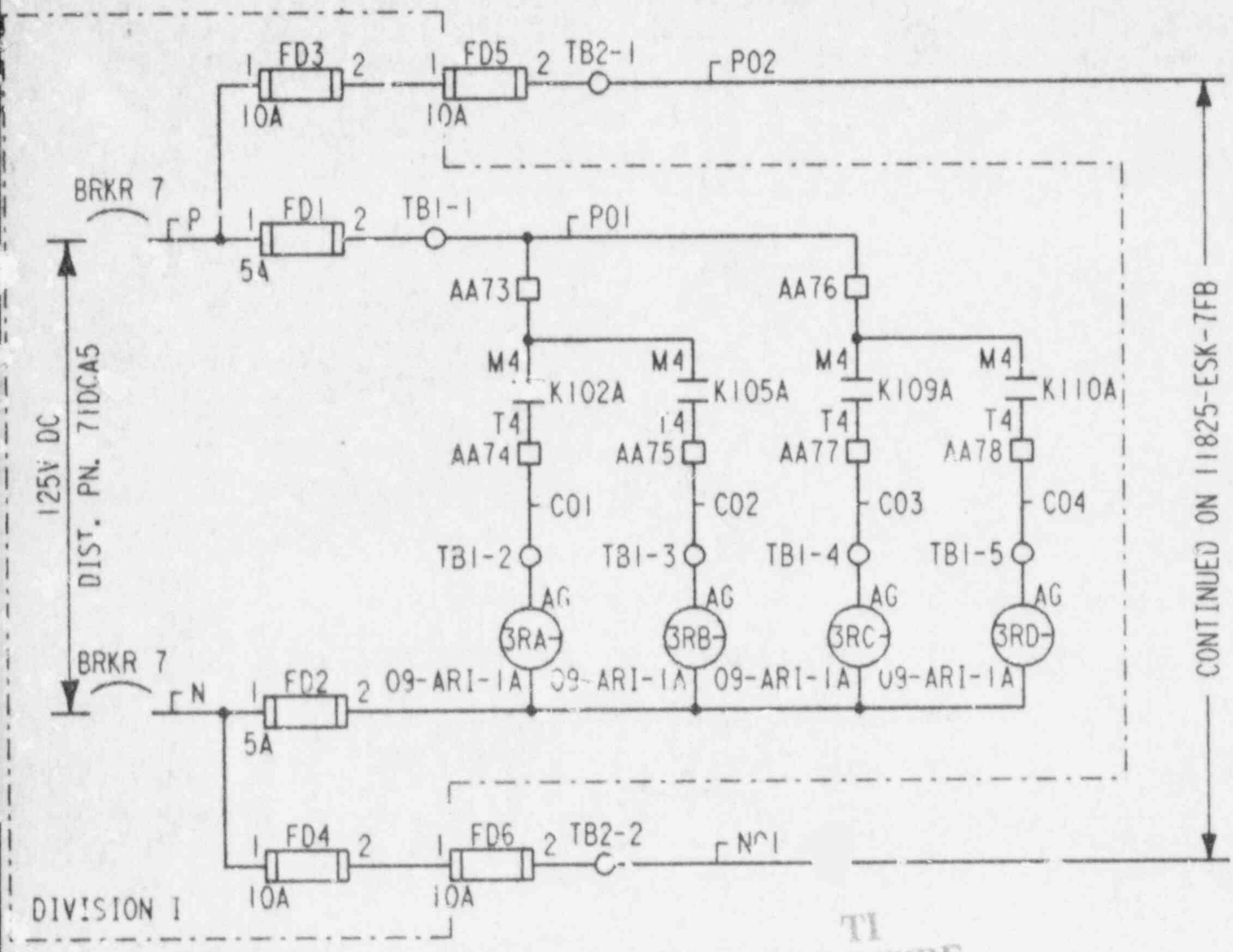
MADE	CHKD	DRAWING NUMBER	SH. NO.	REV
TWO 10/29/87	[illegible]	11825-ESK-7FA		0

PDS | ENG. INTERF 1. 2.

GILBERT ASSOCIATES, INC
ENGINEERS AND CONSULTANTS
READING PA.

SCALE NONE — W.O. 045354000 — ENGINEER APPROVAL — DEPT 0421 — DATE 12-24-87

REV	MADE	CH	PDS	APP	DATE	REV	MADE	CH	PDS	APP	DATE



TI
APERTURE
CARD

Also Available On
Aperture Card

DRAWING REFERENCE
11825-ESK-7FB
ESK-7FB
[illegible]
[illegible]
11825-ESK
11825-ESK-7FB
11825-ESK-7FB

8806200032-06

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