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A SCANA Company

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March 24, 1988

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

SUBJECT: Virgil C. Summer Nuclear Station
Docket No. 50/395
Operating License No. NPF-12
Implementation of ATWS Rule
(10CFR50.62)

Gentlemen:

In accordance with your February 18, 1988 letter, attached are the South Carolina Electric & Gas Company ATWS Mitigation System Actuation Circuitry (AMSAC) Safety Evaluation Report Response, Westinghouse WCAP-8687, Supplement 2-E68A (Proprietary Class 2) and EQDP-ESE-68A (Non-Proprietary), "Qualification of ATWS Mitigating System Actuation Circuitry in Standard Seismic Cabinet."

As WCAP-8687 contains information proprietary to Westinghouse Electric Corporation, it is supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of Section 2.790 of the Commission's regulations.

Accordingly, it is respectfully requested that the information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10CFR Section 2.790 of the Commission's regulations.

Correspondence with respect to the proprietary aspects of the Application for Withholding or the supporting Westinghouse Affidavit should reference CAW-88-021 and should be addressed to R. A. Wiesemann, Manager of Regulatory & Legislative Affairs, Westinghouse Electric Corporation, P. O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

Should you have any further questions, please call at your convenience.

Very truly yours,

OBradham for

D. A. Nauman

APOl
1/1

MDB:DAN/lcd
Attachment

pc: See Page 2

CHANGE	LTR	ENCL
LPDR	1	1NP
NSIC	1	1NP
NRC PDR	1	1NP

pc: J. G. Connelly, Jr./O. W. Dixon, Jr./T. C. Nichols, Jr.
E. C. Roberts
W. A. Williams, Jr.
J. N. Grace
J. J. Hayes, Jr.
General Managers
C. A. Price
R. B. Clary
W. R. Higgins
R. M. Campbell, Jr.
K. E. Nodland
J. C. Snelson
G. O. Percival
R. L. Prevatte
J. B. Knotts, Jr.
M. D. Blue
T. L. Wessner
NSRC
RTS (LTR000620)
NPCF
File (810.12)

AMSAC SAFETY EVALUATION REPORT RESPONSE

FOR VIRGIL C. SUMMER NUCLEAR STATION UNIT 1

South Carolina Electric & Gas Company (SCE&G) has selected and will implement an ATWS Mitigation System Actuation Circuitry (AMSAC) actuation logic which detects a loss of heatsink by monitoring the level in each of the steam generators. This actuation logic incorporates an automatic arming and block circuitry based upon turbine load by monitoring the first-stage turbine pressure. This signal, referred to as the C-20 signal, blocks AMSAC actuation at low power levels to prevent spurious trips during plant startups. This actuation logic is depicted in Figure 1.

The following is the response to the items requested in the NRC Safety Evaluation (SE) of the Westinghouse Owners Group Topical Report WCAP-10858, "AMSAC Generic Design Package," dated February 23, 1987.

Diversity

The basis for diversity of the ATWS mitigation system from the existing reactor trip system (RTS) is to minimize the potential of common mode failures. This diversity is required from sensor output to, but not including, the final actuation device. The ATWS mitigation system for V. C. Summer Nuclear Station will utilize the existing transmitters, transmitter power supplies, isolators associated with the first-stage turbine pressure, and the narrow range steam generator level from the 7300 process protection system. This in accordance with the NRC rule which states that the mitigation system instrument channel components (excluding sensors and isolation devices) must be diverse from the existing RTS. The Westinghouse AMSAC design is a microprocessor-based system with the capability to incorporate three different actuation logic schemes; V. C. Summer Nuclear Station employs actuation on low steam generator level. The RTS utilizes an analog-based process protection system with a discrete component logic system; therefore, V. C. Summer Nuclear Station fulfills the requirement of diversity through the types of technology (analog vs. digital). Additionally, diversity is accomplished through the hardware utilized. Where similar components are utilized for the same function in both AMSAC and the RTS, the components used in AMSAC are provided from a different manufacturer. For example, relays are utilized in both systems for interfacing with the final actuation circuits. At V. C. Summer Nuclear Station, Westinghouse Potter-Brumfield relays are utilized within RTS while Struthers-Dunn relays are used within AMSAC for this function.

Logic Power Supplies

According to the NRC final rule, the AMSAC logic power supply is not required to be safety-related. However, the logic power supply should be from an instrument power supply that is independent from the reactor protection system (RPS) power supplies. Logic power to AMSAC is provided from a non-class 1E computer inverter XIT-5905. The inverter is a dual input inverter which operates in the same manner as do the class 1E inverters. Normal power to the inverter is from the 480 volt AC balance of plant electrical system with a non-class 1E 125 volt DC system as a backup. Figure 6 depicts the power supply system for AMSAC. The inverter provides uninterruptible 120 volt AC power by transferring to the 125 volt DC system on loss of normal power. The 125 volt DC system utilizes a full capacity 125 volt lead calcium battery and solid state battery chargers. During normal operation, the 125 volt DC load is supplied from the battery chargers with the batteries floating on the system. Upon loss of station AC power, the entire load is powered from the batteries until the power is restored by the emergency diesel generators. Each battery is sized to carry the associated continuous emergency load for a minimum one hour period in addition to supplying power for the operation of momentary loads during that period.

Safety-Related Interface

The AMSAC inputs for measuring turbine impulse chamber pressure and narrow range steam generator water level are derived from existing transmitters and channels within the process protection system. Connections to these channels are made downstream of class 1E isolation devices which are located within the process protection cabinets. These isolation devices ensure that the existing protection system continues to meet all applicable safety criteria by providing isolation as demonstrated by tests, which are described in Appendix A of this submittal.

