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FLORIDA POWER & LIGHT COMPANY

JULY 15 1987
L-87-292

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

Gentlemen:

Re: Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251
Anticipated Transients Without Scram (ATWS)
NRC TAC Numbers 59153 and 59154

By letter dated September 24, 1986 you provided a safety evaluation (SE) of the Westinghouse Owners Group generic design for the ATWS mitigation system actuation circuitry (AMSAC) submitted in response to 10 CFR 50.62, "Requirements for Reduction of Risk from Anticipated Transients Without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants." In that letter you requested that FPL review the SE and provide schedules for addressing the plant specific design features discussed in the SE, and for implementation following the NRC Staff's approval of the Turkey Point Plant specific design.

By letter dated November 3, 1986 (FPL Letter No. L-86-448), we stated that the Turkey Point Plant specific design information would be submitted by July 15, 1987, and that a schedule for implementation would be provided following development of the plant specific design and NRC approval of that design.

Accordingly, attached is the conceptual design information requested in your September 24, 1986 letter. Implementation of the required modifications will be in accordance with the Integrated Schedule for the Turkey Point Plant.

If there are any questions, please contact us.

Very truly yours,

C. O. Woody
Group Vice President
Nuclear Energy

COW/TCG/gp

Attachment

cc: Dr. J. Nelson Grace, Regional Administrator, Region II, USNRC
Mr. D. R. Brewer, USNRC Senior Resident Inspector, Turkey Point Plant

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FLORIDA POWER & LIGHT COMPANY
TURKEY POINT PLANT - UNITS 3 & 4
ATWS MODIFICATIONS

AMSAC CONCEPTUAL DESIGN

FLORIDA POWER & LIGHT COMPANY
PLANT TURKEY POINT - UNITS 3 & 4
REA-TPN-84-63, BFI 134-26
ATWS MODIFICATIONS

AMSAC CONCEPTUAL DESIGN

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I. DESIGN DESCRIPTION

On July 26, 1984 the Code of Federal Regulations (CFR) was amended to include Section 10 CFR 50.62, "Requirements for Reduction of Risk from Anticipated Transients Without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants" (known as the "ATWS Rule"). An ATWS event is an expected operational transient (such as loss of feedwater, loss of condenser vacuum, or loss of offsite power) which is accompanied by a failure of the reactor trip system to shut down the reactor. The ATWS rule requires specific improvements in the design and operation of commercial nuclear power facilities to reduce the likelihood of failure to shut down the reactor following anticipated transients, and to mitigate the consequences of an ATWS event.

The basic requirement for Westinghouse plants is specified in paragraph (c)(1) of 10 CFR 50.62, "Each pressurized water reactor must have equipment from sensor output to final actuation device, that is diverse from the reactor trip system, to automatically initiate the auxiliary feedwater system and initiate a turbine trip under conditions indicative of an ATWS. This equipment must be designed to perform its function in a reliable manner and be independent (from sensor output to the final actuation device) from the existing reactor trip system."

For Turkey Point Units 3 and 4, this basic requirement will be met by the addition of AMSAC (ATWS Mitigating System Actuation Circuitry) to both Units. AMSAC is designed to accept inputs from existing instrumentation which indicate that an anticipated transient has commenced, to process the inputs to recognize the event, and to provide signals to initiate the auxiliary feedwater system and a turbine trip, thus preventing overpressurization of the Reactor Coolant System. By doing this, AMSAC will function to mitigate the effects of an ATWS event. This document has been developed to present a conceptual design of AMSAC, which, after NRC approval, will be utilized in the bases for the design to be implemented at both Units.

For each Unit, the AMSAC consists of two microprocessors which process the data received by the system from selected instruments. Input signals originate as analog signals in the Hagan racks and are electrically isolated from the RPS before reaching the AMSAC circuits. These analog signals are fed into bistable trip devices with setpoints consistant with the commencement of an AMSAC event. The digital outputs of the bistable trip devices are then sent to input modules which feed the microprocessors. The microprocessors evaluate the signals to determine when protective mitigating actions should be taken. Once so determined, digital signals are provided by the microprocessors through output modules and isolation devices to the actuation circuitry of systems which perform the protective mitigating functions.

In addition to initiating auxiliary feedwater and a turbine trip, signals are provided to perform two other tasks which promote the conservation of steam generator inventory (the reactor coolant heat sink): 1. Isolating the blowdown recovery system 2. Isolating the steam generator blowdown sampling system.

The Westinghouse Owners Group (WOG) developed three generic designs approved by the NRC to meet the requirements of 10CFR50.62 which permits each utility to select the design that best fits a particular plant's needs. The designs differ essentially in only one aspect, the inputs to AMSAC.

1. Low-Low Steam Generator Level Inputs

   The first design would initiate AMSAC protective actions upon sensing that the steam generator inventory is below a preset level. This logic senses conditions indicative of an anticipated transient when a loss of the reactor coolant system heat sink has occurred. It will not actuate until after the Reactor Protection System has had the opportunity to respond. For the three loop plant design of Turkey Point Units 3 and 4, AMSAC uses one channel per steam generator and two-out-of-three (2/3) input coincidence logic.

2. Low Main Feedwater Flow Inputs

   The second design would mitigate the consequences of an anticipated transient by initiating AMSAC on low main feedwater flow measurements. This logic senses conditions indicative of 25% nominal feed flow using one instrument channel per loop and 2/3 coincidence logic. Time is allowed after 2/3 channels indicate a loss of main feedwater flow to permit the main feedwater system to recover automatically.

3. Main Feedwater Pump Trip or Main Feedwater Valve Closure Inputs

   The third design determines that conditions indicative of an anticipated transient are present by monitoring the main feedwater control and isolation valve positions and the main feedwater pump operational status. Initiation of AMSAC protective actions will occur when it has been determined that all main feedwater pumps have been tripped or when main feedwater flow to 2/3 steam generators has been blocked due to valve closures. Since AMSAC anticipates the plant response due to the loss of main feedwater pumps prior to the reactor protection system detecting an anticipated operational occurrence, AMSAC actuation is delayed to allow sufficient time for the reactor protective system to respond.

The first design, AMSAC actuation on low-low steam generator level, was selected for Turkey Point Units 3 and 4 for two reasons. First, it is less complex in logic than the third design (valve/pump). Second, level channels in the Hagan racks selected for use by AMSAC do not have inputs into an analog control system, as do the flow channels in the second design.

II. INPUTS

There are five analog signal inputs to the mitigating system logic as well as several digital control inputs (i.e., switches, pushbuttons). Of the five signal inputs, three are used to initiate the ATWS protective functions in a two-out-of-three (2/3) logic and two are used to arm AMSAC in a two-out-of-two (2/2) logic. All five signals originate within cabinets constructed by the Hagan/Computer Systems Division of Westinghouse Electric Corporation, Pittsburgh, Pennsylvania. The cabinets are referred to as Hagan racks throughout this document.

The Hagan racks are located in the common Control Room and are maintained under controlled environmental conditions. The north side of the room contains the Hagan racks for Unit 3 and the south side contains those for Unit 4. They are identical for both units. Arranged in 2 rows with both front and back doors, the racks afford easy access for maintenance, calibration, and operations. Cable entry is through the bottom and the top.

1. STEAM GENERATOR LEVEL

Three steam generator level inputs are used to initiate the ATWS protective functions in a 2/3 logic. These signal inputs originate from Hagan rack R3, generated by the steam generator level instrument loops for steam generators A, B, and C, narrow range, Channel I. The signals are derived from secondary 4-20mA loops connected to the instrument loops through existing signal isolators. See Attachment 5. Analog isolators, qualified to the requirements of Appendix A of the SER, will be installed for the S/G input signals. Their purpose will be to provide qualified isolation between AMSAC and the RPS.

