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SUBJECT: Responds to 880518 & 0622 request for addl info re anticipated transients w/o scram.

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FPL

AUGUST 1 5 1988

L-88-343

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Gentlemen:

Re: St. Lucie Plant Unit Nos. 1 and 2
Docket Nos. 50-335 and 50-389
Request for Additional Information
Anticipated Transients Without Scram

By letter dated May 18, 1988 (E. G. Tourigny to W. F. Conway), the NRC requested additional information concerning the Florida Power & Light Company (FPL) plant specific conceptual design submittal of July 15, 1987. FPL provided a schedule for the response to questions 1a, 3a, 3b, 4, 5, 6, 7, 8b, and 8c by letter (L-88-276) dated June 23, 1988. The remaining questions (1b, 2, and 8a) are related to the detailed design and are not part of the conceptual design submitted in July 1987. FPL will provide a schedule for the response to the remaining questions after the conceptual design is approved by the staff.

Attached is the response to your request for additional information.

Should there be further questions, please contact us.

Very truly yours,

W F Conway

W. F. Conway
Senior Vice President - Nuclear

WFC/GRM/cm

Attachment

cc: Dr. J. Nelson Grace, Regional Administrator, USNRC, Region II
Senior Resident Inspector, USNRC, St. Lucie Plant

A055
1/1

FLORIDA POWER & LIGHT COMPANY
ST LUCIE PLANT - UNITS 1 & 2
ATWS: RESPONSES TO NRC QUESTIONS
OF MAY 18 and JUNE 22, 1988

Questions From May 18, 1988 NRC Letter

1. Safety Classification/Logic Schematics/Power Distribution

Question:

The St Lucie Units 1 & 2 diverse scram system (DSS) design uses the existing reactor protection system (RPS) pressurizer pressure transmitter instrument loops. The bistables and logic circuitry are part of the existing engineered safety features actuation system (ESFAS). It is the staff's understanding that the DSS circuitry from the sensors, through the logic, up to and including the isolation devices (that provide the DSS output signals to the CEA drive MG set output breakers and control room annunicators) is safety related Class 1E.

a) Is the staff's understanding correct. If not, please explain.

b) Part 1: Please provide electrical schematic/elementary diagrams for the DSS that clearly show all instrument channels (including bistables), logic, actuation circuits, test circuits, interlocks, bypasses, alarms and indications.

Part 2: Also, provide electrical one-line diagrams showing the CEA drive MG sets and DSS actuated output breakers, and power distribution to the RPS and ESFAS/DSS, including vital buses, inverters, batteries and chargers.

Response:

a) Although the DSS bistables and logic components are not required to be safety related, they are being treated in this manner because they are being installed in the safety related ESFAS cabinets. The DSS circuitry therefore, from the pressurizer pressure sensors to the Class 1E isolation devices that separate the DSS logic from the CEA drive MG set control circuits, will be procured as safety related. This includes the pressure transmitters, signal conditioners, and cables to the ESFAS cabinets. Power for the DSS logic components will be from non-interruptible, non-safety supplies through appropriate safety related isolation to protect the ESFAS cabinets.

b) Part 1

The electrical schematic/elementary diagrams for the DSS which will show in detail all of the components of the DSS including logic, actuation circuits, test circuits, interlocks, bypasses, alarms, and indications have not been developed and are not considered to be part of the DSS Conceptual Design. It is anticipated that they will be a major portion of Phase 2, which is the detailed design, engineering and procurement phase of the project.

Part 2

Figures 1, 2, 3, and 4 include electrical one-line diagrams for the RPS and ESFAS/DSS, including vital buses, inverters, batteries, and chargers. Figures 5 and 6 include electrical one-line diagrams for the CEA drive MG sets.

2. Power Supplies/Failure Modes and Effects Analysis

Question:

Electrical independence is required between the existing RPS and the ATWS prevention/mitigation systems required by the rule. The electrical schematic/elementary diagrams provided in response to Item 1 above should clearly identify all power sources used. Where RPS power supplies are used, it must be demonstrated that 1) faults within the DSS, diverse AFW actuation circuits or diverse turbine trip (DTT) circuits cannot degrade the reliability/integrity of the existing RPS below an acceptable level, and 2) that common mode failure affecting the RPS power distribution system (including degraded voltage and/or frequency conditions, e.g., overvoltage and undervoltage; the effects of degraded voltage conditions over time must be considered if such conditions can go undetected) cannot compromise both the RPS and ATWS prevention/mitigation functions. If the St Lucie Units 1 & 2 design shares common power supplies for the RPS and equipment installed per ATWS rule requirements (i.e., DSS excluding sensors, and diverse AFWS actuation and DTT excluding sensors and actuation devices), provide the information for Items 1 and 2 above.

Response:

The one-line diagrams provided in response to question 1 identify the power sources for the RPS and DSS logic (Figures 1 through 4). As shown in the diagrams, power for the DSS logic in both units will be through isolation devices from vital, non-Class 1E 120Vac buses, which are different buses than the Class 1E buses feeding the RPS. The normal distribution path for DSS power will be through an uninterruptable power supply connected to both safety (SAB) and non-safety buses (Figures 2 and 4). If there is a failure at the 480 Vac or 4160 Vac levels, the non-Class 1E station battery (1D or 2D) will provide temporary power to the DSS logic while the Class 1E station batteries provide temporary power to the RPS and ESFAS loads. The emergency diesel generators will provide long-term backup power through the safety AB buses to the DSS logic.

The exact interconnections included on electrical schematics/elementary diagrams, and required to supply power to the DSS logic and bistable circuitry have not been engineered and are not considered to be part of the DSS Conceptual Design. It is anticipated that they will be part of Phase 2, which is the detailed design, engineering, and procurement phase.

3. Electrical Isolation

Question:

Electrical independence of non-safety related ATWS circuits from safety related circuits is required in accordance with the guidance provided in IEEE Standard 384, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits," as supplemented by Regulatory Guide 1.75, Revision 1, "Physical Independence of Electrical Systems."

a) Information must be provided to demonstrate the adequacy of all isolation devices used to protect the integrity of safety related circuits from non-safety related ATWS circuits. The required information is identified in Attachment 1*. If the isolation devices are identical to isolation devices used in other applications (e.g., to isolate the safety parameter display system from safety related circuits), and the requested information has been previously submitted for staff review, and the isolation devices have been approved for their applications, the related correspondence should be referenced, and no additional information need be provided.

* Attachment 1 of the May 18, 1988 NRC letter.

b) Attachment 6 of FPL's July 15, 1987 letter is a block diagram of the St Lucie Units 1&2 DSS. The DSS is shown to provide isolated output signals to the CEA drive MG set output breakers, however, there is no isolation shown between the DSS and the control room annunciator. Is the diagram correct in this regard?

Response :

a) This question is concerned with protecting the integrity of safety related circuits from non-safety related ATWS circuits. In the St Lucie design, the DSS circuitry will be procured as safety related. (See Question 1a). Furthermore, the DSS circuitry will be electrically isolated from the non-safety related components that it provides output to, including the CEA drive MG set control circuits, the Sequence of Events Recorder, and the Control Room annunciator panels. If the concern applies only to non-safety related DSS circuitry, then FPL's Conceptual Design for a safety related DSS is sufficient to satisfy it. Concern with isolation of the RPS from the safety related DSS has been addressed with existing and proposed safety related isolation devices in the pressurizer pressure instrument loops for both units. The specific arrangement of the loop circuitry will put an additional device between the circuitry and the ESFAS/DSS circuitry to insure that faults in the DSS do not propagate to the RPS.