Buffering of the AMSAC outputs from the safety-related final actuation device circuits is achieved through qualified relays. The relays selected for this application are widely used throughout the industry in both safety-related and non-safety-related applications. To demonstrate the capability of these isolation devices, the devices will be qualified in a manner consistent with the requirements of Appendix A of the NRC SE; details of this can be found in Appendix A of this document.

These output buffering relays are normally de-energized and as a result will not initiate actuations upon a loss of power to the relays or upon a relay coil failing to open. Challenges to the existing safety systems are minimized through this approach and the use of redundant hardware with a majority vote to energize the relay coils. In the unlikely event of a random failure where a relay contact would operate spuriously, starting of an emergency feedwater pump or tripping of the turbine could occur.

Quality Assurance

Generic letter 85-06, "Quality Assurance Guidance For ATWS Equipment That Is Not Safety-Related," provided the explicit quality assurance (QA) guidance for non-safety-related ATWS equipment as required by 10CFR50.62. The generic letter specifically states that the QA program for the non-safety-related ATWS equipment does not need to meet 10CFR50 Appendix B requirements nor would compliance be judged in terms of the Appendix. Detailed QA guidance is provided in the enclosure to the generic letter. For manufacturing, the Westinghouse program exceeds the above requirement.

The SCE&G program provides controls for the AMSAC system in accordance with the requirements specified in Generic Letter 85-06. The system will be installed and controlled under a safety-related modification package utilizing applicable safety-related procedures. The system will be maintained through the use of a quality related plan (QRP). The technical requirement package section of the QRP will specify the applicable technical criteria, procurement of replacement parts, and maintenance associated with this system. Design criteria will be controlled by the use of the engineering design control program.

Test/Maintenance Mode

Test/Maintenance at power is accomplished by positioning the permanently installed bypass switch to bypass and selecting the Test/Maintenance mode. This method complies with the NRC SE by not involving lifting leads, pulling fuses, tripping breakers or physically blocking relays. Placement of the AMSAC bypass switch to the bypass position inhibits operation of the system's output relays which operate the final actuation devices. Status outputs to the plant computer and main control board, indicating that a general warning condition exists with AMSAC, are initiated when the bypass switch is placed in the bypass postion.

Operating Bypass

The V. C. Summer Nuclear Station AMSAC design includes an operating bypass which indicates on a main control board status light when below the C-20 setpoint. Westinghouse Owners Group letter OG-87-10, dated February 26, 1987, has been submitted to the NRC providing the basis for the C-20 setpoint. Although short term protection against high reactor coolant system pressures is not required until 70% of nominal power, AMSAC will operate at or above 40% of nominal power. The C-20 setpoint was a compromise between minimizing the amount of reactor coolant system voiding during an ATWS and preventing spurious AMSAC actuations during start-up at the lower power levels. The C-20 permissive signal uses the existing turbine impulse chamber pressure sensors. The indication of the bypass status is consistent with existing control room design philosophy; an annunciator window in the control room is provided. For guidance in diversity and independence for the process equipment and logic power supplies see those specific sections.

System Bypass

The means for bypassing AMSAC is accomplished with a permanently installed bypass switch which includes human factor design practices. It does not involve lifting leads, pulling fuses, tripping breakers or physically blocking relays.

Manual Initiation

Manual initiation of the emergency feedwater system and tripping of the main turbine are achieved through existing plant controls and circuits for V. C. Summer Nuclear Station. The addition of AMSAC to V. C. Summer Nuclear Station will not result in any changes to the emergency operating procedures or to manual emergency feedwater initiation criteria.

Electrical Independence

Electrical independence from the existing RTS is required from the sensor output to, but not including, the final actuation device. This is to separate safety-related circuits from non-safety-related circuits. The V. C. Summer Nuclear Station AMSAC design fulfills this requirement. For the turbine impulse chamber pressure inputs, SCE&G has elected to use the existing pressure transmitters, loop power supplies and isolation devices within the 7300 system process protection system cabinets. In a like manner, existing narrow range level transmitters, loop power supplies and isolation devices (existing and new) within the process protection system cabinets are utilized for measuring level in each steam generator. Electrical independence between the non-class 1E AMSAC circuitry and the class 1E process protection system cabinet circuits is provided through isolation devices which have been tested as described in Appendix A of this document. Moreover, the non-class 1E logic circuitry and outputs are isolated from class 1E circuits.

Physical Separation

The AMSAC equipment needs to be physically separated from the existing protection system hardware. This requires that the cable routing be independent of protection system cable routing and the location of the AMSAC equipment cabinets in such a place that there is no interaction with the protection set cabinets. The basis of this requirement is IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations." The AMSAC actuation outputs to the redundant turbine trip and emergency feedwater pump start circuits are provided from separate relay panels within the AMSAC cabinet. Separation of the train A and B circuits within the AMSAC cabinet is achieved through a combination of metal barriers, conduit, and distance. Additionally, the isolation fault tests mentioned in Appendix A will demonstrate that credible faults will not disable channels associated with other protection sets. All non-class 1E AMSAC inputs and status outputs will be routed separately in the logic cabinet and, therefore, will be separate from the 1E actuation circuits. Figure 2 depicts the system block diagram along with the cable separation groups.

Environmental Qualification

The SE requires that only the isolation devices comply with environmental qualification (10CFR50.49) and with seismic qualification. These are addressed in Appendix A. The remaining portion of the ATWS mitigation system is neither required to be safety-related nor required to meet IEEE-279-1971. This portion of the AMSAC equipment is located outside containment in a mild environment and follows the same design standard that currently exists for non-class 1E control grade equipment. No Additional equipment is being added inside containment since this modification is using the existing qualified steam generator narrow range transmitters.

Testability at Power

The non-safety-related AMSAC circuitry is testable with the plant on-line. In addition, testing of the AMSAC outputs to the final actuation devices may be performed with the plant on-line. The ATWS mitigation system for V. C.

