Florida Power
CORPORATION

October 2, 1979

File: 3-0-3-a-3

Mr. Robert W. Reid, Chief
Operating Reactors Branch No. 4
Division of Operating Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: Crystal River Unit 3
Docket No. 50-302
Operating License No. DPR-72

Dear Mr. Reid:

On September 19, 1979, Florida Power Corporation received your letter dated September 7, 1979 requesting additional information concerning the upgrade of the anticipatory reactor trips on turbine trip or loss of main feedwater at Crystal River Unit 3.

You specifically requested Florida Power Corporation to provide the additional information identified in the enclosure of your letter and evaluate the possibility of improving the installation schedule for the safety grade anticipatory trips previously identified in our response to IE Bulletin 79-05B.

In that regard, enclosed is our response to Items 1-9 identified in the enclosure of your letter.

Our previous implementation schedule for this design modification was approximately 12 months following NRC approval of our proposed design. This schedule was based on the long lead times necessary for the manufacture, delivery and installation of safety grade equipment. As indicated in our response to Item 5, we have been able to locate some existing qualified equipment from a utility who is experiencing delays in construction of its nuclear plant. These components can be delivered to CR#3 within 22 weeks from the time of NRC approval of our proposed design. The installation of this equipment would be accomplished at the first refueling outage or outage of sufficient duration to permit installation, following receipt of the equipment on site. We believe that this improved schedule is consistent with your September 7, 1979 letter.

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Please contact us if you wish to discuss our response further.

Very truly yours,

FLORIDA POWER CORPORATION

W. P. Stewart

W. P. Stewart
Manager, Nuclear Operations

ECShewT01
D88N

STATE OF FLORIDA

COUNTY OF PINELLAS

W. P. Stewart states that he is the Manager, Nuclear Operations, of Florida Power Corporation; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission the information attached hereto; and that all such statements made and matters set forth therein are true and correct to the best of his knowledge, information and belief.

W. P. Stewart

W. P. Stewart

Subscribed and sworn to before me, a Notary Public in and for the State and County above named, this 2nd day of October, 1979.

Catherine T. Cameron

Notary Public

Notary Public, State of Florida at Large,
My Commission Expires: August 8, 1983

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CameronNotary 3(D12)

QUESTION 1. For your proposed design, state the degree of conformance with the acceptance criteria listed in Column 7.2 of Table 7-1 ("ACCEPTANCE CRITERIA FOR CONTROLS") of the Standard Review Plan. Justify any non-conformance.

QUESTION 2. Provide a discussion of the following:

a. design basis information required by Section 3 of IEEE-279-1971, and

b. conformance with the design requirements of Section 4 of IEEE-279-1971.

RESPONSE TO QUESTIONS 1 AND 2:

The proposed design for safety grade anticipatory trips contains four redundant and independent channels which monitor the main feedwater pumps and the turbine. This equipment will initiate an RPS reactor trip on the tripping of both main feedwater pumps or on a turbine trip. The cabinet mounted equipment will be installed in and become an integral part of the existing four channel RPS-1. As such, the additional equipment will meet or exceed the design bases of the RPS at CR #3 and will meet or exceed the acceptance criteria and design requirements of the RPS. The description of the conformance of the RPS with the acceptance criteria and design requirements of Crystal River Unit 3 can be found in Section 7.1 of the FSAR.

QUESTION 3. Provide a description of any changes to and/or interfaces with the existing protection system. Include diagrams (block, location, functional and/or elementary wiring), as necessary, to clearly depict the changes and/or interfaces. In addition, provide an analysis which demonstrates that these changes and/or interfaces will not degrade the existing protection system.

RESPONSE TO QUESTION 3:

The anticipatory trip equipment will be added to the RPS cabinets and will interface as new trips in the present bistable trip string. Figures 1 and 2 of the Attachment I show the functinal interface of the added equipment with the RPS. Drawings 51079DBG-1 and 51079MLG-1 of the attachment describe the inputs, outputs, and logic of the new trip functions. The added modules will consist of contact buffers, bistables, and auxiliary relays, which have been tested and qualified for use in safety system. Existing RPS power supplies, flux signals, interlock circuits, and indicators will be used as required by the added equipment. The requirements for the RPS, e.g., cooling, power, seismic, environmental, will be the same for the system with anticipatory trips as the requirements prior to addition of the new trips.

A failure analysis of the RPS-1 was performed and is contained in Topical Report BAW-10003, "Qualification Testing of Protection System Instrumentation." This failure analysis was predicated on the use of qualified modules and concluded that any single failure in the RPS will not prevent performance of its protection action when required. The added equipment uses qualified modules and the failure analysis of BAW-10003 is still applicable to the RPS containing anticipatory trips.

The anticipatory trips provide additional protection and conservatism beyond that provided by the rest of the RPS. No credit is taken for any of these trips in the FSAR accident analyses. The sensors will be redundant, separated, and designed such that a single failure will not prevent them from performing their intended function. The sensors are anticipatory to other diverse parameters which will cause a reactor trip. Thus, the protection system will not be degraded by these trips since functioning of the anticipatory trips is not required to provide safety action and contact isolation of 500 volts is provided. The sensor contacts are closed during normal operation and open to cause a reactor trip when either the main feedwater pumps trip or the turbine trips. The contacts serve to interrupt power to cause a reactor trip. Loss of power to the trip circuitry will also initiate a reactor trip.

QUESTION 4. Identify equipment which is identical to equipment utilized in existing safety-grade systems. For the equipment which is not identical, briefly describe the differences.

RESPONSE TO QUESTION 4:

The equipment to be used are bistables, contact buffers, and auxiliary relays. These modules are updated versions of modules already in use in B&W safety systems of the operating plants. Significant changes are: the bistable output to the RPS trip string has been converted from a relay contact to a solid state output; the contact buffer now uses one transformer with a rectified output to monitor the field contacts instead of two transformers with AC outputs; and transistor buffer amplifiers for driving relay coils from current limited grounded input signals have been added to the auxiliary relay. These changes were made to improve the performance of the modules.

QUESTION 5. For all critical components, provide an expected delivery date.

RESPONSE TO QUESTION 5:

The Reactor Protection System components, contact buffers, bistables, and auxiliary relays, which are the critical path components in this design, are available from existing systems which have been delayed in construction. These components can be delivered to CR #3 within 22 weeks from the time of NRC approval of our proposed design.

QUESTION 6. In general, the equipment shall be seismically and environmentally qualified. Therefore, provide the following descriptive information for the qualification test program:

a. equipment, design specification requirements,
b. test plan,
c. test setup,
d. test procedures, and
e. acceptability goals and requirements.

RESPONSE TO QUESTION 6:

The modules to be used have been qualified for use in B&W safety systems. Attachment II contains the seismic and environmental summary reports for each module which describe the test programs and report the acceptability of the modules. The detailed test procedures and test data are available for audit.

QUESTION 7. Identify the portion(s) of the design which are within the scope of supply of B&W and/or other contractors.