The secondary loops are connected to the instrument loops through current-to-voltage (I/V) input modules and existing isolators. The I/V input modules, which transform the instrument loop 4-20mA signals to 1-5Vdc signals for input to the isolators, are wire-wound precision 250 ohm resistors. The existing isolators are the transformer type. They accept 1-5Vdc signals from the I/V input modules and drive 4-20mA secondary current loops. The AMSAC inputs utilize the voltage drop across the existing 250 ohm test point resistors in the secondary loops located in rack R26. A high impedance input resistance is used to prevent excessive signal loss in the secondary loops. Power for the secondary loops is from 120Vac vital supplies and is wired directly to the existing isolators. The following table lists all of the components involved with the three steam generator input signals and their locations:

	UNIT 3		
Instrument	LT-3-474	LT-3-484	LT-3-494
Location	S/G A	S/G B	S/G C
I/V Module	LM-3-474/R	LM-3-484/R	LM-3-494/R
Location	Rack 3	Rack 3	Rack 3
Secondary Loop			
Signal Isolator	LM-3-474	LM-3-484	LM-3-494
Location	Rack 3	Rack 3	Rack 3
Power	3P06	3P06	3P06
Test Point	TP-3-474-2	TP-3-484-2	TP-3-494-2
Location	R26	R26	R26

UNIT 4

Instrument	LT-4-474	LT-4-484	LT-4-494
Location	S/G A	S/G B	S/G C
I/V Module	LM-4-474/R	LM-4-484/R	LM-4-494/R
Location	Rack 3	Rack 3	Rack 3
Secondary Loop Signal Isolator	LM-4-474	LM-4-484	LM-4-494
Location	Rack 3	Rack 3	Rack 3
Power	4P06	4P06	4P06
Test Point	TP-4-474-2	TP-4-484-2	TP-4-494-2
Location	R26	R26	R26

2. TURBINE FIRST STAGE PRESSURE

Two inputs are used to arm AMSAC above certain power levels in a 2/2 logic as indicated by turbine first stage pressure. These signal inputs originate from Hagan racks R16 and R25 and are generated by the instrument loops for the turbine first stage pressure instruments, Channels III and IV, respectively. Similar to the steam generator level inputs, the signals are not taken directly from the instrument loops, but from the 4-20mA secondary loops by utilizing the voltage drop across the existing 250 ohm test point resistors located in rack R27.

Also similar to the steam generator level inputs, I/V input modules and existing isolators are used to couple the instrument loops to the secondary current loops. Qualified isolators will be used in addition to the existing secondary loop isolators to provide electrical isolation between AMSAC and the RPS in accordance with Appendix A of the SER. The following table lists all of the components involved with the two turbine first stage pressure input signals and their locations:

UNIT 3

Instrument	PT-3-446	PT-3-447
Location	Turbine	Turbine
Channel	III	IV
I/V Module	PM-3-446A/R	PM-3-447A/R
Location	R16	R25
Secondary Loop Signal Isolator	PM-3-446A	PM-3-447A
Location	R16	R25
Power	3P08	3P09
Test Point	TP-3-446-2	TP-3-447-2
Location	R27	R27

UNIT 4

Instrument	PT-4-446	PT-4-447
Location	Turbine	Turbine
Channel	III	IV
I/V Module	PM-4-446A/R	PM-4-447A/R
Location	R16	R25
Secondary Loop Signal Isolator	PM-4-446A	PM-4-447A
Location	R16	R25
Power	4P08	4P09
Test Point	TP-4-446-2	TP-4-447-2
Location	R27	R27

3. POWER FAILURE PROTECTION

The 120Vac power source is the same for both the instrument loop power supply and the existing isolator in channel I of all three steam generator level circuits. For Unit 3, it is 120Vac panel 3P06 and for Unit 4, 120Vac panel 4P06. Without power failure protection, failure of one of these sources will cause all three channel I AMSAC input signals for that Unit to appear to be below the low steam generator level AMSAC actuation setpoint. Twenty-five seconds later (approximately), AMSAC would initiate the four protective mitigating functions for that Unit, even though actual steam generator levels were within their normal operating range. To avoid this inadvertant AMSAC actuation due to a loss of power to the input instruments, an isolating relay will be added to monitor each power source. Loss of power will cause a digital signal to be sent directly to the microprocessor logic, which will then override the actuation signals and will advise the operators that a problem exists through the common annunciator window.

The 120Vac power source for both the instrument loop power supply and the existing isolator for channel III of the turbine first stage pressure in Unit 3 is 120Vac panel 3P08. Loss of power (panel 3P08) would cause turbine first stage pressure to appear low and would disarm AMSAC since two-out-of-two logic is used to arm the system. An isolating relay will be added to monitor each power source. Loss of power will cause a digital signal to be sent to the common annunciator window and an indicating light in the Control Room. A similar configuration will be designed for Unit 4.

III. OUTPUTS

There are output signals for four protective, mitigating functions as well as several control indications. However, only two output signals actually are used to initiate mitigating functions: turbine trip and auxiliary feedwater initiation. The other two functions, blowdown recovery isolation and blowdown sampling isolation, are initiated by the auxiliary feedwater auto start relays. By using the auto start relays to initiate the latter two functions instead of adding contacts to the existing circuitry, it can be certain that the mitigating action is consistent with the designed operation of the existing circuitry. Consistency with the circuitry of turbine trip and auxiliary feedwater systems is achieved by installing contacts in parallel with existing actuating contacts.

Isolating devices are required to electrically isolate the non-safety AMSAC from safety-related auxiliary feedwater initiating circuits. The turbine trip circuits are not safety-related and will not be isolated. The other two systems, the blowdown recovery system and blowdown sampling system, are not connected electrically to AMSAC and will not require isolation either.

1. TURBINE TRIP

Turbine trip is performed by energizing either of two turbine trip solenoids, a primary or a backup, or both. Either will cause oil to be dumped from the auto stop oil lines, each solenoid using a different mechanical sequence for diversity. Consequently, for either sequence, the turbine right and left stop valves will close, and the turbine will shut down. There are two additional design features that contribute to turbine trip reliability. First, the trip signal is provided to both solenoids through two independent trip circuits and second, the power supply for the backup auto trip circuit is provided by 125 Vdc from the opposite Unit, (i.e. Unit 4 provides Unit 3 backup trip power). 125 Vdc can be lost to the main control boards in either Unit and turbine trip can still be accomplished for both Units. The AMSAC conceptual design makes use of these features by connecting directly into both the primary and backup auto trip circuitry.

New non-safety cables will be routed from the AMSAC cabinet to control console section 3C02 (4C02 for Unit 4) in order to provide contact closure to energize both turbine trip solenoids. Electrical isolation will not be required. Contact closure will be controlled by processor logic and will take place in processor output modules. A total of four contacts will be required, two for the primary auto stop trip solenoid (20/AST) and two for the backup auto stop trip solenoid (20/ASB). Failure of either processor or its associated output modules will not trip the turbine. See attachment 1 for contact arrangement and tie-in to the turbine trip circuitry.

Within control console section 3C02, one pair of contacts will be electrically connected to 20/AST and the other to 20/ASB as shown in attachment 1. This bypasses all trip controls to energize the solenoids in parallel with the manual trip push buttons without interferring with existing circuit functions. To ensure that AMSAC will actuate after a turbine trip, a time delay precludes disarming the system for approximately 120 seconds after power has been reduced below 40%. This is similar in Unit 4 control console section 4C02.

2. AUXILIARY FEEDWATER INITIATION

Auxiliary feedwater initiation consists of opening three motor operated valves per Unit to admit steam to the three auxiliary feedwater pump steam turbines and opening the flow control valves to a pre-determined flow rate. If both Units are operating, all three pump turbines will start. If only one Unit is operating, one pump is administratively removed from service and only two pump turbines will start. Initiation of auxiliary feedwater for one Unit will not affect operation of the other Unit. In this section, only Unit 3 will be referenced, Unit 4 is similar.

