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SUBJECT: Responds to 871111 request for mod of info re ATWS Mitigation Sys Actuation Circuitry plant-specific design concerning Generic Ltr 83-28. Implementation package to be provided by end of May 1988.

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AEP:NRC:0838AD
10 CFR 50.62

Donald C. Cook Nuclear Plant Units 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
GENERIC LETTER 83-28 ANTICIPATED TRANSIENT WITHOUT SCRAM (ATWS) MITIGATION SYSTEMS ACTUATION CIRCUITRY (AMSAC) ADDITIONAL INFORMATION

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

Attn: T. E. Murley

December 18, 1987

Dear Dr. Murley:

The purpose of this letter is to respond to your staff's November 11, 1987 telephone request to modify the information on our AMSAC plant specific design.

Attachment 1 to this letter is an iteration of our responses to the 14 items in the NRC Safety Evaluation Report dated September 24, 1986 that addresses the generic design of AMSAC. We have modified these responses to include the additional information requested by telephone. Please note that items 2, 7, 11, and 13 have not changed.

Attachment 2 contains our logic diagram for the AMSAC. Originally we had envisioned using four control switches. As a result of our human factors review, we will be using only two control switches as shown on the diagram. We believe the two switches contain the same capability as the four switch configuration and some consolidation is achieved.

In confirmation of our telephone conversation, the Westinghouse variable timer design will be used in our Donald C. Cook Nuclear Plant specific design. We plan to use the Foxboro Spec 200 Micro Control Card, N2CCA-S, to: (1) perform the lag function on the turbine impulse chamber pressure signals from the pressure transmitters (MPC253 and MPC254), (2) auctioneer high the two lagged signals, and (3) perform the timer function. An input

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[illegible]

contact to the card will be provided from the 3 out of 4 low feedwater relay logic. After we have received a low feedwater flow signal and we have successfully completed the timing period, the N2CCA-S will provide an output to the initiate relays via one of the relay output isolators.

The variable timer performance characteristic will be within the Westinghouse-specified acceptable limits. Attachment 3 is a graph showing initiation timer delay vs. power level, which was published by Westinghouse.

We also acknowledge your comment concerning double fuses on the AMSAC inverter input power source. The double fusing feature will be incorporated in the Donald C. Cook Nuclear Plant final AMSAC design.

We intend to have the Donald C. Cook Nuclear Plant specific design completed by the end of April 1988. We also hope to have all vendor information available by the end of April 1988. Therefore we believe we will be able to provide you with our implementation package by the end of May 1988.

This document has been prepared following Corporate procedures which incorporate a reasonable set of controls to ensure its accuracy and completeness prior to signature by the undersigned.

Sincerely,

M. P. Alexich
Vice President

cm

Attachments

cc: John E. Dolan (w/o attachments)
W. G. Smith, Jr. - Bridgman (w/o attachments)
R. C. Callen (w/o attachments)
G. Bruchmann (w/o attachments)
G. Charnoff (w/o attachments)
NRC Resident Inspector - Bridgman (w/attachments)
A. B. Davis - Region III (w/attachments)

Attachment 1 to AEP:NRC:0838AD

1. Diversity

"The plant specific submittal should indicate the degree of diversity that exists between the AMSAC equipment and the existing Reactor Protection System. Equipment diversity to the extent reasonable and practicable to minimize the potential for common cause failures is required from the sensors output to, but not including, the final actuation device, e.g., existing circuit breakers may be used for the auxiliary feedwater initiation. The sensors need not be of a diverse design or manufacture. Existing protection system instrument sensing lines, sensors, and sensor power supplies may be used. Sensor and instrument sensing lines should be selected such that adverse interactions with existing control systems are avoided."

Response

We will sense the feedwater flow from the existing flow transmitters, FFC-211, FFC-221, FFC-231, and FFC-241. The AMSAC power permissive signals will be sensed from the existing turbine first stage pressure transmitters, MPC-253 and MPC-254. Please note that the associated instrument sensing lines and sensor power supplies will be used.

The logic and sensing equipment will be a combination of Foxboro Spec. 200 cards, a Foxboro Spec. 200 micro card, Agastat Timer, and GE HFA auxiliary relays. These components are totally separate and different models from the existing reactor protection system (RPS). These devices will be arranged such that adverse interactions with the RPS logic and the RPS output relays will be prevented.

2. Logic power supplies

"The plant specific submittal should discuss the logic power supply design. According to the rule, the AMSAC logic power supply is not required to be safety-related (Class 1E). However, logic power should be from an instrument power supply that is independent from the reactor protection system (RPS) power supplies. Our review of additional information submitted by WOG indicated that power to the logic circuits will utilize RPS batteries and inverters. The staff finds this portion of the design unacceptable, therefore, independent power supplies should be provided."

Response (No Change)

We will use the existing N-train battery and use an AMSAC inverter which will not be used to power any RPS loads. The

N-train battery is independent of the station batteries which power the RPS inverters. The logic power supply will be direct current from the N-train battery and the bistables will be powered from the AMSAC inverters.

3. Safety-related interface

"The plant specific submittal should show that the implementation is such that the existing protection system continues to meet all applicable safety criteria."

Response

The AMSAC system inputs will be isolated by analog isolators such that a failure in the AMSAC system will not result in a failure of RPS.

We are adding another analog current to the current isolator to the four feedwater flow loops (FFC-211, 221, 231, and 241) and the turbine first stage pressure loops (MPC-253 and 254). These devices will connect to the Foxboro Spec. 200 logic processing equipment. Please note that we plan to power these isolators from the existing reactor protection system cabinet power supplies. This was recommended by the NRC in their Safety Evaluation Report on the generic Westinghouse design.