Summer Nuclear Station provides for periodic testing, which is performed with the AMSAC outputs bypassed. This bypass is accomplished through a permanently installed bypass switch alleviating the requirement to lift leads, pull fuses, trip breakers or physically block relays. Status outputs to the plant computer and main control board, indicating that a general warning condition exists with AMSAC, are initiated when the system's outputs are bypassed. Once the system bypass is established, a series of overlapping tests are performed to verify analog channel accuracy, setpoint (bistable trip) accuracy, coincidence logic operation (operation and accuracy of all timers), and continuity through the output relay coils. Switches are provided for each output relay to perform testing of AMSAC outputs through the final actuation devices. A simplified block diagram is shown in Figure 3 reflecting the test overlaps for the periodic on-line tests. A summary of each of the tests follows.

Analog Input Channel Testing

The field input to each analog channel is replaced with a variable test reference which is used to confirm accuracy of the channel gain and offset. The test reference is then ramped up and down throughout a portion of the channel range to verify accuracy of the channel setpoint and associated deadband. This test confirms operation of the input channel signal conditioning circuitry, analog-to-digital converters, and processor operation.

Processor Logic Testing

The second sequence of testing verifies that each actuation logic processor performs the proper coincidence logic, including timing functions, and generates the proper outputs. In this test, the field input to each input channel for the processor under test is replaced with test references. These test references simulate the channel values as either above or below the setpoint which verifies all combinations of coincidence logic and generation of the proper processor outputs to the majority voting modules. This test also confirms operation of the input channel signal conditioning circuitry and the analog-to-digital converters.

Majority Voter and Output Relay Tests

Each majority voting module and associated output relays are tested to verify operation of the majority vote (2 out of 3) and continuity for each of the output relay coils. Integrity of the relay coils along with associated wiring is verified while exercising the voting logic.

Completion of Mitigative Action

Completion of mitigative actions in response to AMSAC actuation is performed through existing plant circuits for emergency feedwater system actuation and for turbine trip. Signals from the AMSAC output relays for actuation of the emergency feedwater system and turbine trip tie in at the output termination cabinets for the solid state protection system (SSPS). All signals from AMSAC act as a redundant signal for the RPS for low steam generator level reactor trips, thereby providing a backup if RPS fails to actuate. Steam generator blowdown and sample lines are isolated by a interlock from the emergency feedwater pump start circuits. This circuitry was part of the initial system design and requires no additional design to meet the ATWS rule.

Technical Specifications

The Westinghouse Owners Group is on record (reference WOG letter OG-171, dated February 10, 1986) that Technical Specifications for AMSAC are unnecessary. SCE&G concurs that the Technical Specifications for AMSAC are unnecessary. In addition, SCE&G believes that the quality related program and normal nuclear plant administrative controls are sufficient to control AMSAC.

APPENDIX A - AMSAC ISOLATION DEVICE

Electrical independence of AMSAC from the existing RPS is provided through several means for V. C. Summer Nuclear Station . A block diagram showing the relationship of AMSAC to the existing RPS is provided in Figure 4, which details the AMSAC/RPS connections and points of isolation.

The steam generator narrow range level inputs to AMSAC are derived from existing isolated signals from the process protection system. These signals are provided from differential pressure transmitters to the process protection cabinet and then from the protection cabinet to the control cabinets and AMSAC. This arrangement does not require the use of new isolators to provide electrical independence of these instrument channels from the existing RPS. However, to prevent overloading of the existing current loops, several isolators of the existing type were added.

For measuring turbine load at the first stage, SCE&G has elected to utilize the existing pressure transmitters. As with the narrow range steam generator inputs, the isolated signals are from the RPS which have been routed to the control cabinets and AMSAC.

Isolation is provided in the process protection cabinet for the signals used as input for AMSAC. As reported in WCAP-8892A, "Westinghouse 7300 Series Process Control System Noise Tests," these isolation devices, which are powered by a class 1E source, have been tested to demonstrate that the device is acceptable for this application. The purpose of the tests was to determine whether or not protection circuitry could be perturbated to the extent that protective action would be prevented by the pick-up or presence of credible interference on control wiring in close proximity to protection wiring within the process control racks. Isolation devices are used in the Process Control Systems 7300 Series equipment to electrically isolate the protection circuits inside the process control racks from control circuits outside the cabinets. The system was subjected to tests that included magnetic noise tests, output cable voltage faults (maximum credible voltages: 550 volts AC, 250 volts DC), cross talk, random noise, and others. The acceptance criteria for these tests were that the postulated fault should not prevent required protective action and that spurious protective action caused by the postulated fault should be acceptable. Since AMSAC is separate from the reactor protection system and the cable is not routed in an area that exceeds the 550 volts AC 250 volts DC test limits, any interference from AMSAC would not affect the reactor protection system.

Under all tested conditions, the protection circuitry operated as intended. The tests showed conclusively that electrical interference imposed onto the isolator output wiring (control wiring) is not a consideration for the proper operation of the perturbated channel nor any adjacent channels. The magnitude of the electrical interference introduced into the system and the stringent testing procedures far exceeded any conditions that would be present in actual plant operations.

Relays are provided at the output of AMSAC for isolating the non-class 1E AMSAC circuits from the class 1E final actuator circuits. For V. C. Summer Nuclear Station, the AMSAC outputs are provided from separate relay panels within the AMSAC cabinet. Separation of the Train A and B circuits within the AMSAC cabinet is achieved through a combination of metal barriers, conduit, and distance. These relays were tested with the maximum credible faults applied to the relay coil in the transverse mode. Tests were performed with the relay coil operating contact in both the open and closed postion. Figure 4 depicts the simplified diagram of this output isolation circuit, and point of application for the maximum credible faults. Details of the actual tests, fault levels and their origin, test data, and the pass/fail acceptance criteria are included in the attached Westinghouse WCAP-8687, Supplement 2-E68A, "Qualification of ATWS Mitigating System Actuation Circuitry In Standard Seismic Cabinet."