Devices used to isolate the ESFAS/DSS circuitry from the safety related RPS are not yet installed in St Lucie - Unit 1. As can be seen in Figure 7, a single I/I (current to current) converter provides pressurizer pressure signals to the Sequence of Events cabinet, ESFAS cabinet MC, a pressure indicator in RTGB-103, and the RPS circuitry in RPS cabinet C. A second similar I/I converter will be installed in RTGB-106 which will supply pressurizer pressure signals to ESFAS and the DSS circuitry. This is similar for the other three pressure loops.

Devices used to isolate the ESFAS/DSS circuitry from the safety related RPS is part of the original plant design for St Lucie - Unit 2. It can be seen in Figure 8 that there are two E/I (voltage-to-current) converters for the pressure transmitter signal loop installed in Instrument Cabinet MC. One E/I converter provides pressurizer pressure signals to RPS circuitry in RPS cabinet C. The other E/I converter provides similar signals to the Sequence of Events cabinet, ESFAS cabinet MC, and a pressure indicator in RTGB-203. It is from the second E/I converter that the DSS will receive signals representative of pressurizer pressure, isolated from the RPS through two E/I converters. This is similar for the other three pressure loops.

If there is a change in the Conceptual Design, the safety classification of the DSS, or the proposed DSS vendor (Consolidated Controls) which affects the proposed isolation between the RPS and and the safety related DSS, then isolation devices will be procured which will meet the requirements of Attachment 1 to the May 18, 1988 NRC letter.

b) The Control Room annunciator panel circuitry will be isolated from the DSS logic circuitry as it is from all safety related components. The block diagram shown as Figure 6 of the Conceptual Design does not indicate this although the paragraphs in Section IV DSS Logic does specify isolation from the annunciator panel circuits.

4. Breaker Diversity

Question:

Using circuit breakers from different manufacturers is generally not considered sufficient to provide the required diversity for interruption of control rod power. In general, circuit breakers from different manufacturers are considered susceptible to common mode failure (CMF) because of common design features such as mechanical linkage (consisting of springs, pivots, latches, pins, cams, etc.) that are subject to binding/malfunction from a number of causes (e.g., dirt, corrosion, improper lubrication, etc.) as has been demonstrated through operating experience. Please provide information that demonstrates physical hardware diversity of the CEA drive MG set output breakers from the reactor trip breakers actuated by the RPS.

Response:

Due to the NRC's concern for diversity between the reactor trip breakers and the CEA drive MG set output breakers, FPL will investigate the use of alternate methods for ATWS actuation, including the use of existing MG set contactors and excitation control. A letter will be forwarded to the NRC within 150 days to document the results of that investigation.

5. DSS Modifications and Diversity

Question:

During the life of a commercial light-water-cooled nuclear power plant many components reach their end of life and must be replaced, including components installed in the RPS, AFWS, DSS, and DTT system. Provide a description of the measures/programs implemented at St Lucie to assure that the equipment diversity provided in accordance with the ATWS rule will be maintained during component repair, replacement, modifications and/or design changes etc. throughout the life of the plant.

Response:

Florida Power and Light Company (FPL) has developed procedures to control changes to the nuclear units. These procedures ensure that appropriate regulatory requirements are met in that the design bases established in the FSAR are maintained.

After implementation of the ATWS modifications the FSAR will be updated in accordance with 10CFR50.71 to reflect the new diversity requirements. This update, in conjunction with established procedures, provides assurance that future changes will maintain the diversity requirements.

6. Human Factors Engineering

Question:

Discuss how good human factors engineering practices are incorporated into the design of ATWS prevention/mitigation system components located in the control room. Specifically address coordination of displays used to provide the status of ATWS systems/equipment to the operator with existing displays.

Response:

Only a single annunciator window will be used for constant indication in each of the Control Rooms which will provide alarm status when either channel of the DSS is placed in the bypass condition for testing or when either channel actuates. At the ESFAS cabinets, each channel will have an ACTUATE status indicating light and a BYPASS status indicating light. As long as the ESFAS is operating, the DSS will also be operating. Appropriate labels will be used to identify the indicating lights following the existing St Lucie standards for lettering size, color, and layout. The annunciator window will be labelled in a manner similar to the other existing annunciator windows. Since there will be no active or mimic displays available to the operators, coordination with existing displays will not be required. The final design of the system will take into account the FPL Human Factors Engineering program and will meet the guidelines of the appropriate sections of NUREG 0700 "Guidelines for Human Factors Engineering".

7. Turbine Trip Circuits

Question:

FPL's July 15, 1987 letter states that inherent to the DSS design is a turbine trip independent and diverse from the RPS, which is inititated by undervoltage conditions sensed in the CEA drive control system. Explain in detail how this arrangement satisfies the ATWS rule requirements for a diverse turbine trip. Please provide electrical schematic/elementary diagrams of the DTT circuits.

Response:

The existing turbine trip is diverse from the RPS in that the actuation of the turbine trip is based on an undervoltage condition in the reactor trip switchgear and is not based on the RPS logic. This assumes that there is an operational DSS which causes the undervoltage condition regardless of the status of the reactor trip breakers. As can be seen in the one-line diagrams in Figures 9 and 10, there are four voltage sensing devices (different devices for each Unit) that are fed into two 2/4 logic circuits, which in turn actuate to the auto trip solenoid and emergency trip solenoid valve to release auto stop hydraulic oil and emergency trip hydraulic oil, respectively. Loss of hydraulic oil pressure from either source will cause a turbine trip.

8. Testing

Question:

The equipment required by 10CFR50.62 to reduce the risk associated with an ATWS event must be designed to perform its functions in a reliable manner. The DSS, diverse AFWS actuation circuitry, and diverse turbine trip circuits must be designed to allow periodic testing to verify operability while at power. All bypass conditions should be automatically and continuously indicated in the main control room.

a) Describe the scope and intent of the various surveillance tests (e.g. sensor/channel checks, instrument channel functional tests, logic channel and actuation device tests, channel/system calibrations, overall system functional tests, etc.) that FPL intends to use to periodically verify operability of the DSS and DTT equipment/circuitry installed at St Lucie Units 1 & 2. Indicate the frequency for which each surveillance test is conducted. Also discuss the controls/programs (e.g., technical specifications) to be used to ensure that the equipment/circuitry installed in accordance with the ATWS rule will be properly tested and maintained in an operable condition. The controls/programs would provide reasonable assurance that the ATWS equipment/circuitry will perform its design functions when required, and therefore, satisfy the reliability requirements of the ATWS rule.

b) Please indicate whether the test procedures involve undesirable practices such as installing jumpers, lifting leads, pulling fuses, tripping breakers, blocking relays, or other circuit alterations.

c) Describe the specific indication provided in the control room of the bypass condition when equipment/circuits required by the ATWS rule are bypassed/rendered inoperable during testing (including use of the bistable bypass switches).