Auxiliary feedwater is initiated by energizing the six auto start relays, three each in two separate, identical control circuits, labelled train A (scheme 3CRX) and train B (scheme 3CRZ). See attachment 2. Relays 3-AF1 in train A and 3-AF10 in train B are energized to open the motor operated, steam supply valve MOV-3-1404. Relay 3-AF1 also opens steam supply valve MOV-3-1405 while relay 3-AF10 also opens steam supply valve MOV-3-1403. Besides operating the steam supply MOVs, these six relays also:

a) Automatically reinitiate restart of the turbine if an electronic overspeed has occurred or if the trip and throttle (T&T) valves, MOV-6459A, MOV-6459B, and MOV-6459C, have been closed (tripped) during surveillance testing.
b) Close the steam generator water sampling isolation valves MOV-3-1425, MOV-3-1426, MOV-3-1427.
c) Close the steam generator blowdown recovery isolation valves SV-3-6275A-1, SV-3-6275B-1, SV-3-6275C-1 and CV-3-6275A, CV-3-6275B, CV-3-6275C.

There are six parallel circuit paths for each control circuit which energize the auto start relays and initiate auxiliary feedwater. The contacts in these parallel paths are closed by the following conditions:

1. Steam generator A low-low water level
2. Steam generator B low-low water level
3. Steam generator C low-low water level
4. Safety injection
5. Loss of voltage, A or B 4.16 KV buses
6. Loss of one feedwater pump when less than 60% power or two pumps under normal conditions

By adding one more parallel path to the control circuit with contacts operated by AMSAC, an ATWS condition will initiate auxiliary feedwater consistent with existing circuit functions. This tie-in is preferrable to a connection directly to the MOV motor starter opening coil as it permits normal use of the entire starter circuit. It also permits the other functions normally carried out by the auto start relays to take place. Attachment 2 provides clarification of the tie-in. To initiate auxiliary feedwater, the flow control valves must also be opened. This is accomplished automatically when the steam supply MOVs are opened and their limit switches close. This opens the solenoid valves supplying air to the control valve operators. Signal isolation is required.

3. BLOWDOWN RECOVERY ISOLATION

Along with the initiation of auxiliary feedwater and turbine trip, AMSAC is also required to isolate the blowdown recovery system. In Unit 3, the valves selected for this task include air operated control valves CV-3-6275A, CV-3-6275B, and CV-3-6275C and solenoid valves SV-3-6275A-1, SV-3-6275B-1 and SV-3-6275C-1. These valves were selected in lieu of using control valves FCV-3-6278A, FCV-3-6278B, and FCV-3-6278C due to their relative location upstream of the control valves and due to the connection of their existing control circuits with the auxiliary feedwater actuation circuits.

As stated in Section 2, initiation of auxiliary feedwater by AMSAC is accomplished by energizing six auto start relays. In addition to starting the auxiliary feedwater pump turbines and opening the auxiliary feedwater steam supply valves, these relays also de-energize and close solenoid valves SV-3-6275A-1, SV-3-6275B-1, and SV-3-6275C-1 and SV-3-6275A, SV-3-6275B and SV-3-6275C. The latter three solenoid valves direct air to the valve operators of control valves CV-3-6275A, CV-3-6275B and CV-3-6275C. Without modifications to valve control circuits, automatic initiation of auxiliary feedwater by AMSAC will also cause the closing of solenoid and control valves to isolate the blowdown recovery system.

Three additional switches, HS 3-1425X, HS 3-1426X, and HS 3-1427X, which bypass automatic blowdown recovery system isolation functions, are kept locked in the NORMAL position under plant conditions in which AMSAC would normally be armed. Since they would be placed in the OVERRIDE DRAIN AND FILL position only to operate blowdown recovery isolation valves when the steam generators are drained under shutdown conditions, they will not interfere with the blowdown isolation function of AMSAC and will not require control circuit modifications. Unit 4 is similar to Unit 3.

4. BLOWDOWN SAMPLING ISOLATION

Along with the initiation of auxiliary feedwater and turbine trip, AMSAC is also required to isolate the steam generator blowdown sampling system. In Unit 3, the valves selected for this task include MOV-3-1425, MOV-3-1426, and MOV-3-1427, AC powered motor operated valves. Controls for the three valves include both opening and closing circuits, with contacts in those circuits from the auto start relays in the auxiliary feedwater system.

As stated in Section 2, initiation of auxiliary feedwater by AMSAC is accomplished by energizing the six auto start relays. Relay 3-AF3 provides signals to close MOV-3-1426 and MOV-3-1427 while relay 3-AF30 provides signals to close MOV-3-1425 and MOV-3-1427. Therefore, without modifications to the valve control circuits, automatic initiation of auxiliary feedwater by AMSAC will also isolate the sampling system.

Three additional switches, HS 3-1425X, HS 3-1426X, and HS 3-1427X, which bypass automatic sampling system isolation functions, are kept locked in the NORMAL position under plant conditions in which AMSAC would normally be armed. Since they would be placed in the OVERRIDE SAMPLE VALVE position only to operate sampling valves in an accident scenario, they will not interfere with the sampling system isolation function of AMSAC and will not require control circuit modifications. Unit 4 is similar to Unit 3.

IV. LOGIC

The three, isolated, analog, steam generator level signals will be converted to digital (on-off) signals by three bistable trip devices calibrated to turn on at the low steam generator actuation setpoint of 5%. The digital signals will be examined for two-out-of-three (2/3) coincidence by the AMSAC logic. In addition, a non-accumulative 25 second time delay will be utilized after 2/3 coincidence has occurred to allow the Reactor Protective System to function prior to AMSAC and to permit temporary unstable steam generator levels to stabilize without causing AMSAC actuation. A single pushbutton will be available in the Control Room to reset AMSAC after actuation.

The two, isolated, analog, turbine 1st stage pressure signals will be converted to digital signals by two bistable trip devices calibrated to turn on at a corresponding power level of 40%. The digital signals will be examined for two-out-of-two (2/2) coincidence by the AMSAC logic. If both digital signals are present, indicating that the plant is operating above 40% power, AMSAC will be armed. Actuation of AMSAC cannot occur regardless of steam generator levels unless it has been armed. Following a turbine trip, AMSAC will remain armed for 120 seconds after power has been reduced to below 40% to ensure that AMSAC can actuate if an anticipated transient has occurred. The 120 second time delay will not prevent the operators from resetting the system after actuation.

The logic will be performed in a single cabinet for each Unit by two solid state microprocessors which will operate in parallel. Each microprocessor will be supplied with an identical set of digital input signals electrically isolated prior to reaching the cabinets and will produce an identical set of unisolated digital output signals. The output isolating devices will be of the digital type, qualified to Class 1E standards and powered from Class 1E sources. Digital control input and output isolators may also be required. If so, then they will also be qualified Class 1E and will be powered from Class 1E sources. All logic components located in the AMSAC cabinets will be qualified as non-safety and non-seismic although the cabinets themselves may be seismically qualified to support the safety-related components or to prevent the cabinets from damaging adjacent safety-related equipment. See attachment 3 to identify the safety/non-safety boundaries of AMSAC and Attachment 4 for the system logic.

AMSAC will be designed to operate in two different modes: 1) NORMAL 2) BYPASS. In the NORMAL mode, the circuitry will function automatically, giving the operator notice with status lights in the Control Room of when AMSAC is on, when it is in BYPASS, when it is armed, and when it actuates. A multifunction, single annunciator window in the Control Room will be illuminated when the system loses power, when there is hardware trouble, when the system is in BYPASS, or when AMSAC automatically actuates. Manual actuation of AMSAC will not be included in the circuit design.