Relay coil/contact isolation at the AMSAC output will prevent failures within AMSAC from being propagated into the safeguards actuation circuits.

Please see the attached GE publication 7382, dated March 22, 1982, for the Relay Standards (Attachment 4). Page 2 of the Relay Standards provides the surge withstand capability, which far exceeds the 120V AC and 250V DC control power associated with AMSAC.

4. Quality assurance

"The plant specific submittal should provide information regarding compliance with Generic Letter 85-06, 'Quality Assurance Guidance for ATWS Equipment that is not Safety-Related.'"

Response

The applicable portions of the Quality Assurance Program as set forth in the "Updated Quality Assurance Program Description for the Donald C. Cook Nuclear Plant" (FSAR Chapter 1.7) will be

applicable to those items of AMSAC equipment designated Class IE. We believe we will meet the intent of Generic Letter 85-06.

5. Maintenance bypasses

"The plant specific submittal should discuss how maintenance at power is accomplished and how good human factors engineering practice is incorporated into the continuous indication of bypass status in the control room."

Response

AMSAC will be disabled for repair and maintenance. This will be accomplished through a bypass switch whose status will be continuously displayed in the control room. We have completed a human factors review and Attachment 5 contains the figure showing the future switch locations and configurations which are consistent with the results of the review. The switch will be used by plant operators, and plant procedures will be written to incorporate proper operating and maintenance sequences.

6. Operating bypasses

"The plant specific submittal should state that operating bypasses are continuously indicated in the control room; provide the basis for the 70% or plant specific operating bypass level; discuss the human factors design aspects of the continuous indication; and discuss the diversity and independence of the C-20 permissive signal (Defeats the block of AMSAC)."

Response

We will have continuous indication in the control room when AMSAC is in the bypass mode. We understand that the 70% operating bypass level addressed in the NRC question has been revised to 40%. The Westinghouse Generic Design contains the basis for the 40% power operating bypass level and the diversity and independence of the C-20 permissive signal. As a result of the Human Factors Review, an indicating light will be used to display the status of the C-20 Permissive Signal in the control room. The C-20 will enable AMSAC above 40% power. Please see Attachment 5 for switch locations/configurations. The operating bypass switch will be under administrative controls to be specified in relevant plant procedures.

7. Means for bypassing

"The plant specific submittal should state that the means for bypassing is accomplished with a permanently installed, human factored, bypass switch or similar device, and verify that disallowed methods mentioned in the guidance are not utilized."

Response (No Change)

We will utilize a permanently installed switch for bypassing AMSAC. We will not be using any disallowed methods to place AMSAC in bypass. The disallowed methods consist of pulling fuses, lifting leads, tripping breakers, or physically blocking relays. On-line testing of the logic portion of the circuits will be done by use of this bypass switch. Relay output testing will be done on an off-line basis.

8. Manual initiation

"The plant specific submittal should discuss how a manual turbine trip and auxiliary feedwater actuation are accomplished by the operator."

Response

At the component level, the operator can manually trip the turbine and manually actuate auxiliary feedwater from the control room.

Manual initiation of AMSAC at the system level will be accomplished through a control switch. Please see Attachment 5 for the switch configurations and locations which resulted from our Human Factors Review.

9. Electrical independence from existing reactor protection system

"The plant specific submittal should show that electrical independence is achieved. This is required from the sensor output to the final actuation device at which point non safety-related circuits must be isolated from safety related circuits by qualified Class 1E isolators. Use of existing isolators is acceptable. However, each plant specific submittal should provide an analysis and tests which demonstrates that the existing isolator will function under the maximum worst case fault conditions. The required method for qualifying either the existing or diverse isolators is presented in Appendix A."

Response

AMSAC logic and power supply are independent of the RPS logic and power supply. The AMSAC alarms will be annunciated on annunciators that are powered from the existing control room 125 Vac annunciator bus. The AMSAC analog inputs will be from existing sensors which are powered from existing RPS power supplies. Please refer to our response to Appendix A (reference AEP:NRC:0838Z and AEP:NRC:0838V dated June 25, 1987 and November 7, 1986, respectively) for information on the isolators submitted previously.

Please note that the new electrical current repeaters (I/Is), which serve as isolation devices, will be located in the appropriate RPS cabinets and they will be powered by existing RPS cabinet power supplies.

AMSAC implementation will not degrade any of our existing RPS separation criteria.

10. Physical separation from existing reactor protection system

"Physical separation from existing reactor protection system is not required, unless redundant divisions and channels in the existing reactor trip system are not physically separated. The implementation must be such that separation criteria applied to the existing protection system are not violated. The plant specific submittal should respond to this concern."

Response

The RPS separation criteria will remain unaffected by AMSAC. We will follow existing practices regarding this issue. The input cables from the I/Is to the Foxboro Spec. 200 cards will be run in channel associated trays and will conform to existing fire protection guidelines. The output cables running from the initiating relays (IR1, IR2, IR3) will be run with their respective safety associated trays. Where cables leave trays to enter cabinets (housings, etc.) they will be in conduits, such that the separation requirements are maintained, per our existing practices.

11. Environmental qualification

"The plant specific submittal should address the environmental qualification of ATWS equipment for anticipated operational occurrences only, not for accidents."

Response (No Change)

We will be placing the new equipment for the AMSAC system in a controlled environment in the control room. There are no high-energy lines present in the area; therefore, special 10 CFR 50.49 environmental qualification will not be needed.