Response:

a) As described in the DSS Conceptual Design, the DSS will include the capability to test the DSS function from sensor output to and including the MG set control circuits with the plant in a shutdown condition. Two bypass switches on ESFAS cabinets SA and SB will allow testing of the DSS function from sensor output to, but not including, the final actuation devices at power. Sensor output is defined as the point at which the analog signal enters the ESFAS cabinets. To test the DSS, a test signal will be substituted for the sensor output at the bistable cards without affecting the ESFAS circuitry. In addition, the existing ESFAS cabinet automatic test instrument, which uses counts on the auto-test generator, will be employed to check internal DSS logic functions from the bistable devices through the logic modules whenever the ESFAS cabinets are energized. However, the specifics of testing and maintenance, including schedules, are not considered to be part of the DSS Conceptual Design, and it is anticipated that they will be developed during Phase 2, which is the detailed design, engineering, and procurement phase.

The turbine trip circuitry currently exists and is assumed to be diverse, inherent to the design of the DSS (See the response to question 7). Since the system is installed and operating, its design and functions are not in question and additional maintenance and testing are not envisioned.

FPL does not intend to integrate the DSS into the St Lucie Plant Technical Specifications and will utilize the standard plant maintenance programs and procedures to ensure tha the DSS is properly tested and maintained in an operable condition.

b) The specification that will be prepared for the procurement and installation of the DSS from Consolidated Controls will include requirements to prevent the inclusion of undesirable practices in DSS testing. These undesirable practices are installing jumpers, lifting leads, pulling fuses, tripping breakers, blocking relays, and other circuit alterations.

c) A single annunciator window will be used for constant indication in each of the Control Rooms to provide alarm status when either channel of the DSS logic is placed in the bypass condition for testing or when either channel actuates.

Question from June 22, 1988 Phone Conversation

Question:

Along with the eight questions in the NRC letter of May 18, 1988, an additional point was raised by the NRC during the FPL/NRC phone conversation of June 22, 1988 dealing with the diversity between the RPS and AFAS matrix relays.

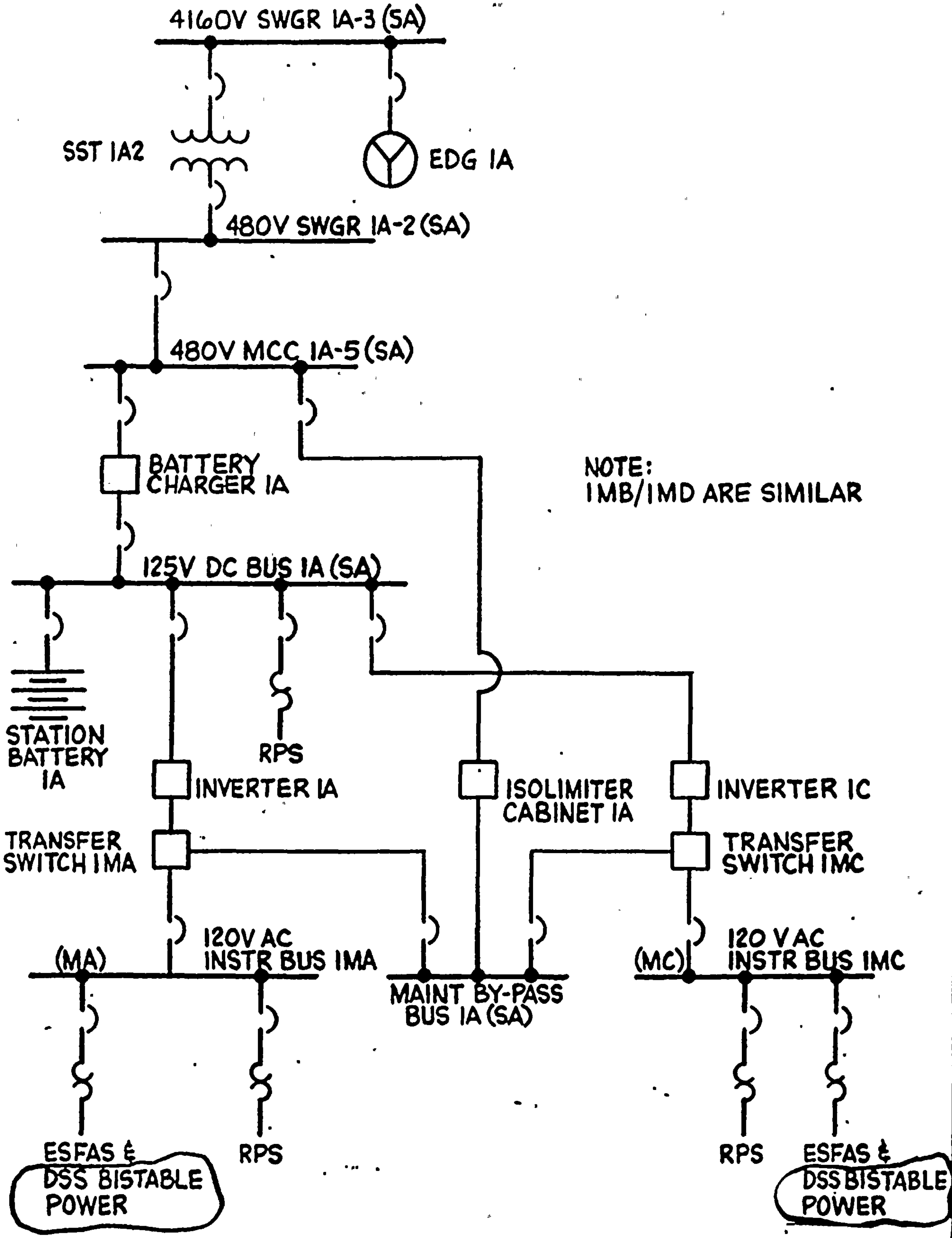
Response:

As stated in the RPS/AFAS Diversity Study, both systems employ Douglas Randall dual coil, reed type relays. The main points of diversity include coils with different voltage and resistance ratings and different insulations, widely spaced manufacturing lot numbers, and different mounting arrangements. In addition to this diversity, these are very high-quality relays with excellent reliability. They are located in a controlled environment, utilize different power supplies and circuits, are located in different cabinets, are sealed units, and are de-energized to actuate (fail safe). It is highly improbable that a common mode failure could exist that would disable them functionally and would not also disable other types of logic devices (e.g. fire, seismic event, improper maintenance techniques, power surge or power failure). The only common mode failure of concern is the fusing of the contacts since the matrix relays are normally energized, fail safe.

The Douglas Randall relays at St Lucie Units 1 & 2 have accumulated 12.2 million operating hours without a failure and have an expected life of one million operations at rated load. The coils are potted in epoxy. The reeds and contacts are hermetically sealed in glass capsules and backfilled with dry nitrogen. Contacts are rhodium with a rating of 30 volt-amperes maximum, which is well above the expected operational demands.