RESPONSE TO QUESTION 7:

The B&W scope of supply is limited to the RPS modules, i.e., contact buffers, bistables, and auxiliary relays contained within the RPS system cabinets. The cable, relays, and pressure switches used in the design will be purchased by Florida Power Corporation directly.

QUESTION 8. Provide the criteria for the overall reactor protection system installation testing which will demonstrate that the new trip has been installed properly. If this information is not available at this time, provide a schedule for its submittal.

RESPONSE TO QUESTION 8:

Detailed installation instructions and test procedures will be provided to ensure that the anticipatory trip equipment is properly installed and performs the functions described. In addition, the cabinet mounted equipment to be supplied by B&W will be fully testable from the RPS cabinets. The equipment will have provision for simulating input signals and verifying the proper response of the RPS channel. This testing will be similar to that presently performed on the RPS and will be integrated into the periodic testing of the cabinets.

Overall reactor protection system installation testing to be performed by the utility could include actuation of the new sensors and verification of proper reponse at the CRDCS cabinets.

QUESTION 9. The safety evaluations for the anticipatory trips are either missing or are incomplete. Submit supporting analysis to justify the proposed trip signals by addressing the following items:

a. Provide an analysis that quantifies the improvement in the time-to-reactor-trip for both the turbine trip and the loss of main feedwater signals;

b. Address the need to bypass these trips at 20% power versus bypass at a lower power (approximately 10%);

c. Discuss the adequacy of the proposed trip signals for loss of main feedwater for a variety of failure scenarios (such as feedwater valve closures), i.e., see the Oconee 1 transients of 6/11/79; and

d. Provide an evaluation of why a reactor trip on low steam generator level is not a viable anticipatory trip signal when the other signals are bypassed, i.e., see the Crystal River 3 transient of 8/2/79.

RESPONSE TO QUESTION 9:

a. The primary purpose of anticipatory reactors trips (ARTs) is to reduce the probability of lifting the PORV for turbine trip/loss of main feedwater type events. For a reactor high pressure trip setpoint of 2300 psig, it was shown in References 1 and 2 that the PORV would not lift with a setpoint of >2400 psig. The margin to the PORV setpoint can be increased, however, by use of ARTs. Figure 9a-1 shows the pressure increase from nominal operating pressure as a function of time to trip for the loss of main feedwater event. From this figure, it can be seen that an ART that detects and trips the plant at 4 seconds results in a peak pessure increase of 60 psi; whereas the high R.C. pressure trip which would occur at 8 seconds results in a peak pressure increase of 184 psi. The anticipatory trip signals which have been selected will initiate a reactor trip in less than one second. As seen on Figure 9a-1, a one second time to trip results in a 12 psi pressure increase, compared to a 184 psi pressure increase for the high pressure trip at 8 seconds.

The analyses presented above are for a loss of main feedwater event which produces higher peak pressures than turbine trips produce. The time to reactor trip after a turbine trip from full power is, however, approximately the same as that for a loss of main feedwater.

b. Sensitivity studies on time to reach the PORV setpoint vs. power level for a loss of feedwater event have been performed. Table 9B-1 displays the results of these analyses. The results are for a trip on high RC pressure since that gives the shortest time to steam generator dryout assuming no auxiliary feedwater. For power levels <25% FP, it can be seen that sufficient time for operator action exists to initiate feedwater and any bypass setpoint below this value should be a matter of providing sufficient operat nal flexibility.

For the turbine trip event, the system has sufficient responsiveness such that, at lower power levels (≤25%), a reactor trip is not anticipated if the turbine trips. The power level >25% for which the turbine trip-reactor trip may be bypassed is plant specific, and is dependent on the condenser bypass and atmospheric dump valve capacities.

c. The Oconee 1 transient of 6/11/79 was a reactor startup situation with 1 MFWP reset and not operating. When the operating feedwater pump tripped, the reactor did not automatically trip on loss of feedwater because the low discharge pressure trip on the reset MFWP was not reached prior to the operator manually tripping the plant. There are two important points to be made with respect to the above situation. First of all, a reactor trip based on feed pump operation, such as the proposed safety grade trips will be, would have detected this loss of feedwater event. Secondly, at a startup condition such as this transient occurred at the ARTs would have been bypassed. However, as discussed in response to b. above, there is sufficient operator action time.

   It should also be noted that the purpose of ARTs is to decrease the probability of PORV actuation on turbine trip/loss of main feedwater type events. Since it has been demonstrated [1,2] that with a reactor trip of 2300 psig and PORV setpoint >2400 psig, no lifting of the PORV will occur, the addition of ARTs only increase the margin to PORV setpoint pressure.

d. The Crystal River transient of 8/2/79 was similar to the Oconee transient briefly described in c. above, only the operating pump lost flow slowly and the reactor trip was by automatic control grade trip on low steam generator level instead of a manual trip. The RC pressure rise (~2255 psig at time of trip) would have tripped the plant had the level trip not functioned. As was shown in Response 9b, an ART in this power level is not really needed, although it may indeed trip the plant before the high RC pressure trip.

REFERENCES:

1. B&W Report to the NRC, May 1, 1979, "Evaluation of Transient Behavior and Small Reactor Coolant System Breaks in the 177 Fuel Assembly Plant."

2. Toledo Edison Report to the NRC, May 15, 1979, "Evaluation of Transient Behavior and Small Reactor Coolant System Breaks in the 177 Fuel Assembly Plant, Volume 3."

ATTACHMENT I

# NEW SAFETY-GRADE REACTOR TRIPS FOR RPS-I

## CABINET MOUNTED EQUIPMENT FOR ADDITION OF RPS TRIPS ON LOSS OF MAIN FEEDWATER AND TURBINE TRIP

| | |
|---|---|
| 3 Contact Buffers | |
| 2 Bistables | Per Channel |
| 2 Auxiliary Relays | |

Modules will be installe. in a pre ·red mounting case and tested as a unit prior to shipment. The mounting c. .e is to be installed in an empty row of each RPS channel and connections made to the RPS wiring.

Trip response time of the RPS cabinet mounted equipment will be $\leq$ 150 ms.

Isolation of the contact buffer module is 600 volts with the contact input lines not grounded.

Customer contact input requirements:

| | |
|---|---|
| Continuous | 90 ma, P-P |
| Surge | 250 ma, P-P |
| Voltage | 118 VAC |

Closed contact indicates pump running

Open contact indicates pump tripped

This report describes the implementation of safety-grade reactor trips into the RPS-I for loss of main feedwater and turbine trip.

Loss of Main Feedwater Trip - Control oil pressure switches on both main feedwater pumps will input an open indication to the RPS on feedwater pump trip. Contact buffers in the RPS will sense the contact inputs and initiate an RPS trip when both pumps have tripped. This trip will be bypassed below a predetermined flux level, typically 20% FP. Reference Figure 1.