In the BYPASS mode, outputs to the final actuation devices will be blocked electrically to allow plant personnel to perform calibrations, tests, and maintenance while the plant remains at power. A single, two position switch, controlled by a key, will perform the blocking functions while also providing operators in the Control Room with a status light which illuminates when the outputs are blocked. Outputs also will be directed to indicating lights on the Test/Maintenance panel to assist in testing. AMSAC will be designed so that it can accept test signals from the Hagan racks or from a portable signal generator to test the bistable trip setpoints, microprocessor logic, and input/output modules. Silent status lights on the Test/Maintenance panel will be used to inform plant personnel when each bistable has tripped, when AMSAC is armed, when it actuates, when each output is energized, when the system is on, and when it is in the BYPASS mode.

The microprocessors called for in the design description will be two industry standard programmable controllers which handle digital inputs and outputs only. Each will perform all the logic functions, including actuation, arming, and testing and will be installed with a modular input and a modular output system. Output modules for the programmable controllers will be of the relay contact type rather than solid state (triac) to prevent output circuit failures from causing inadvertant AMSAC actuation. In addition, outputs will be energized to initiate mitigating actions to prevent inadvertant AMSAC actuation due to power failures, output module failures, wiring opens, microprocessor failures et al. Output modules from the two programmable controllers will be wired to prevent the failure of a single microprocessor or of its output modules from causing inadvertant AMSAC actuation.

Specifications for the programmable controllers may include:

1. RAM and PROM memories. The RAM memory will be utilized for programming and system testing. The program will be transferred to PROM after satisfactory testing to prevent it's inadvertant loss or modification.

2. Digital, modular, input and output systems. Modular construction will facilitate troubleshooting, repair, and modification to the system. The use of digital inputs and outputs will facilitate programming and reduce the complexity of the programmable controller.

3. Ladder logic language. Use of industry standard ladder logic will reduce training requirements and will enable the Units 3 & 4 to use their own plant personnel to troubleshoot the system.

4. A programming device with visible ladder logic display. This will provide the plant personnel with a visual aid directly related to the program. The programming device and program display may be of the small, hand-held size.

5. Relay contact type of output modules: This prevents problems associated with the shorting of solid state (triac) output devices.

6. Isolated inputs and outputs. Use of isolated inputs and outputs will prevent the transfer of circuit problems from one input or output to another. This is not to be confused with the isolating devices that are used to separate the non-safety related and safety-related circuits.

7. Trouble outputs: These are outputs provided by the programmable controllers to indicate trouble in the performance of the logic software.

Two programmable controllers with two-out-of-two (2/2) output coincidence logic were selected rather than three programmable controllers with two-out-of-three (2/3) output coincidence logic for three reasons. First, three outputs would reduce AMSAC reliability by adding circuitry to perform the 2/3 output logic. Second, a two-programmable controller system would be less complex, easier to maintain and test, and smaller. Third, the chances of inadvertant AMSAC actuation is not reduced by the addition of 2/3 output logic.

Installed in the AMSAC cabinets, along with the operational components, will be a complete spare programmable controller with a full set of input and output modules. The microprocessor will be programmed but not wired up. In addition, one spare output isolator will be installed but not wired up. These "installed" spares will facilitate repair of the system by allowing component swapping and replacement with identical, programmed, readily available spares. Testing of the spares will only be performed at initial system startup.

V. 14 KEY ELEMENTS OF DESIGN

The NRC letter of September 24, 1986 to Florida Power & Light forwarded the Safety Evaluation Report (SER) for the Westinghouse Owners Group (WOG) Topical Report WCAP-10858 "AMSAC Generic Design Package". In the letter, it was concluded that the generic design was acceptable although specific details were needed for each plant in order to ensure conformance with the ATWS Rule. The specific details were labelled as the fourteen key elements of the plant specific design and were requested to complete the NRC review of the design on a specific plant basis. The following fourteen sections provide the information requested by the SER based on the conceptual design for AMSAC for Turkey Point Units 3 and 4.

1. DIVERSITY

The conceptual design for AMSAC includes hardware which is as diverse from Reactor Protection System (RPS) components as is practical. Diversity at the sensor level was considered and it was determined that AMSAC will utilize the existing sensor outputs as allowed in the SER. The existing sensor outputs are herein defined as the existing instrument sensing lines, sensing devices and transmitters, instrument current loops, and loop power supplies. At the actuation device level, diversity was considered. However, it was determined that existing circuitry of the actuation devices will be used to minimize interference with their normal operation.

At the logic level, diversity betweem AMSAC and the RPS will be accomplished by the difference in the technology used to design and fabricate them. AMSAC hardware will be solid state, microprocessor based circuitry of modern design with logic performed as programmed in the memory. It will utilize computer chips mounted on electronic cards. In the Hagan racks, hardware is comprised of individual modules which were designed and manufactured in the 1960's. It utilizes operational amplifiers and transistors mounted in circuit boards. While some simple electronic devices such as resistors, capacitors, and diodes will be similar for both the RPS and AMSAC, the overall design of the circuitry will not be.

As recommended by the SER, sensor outputs were selected such that adverse interactions with existing control systems will be avoided. In particular, channel I narrow range instruments for steam generator level were selected to prevent interactions with the steam generator water level control system (feedwater valve control) which uses channel III level instruments. The use of turbine first stage pressure instruments, also used for steam generator water level control, will be used for the C-20 permissive to arm AMSAC at 40% power.

2. LOGIC POWER SUPPLIES

Power for the AMSAC logic will include power for the two microprocessors, the input and output modules, bistables, and local indicating lights. Output isolating devices will be powered from Class 1E sources. AMSAC will utilize a power supply that is independent from the RPS power supplies, is instrument quality, and is uninterruptible. For Unit 3, it will be either 120Vac panel 3P25 or 120Vac panel 3P31. They are fed from inverters 3Y25 and 3Y111, respectively, which are fed by 125Vdc bus 3D31. Bus 3D31 is normally fed from MCC 3B43 through battery charger 3D32 with MCC 4B43 and battery charger D33 as backup. In the event of a loss of power from MCC 3B43, battery 3D34 will maintain power on 125Vdc bus 3D31, thereby preventing the immediate loss of AMSAC. In addition, panels 3P31 and 3P25 may be fed through 480/120Vac transformers directly from MCC 3B43 if their inverters fail. The following table lists the distribution of power as it is fed from transformers 3C and 4C down to 120Vac panels 3P31 and 3P25. Unit 4 is similar and its distribution is also listed.

	Unit 3		Unit 4	
120Vac Panel	3P25	3P31	4P25	4P31
NORMAL SUPPLY	INV 3Y25	INV 3Y111	INV 4Y25	INV 4Y111
BACKUP SUPPLY	MCC 3B43	MCC 3B43	MCC 4B43	MCC 4B43

INVERTER	3Y25	3Y111	4Y25	4Y111
NORMAL SUPPLY	BUS 3D31	BUS 3D31	BUS 4D31	BUS 4D31
125VDC BUS		3D31		4D31
NORMAL SUPPLY	MCC 3B43 & CHARGER 3D32		MCC 4B43 & CHARGER 4D32	
BACKUP SUPPLY	MCC 3B43 & CHARGER D33		MCC 3B43 & CHARGER D33	
BATTERY SUPPLY	BATTERY 3D34		BATTERY 4D34	
480VAC MCC	3B43		4B43	
SUPPLY	LC-3E(3B41)		LC-4E(4B41)	
480VAC LOAD CTR	LC-3E(3B41)		LC-4E(4B41)	
SUPPLY	XFMR LC-3E(3X41)		XFMR LC-4E(4X41)	
	BUS 3C (3AC)		BUS 4C (4AC)	
4160VAC BUS	3C (3AC)		4C (4AC)	
NORMAL SUPPLY	XFMR 3C (3X21)		XFMR 4C (4X21)	
BACKUP SUPPLY	XFMR 4C (4X21)		XFMR 3C (3X21)	
BACKUP SUPPLY	CRANKING DIESELS		CRANKING DIESELS	

3. SAFETY-RELATED INTERFACE

Implementation of AMSAC will be accomplished in such a manner that the existing protection system will continue to meet all applicable safety criteria. This is defined herein to mean that the RPS will perform its safety functions without interference from AMSAC, whether or not AMSAC has been actuated. Two different design practices will be used for this purpose: 1) system isolation 2) parallel control signals.