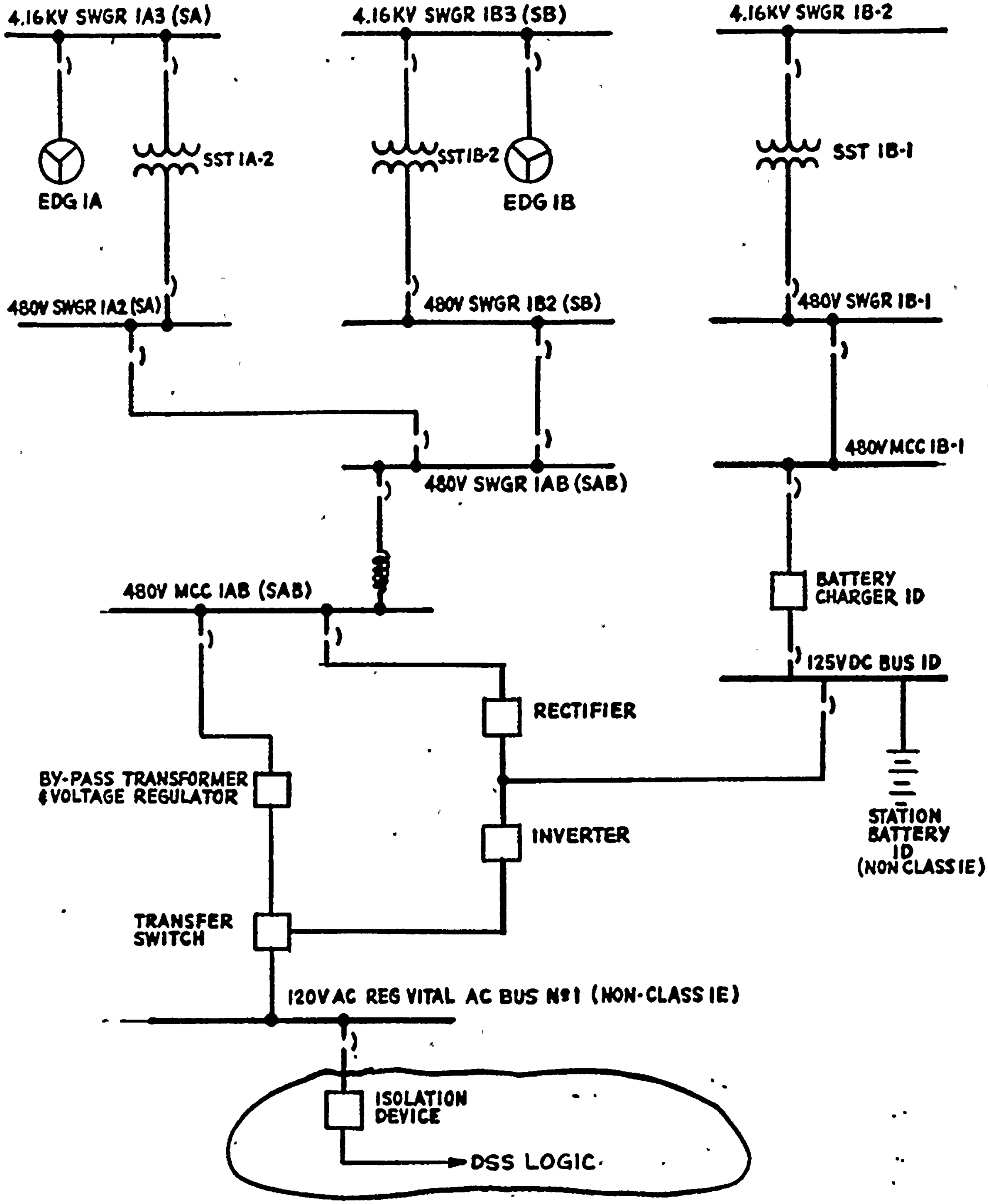
It is FPL's concern that replacement of these relays may increase diversity at the expense of proven reliability and that the probability for common mode failures is so remote that their replacement is not justified. There is the potential of replacing the relays with less reliable devices and of reducing circuit functional reliability due to the new design. It is therefore proposed that the existing RPS and AFAS matrix relays be found acceptable for their proposed ATWS functions.

FIGURE 1



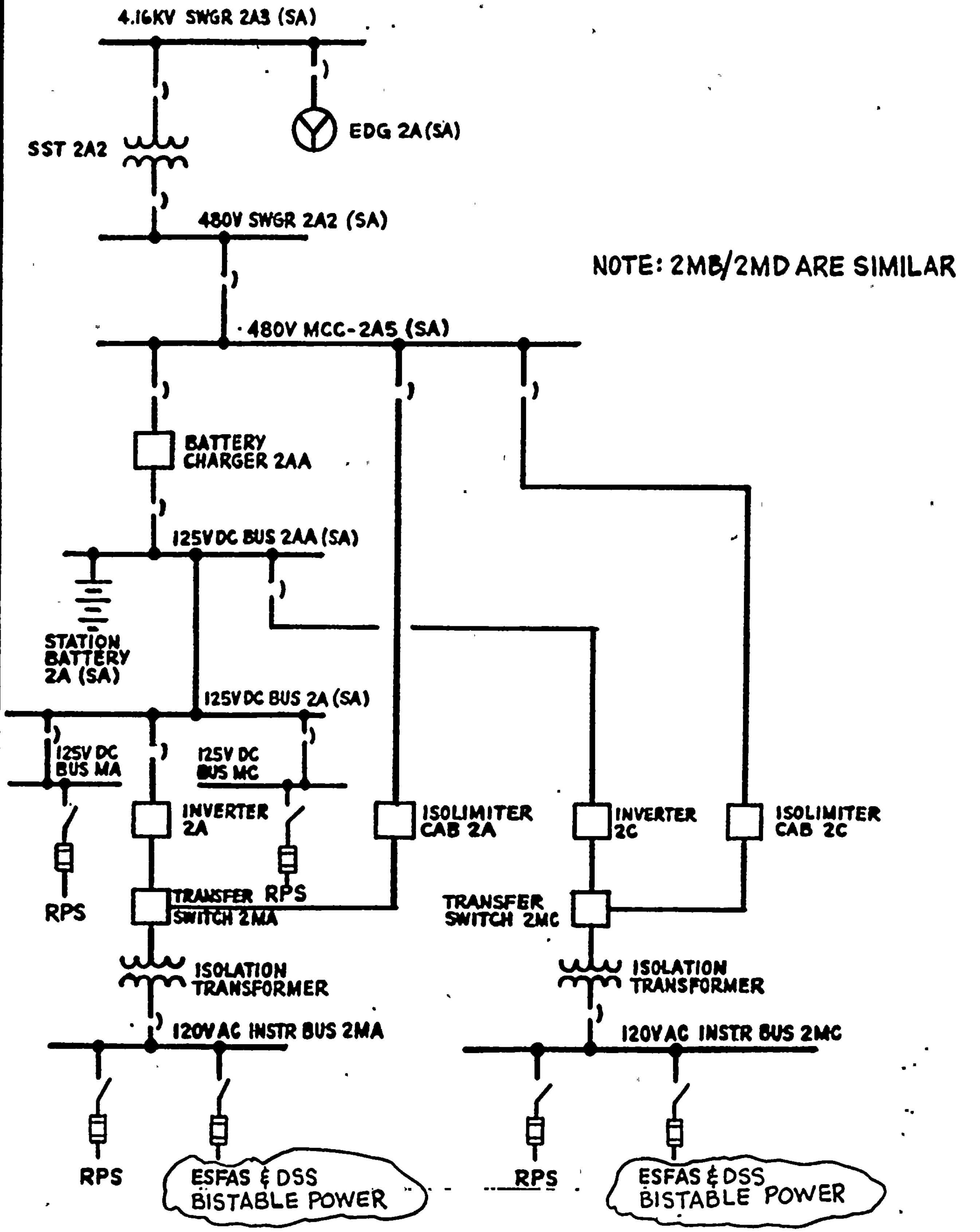
ST. LUCIE PLANT UNIT NO.1
RPS / ESFAS POWER SUPPLY