Turbine Trip - Contact outputs from the main turbine electro-hydraulic control unit will input an open indication to the RPS on turbine trip. Contact buffers in the RPS will sense the contact inputs and initiate an RPS trip when a turbine trip is indicated. This trip will be bypassed below a predetermined flux level, typically 20% FP. Reference Figure 2.

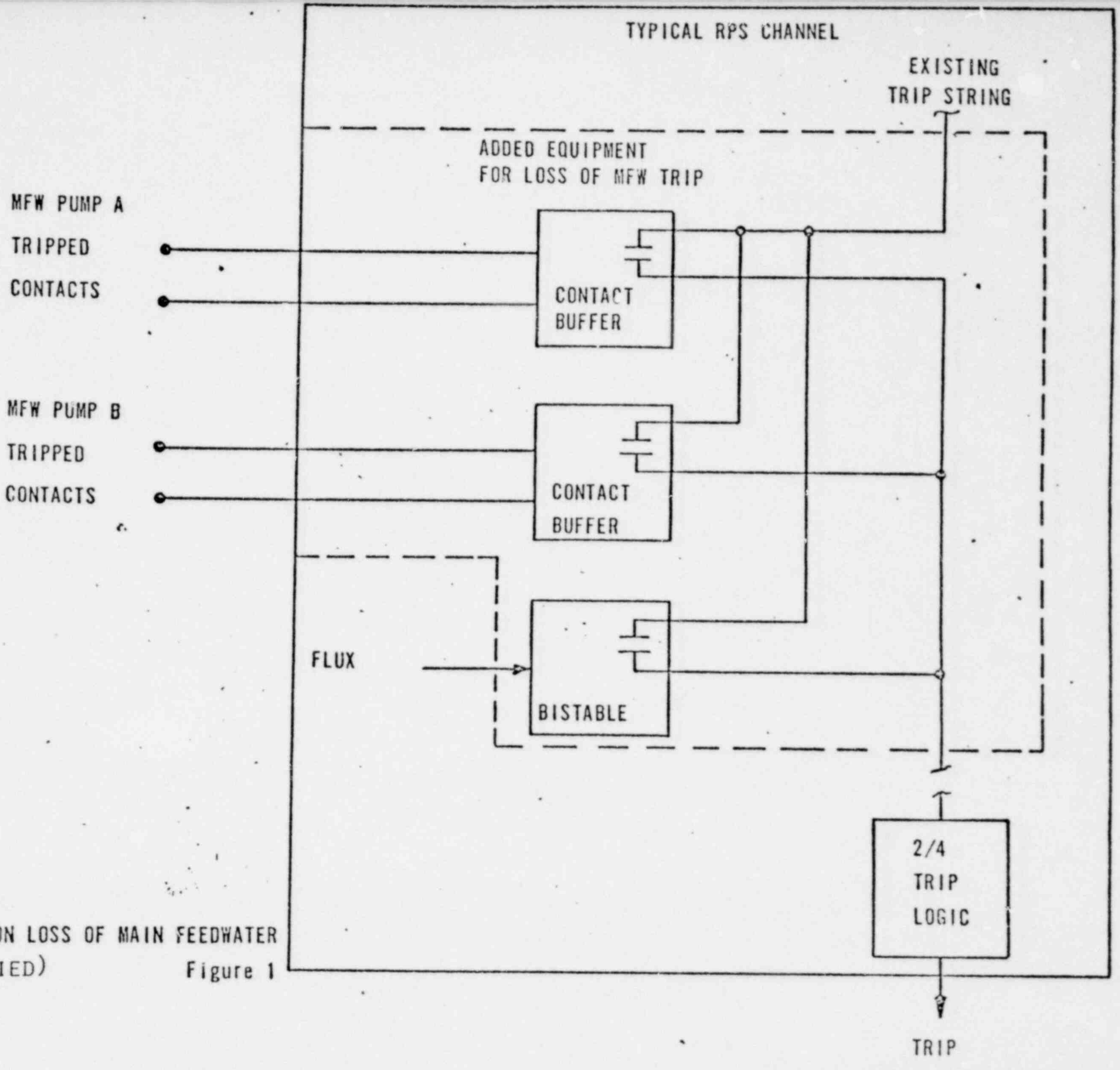
Pressure switches for both trips will be supplied by the customer. B&W will supply all RPS cabinet mounted equipment. Attachment 1 lists the cabinet mounted equipment and gives the trip response time. Attachment 1 also gives the contact buffer isolation voltage and the customer requirements for the contact inputs.

Figure 1 is a simplified drawing of the main feedwater pump trip.

Figure 2 is a simplified drawing of the turbine trip.

Drawing 51079DGB-1 shows the generic logic for the new trips.

Drawing 51079MLG-1 is a legend for the generic logic drawing.




RPS TRIP ON LOSS OF MAIN FEEDWATER
(SIMPLIFIED)

Figure 1

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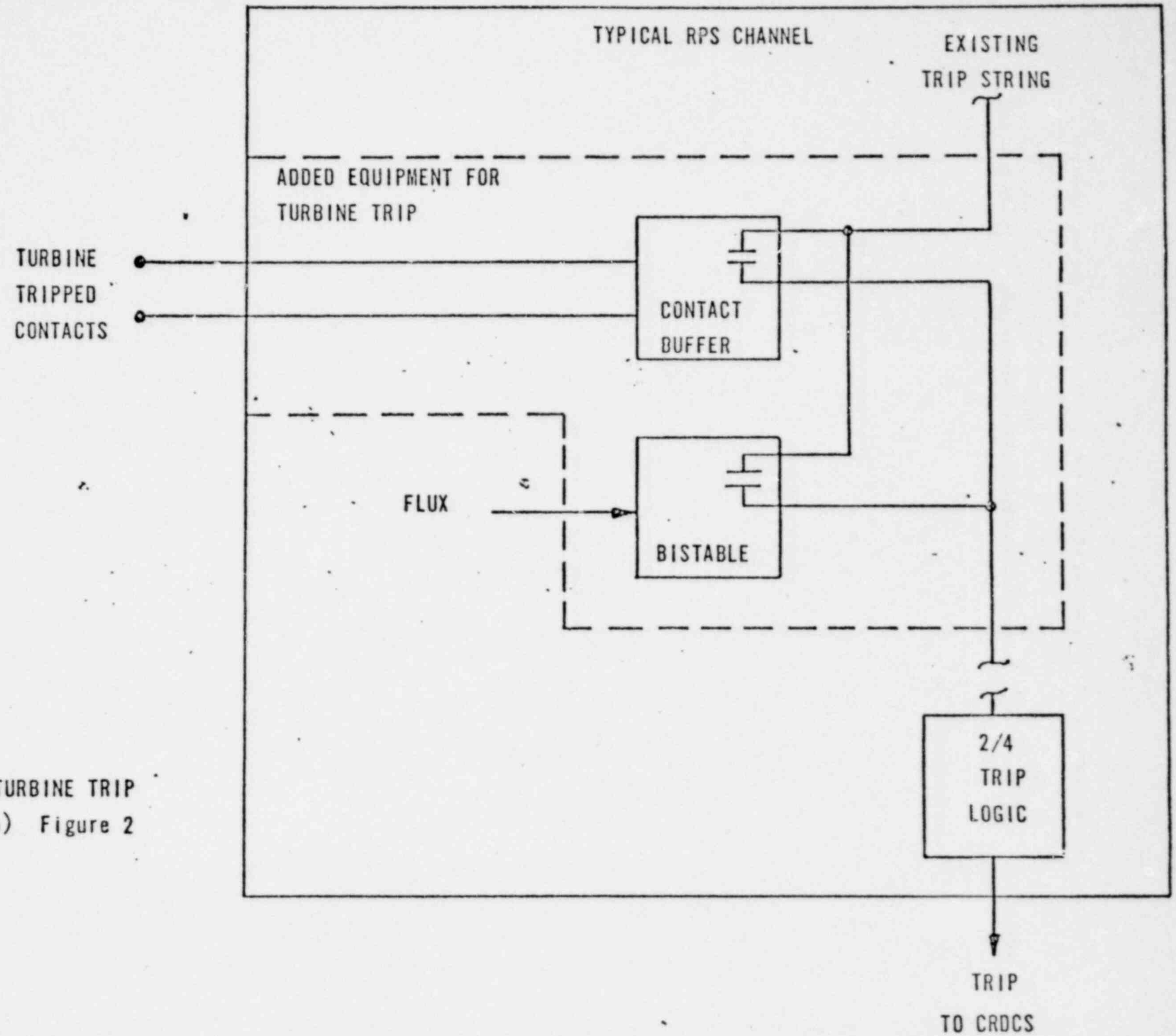