12. Testability at power

"Measures are to be established to test, as appropriate, non safety related ATWS equipment prior to installation and periodically. Testing of AMSAC may be performed with AMSAC in bypass. Testing of AMSAC outputs through the final actuation devices will be performed with the plant shut down. The plant specific submittals should present the test program and state that the output signal is indicated in the control room in a manner consistent with plant practices including human factors."

Response

We plan to perform end-to-end tests at every refueling outage. Testability at power has been incorporated into the design to allow for reasonable post maintenance operability testing. Note: Testability at power does not include the ability to exercise the final actuation relays/devices. Plant procedures will cover AMSAC testing. When we are in the bypass/test/disable mode, there will be continuous indication in the control room.

13. Completion of mitigative action

"AMSAC shall be designed so that, once actuated, the completion of mitigating action shall be consistent with the plant turbine trip and auxiliary feedwater circuitry. Plant specific submittals should verify that the protective action, once initiated, goes to completion, and that the subsequent return to operation requires deliberate operator action."

Response (No Change)

The Westinghouse Owners Group low feed flow design delays the unlocking of AMSAC (C-20 signal) for 60 seconds to allow AMSAC initiation to follow through to completion. The WCAP-10858 provided the basis for this design. Its implementation will be consistent with existing plant turbine trip and existing auxiliary feedwater control circuit requirements.

Initial plant checkout testing will verify that once initiated, AMSAC will go to completion. Our design requires a deliberate action from the operator to reset the AMSAC system. AMSAC system will be continuously monitored in the control room.

14. Technical Specifications

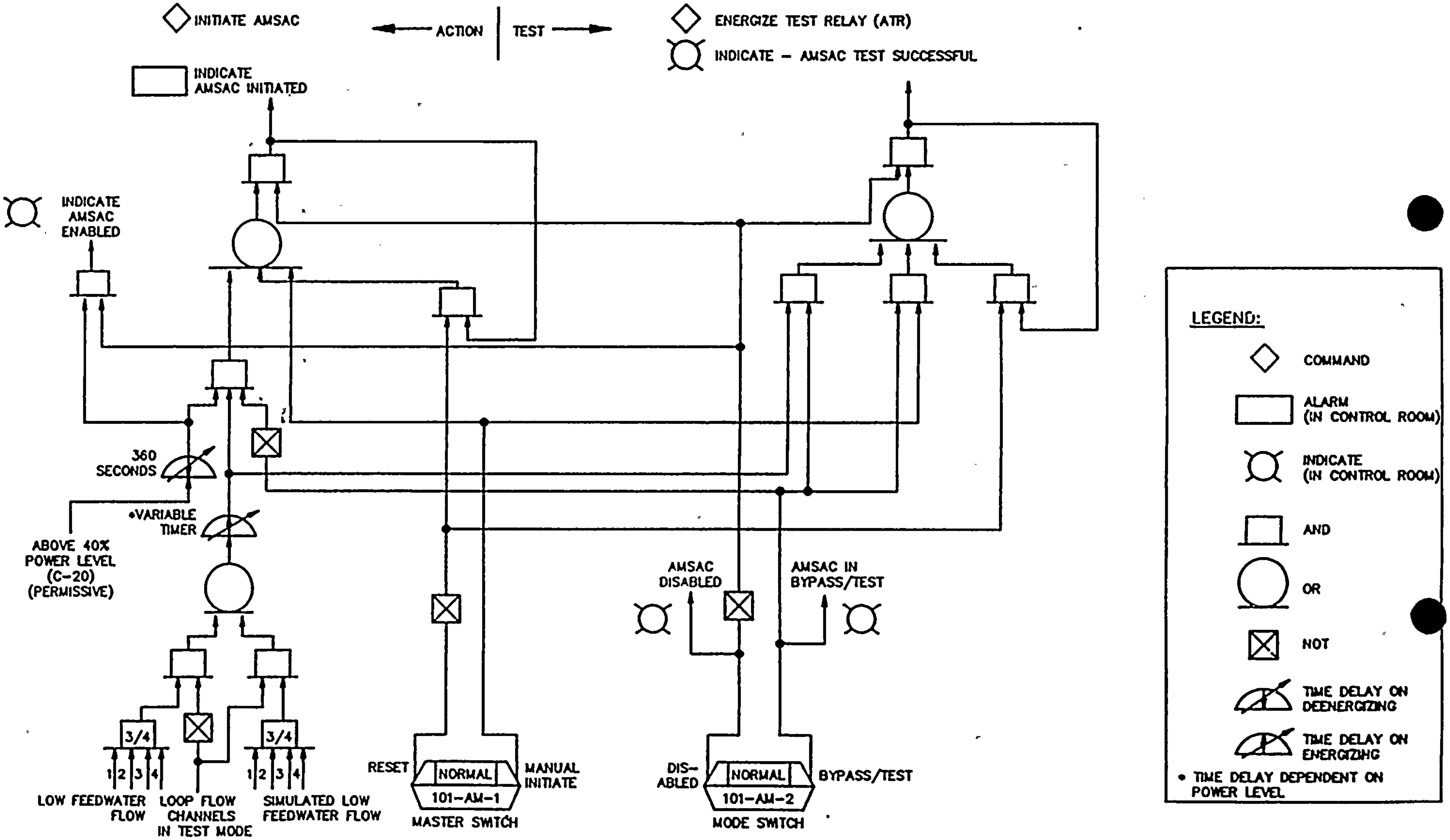
"Technical specification requirements related to AMSAC will have to be addressed by plant specific submittals."