System isolation is the electrical isolation between AMSAC and the RPS at the input and output signals to protect the RPS from electrical faults in AMSAC. The input signals are received from Hagan racks through new isolators which will be qualified to the requirements of Appendix A of the SER as described in Section VI. The output signals that require isolation include those for auxiliary feedwater initiation. The output isolation devices will be new digital devices, consistant with qualification requirements of Appendix A of the SER and powered from a Class 1E source. Isolation devices may also be required for digital control inputs and outputs. If required, they will meet Class IE qualification standards and will be powered from a Class IE source.

The AMSAC output contact that will be used to initiate turbine trip and auxiliary feedwater will be wired in parallel with the existing contacts from other systems that currently initiate turbine trip and auxiliary feedwater. Placing the AMSAC contacts in parallel allows the circuits to function normally when they receive AMSAC actuation signals, opening and closing the appropriate valves and operating the systems' interlocks. The contacts close to initiate protective mitigating actions which makes them invisible to circuit functions when AMSAC has not been actuated.

4. QUALITY ASSURANCE

For those portions of the AMSAC design which are identified within the body of this Conceptual Design Report as being safety-related, compliance with the requirements of 10CFR50, Appendix B, will be maintained in accordance with the Florida Power and Light Company Quality Assurance (QA) Program.

As stated previously and in accordance with Generic Letter 85-06, there are portions of the AMSAC system which are non-safety related. For those non-safety related portions of the AMSAC, it is Florida Power & Light's intent to implement a QA program which meets the intent of Generic Letter 85-06. This program will include the preparation of a procurement specification to ensure appropriate elements of NRC Generic Letter 85-06 are addressed. It is FPL's intent to procure AMSAC hardware as "Commercial Grade" (QL-2). Commercial Grade (QL-2) suppliers are evaluated by the Florida Power and Light Company Quality Assurance Department and are listed within the FPL Approved Suppliers List. The FPL Quality Assurance Department will evaluate and ensure compliance to those attributes of the NRC guidelines deemed applicable and appropriate to ensure the AMSAC hardware performs its intended function.

5. MAINTENANCE BYPASSES

Maintenance at power is accomplished by way of a permanently installed bypass switch and does not involve lifting leads, pulling fuses, tripping breakers, or physically blocking relays. The effect of the bypass switch is to electrically block the output signals from reaching the final actuating circuitry. With the switch in the BYPASS position, AMSAC may be tested (except the output isolators and the final actuation components), calibration of bistables may be performed, and troubleshooting of the system or of its individual components may be conducted when the plant is at power. To alert the operators that the system is in BYPASS, annunciation and status lights will be utilized. The annunciator window will be located in the Control Room.

6. OPERATING BYPASSES

Westinghouse has prepared a letter (OG-87-10, dated February 26, 1987) for the WOG to submit to the NRC providing the basis for the C-20 permissive signal (defeats the block of AMSAC). The C-20 permissive signal, which arms AMSAC (bypassing the block) above 40% power will be controlled by inputs from existing sensors in channels III and IV, first stage turbine pressure. When both channel input signals indicate that power has increased to 40%, AMSAC logic will automatically arm the system, enabling AMSAC to initiate protective mitigating functions when low steam generator signals subsequently are received. Human Factors Engineering considerations include an indicating light in the Control Room which will illuminate when AMSAC arms.

The C-20 permissive logic is contained in the software of a pair of modern microprocessors operating in parallel. This arrangement is diverse from the existing RPS circuitry, which utilizes operational amplifiers and transisters. Although the C-20 permissive signal uses existing sensor outputs, their uses are permitted by the SER. Independence is maintained with qualified isolators.

7. MEANS FOR BYPASSING

The means for providing the maintenance bypass is a permanently mounted, two position, key locked switch on the Test/Maintenance panel. The switch is locked and the key is removable only in the NORMAL position to prevent unauthorized bypassing of the protective mitigating functions. The BYPASS position will be indicated in the Control Room by the multi-function annunciator window and by a status light. Placing AMSAC in a BYPASS mode will not involve lifting leads, pulling fuses, tripping breakers, or physically blocking relays.

8. MANUAL INITIATION

The capability of manually initiating the mitigating system is desirable to the NRC, but not required. Current AMSAC conceptual design does not include manual initiation since 1) it could lead to inadvertent, undesirable initiation of the system at power 2) it increases the cost and complexity of design 3) it creates an operational question of when to use it, and 4) all actions which it normally performs can be carried out by the operators using existing controls in the Control Room.

To manually trip the main turbine for either Unit, there is a Turbine Trip Pushbutton on control console section 3C02 (4C02 for Unit 4) which will energize both the primary auto trip and backup auto trip solenoids for each Unit independent from the RPS circuits. Energizing either solenoid is sufficient to trip the turbine. In addition, turbine trip can be accomplished at the turbine by placing the Overspeed Trip Reset Handle in the TRIP position.

Manual initiation of auxiliary feedwater is accomplished by operating control switches for individual valves on control console section 3C02 (4C02 for Unit 4). The three motor operated steam supply valves for each Unit are opened by holding their respective switches in the open positions until lights on the control console indicate that the valves have fully opened. Operation of the valve limit switches open the six solenoid valves that provide air to the auxiliary feed flow control valves. This causes the auxiliary feed flow control valves to open to a predetermined flow rate. The three trip and throttle valves are normally in the open position and should remain in that condition. If not, switches on the control console can be used to open them.

9. ELECTRICAL INDEPENDENCE FROM EXISTING REACTOR PROTECTION SYSTEM

Electrical independence between AMSAC and the RPS is achieved by utilizing isolators to electrically separate the RPS from the AMSAC input and output signals. New isolators will be used in all cases for signal isolation and will be qualified per Appendix A of the SER. See Section VI of this document for details of the qualification. Details concerning the specifications and diversity of the isolators will be documented in the AMSAC detailed design.

10. PHYSICAL SEPARATION FROM EXISTING REACTOR PROTECTION SYSTEM

The AMSAC hardware will be located in a single, dedicated cabinet for each Unit. Therefore, AMSAC circuitry will be physically separated from the RPS circuitry from which it obtains input signals. Its non-safety related input and output cables will be routed separate from the safety-related RPS cables, although not necessarily from other non-safety related cables. The AMSAC cabinets themselves will be designed to prevent adverse interactions with safety-related equipment installed adjacent to them. Safety-related RPS channels will remain physically separated from each other.

11. ENVIRONMENTAL QUALIFICATION

An anticipated operational occurrence is a condition of normal operation which is expected to occur one or more times during the life of the plant and includes, but is not limited to, tripping of the turbine generator set, isolation of the main condenser, and loss of all offsite power. The AMSAC equipment will be environmentally qualified for anticipated operational occurrences, although not for accidents.

Since it is expected that the AMSAC cabinets will be installed in the Control Room which is a mild and controlled environment, operating conditions normally will be 75°F, 50% r.h., and normal atmospheric pressure. This will not change under anticipated operational occurrences. There are three air conditioning units available to cool the Control Room, powered from redundant Class 1E buses. In the unlikely event that two of three units are inoperative, the third unit will maintain the Control Room within a 120°F and 95% r.h. environment. The AMSAC cabinets will also be qualified to operate in those conditions. Radiation is negligible except under accident conditions, which AMSAC is not required to be qualified for.