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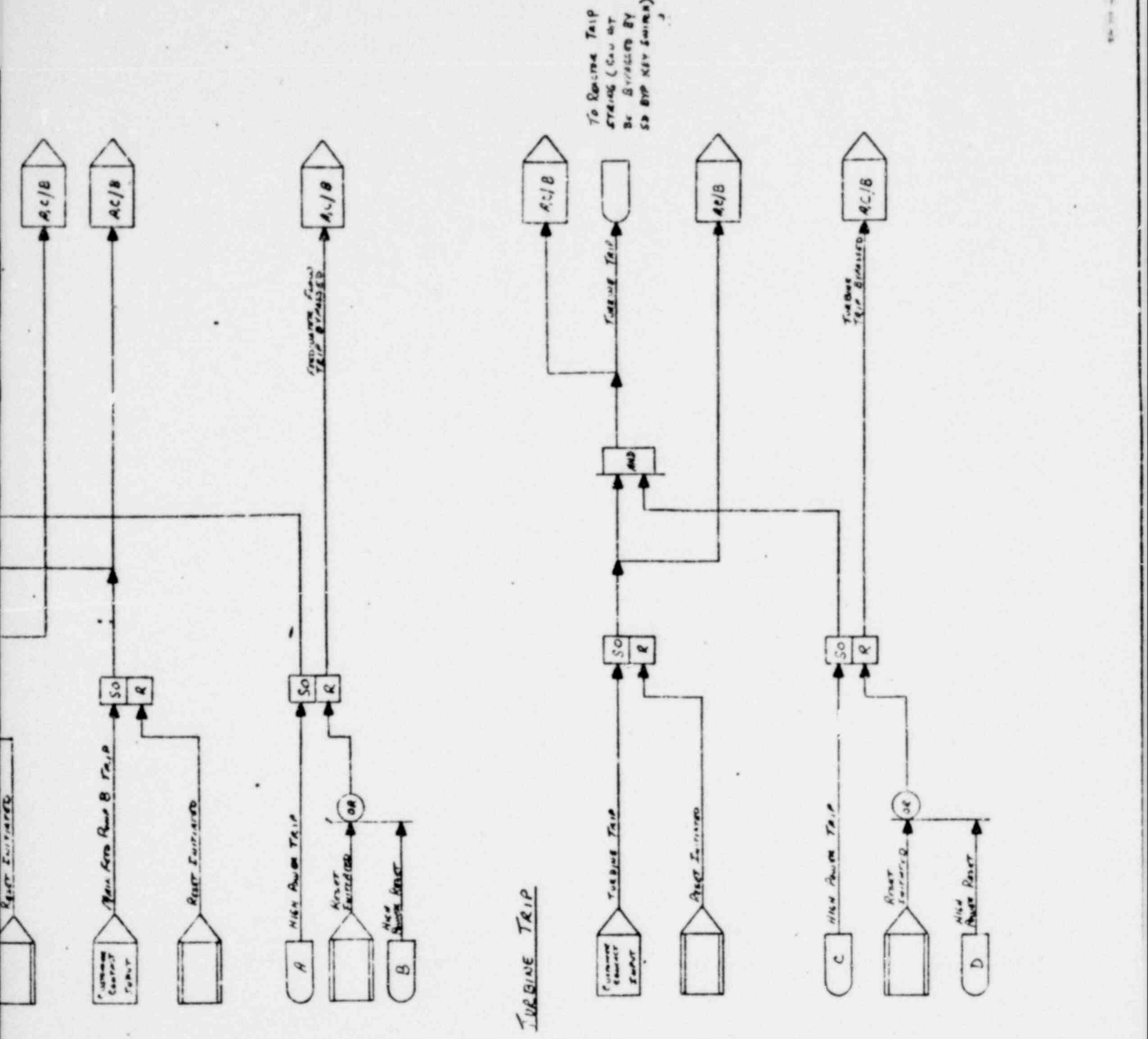
RPS TRIP ON TURBINE TRIP
(SIMPLIFIED) Figure 2

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Generic Logic
Safety Grade Trips

CUSTOMER:
PLANT:
CONTRACTING ENG.:
B C CO. JOB NO.:
CUST. ORDER NO.:

Babcock & Wilcox
Bailey Controls Company

D 5707?DGB-1

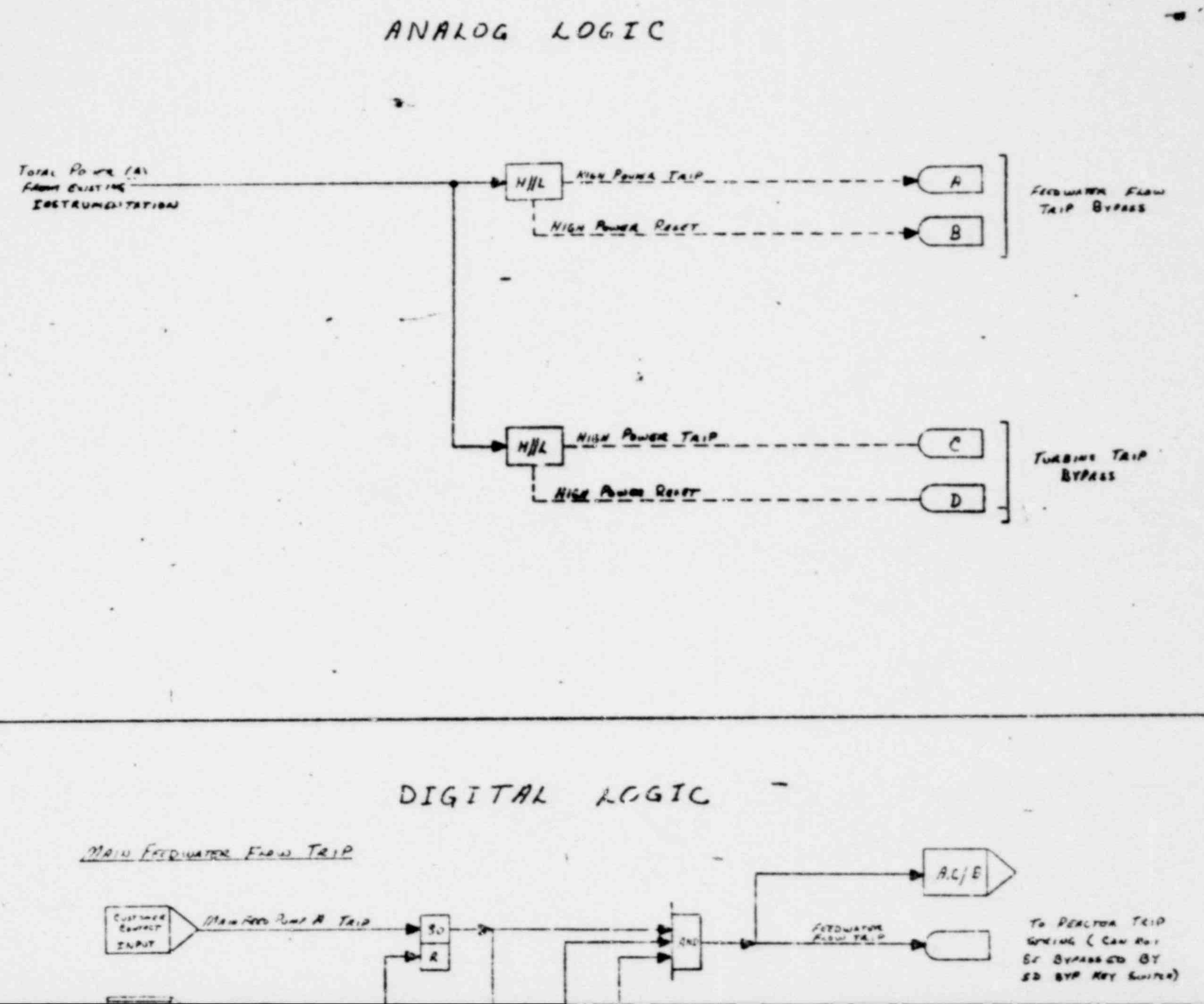
ANALOG LOGIC
Total Power (A) From Existing Instrumentation
H/L
High Power Trip
High Power Reset
A
B
Feedwater Flow Trip Bypass
H/L
High Power Trip
High Power Reset
C
D
Turbine Trip Bypass
DIGITAL LOGIC
Main Feedwater Flow Trip
Customer Contact Input
Main Feed Pump A Trip
SO
R
AND
A.C/E
Feedwater Flow Trip
To Reactor Trip String (Can Not Be Bypassed By SD Byp Key Switch)

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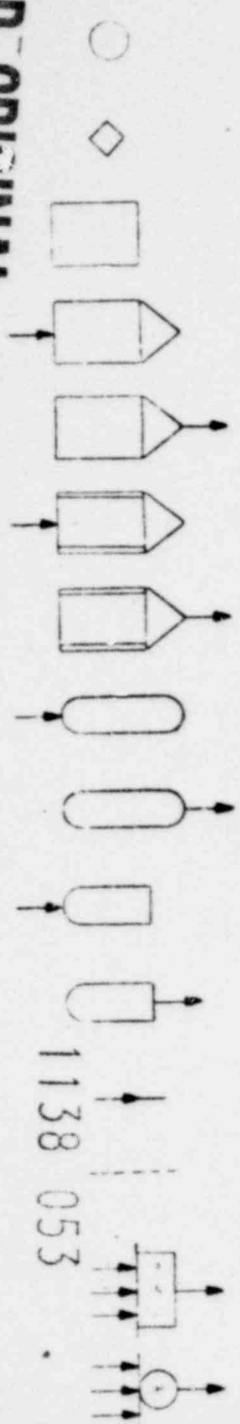
TABLE 1

[illegible]



| | |
|---|---|
| MEASURING OR LOCAL [illegible] | |
| MANUAL SIGNAL PROCESSING | |
| AUTOMATIC SIGNAL PROCESSING | |
| SYSTEM OUTPUT (PROCESS/OTHER SYSTEM TYPE) | THE SYMBOL REPRESENTS ACTUAL INPUTS FROM OR ACTUAL OUTPUTS TO A PROCESS OR ANOTHER SYSTEM. |
| SYSTEM INPUT (PROCESS/OTHER SYSTEM TYPE) | |
| SYSTEM OUTPUT (HUMAN COMMUNICATION TYPE) | THE SYMBOL REPRESENTS ACTUAL INPUTS FROM OR ACTUAL OUTPUTS TO THE OPER[illegible] |
| SYSTEM INPUT (HUMAN COMMUNICATION TYPE) | |
| BREAK POINT | THE SYMBOL DENOTES BREAKS AND RESUMPTIONS OF SIGNAL LINES ON A SINGLE PAGE OF LOGIC AND/OR BETWEEN PAGES OF LOGIC. (DIGITAL LOGIC TO DIGITAL LOGIC DRAWING.) |
| RESUMPTION POINT | |
| BREAK POINT | THE SYMBOL DENOTES BREAKS AND RESUMPTIONS OF SIGNAL LINES ON A SINGLE PAGE OF LOGIC AND/OR BETWEEN PAGES OF LOGIC. (ANALOG LOGIC TO DIGITAL LOGIC DRAWING.) |
| RESUMPTION POINT | |
| ARROWHEAD | THE ARROWHEAD SYMBOL SHOWS DIRECTION OF FLOW OF A SIGNAL LINE. |
| DASHED LINE | THE DASHED LINE SYMBOL SHOWS ANALOG SIGNAL LINES ON A DIGITAL LOGIC DRAWING OR DIGITAL SIGNAL LINES ON AN ANALOG LOGIC DRAWING. |
| AND | THE OUTPUT IS A LOGIC ONE IF ALL OF THE INPUT SIGNALS ARE LOGIC ONE. |
| OR (INCLUSIVE) | THE OUTPUT IS A LOGIC ONE IF THERE IS ONE OR MORE LOGIC ONE INPUTS. |