Response

As agreed in our November 11, 1987 telephone conversation, technical specifications are not relevant to AMSAC. (All references to technical specifications in our submittals AEP:NRC:0838V of November 7, 1986 and 0838Z of June 25, 1987, are inappropriate and should be disregarded).

Attachment 2 to AEP:NRC:0838AD

AMSAC LOGIC DIAGRAM



Attachment 3 to AEP:NRC:0838AD

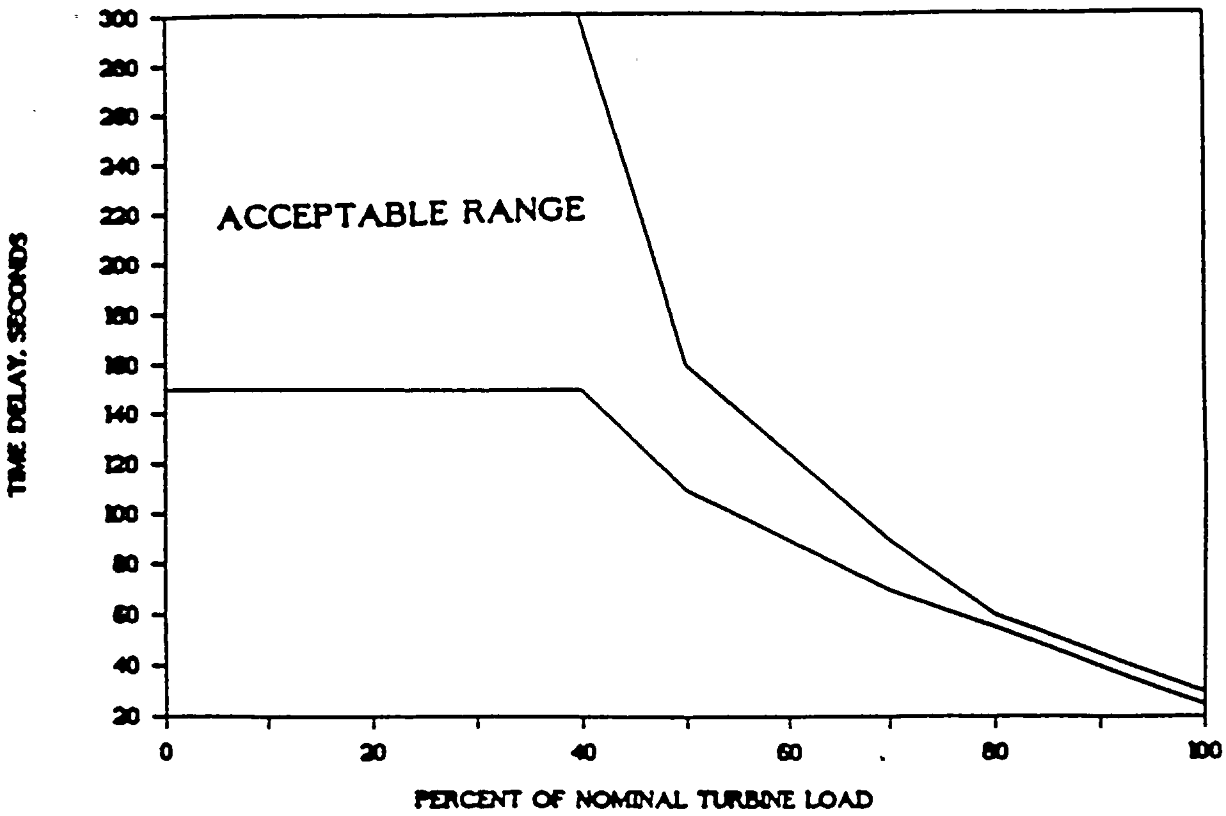


FIGURE 3-8: AMSAC VARIABLE TIME DELAY

Attachment 4 to AEP:NRC:0838AD

Relay Standards

FOR HFA relays used in AN SAC for coil/contact isolation (AN SAC/safeguards actuation isolation)

INTRODUCTION

All General Electric protective relays in this handbook, unless otherwise noted, are designed and manufactured in accordance with the ANSI/IEEE standard C37.90 that applies to protective relays. To better understand the application, design, rating and selection of protective relays, certain parts of the American National Standard (ANSI) and IEEE standard will be summarized for easy reference. This summary should help guide the relay engineer regarding service conditions, standard ratings and other application requirements, but is not intended as a substitute for a reference to the complete standard.

CONTENTS

REFERENCE STANDARD

ANSI/IEEE C37.90 - 1978 "Standards for Relays and Relay Systems"

Scope and Limitations

The standards and references that follow apply primarily to relays and relay systems used to control power switchgear.

What is a Relay?

A relay is "an electrical device designed to respond to input conditions in a prescribed manner, and after specified conditions are met, to cause contact operation or similar abrupt change in associated electric control circuits."

Usual Service Conditions:

Relays must be suitable for operation under the following:

(a) The ambient temperature of the air immediately around the relay case or other enclosure shall be within the limits of −20C to +55C.

(b) The altitude shall not exceed 5000 ft (1500 meters).

Ratings

(a) Standard current and voltage ratings— The standard current and voltage ratings for relays shall be as follows:

Voltage (V)		Current (A)
Ac (rms)	Dc	Ac (rms)
120 240 480	24 48 125 250	1 5

(b) Allowable variation from rated voltage — Protective relays which are designed to be energized continuously with ac voltage shall operate without damage at rated frequency with voltage not more than 10 percent above rated voltage, but not necessarily in accordance with temperature rise limits established for operation at rated voltage.