FIGURE 2



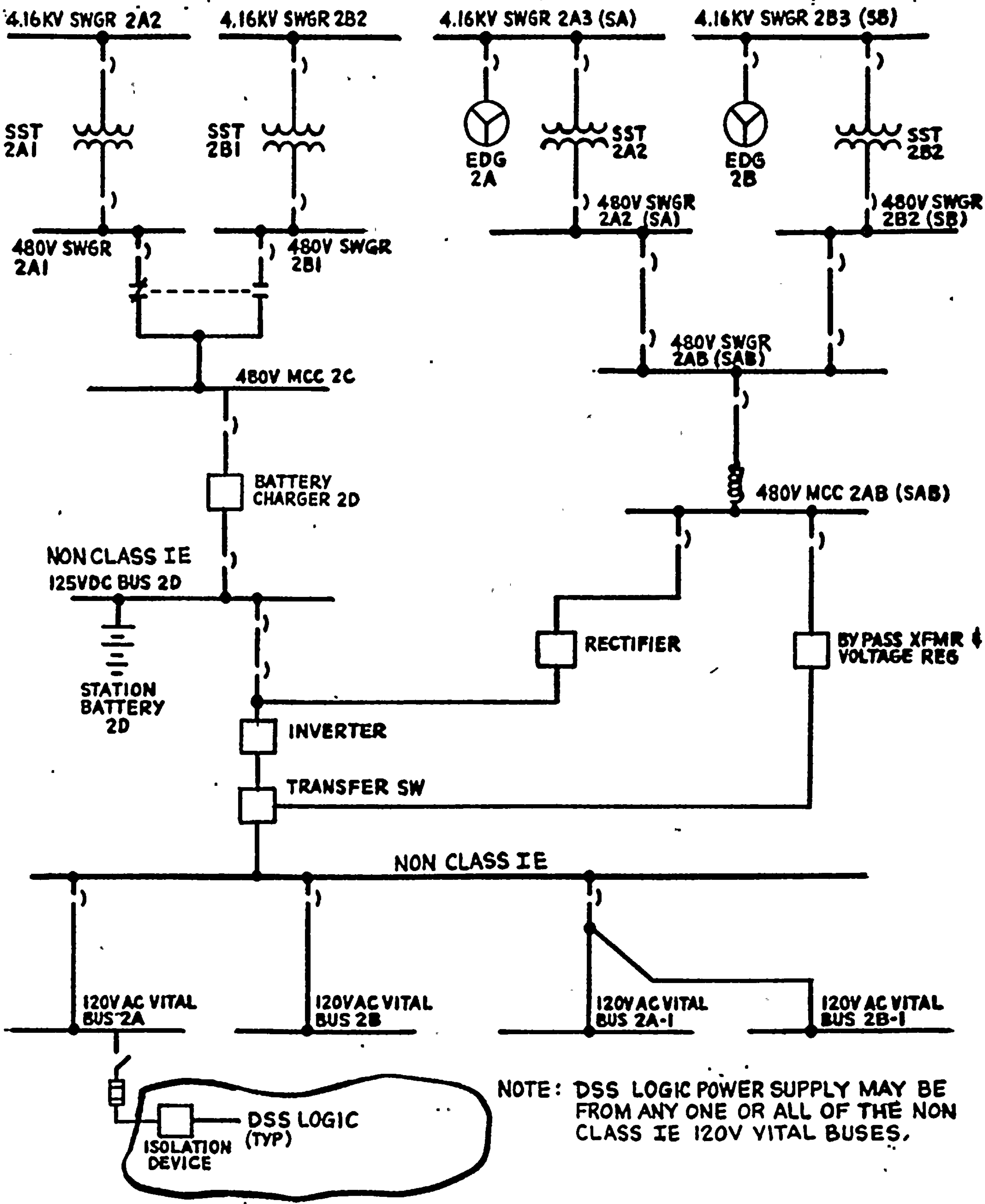
ST. LUCIE PLANT UNIT NO. 1
DSS LOGIC POWER SUPPLY