Additionally, the SE requires that the isolation devices comply with the environmental qualifications (10CFR50.49) and with the seismic qualifications which were the basis for plant licensing. The isolation device at the output of AMSAC is the boundary between safety-related and non-safety-related circuits and, therefore, must be qualified. For V. C. Summer Nuclear Station configuration, the AMSAC output isolation device will be qualified in accordance with the current Westinghouse seismic qualification program. The program development and implemention were based on the requirements of IEEE-344-1975, "IEEE Standard for Seismic Qualification of Class 1E Electrical Equipment for Nuclear Power Generating Stations." The isolation provided at the protection system have been seismically qualified. Environmental Qualifiction Reports, however, are not applicable to the AMSAC output relays since these are located in a mild environment. The methodology for qualification is contained in WCAP 8587 Rev. 6-A, "Methodology for Qualifying Westinghous WRD Supplied NSSS Safety Related Electrical Equipment."

The class 1E loads operated by the isolation relay contacts are powered from a class 1E source. The plant specific details of the wiring configuration can be found on the SCE&G elementary drawing if needed.

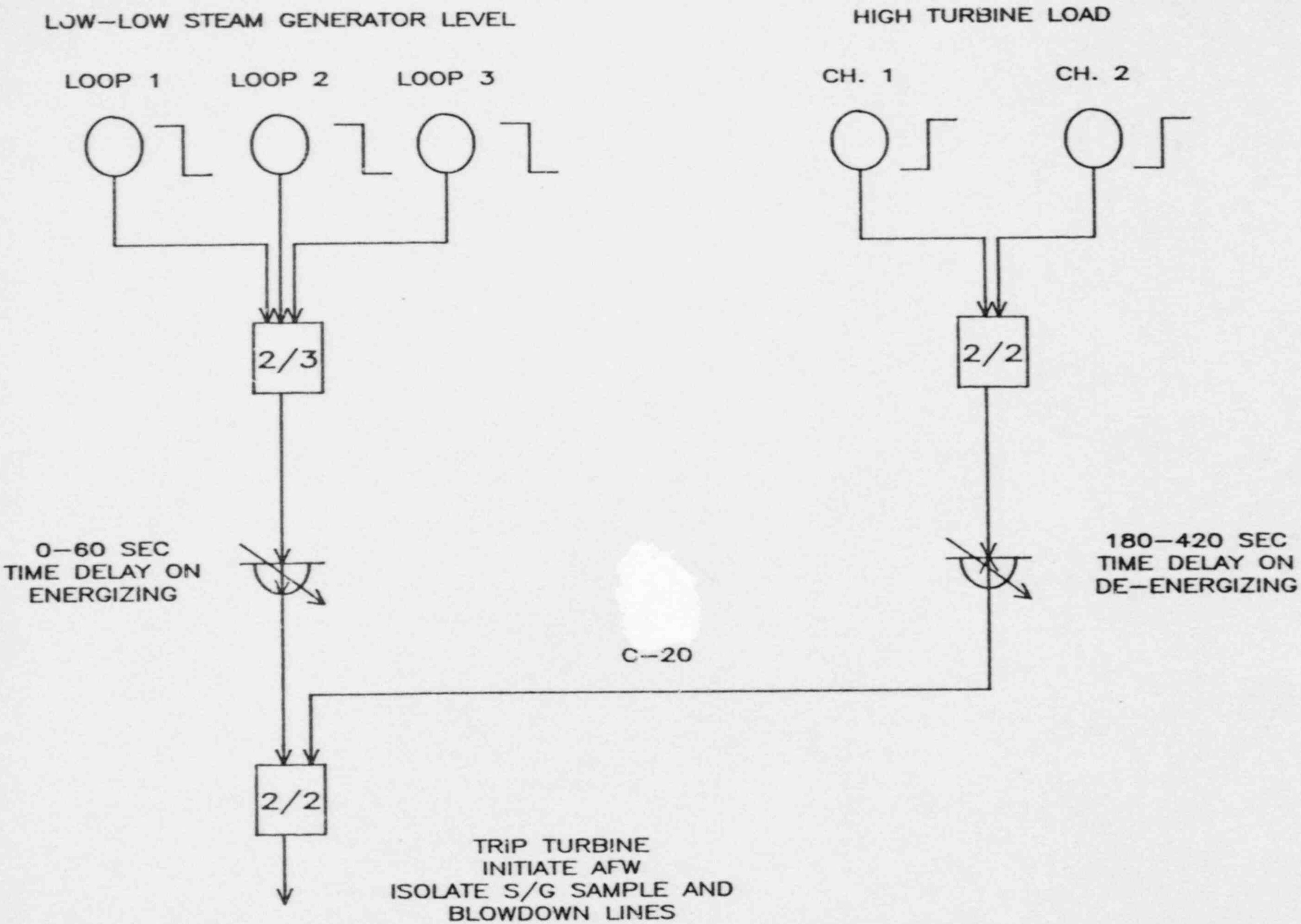


Figure 1: AMSAC Actuation Logic

amsacA-8

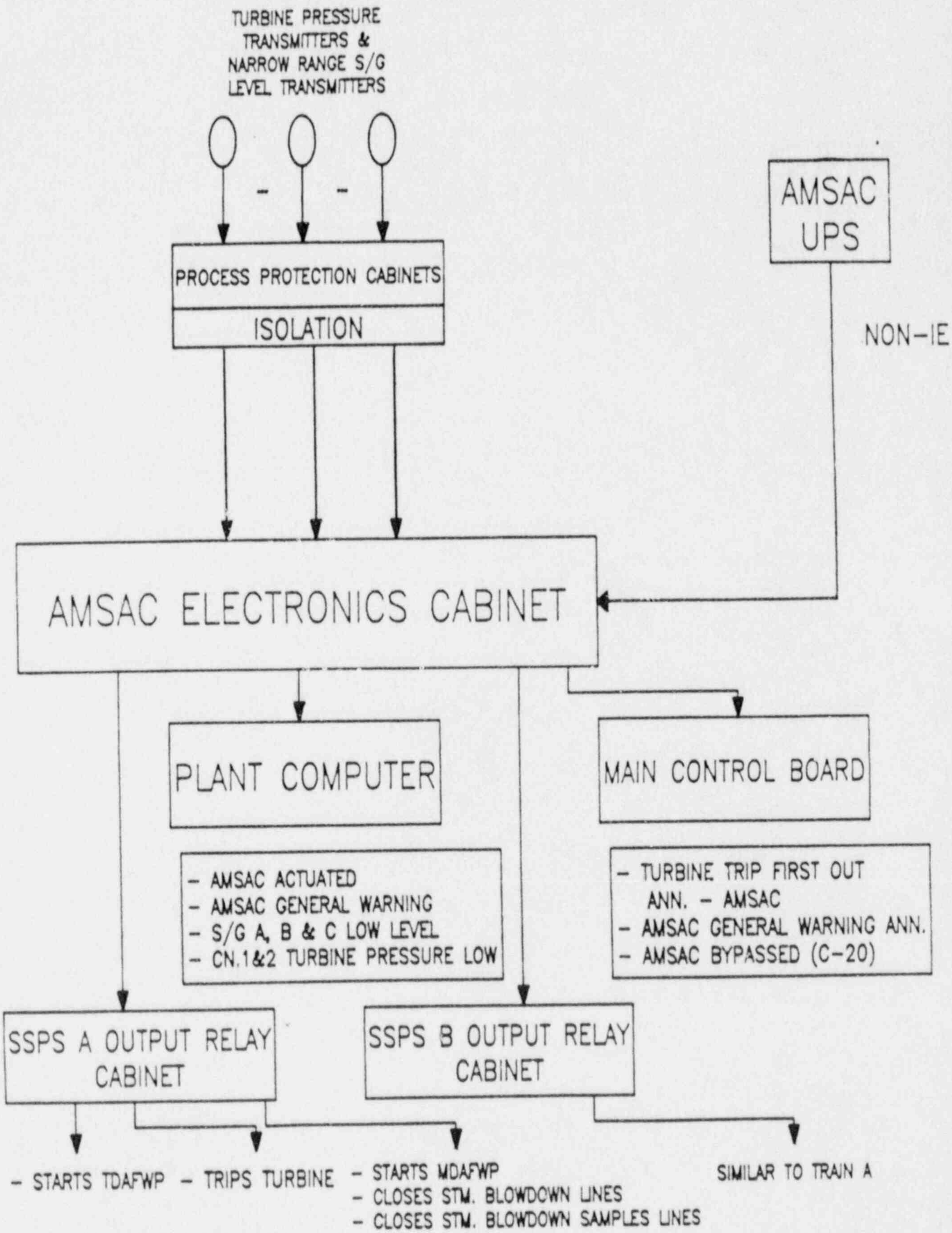
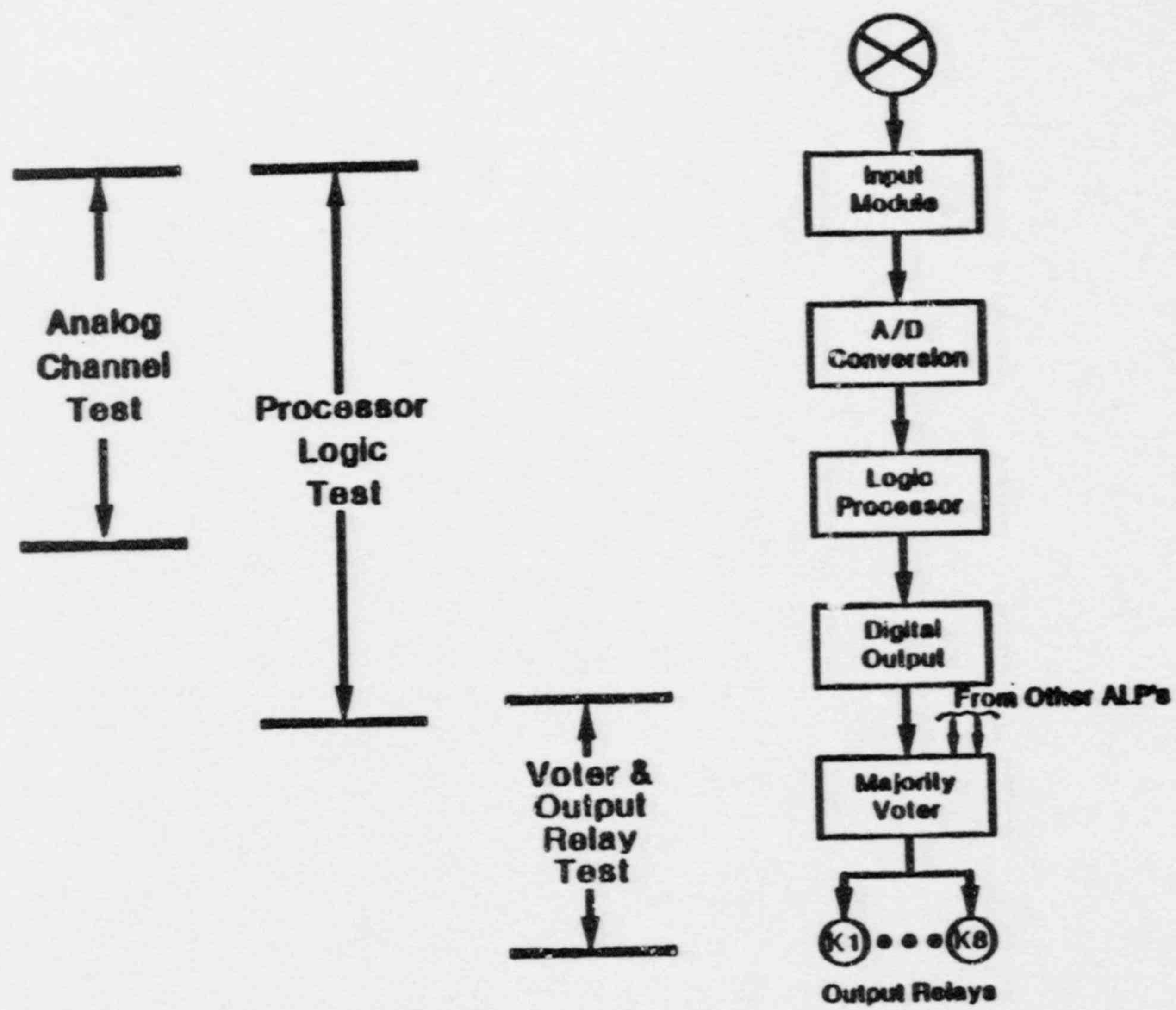