(c) Maximum design voltage or current—The maximum design voltage or current for all relays, other than voltage-operated auxiliary relays, shall be equal to the rated voltage or current of the relay. This is the highest rms alternating or direct voltage or current at which the relay is designed to be energized continuously without exceeding the allowable temperature rise for the class of insulation (Many GE relays are designed to continuously carry current in excess of the rated current).

For dc auxiliary relays, relay power supply, or auxiliary relay circuits with dc voltage ratings, the maximum design voltage shall be as shown in Table 1.

The maximum design voltage for ac auxiliary relays shall be 110 percent of rated voltage.

(d) Range of operating voltage for auxiliary relays — dc auxiliary relays, which may be continuously energized for indefinite periods, dc power supplies, and auxiliary relay circuits with dc voltage ratings, shall be able to withstand the maximum design voltage without exceeding the allowable temperature rise. These relays shall operate successfully over a range from 80 percent of rated voltage to the maximum design voltage. Ac auxiliary relays shall be able to withstand 110 percent of rated voltage without exceeding the allowable temperature rise. These relays shall operate successfully over a range from 85-110 percent of rated voltage.

Table 1

Rated Volts	Maximum Design Volts
24	28
48	56
125	140
250	280

(e) Make and Carry Ratings for Tripping Contacts (revised 1978) — a tripping contact is designed for the purpose of energizing a power circuit breaker trip coil.

The contact shall make and carry 30 amperes for at least 2000 operations in a prescribed duty cycle.

Relay Standards

Dielectric Tests

General—Dielectric tests between circuits, and dielectric tests between circuits and relay frame, shall be considered as routine tests. Dielectric tests across open contacts shall be considered as design tests. Dielectric tests are not required across contacts with surge-suppression components, nor across solid-state output circuits; when these are used, the Surge Withstand Capability (SWC) test should be substituted for the dielectric test.

Standard Test Voltage — Relays rated 600 volts and below shall withstand for one minute a low-frequency alternating-current voltage test of twice rated voltage plus 1000 volts with a minimum of 1500 volts.

Duration of Test Voltage

The test voltage for all relays shall be applied continuously for a period of 60 seconds.

As an alternate, to be made at the point of manufacture only, it is permissible to test any relay for one second at a value of 20 percent higher than the standard 60 second test voltage.

Dielectric Tests by Users

Dielectric tests, in accordance with the standard, may be made by the user on new relays only, to determine whether specifications are fulfilled. New relays are defined as those which have not been in service and are not more than one year old from date of shipment and have been suitably stored to prevent deterioration.

Additional dielectric tests may be made, using 75 percent of the standard test voltage, at the point of installation to determine the practicality of placing or continuing the device or equipment in service.

Points of Application of Voltage

The test voltage of insulation to ground and between circuits shall be applied successively between each electric circuit and all other electric circuits, and between each electric circuit and the metal frame of the relay. The test voltage across open contacts shall be applied to the relay terminals which connect to the contacts.

Surge Withstand Capability (SWC) Tests

The surge withstand capability (SWC) is a design test for relay systems and, in particular, static relays.

The purpose of this test is to apply to the terminals of the relay system a standardized test wave shape that is representative of surges observed and measured in actual installations. In order to pass this test, relay systems must be able to withstand the applied surge without damage to components and without operating incorrectly.

Surge Withstand Capability (SWC) Wave Shape and Characteristics

The SWC test wave is an oscillatory wave, with a frequency range of 1.0 MHz to 1.5 MHz, voltage range of 2.5 kV to 3.0 kV crest value of the first half cycle peak, and envelope decaying to 50 percent of the crest value of the first peak in not less than 6 μs from the start of the wave. The source impedance of the surge generator used to produce the test wave shall be 150 ohms $\pm$ 5 percent. The test wave to be applied to test specimen at a repetitive rate of not less than 50 tests per second for a period of not less than 2.0 seconds.

NOTE: (1) All voltage and time values refer to the open circuit condition of the surge generator.
(2) Time period and repetition rate have been chosen to cover equipment which is used on 50 Hertz as well as 60 Hertz systems. The SWC test shall be applied to the relay as specified in ANSI C37.90.

FAST TRANSIENT TEST

(Ref: W. C. Kotheimer and L. L. Mankoff, Protection of Relays from Their Electrical Environment - Georgia Tech Relay Conference, 1977)

The Fast Transient test simulates the surges due to the interruption of inductive devices such as auxiliary relay coils, alarm bell coils, solenoids, etc. These surges are localized in effect, being attenuated by a few tens of feet of circuit from the source. Laboratory experiments show, however, that this surge presents a very real hazard to solid state equipment in the circuit close to it, possibly causing false operation or damage to semiconductor devices.

This "fast transient," produced by interrupting the current through an auxiliary relay coil or a breaker trip coil, has rise times in the 5-nanosecond range and power in the tens of kilowatts range. When subjected to such a transient, many semiconductor devices can be degraded such that failure may occur at a later time.

All new relay designs are subjected to this "fast transient" as a design-proof test. It was found that relays which survive the SWC test may fail the "fast transient" test.

(Recommend Guide Form Specification)

"The test shall be the application for two seconds of at least 60 pulses per second at each polarily from a surge generator having a source impedance of about 75 ohms resistance.

"When measured open circuit, the surge generator shall produce pulses having a rise time of 5 nanoseconds or less to a peak value of $\pm$5000 volts. The test voltage shall be applied to the relay as specified in ANSI C37.90 for the SWC test."