FIGURE 3



ST. LUCIE PLANT UNIT NO.2
RPS/ESFAS POWER SUPPLY

FIGURE 4



ST. LUCIE PLANT UNIT NO. 2
DSS LOGIC POWER SUPPLY

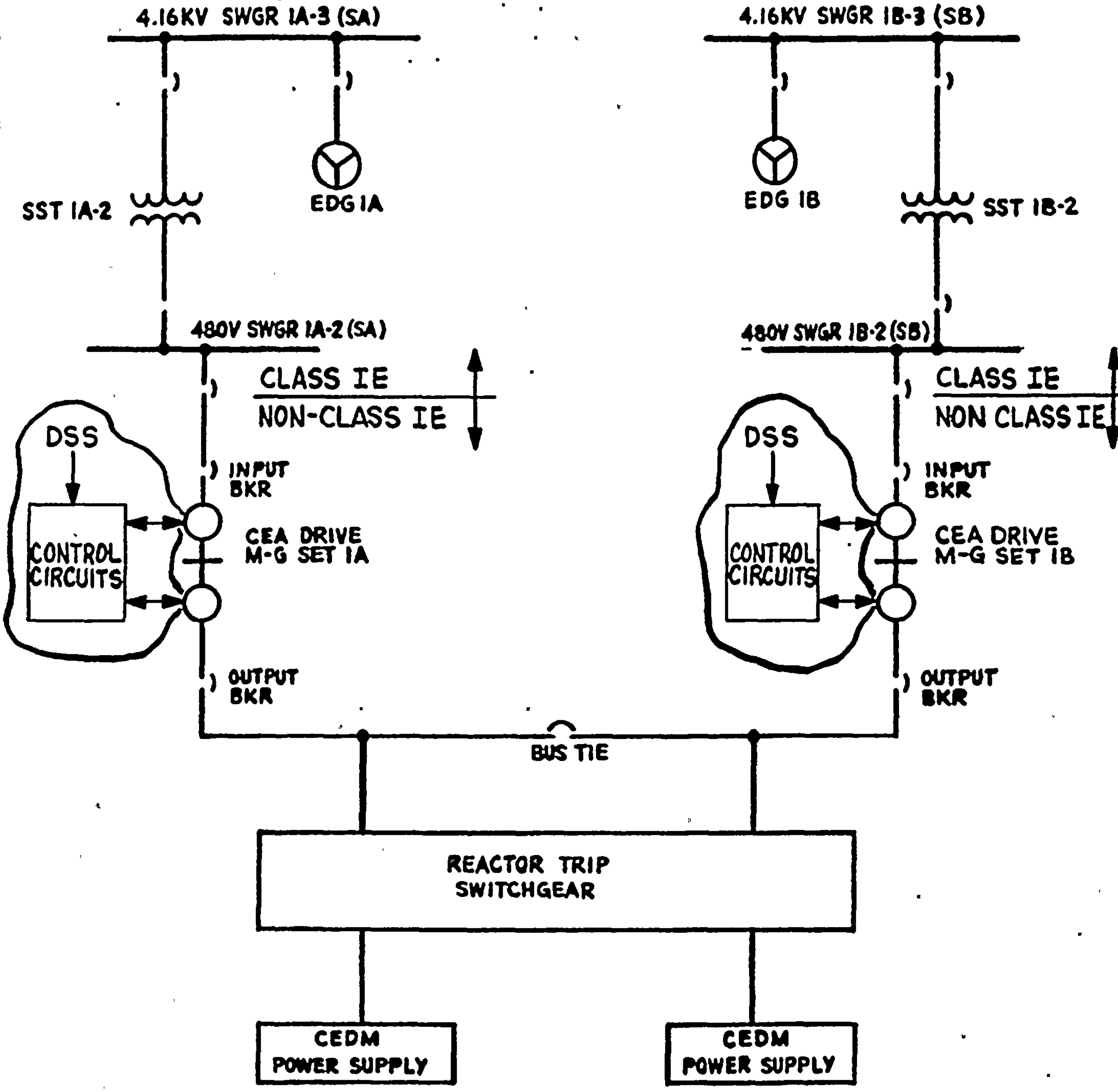
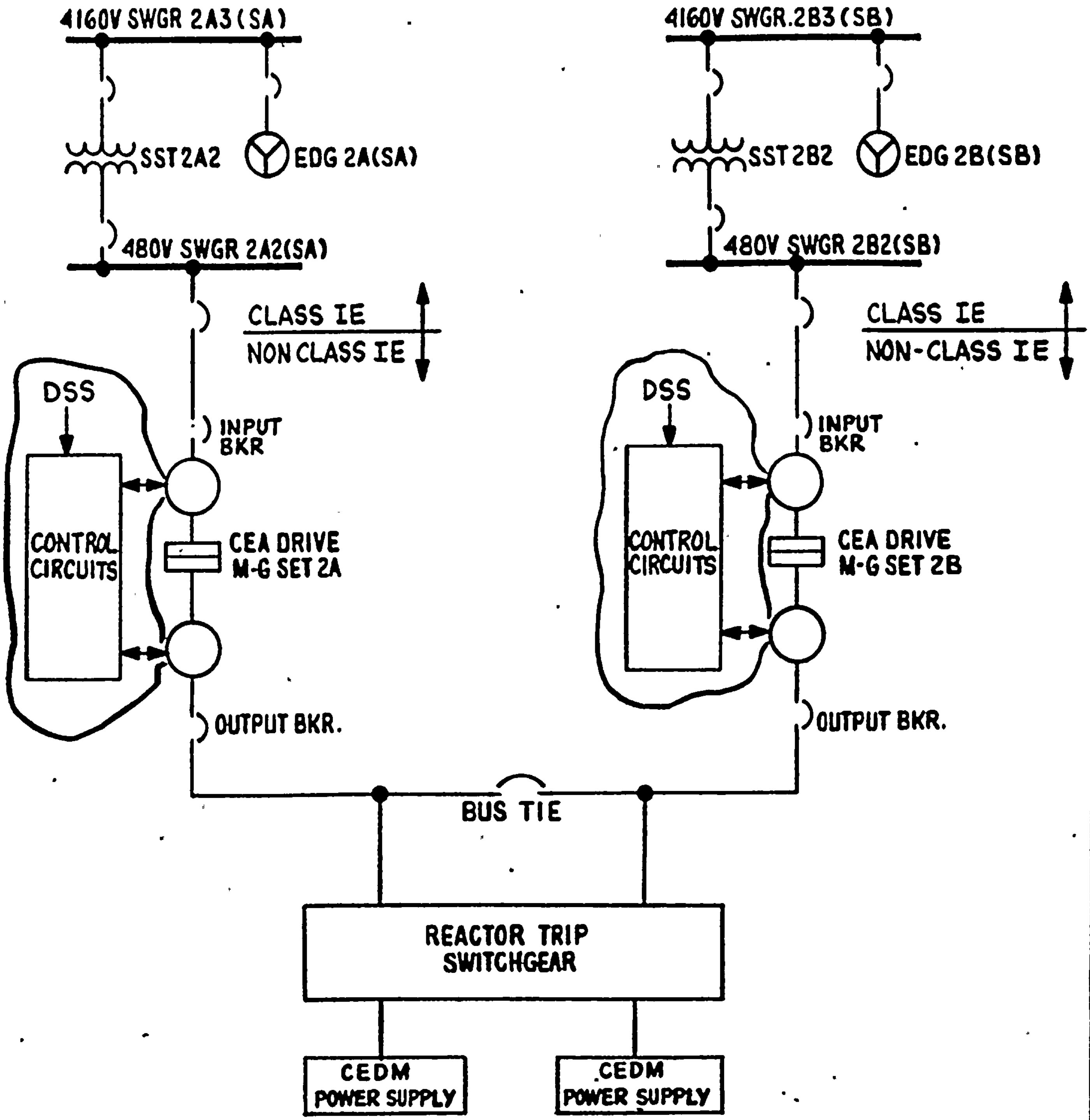