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TABLE 2

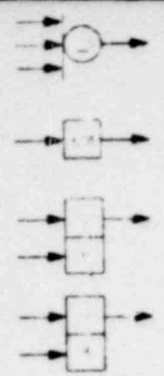
[illegible] LETTERS

| | |
|---|---|
| BIC | BOTTOM ION CHAMBER |
| BII | BOTTOM ION CHAMBER INDICATOR |
| CIC | COMPENSATED ION CHAMBER |
| CRI | COUNT RATE INDICATOR |
| [illegible] | DIVISION [illegible] PANEL |
| DPS | DETECTOR POWER SUPPLY |
| DPT | DIFFERENTIAL PRESSURE TRANSMITTER |
| FFD | FAN FAILURE DETECTOR |
| FLI | FLOW LOOP INDICATOR |
| [illegible] | [illegible] |
| [illegible] | LOG N INDICATOR |
| MI | MODULE INTERLOCK |
| ODI | OFFSET DIGITAL INDICATOR |
| PC | PROPORTIONAL COUNTER |
| PII | POWER IMBALANCE INDICATOR |
| PIP | PAC INDICATING PANEL |
| PLI | PRESSURIZER LEVEL INDICATOR |
| PT | PRESSURE TRANSMITTER |
| RCI | RATE OF CHANGE INDICATOR |
| RPI | REACTOR COOLANT PRESSURE INDICATOR |
| RTI | REACTOR COOLANT TEMPERATURE INDICATOR |
| SPS | SYSTEM POWER SUPPLY |
| TFI | TOTAL FLOW INDICATOR |
| TIC | TOP ION CHAMBER |
| TII | TOP ION CHAMBER INDICATOR |
| TPI | TOTAL POWER INDICATOR |
| TT | TEMPERATURE TRANSMITTER |

TABLE 3

SIGNAL PROCESSING SYMBOLS

| | | |
|---|---|---|
| Σ | SUMMING | THE OUTPUT EQUALS THE ALGEBRAIC SUM OF THE INPUTS. |
| Δ | DIFFERENCE | THE OUTPUT EQUALS THE ALGEBRAIC DIFFERENCE BETWEEN THE TWO INPUTS. |
| K | PROPORTIONAL | THE OUTPUT IS DIRECTLY PROPORTIONAL TO THE INPUT. |
| d/dt | DERIVATIVE | THE OUTPUT IS PROPORTIONAL TO THE RATE OF CHANGE (DERIVATIVE) OF THE INPUT. |
| √ | ROOT EXTRACTION | THE OUTPUT EQUALS THE ROOT (I.E., SQUARE ROOT, FOURTH ROOT, 3/2 ROOT, ETC.) OF THE INPUT. |
| > | HIGH [illegible] | THE OUTPUT IS EQUAL TO THAT INPUT WHICH IS THE GREATEST OF THE INPUTS. |
| A | ANALOG SIGNAL GENERATOR | THE OUTPUT IS AN ANALOG SIGNAL DEVELOPED WITHIN THE GENERATOR. |
| T | TRANSFER | THE OUTPUT EQUALS THE INPUT WHICH HAS BEEN SELECTED BY TRANSFER. THIS IS A MULTIPOSITION MANUAL SELECTION TEST SWITCH FOR TESTING OF ASSOCIATED INSTRUMENT STRING. EACH STRING HAS A SEPARATE TEST SWITCH. THE STATE OF THE [illegible] |



| | | |
|---|---|---|
| | OR (CODED OR) | THE OUTPUT IS A LOGIC ONE IF THE NUMBER OF LOGIC ONE INPUTS IS __N WHERE N IS 1,2,3,... AND __ REPRESENTS ONE OF THE FOLLOWING: GT = GREATER THAN, LE = LESS THAN OR EQUAL TO, LT = LESS THAN, GE = GREATER THAN OR EQUAL TO, EQ = EQUAL TO |
| | NOT | THE OUTPUT IS A LOGIC ONE IF THE INPUT IS A LOGIC ZERO. |
| | MAINTAINED MEMORY | WHEN AN INPUT TO A SQUARE IS LOGIC ONE, THE OUTPUT FROM THAT SQUARE IS LOGIC ONE. WHEN ONLY ONE INPUT TO THE SYMBOL IS LOGIC ONE AND THIS INPUT IS SUBSEQUENTLY LOST (I.E., LOGIC 0), THE OUTPUT ASSOCIATED WITH THAT INPUT IS REMEMBERED (RETAINED AT LOGIC ONE). WHEN AN OVERRIDE DESIGNATION (O) IS IN ONE OF THE SQUARES AND INPUTS TO BOTH SQUARES ARE LOGIC ONE, ONLY THE OUTPUT FROM THE SQUARE WITH THE OVERRIDE DESIGNATION IS LOGIC ONE. |
| H/ | BISTABLE | THE OUTPUT WILL BE TRIPPED WHEN THE INPUT IS ≥ SET POINT. |
| /L | BISTABLE | THE OUTPUT WILL BE TRIPPED WHEN THE INPUT IS ≤ SET POINT. |
| H/L | BISTABLE | THE OUTPUT WILL BE TRIPPED WHEN THE INPUT IS ≥ SET POINT AND WILL RESET WHEN THE INPUT IS ≤ DEADZONE (I.E., RESET = [illegible]). |
| $\int$ | INTEGRAL | THE OUTPUT VARIES IN ACCORDANCE WITH BOTH MAGNITUDE AND DURATION OF THE INPUT. THE OUTPUT IS PROPORTIONAL TO THE TIME INTEGRAL OF THE INPUT. |
| LOG | LOGARITHMIC | THE OUTPUT EQUALS THE LOGARITHM (I.E., Y = LOG X) OF THE INPUT. |

## OUTPUT DESIGNATION LEGEND

SYSTEM OUTPUTS ARE IDENTIFIED BY THE FOLLOWING LETTER CODES. THE FIRST LETTER DESCRIBES THE DESTINATION AND THE SECOND LETTER DESCRIBES THE PURPOSE OR USE (E.G., A/B = [illegible] UNIT ANNUNCIATOR FOR ALARM [illegible]).

| DESTINATION | PURPOSE |
|---|---|
| A = UNIT ANNUNCIATOR | A = REQUIRED FOR HEAT BALANCE CALCULATION |
| C = UNIT COMPUTER | B = HIGH OR LOW LEVEL ALARM (ANALOG); ALARM (DIGITAL) |
| CR = CONTROL ROOM | C = ALARM ON ERRATIC DEVIATION FROM NORM OR OTHER INPUTS MONITORING SAME PARAMETER |
| CRD = CONTROL ROD DRIVE CONTROL SYSTEM | D = HOURLY LOG |
| DI = DIGITAL INDICATOR | E = CONTROL |
| I = CONTROL ROOM INDICATOR | F = FUTURE |
| ICS = INTEGRATED CONTROL SYSTEM | I = OPERATOR INFORMATION |
| [illegible] = CONTROL ROOM RECORDER | |

## NOTES

1) A COMPLETE SYMBOL CONSISTS OF AN ENCLOSURE OR DIAGRAMMING SYMBOL (TABLE 1) WITHIN WHICH IS CONTAINED A MEASURING OR READOUT LETTER (TABLE 2) OR A SIGNAL PROCESSING SYMBOL (TABLE 3). COMPLEX FUNCTIONS ARE REPRESENTED BY THE COMBINATIONS OF THESE BASIC SYMBOLS.