12. TESTABILITY AT POWER

The AMSAC hardware and logic will be fully testable with the Units at power, not including the final actuation devices and their isolators, by placing AMSAC in the BYPASS mode. This will electrically disconnect the AMSAC output signals from the four protective mitigating functions (turbine trip, auxiliary feedwater actuation, blowdown recovery isolation, sampling isolation) and will alert the operators in the Control Room with annunciation and status lights. Once in the BYPASS mode, the bistable devices can be calibrated and the logic can be tested. Lights on the Test/Maintenance panel will illuminate to indicate when each bistable device has tripped, when AMSAC is armed, and when the logic is operating correctly. Overlapping is taken into account from the sensor input signals to microprocessor outputs, not including the final actuation devices. Testing and calibrations will be performed periodically with an interval to be determined later. Testing of AMSAC through the final actuation devices will be performed only with the units shut down.

Human factors considerations will be taken into account in the design of the Test/Maintenance Panel, in the logic, and with the indications in the Control Room of AMSAC status (ON, ARMED, ACTUATED, BYPASS). The Test/Maintenance panel will be designed to show a mimic of the signal path to facilitate operator understanding of the test sequence and results. Interlocks will be programmed into the logic to prevent inadvertant plant shutdown during testing and the bypass switch will be key locked.

13. COMPLETION OF MITIGATIVE ACTION

System design will be such that AMSAC is consistent with the circuitry of the auxiliary feedwater and turbine trip control systems, as well as the blowdown and sampling systems. Once initiated, design will ensure that protective action goes to completion as required by the SER. Deliberate operator action in the form of a reset pushbutton in the Control Room will be required to return the final actuation devices to operator control. An explanation of the circuit compatibility can be found in Section III of this report.

14. TECHNICAL SPECIFICATIONS

The WOG is on record (OG-171, dated February 10, 1986) that Technical Specifications for AMSAC are unnecessary, do not enhance the overall safety of nuclear power plants, and constitute a backfit. The WOG believes that normal nuclear plant administrative controls are sufficient to control AMSAC. Florida Power & Light concurs with this position and does not intend to modify the Turkey Point Units 3 and 4 Technical Specifications to include requirements for AMSAC, a non-safety related system. Existing Technical Specifications for components and systems associated with the operation of AMSAC will not be affected by its implementation.

VI. ISOLATOR QUALIFICATION

Electrical independence between AMSAC and the RPS is achieved by utilizing isolators to electrically separate the RPS circuits from the AMSAC input and output signals. These new isolators, labelled as "qualified isolators," will meet the requirements of Appendix A of the SER as specified by the following paragraphs. Actual isolator specifications will be provided in the final design document.

1. For the type of device used to accomplish electrical isolation, the specific testing performed to demonstrate that the device is acceptable for its application(s) will be described. This description should include elementary diagrams when necessary to indicate the test configuration and how the maximum credible faults were applied to the devices.

2. Data will be included to verify that the maximum credible faults applied during the test were the maximum voltage/current to which the device could be exposed and to define how the maximum voltage/current was determined.

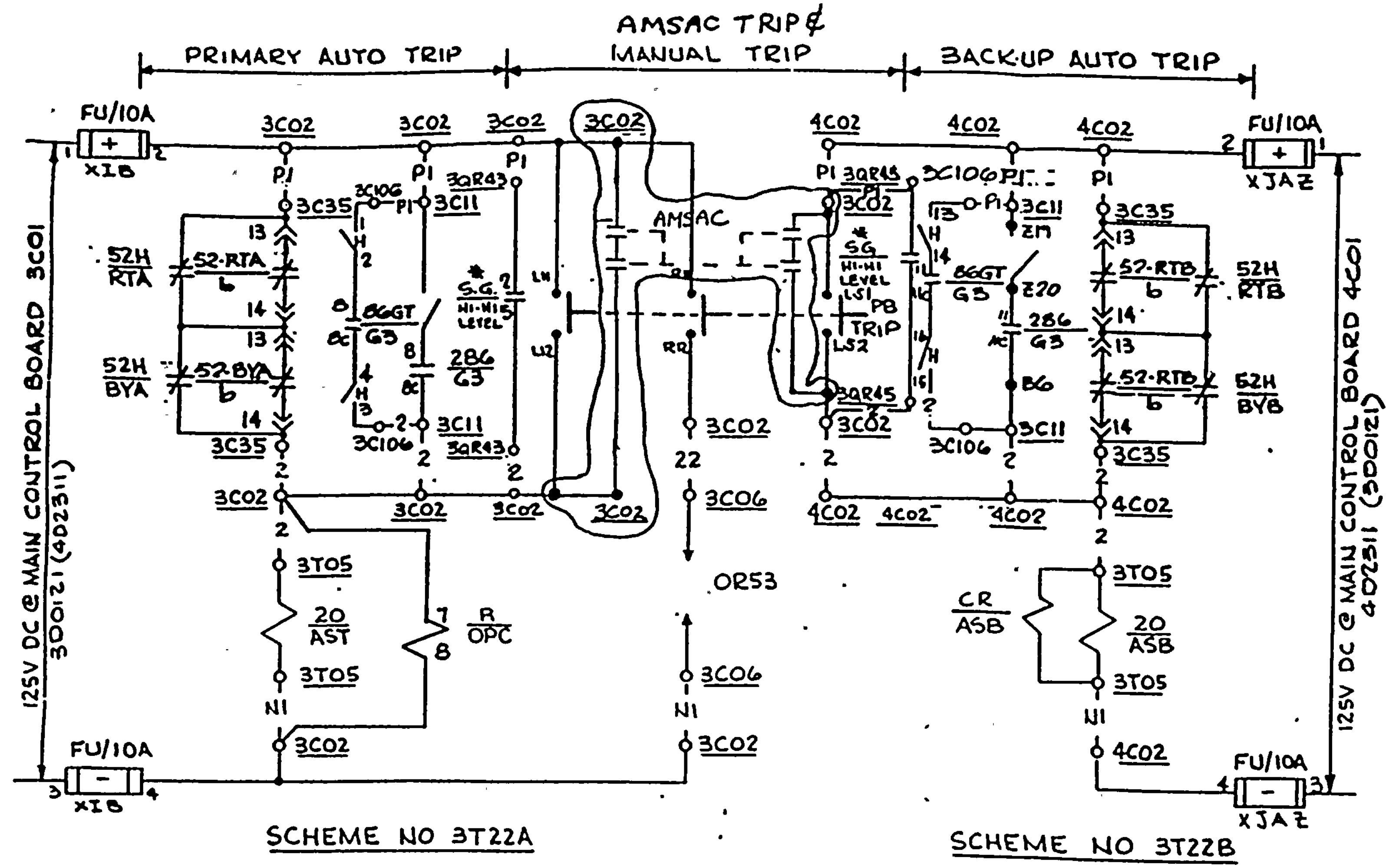
3. Date will be included to verify that the maximum credible fault was applied to the output of the device in the transverse mode (between signal and return) and other faults were considered (i.e,, open and short circuits).