Figure 2: AMSAC Block Diagram

amsacB



ON-LINE TESTING COMPOSITION

FIGURE 3: TESTING OVERLAPS

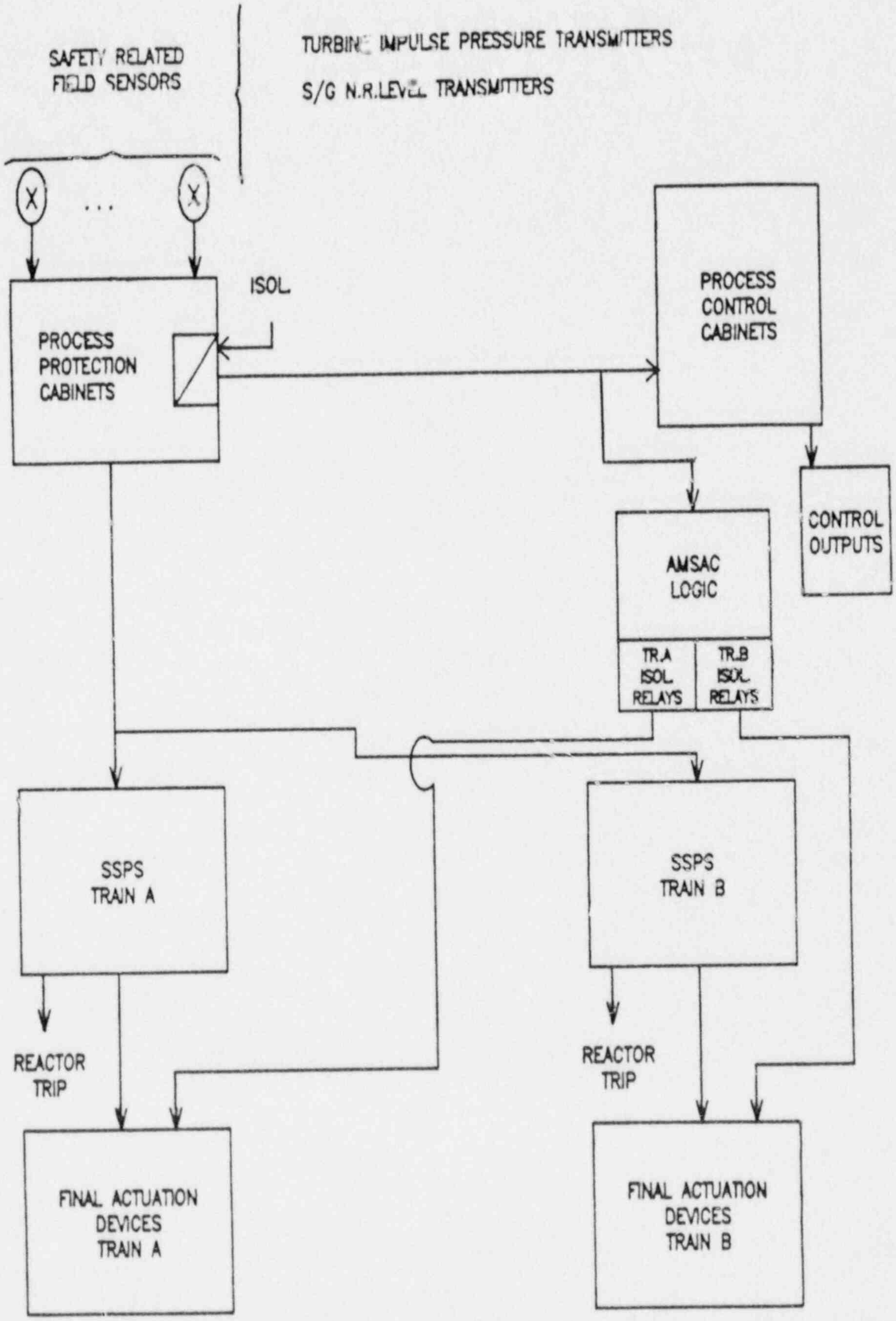