2) NI/RPS CHANNEL INPUT/OUTPUT DEVICE IDENTIFICATION

| PARAMETER | NI/RPS DIVISION A | B | C | D |
|---|---|---|---|---|
| LOOP A RC FLOW | RC-FT-1A1 | RC-FT-1A2 | RC-FT-1A3 | RC-FT-1A4 |
| LOOP B RC FLOW | RC-FT-1B1 | RC-FT-1B2 | RC-FT-1B3 | RC-FT-1B4 |
| NI DETECTOR | 5 | 6 | 7 | 8 |
| RC PUMP MONITOR | P1A1 | P1A1 | P1A1 | P1A1 |
| | P1A2 | P1A2 | P1A2 | P1A2 |
| | P1B1 | P1B1 | P1B1 | P1B1 |
| | P1B2 | P1B2 | P1B2 | P1B2 |
| LOOP A TH | RC-TE-4A1 | RC-TE-4A5 | RC-TE-4A3 | RC-TE-4A7 |
| LOOP B TH | RC-TE-4B1 | RC-TE-4B2 | RC-TE-4B3 | RC-TE-4B7 |
| LOOP TW | RC-TE-3A3 | RC-TE-3A1 | RC-TE-3B1 | RC-TE-3B3 |
| | (LOOP A) | (LOOP A) | (LOOP B) | (LOOP B) |
| RC PRESS | RC-PT-2A1 | RC-PT-2A2 | RC-PT-2B1 | RC-PT-2B2 |
| RC FLOW | RC-FT-14-1 | RC-FT-14-2 | RC-FT-14-3 | RC-FT-14-4 |
| [illegible] | A | B | C | D |
| [illegible] | A | B | C | D |

3) PAC INPUT/OUTPUT DEVICE IDENTIFICATION

| PARAMETER | PAC-A | PAC-B |
|---|---|---|
| SOURCE RANGE | NI-1 | NI-2 |
| INTERMEDIATE RANGE | NI-3 | NI-4 |
| LOG N RECORDER | NI-3 | NONE |
| OPTIC SIGNALS FROM NI/RPS | A&B | C&D |
| AUCTIONEERED TOTAL POWER RECORDER | NONE | NI-4A-5-8-NIA |

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NI/RPS & PAC [illegible] LEGEND AND [illegible]

CUSTOMER:
PLANT:
CONTRACTING ENG.:
B.M.CO. JOB NO.:
CUST. ORDER NO.:



REV | DATE | CHANGE | APPR

Babcock & Wilcox
Bailey Meter Company, U.S.A.

DATE [illegible]
D [illegible]

ATTACHMENT II

SEISMIC AND ENVIRONMENTAL
SUMMARY REPORTS

Equipment: The Bailey Controls Company Solid State Bistable module P/N 6628492A1 was environmentally tested providing type test data. The Solid State Bistable is a standard 2-unit-wide module designed for plug-in mounting.

Brief Summary of Test Results: Tests were performed to verify that the performance characteristics of the Solid State Bistable Module qualify it for use in a Nuclear Power Generating Facility. The test unit failed to meet the acceptance criteria for output load voltages during humidity effect testing. Engineering replaced a reference amplifier. Upon retest, the module met specified acceptance criteria. Based on the test data, the Solid State Bistable meeting all the design range requirements.

| Test title sequence | Set up conditions | Environment conditions | Acceptance criteria | Units tested | Units acceptable |
|---|---|---|---|---|---|
| Solid State Bistable | | | | | |
| 1. Repeatability of set point trip conditions | a. Normal input/output configuration<br>b. Power supplies ±15V dc, ±5%<br>c. Load: 3K ohms | Standard test conditions<br>Temperature: 75°F ± .5%<br>Humidity: 50% ± 20% RH | <0.02% set point span | 2 | 2 |
| 2. Power supply effect | Same as test No. 1 except power supplies: ±15 dc with ±1% variation from references repeated using ±5% variations | Standard test conditions | For ±1% variation ≤0.02% set point span<br>For ±5% variation ≤0.1% set point span | 2 | 2 |
| 3. Ambient temperature effect | Same as test No. 1 except set internal set point to 8.00 V dc and apply external set point voltage | Temperature: 40°F to 140°F<br>Humidity: RH ≤50% | For 40°F to 140°F<br>Trip point accuracy ≤0.1% set point span shift<br>Response Time: >32 ms-low lvl contact volt. <0.5V dc<br>High lvl contact volt. ≤2.0V dc | 2 | 2 |
| 4. Ambient relative humidity effect | Same as temperature tests | Temperature: 110°F<br>Humidity: 80% RH for 96 h<br>90% RH for 24 h | Trip point accy: ≤0.1% set point span chge in internal set point <0.1% low lvl contact <0.5V dc-hi lvl contact ≤2.0V dc<br>Response Time: ≤32 ms | 2 | 2 |
| 5. Drift, long term (30 day) | Same as test No. 1 except setpoint adjusted to 9.00V dc | Standard test conditions | Change in trip accuracy ≤0.07% setpoint span | 2 | 2 |

Equipment: The Bailey Controls Company Solid State Bistable Module, P/N 6628492A1, was seismically tested providing type test data.

Test Mounting: The Solid State Bistable Module was mounted in a standard Module Mounting Case with backplate. A standard 32-blue ribbon connector was utilized to interface the module with the signal source. The standard Module Mounting Case was then securely attached to the Seismic Test Mounting Box. The Seismic Test Mounting Box was attached to the Qualification Test Lab 45° Biaxial Test Table. The use of the 45° Biaxial Table results in equal horizontal and vertical components. Electrical interface, hardware, and mounting were equivalent to field installation.

Seismic Testing:

Exploratory Testing: The resonant survey consisted of a sinusoidal vibration input of 0.2 g's vertical peak acceleration at frequencies from 1 to 35 Hz and back to 1 Hz. The resonant survey was conducted at a sweep rate of 1 octave/minute. The constant input was applied to the 45° Biaxial Table and continuously monitored.

Proof Testing: A biaxial multifrequency excitation was applied to the Solid State Bistable for a period of 30 seconds. Each 30-second event consisted of dependent biaxial pseudorandum excitation. The random input frequencies were adjusted in 1/3-octave bandwidths until the Test Response Spectrum (TRS) enveloped the Required Response Spectrum (RRS) within the limits of the biaxial table displacement. A damping of 5 percent (Q of 10) was utilized for the control accelerometer in testing. The TRS did not envelope the RRS (below 6.0 Hz worst case) in the low-frequency range. No resonant frequencies exist in the range not enveloped during test; therefore, this is an acceptable deviation.