RADIO FREQUENCY INTERFERENCE (RFI)

Approximate Frequencies below 550 Mhz used by Electric Utilities in the USA

Freq. Band Mhz	Notes
27	Citizens Band, Class D
37	
47-48	
158-173	
216-220	
220-225	Citizens Band, Class E
450-470	Citizens Band, Class A
470-512	Land Mobile

A study has indicated that the possibility of misoperation of a protective or control device to radiated electromagnetic interference is a function of the following:

1. Field intensity and frequency of radiation.
2. Sensitivity of the affected circuitry to radiation.
3. Coupling efficiency resulting from device construction, lead configuration, etc.

An in-house test to check the security of static relays against false tripping is now used.

(Recommended Guide Form Specification)

"The relay shall not be damaged nor exhibit spurious output when subjected to a radio frequency susceptibility test, over a frequency range of 25 - 500 megahertz with a field strength measured at the front face of the relay, of 7.0 volts per meter. For these tests the relay is energized and connected for normal operation."

STANDARD FOR QUALIFYING CLASS 1E EQUIPMENT FOR NUCLEAR POWER GENERATION STATIONS* IEEE323-1974—A Guide for the Qualification of Class 1E

Class 1E - The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, or are otherwise essential in preventing significant release of radioactive material to the environment.

Testing - Outline of procedures which can be used to seismically qualify equipment by test.

Proof Testing - To qualify equipment for a particular application.

Fragility Testing - To qualify equipment by determining its ultimate capability.

SEISMIC TESTING OF RELAYS* IEEE C37.98 (Formerly IEEE-501)—

standard to establish procedures for determing the seismic capabilities of protective and auxiliary relays by fragility and testing.

In order to define the conditions for fragility testing of relays, parameters in three separate areas must be specified.

(a) Electrical settings and inputs to the relay.

(b) The change in state deviation in operating characteristics or other change of performance which constitutes failure.

(c) The seismic vibration environment to be imposed during test.

Typical Fragility Test

Tests are conducted with biaxial multi-frequency broadband vibrations applied to the shaker table. The standard response spectrum (SRS) of the vibrational stimulus (See Figure 1) is plotted as a percentage of the Zero Period Acceleration (ZPA). The 1.0 Hz point is 25% of the ZPA, the 4.0 to 16.0 HZ band is 250% of the ZPA and 33.0 HZ and above is equal to the ZPA. The range of maximum amplification of acceleration, 4.0 to 16.0 HZ, has been designed to most realistically match the range of peak acceleration input to the relays by equipments and panels on which they are mounted.