4. The pass/fail acceptance criteria for each type of device will be defined.

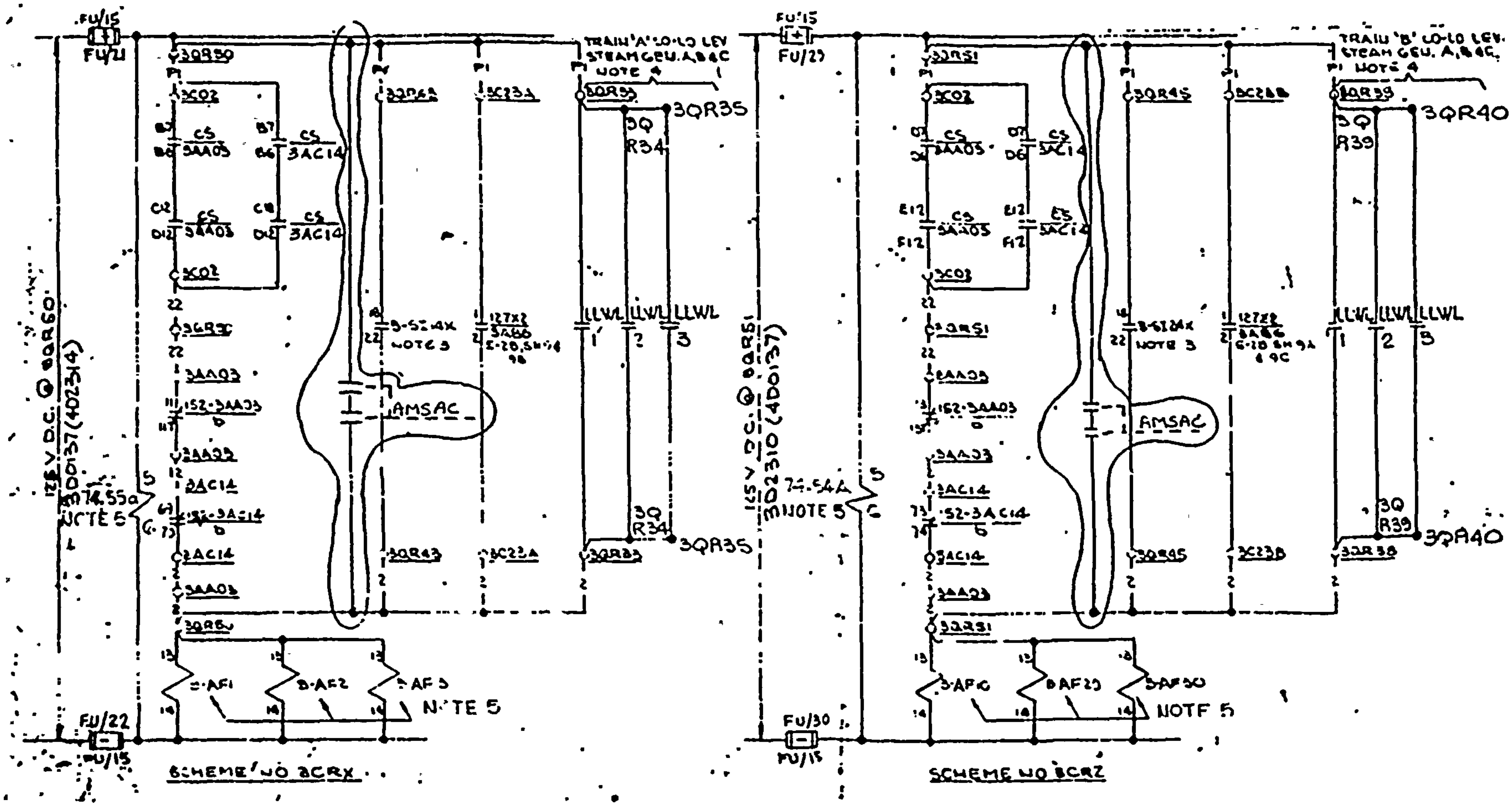
5. A commitment will be provided that the isolation devices comply with the environment qualifications (10CFR50.49) and with the seismic qualifications which were the basis for plant licensing.

6. A description will be provided of the measures taken to protect the safety systems from electrical interference (i.e., Electrostatic Coupling, EMI, Common Mode and Crosstalk) that may be generated by the ATWS circuits.

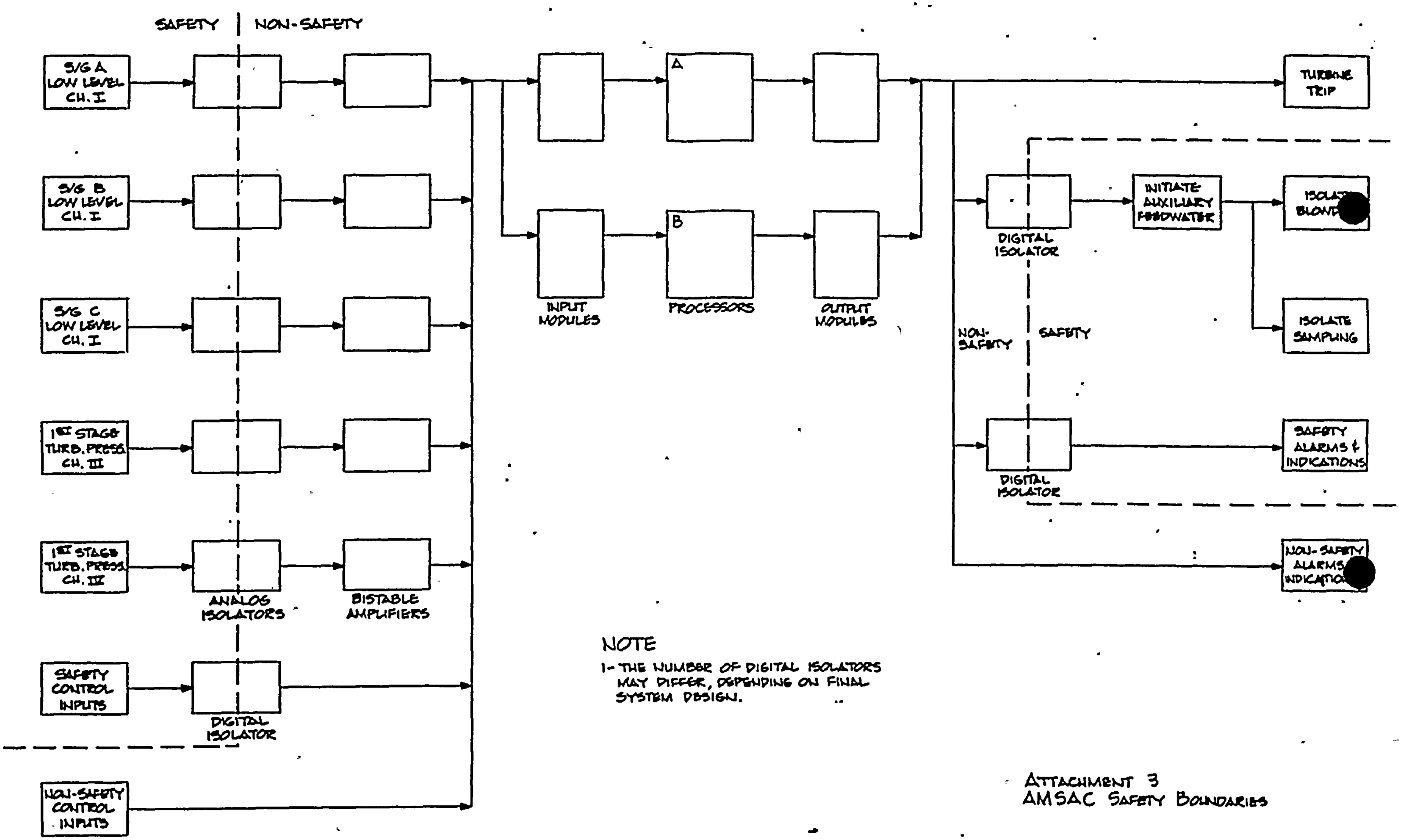
7. Information will be provided to verify that the Class IE isolator is powered from a Class IE source.