FIGURE 5

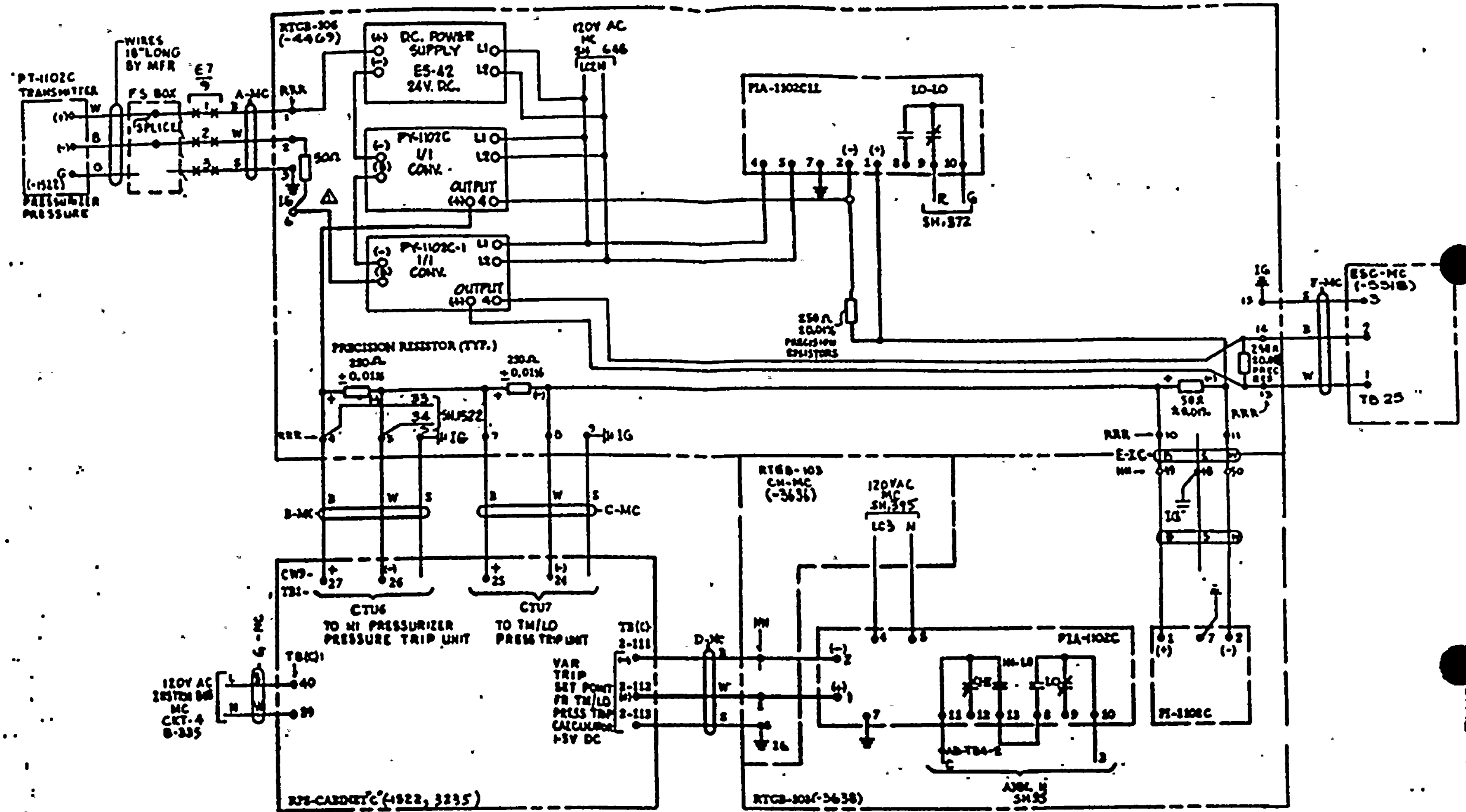
ST. LUCIE PLANT UNIT NO. 1
CEA DRIVE MG SET POWER SUPPLY

FIGURE 6



ST. LUCIE PLANT UNIT NO.2
CEA DRIVE MG SET POWER SUPPLY

BRUNING 44-232 60518



△ RESISTOR-50Ω ±0.01% BM# C17-1

INPUT WIRING PSL-1
PROPOSED

FIGURE 7

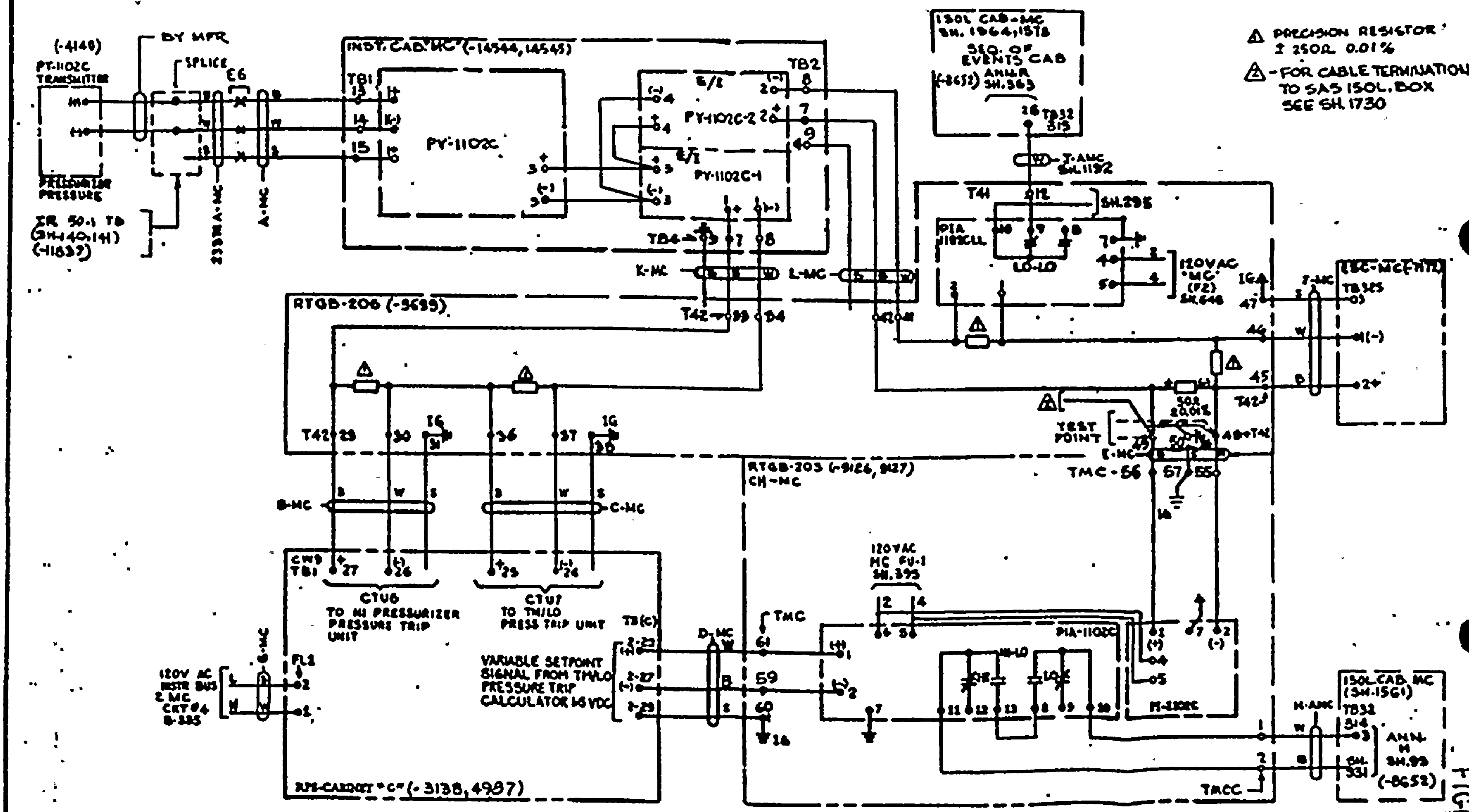
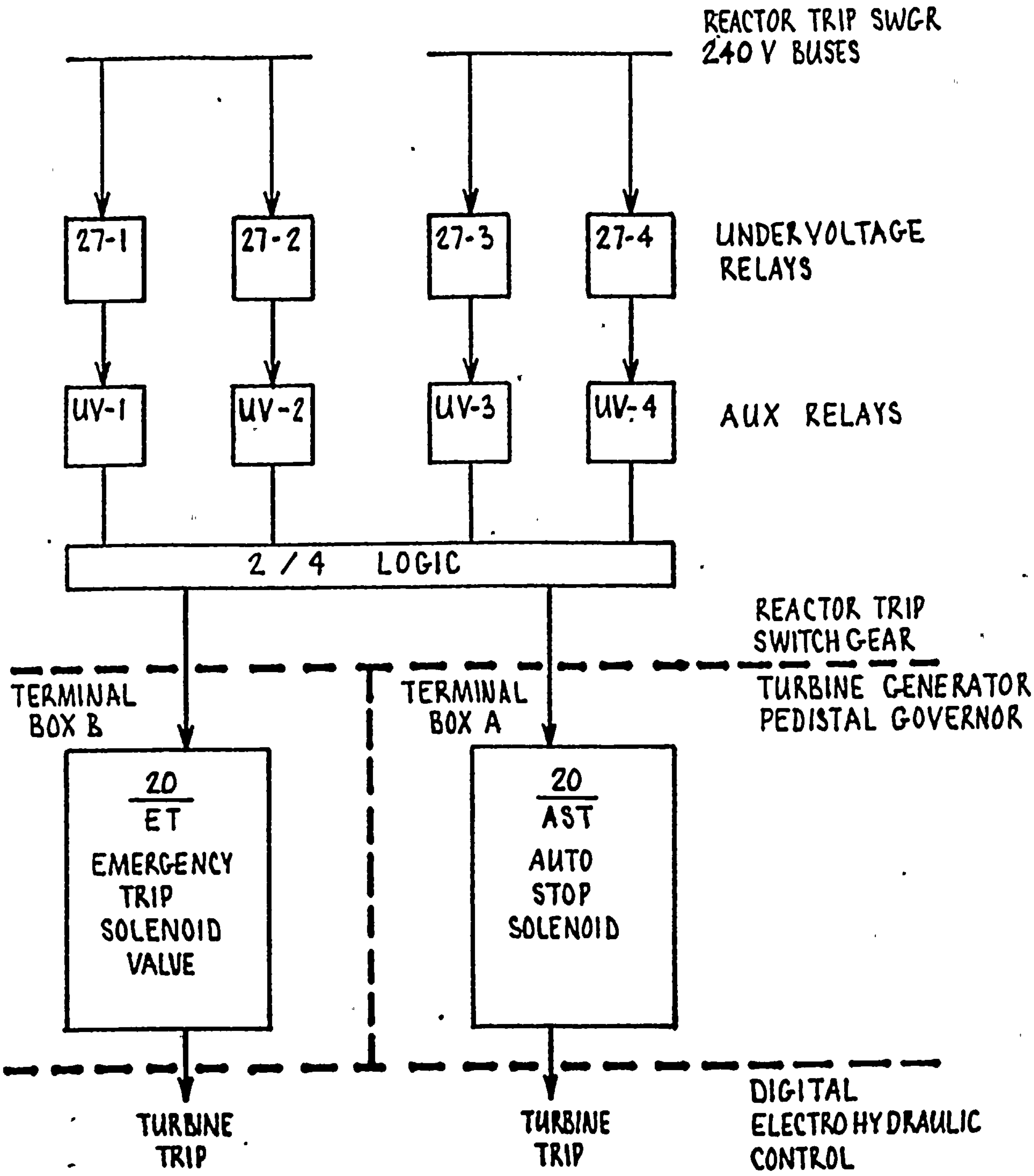