Figure 4: RPS-AMSAC Block Diagram

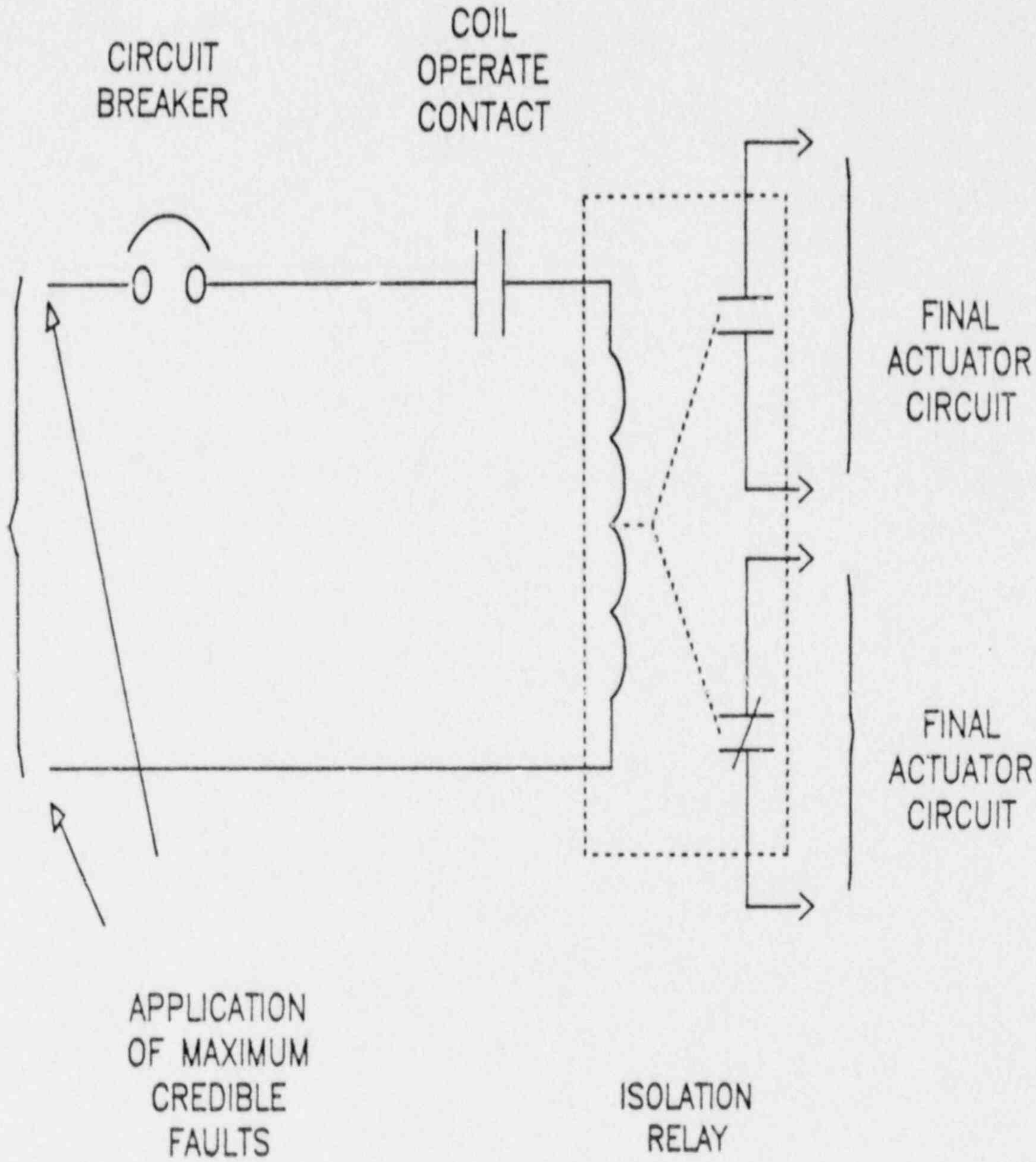
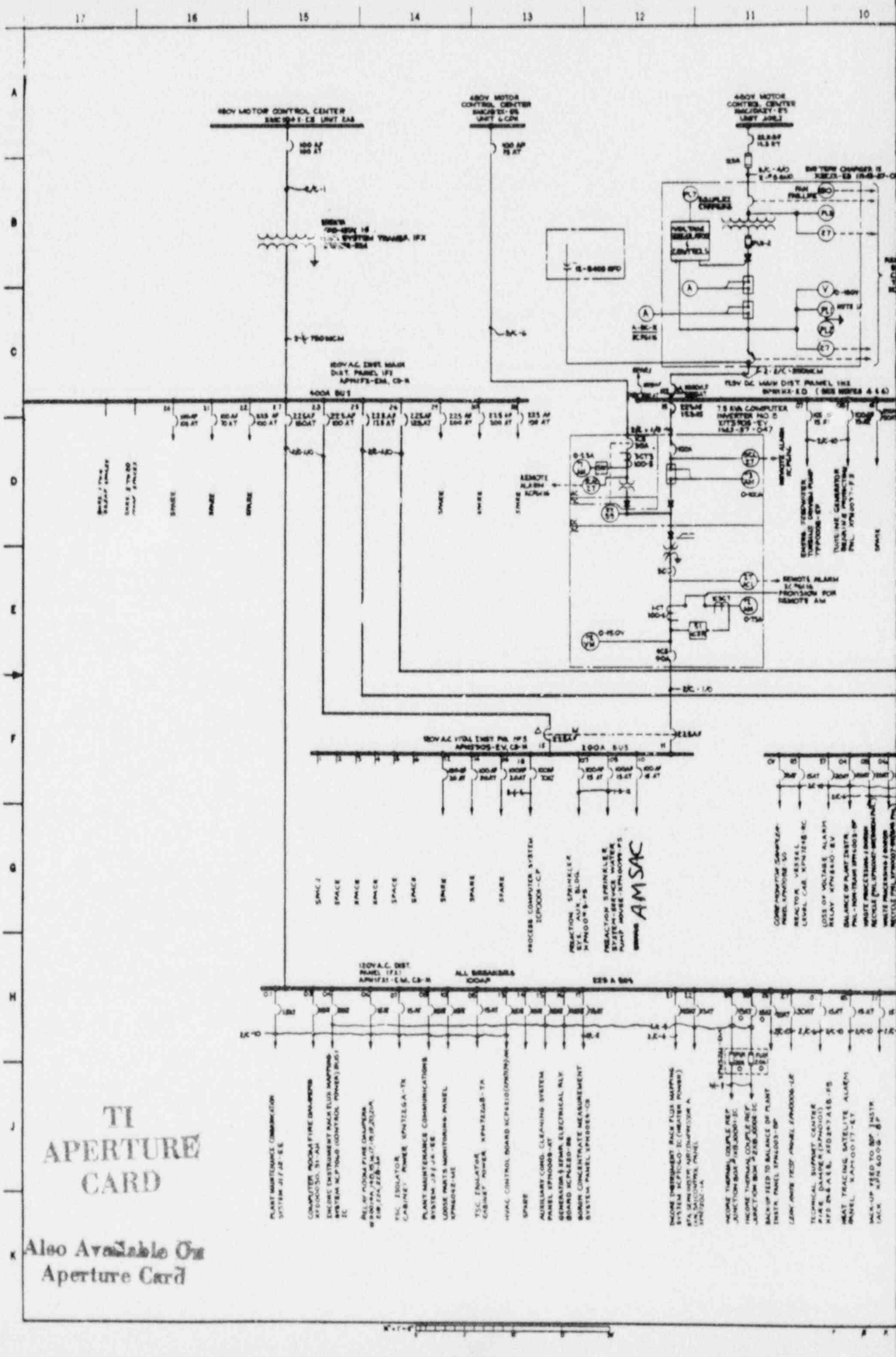