Attachment 1
Turbine Trip Solenoids



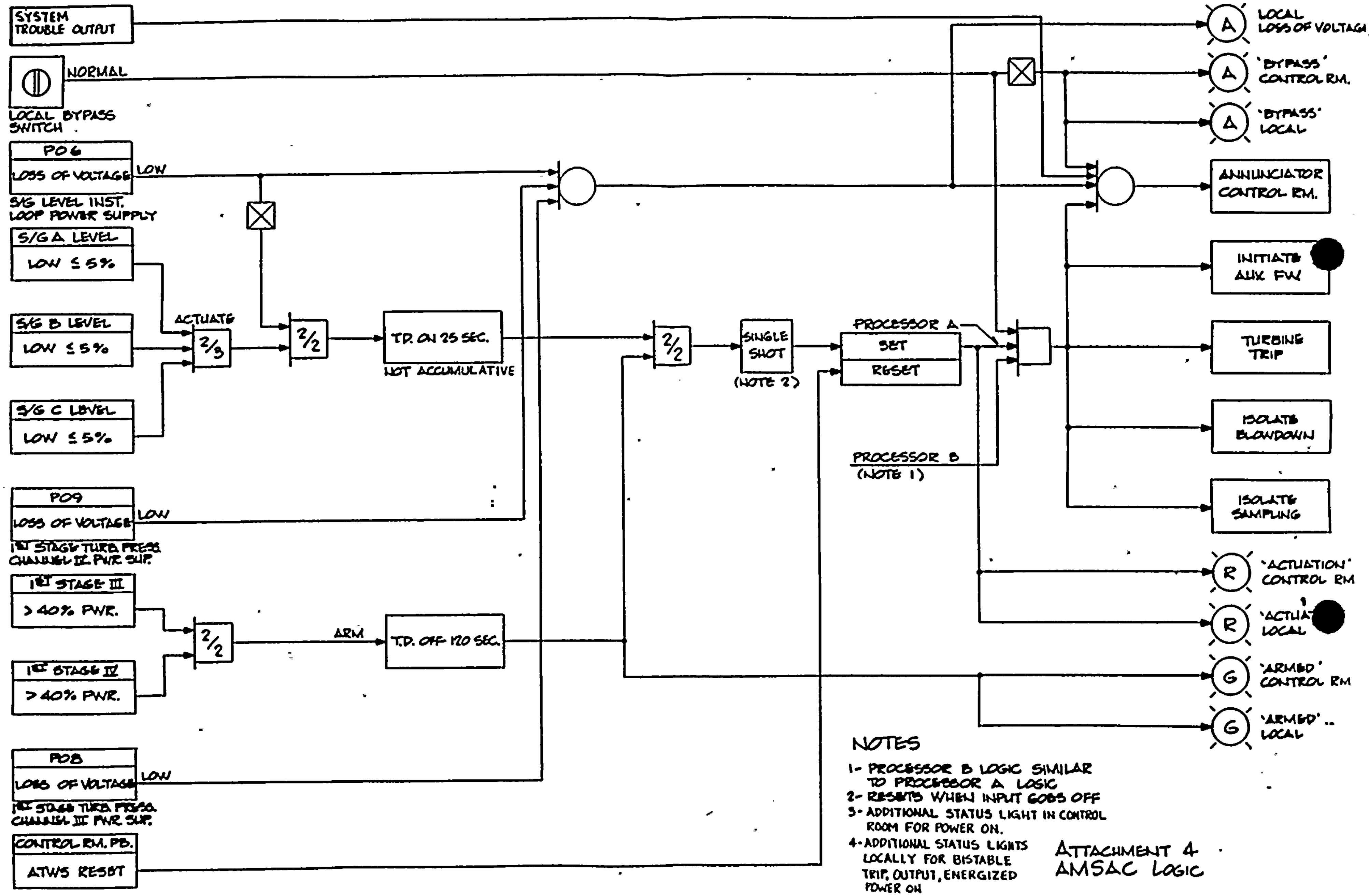
ATTACHMENT 2
AFW AUTO START RELAYS



NOTE

1- THE NUMBER OF DIGITAL ISOLATORS MAY DIFFER, DEPENDING ON FINAL SYSTEM DESIGN.

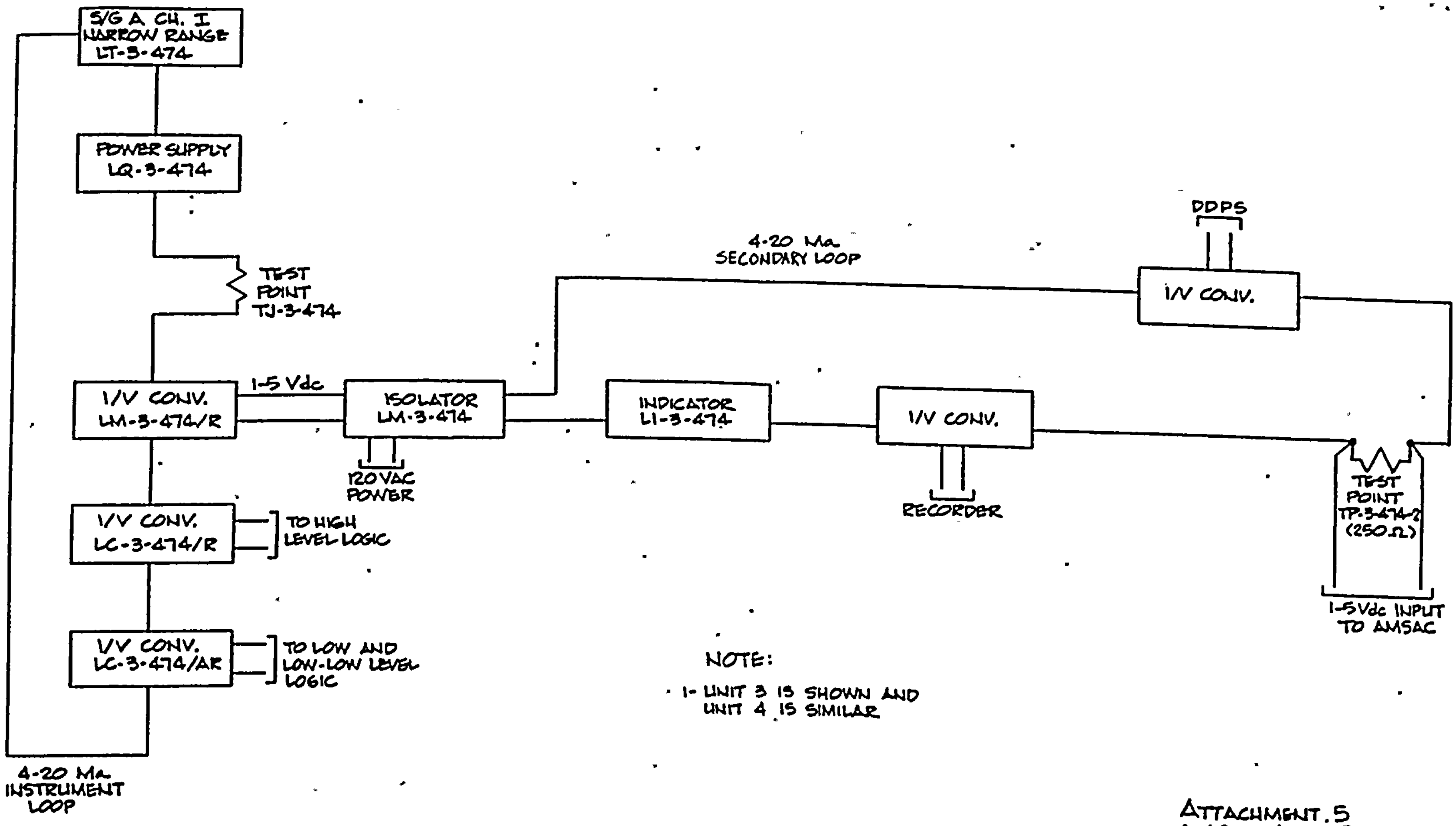
ATTACHMENT 3
AMSAC SAFETY BOUNDARIES



NOTES

1- PROCESSOR B LOGIC SIMILAR TO PROCESSOR A LOGIC
2- RESETS WHEN INPUT GOES OFF
3- ADDITIONAL STATUS LIGHT IN CONTROL ROOM FOR POWER ON.
4- ADDITIONAL STATUS LIGHTS LOCALLY FOR BISTABLE TRIP, OUTPUT, ENERGIZED POWER ON

ATTACHMENT 4
AMSAC LOGIC



ATTACHMENT 5
AMSAC INPUT SKETCH

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