FIGURE 8

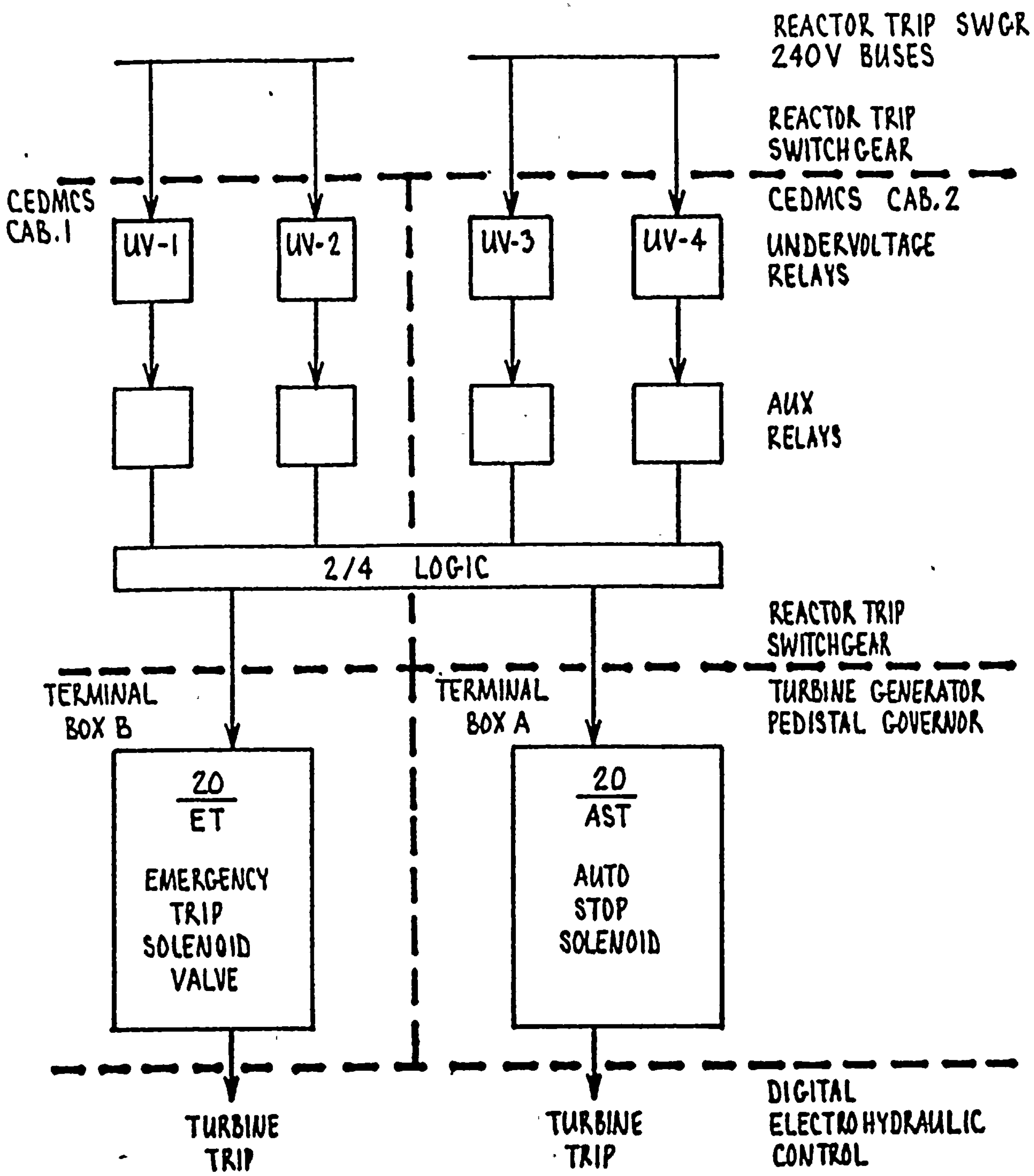
INPUT WIRING PSL-2

FIGURE 9



ST. LUCIE PLANT UNIT NO. 1
TURBINE TRIP - REACTOR TRIP
SWITCHGEAR UNDERVOLTAGE

FIGURE 10



ST. LUCIE PLANT UNIT NO. 2
TURBINE TRIP - REACTOR TRIP
SWITCHGEAR UNDERVOLTAGE