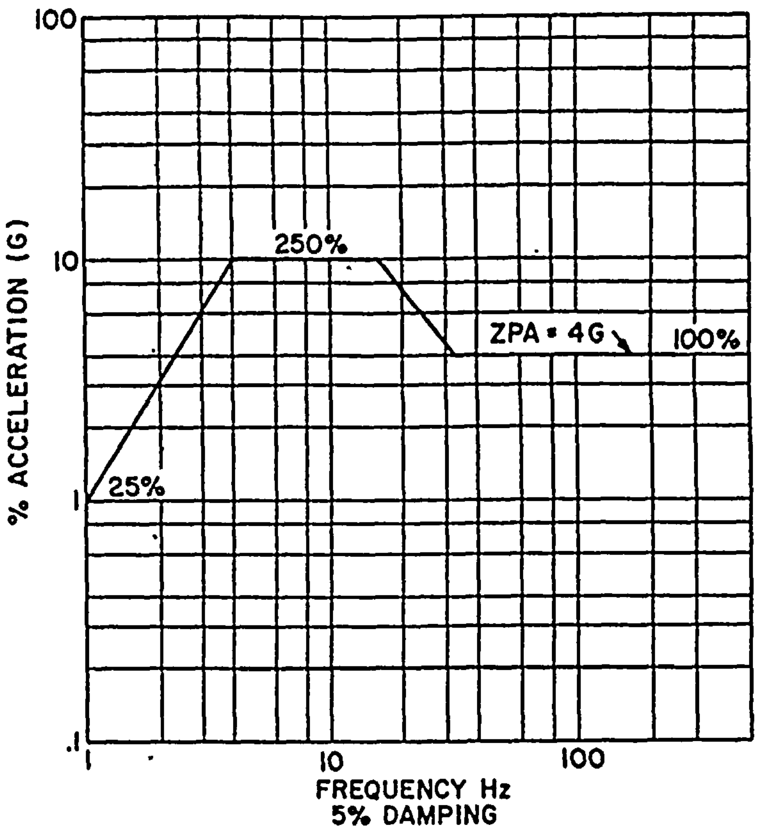


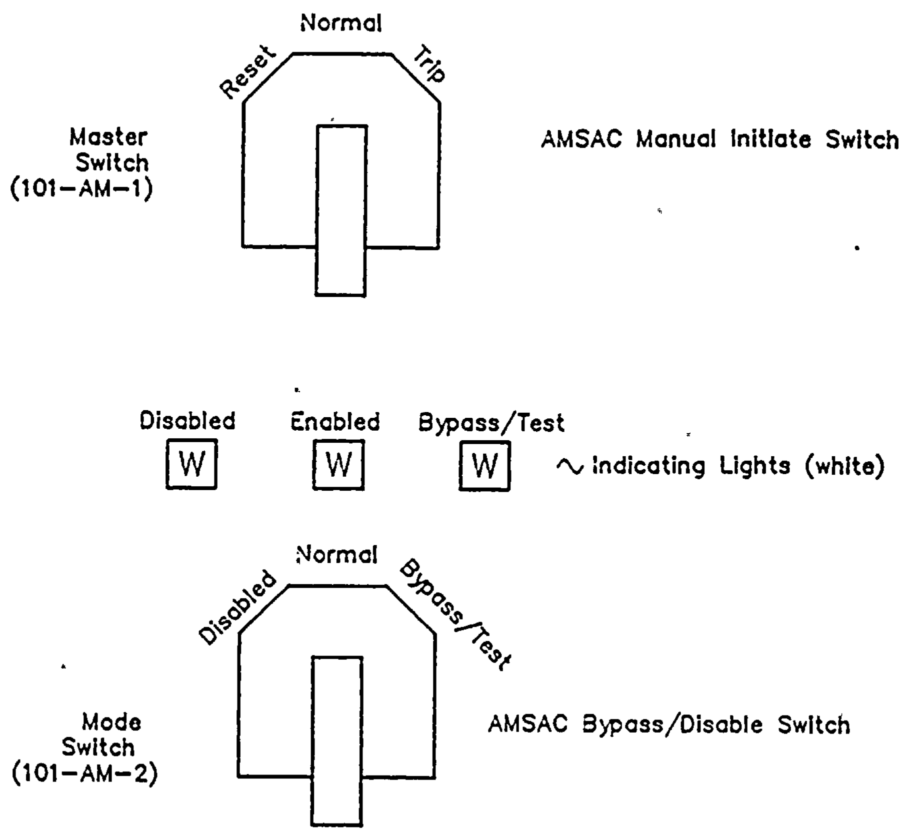
Fig. 1. Multi-frequency broad-band standard response spectrum shape (SRS) for relay with ZPA level of 4 Gs

The stimulus is increased in amplitude until failure occurs (per Item b, above) or the limits of the shaker table are reached. The fragility level of a relay or device is defined as the maximum ZPA level, expressed in Gs, that can be applied without causing failure.

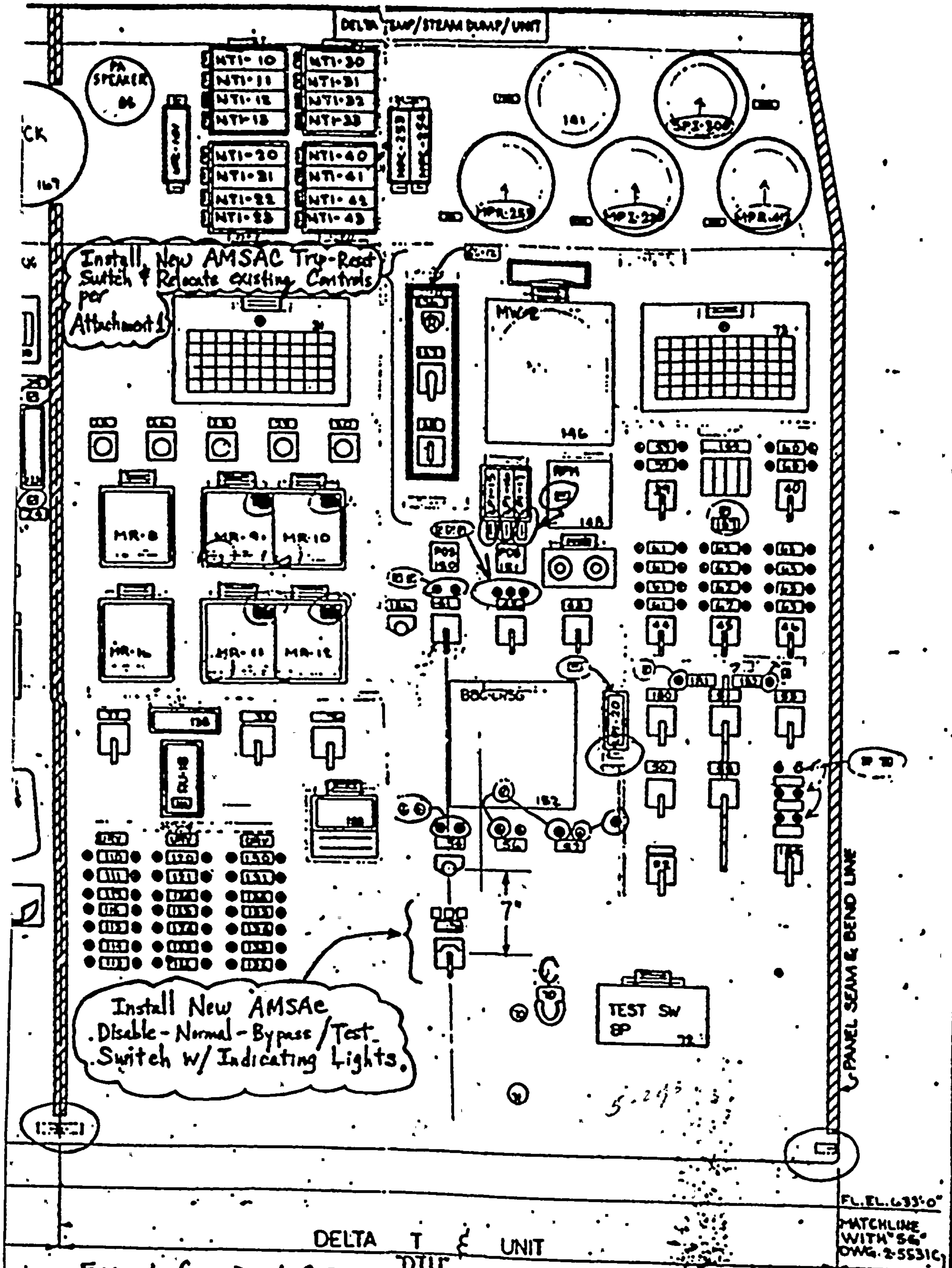
* Relays for Class 1E duty are tested and qualified on a selective basis only. For information on specific relay types contact your local General Electric sales office.