Figure 5: Isolation Relay



TI APERTURE CARD

Also Available On Aperture Card

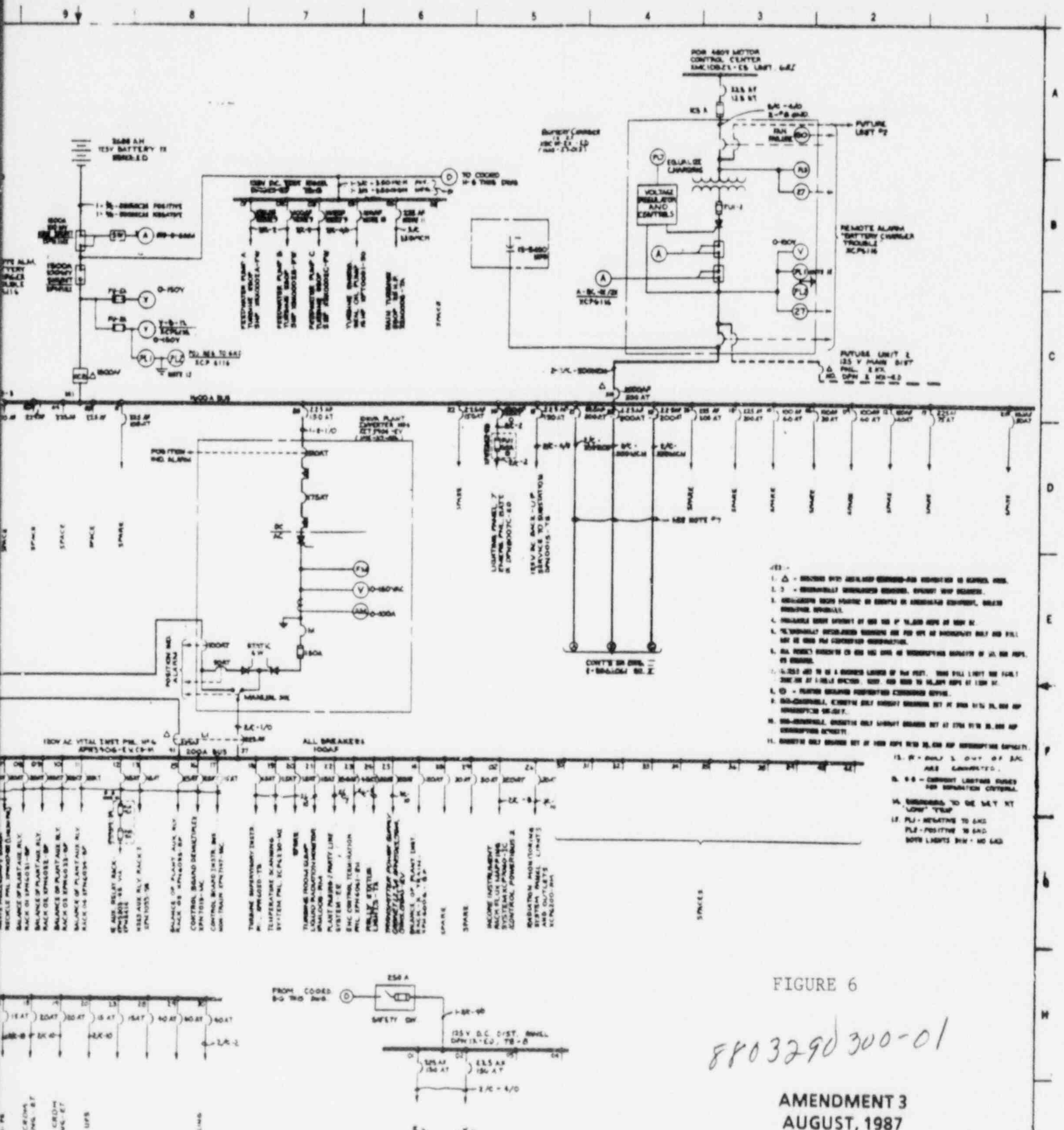


FIGURE 6

8803290300-01

AMENDMENT 3
AUGUST, 1987

SOUTH CAROLINA ELECTRIC & GAS CO.
VIRGIL C. SUMMER NUCLEAR STATION

Balance of Plant
Vital AC - DC System
(GAI Dwg. No. E-206-061, Sh. 1)

Figure 8.3-4