Attachment 5 to AEP:NRC:0838AD

AMSAC CONTROL SWITCHES IN THE CONTROL ROOM DTU PANEL



Note: GE Type SB-1 Switches With Pistol Grip Handles Are Used.



Excerpt from DR.No. 2-5531B-0

NOTE: THIS DRAWING IS THE CONTROLLING DOCUMENT FOR THE COLOR, SHAPE, SIZE AND LOCATION CODES SHOWN

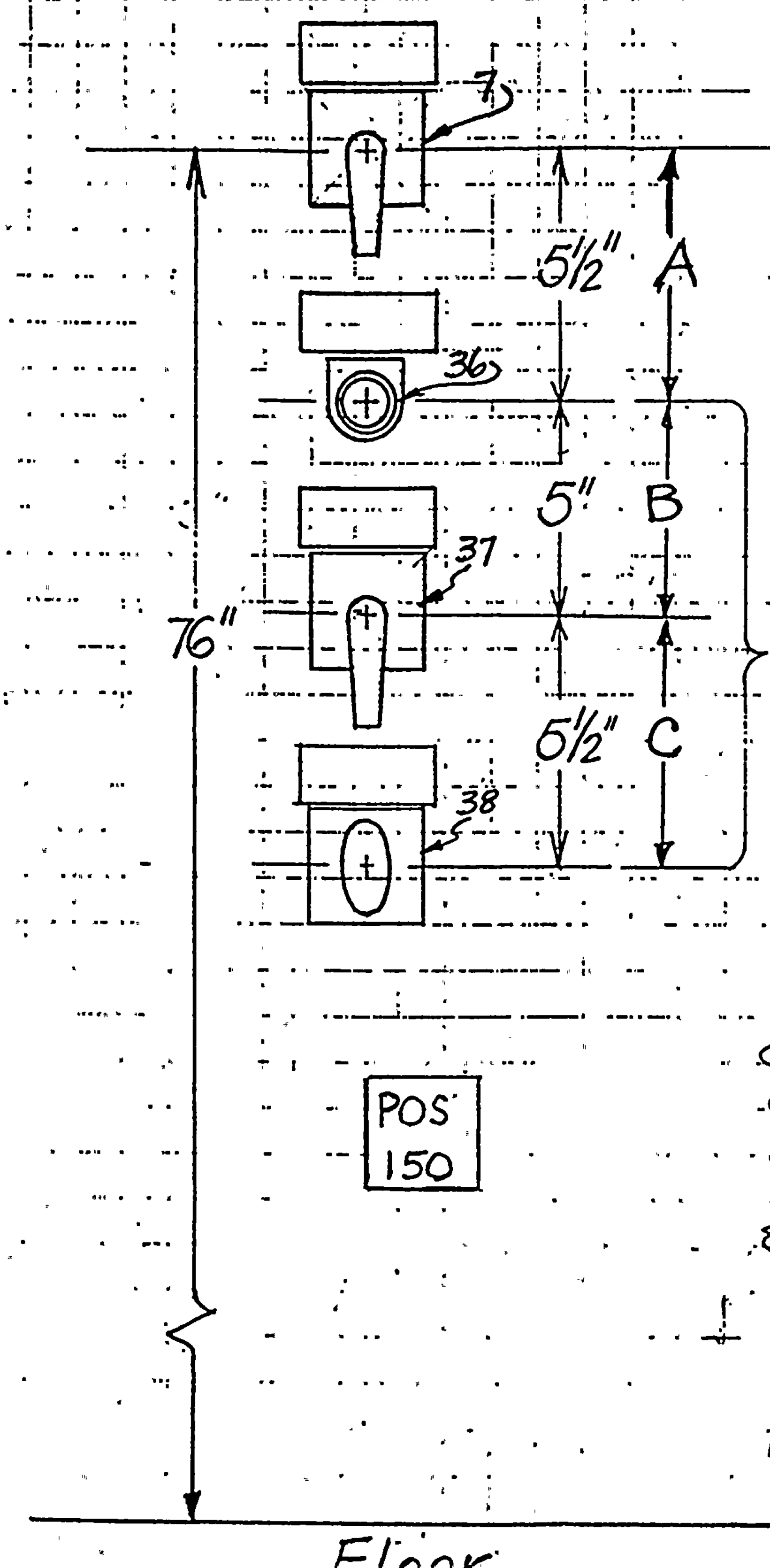
Attachment 3

K 20 30 L INCHES 1 2 N

Suggested AMSAC Trip-Reset Control Switch Location on DTU Panel

ATTACHMENT 5 to AEP:NRC:0838AD (3 of 3)

Ref. Dr. No. 2-5531B-0



Install New AMSAC Trip-Reset Sw

Relocate Main Turbine Vacuum Breaker Trip Solenoid Trip Turbine Reset Controls

Note: Spacings between Controls less than standard, but satisfactory since no indicating lamps with switches and space restrictions are acute.

Have EGS verify above dimensions physically possible

Attachment 1