Test Monitoring:

Seismic: The Solid State Bistable Module was monitored with accelerometers through appropriate signal conditioning to determine its mechanical response. The location of the monitoring accelerometers is delineated in the seismic report. The control accelerometer was mounted directly to the biaxial test table for controlled input.

Electrical: The unit's outputs were monitored and documented on a strip chart recorder during these events.

Brief Summary of Test Results: The Solid State Bistable Module was within the specifications cited in the module test procedure acceptance criteria section during and after the SSE tests. Consequently, the Solid State Bistable Modules are considered qualified for nuclear applications.

Specified Features Demonstrated by Test: The purpose of this test was to satisfy seismic level testing requirements before, during, and after test of the Solid State Bistable.

Module functional operability and solid-state relay state were maintained throughout the exploratory and seismic events.

Structural integrity of enclosures was maintained.

Equipment: The Bailey Controls Company Contract Buffer, P/N 6628908A1 was environmentally tested providing type test data.

The Contact Buffer module is a 2-unit-wide module designed for plug-in mounting. Electrical connections are made through a standard 32-pin Blue Ribbon connector at the rear of the module. The vital bus uses a separate plug-in connector.

Brief Summary of Test Results: Tests were performed to verify that the performance characteristics of the Contact Buffer module qualify it for use in a Nuclear Power Generating Facility.

Based on the test data, the Contact Buffer module meets all the design range requirements.

Type Test Justification: Because of the nature of application, this product consists of various types, versions, or ranges. A worst case representative sampling has been tested by BCCo Qualification Test Laboratory to verify that this product performs the required functions within the required operating and environmental conditions.

| Part Number | Nature of Difference |
|---|---|
| 6628908A2 | Variation of Frontplate Silkscreening |

Contact Buffer

| Test title sequence | Set up conditions | Environment conditions | Acceptance criteria | Units Tested | Units acceptable |
|---|---|---|---|---|---|
| 1. Functional test | a. Normal input/output configuration<br>b. Power supply: 118 V ac<br>c. Load | Standard test conditions<br>Temperature: $75^\circ$F $\pm$ $5^\circ$F<br>Humidity: 50% $\pm$ 20% RH | No faulty operation | 2 | 2 |
| 2. Power supply effect | Same as test No. 1 except power supplies:<br>Minimum: 105 V ac<br>Maximum: 130 V ac | Standard test conditions | Same as test No. 1 | 2 | 2 |
| 3. Ambient temperature | Same as test No. 1 for function test<br>Vac = 106 for response time test | Temperature: $40^\circ$F to $140^\circ$F<br>Humidity: RH $\leq$50% | No fault operation for function test.<br>$\leq$12 ms. for response time test | 2 | 2 |
| 4. Ambient relative humidity effect | Same as test No. 3 | Temperature: $110^\circ$F<br>Humidity: 80% RH for 96 h<br>90% RH for 24 h | Same as test No. 3 | 2 | 2 |
| 5. Drift, long term (30 day) | Same as test No. 1 with both relays energized during drift test | Standard test conditions | Relays do not change state during drift period | 2 | 2 |

1138 060

Equipment: The Bailey Controls Company Contact Buffer Module, P/N 6628908A1, was seismically tested providing type test data.

Test Mounting: The Contact Buffer Module was mounted in a standard Module Mounting Case with backplate. A standard 32-pin blue ribbon connector and a separate standard 2-prong connector for the vital bus were utilized to interface the module with the signal source. The standard Module Mounting Case was then securely attached to the Seismic Test Mounting Box. The Seismic Test Mounting Box was attached to the Qualification Test Lab 45° Biaxial Test Table. The use of the 45° Biaxial Table results in equal horizontal and vertical components. Electrical interface, hardware, and mounting were equivalent to field installation.

Seismic Testing:

Exploratory Testing: The resonant survey consisted of a sinusoidal vibration input of 0.2 g's vertical peak acceleration at frequencies from 1 to 35 Hz and back to 1 Hz. The resonant survey was conducted at a sweep rate of 1 octave/minute. The constant input was applied to the 45° Biaxial Table and continuously monitored.

Proof Testing: A biaxial multifrequency excitation was applied to the Contact Buffer Module for a period of 30 seconds. Each 30-second event consisted of dependent biaxial pseudorandom excitation. The random input frequencies were adjusted in 1/3-octave bandwidths until the Test Response Spectrum (TRS) enveloped the Required Response Spectrum (RRS) within the limits of the biaxial table displacement. A damping of 5 percent (Q of 10) was utilized for the control accelerometer in testing. The TRS did not envelope the RRS (below 5.0 Hz worst case) in the low-frequency range. No resonant frequencies exist in the range not enveloped during test; therefore, this is an acceptable deviation.

Test Monitoring:

Seismic: The Contact Buffer was monitored with accelerometers through appropriate signal conditioning to determine its mechanical response. The location of the monitoring accelerometers is delineated in the seismic report. The control accelerometer was mounted directly to the biaxial test table for controlled input.

Electrical: The unit's outputs were monitored by chatter detectors per MIL-STD-202D, Method 310.

Results: The Contact Buffer was within the specifications cited in the module test procedure acceptance criteria section during and after the SSE tests. Consequently, the Contact Buffer Modules are considered qualified for nuclear applications.

Specified Features Demonstrated by Test: The purpose of this test was to satisfy seismic level testing requirements before, during, and after test of the Contact Buffer. Module functional operability and predetermined relay state were maintained throughout the exploratory and seismic events. Structural integrity of enclosures was maintained.

Equipment: The Bailey Controls Company Auxiliary Relay, P/N 6628807 B1 was environmentally tested providing type test data. The Auxiliary Relay Module is a 2-unit-wide module designed for plug-in mounting.

Brief Summary of Test Results: Tests were performed to verify that the performance characteristics of the Auxiliary Relay qualify it for use in a Nuclear Power Generating Facility. Based on the test data, the Auxiliary Relay meets all the design range requirements.

Auxiliary Relay P/N 6628807 B1

| Test title sequence | Set up conditions | Environment conditions | Acceptance criteria | Unit tested | Units acceptable |
|---|---|---|---|---|---|
| 1. Functional verification | a. Normal input/output configuration<br>b. Power supplies -15 V dc<br>c. Load: none | Standard test conditions<br>Temperature: 75°F ± 5°F<br>Humidity: 50% ± 20% RH | Proper operation of relays | 1 | 1 |
| 2. Power supply effect (DC) | Same as test No. 1 except power supplies: from -13.5 V dc to -16.5 V dc | Standard test conditions | Same as test 1 | 1 | 1 |
| 3. Ambient temperature effect | Same as test No. 1 | Temperature: 40°F to 140° F<br>Humidity: RH ≤ 50% | Same as test 1 | 1 | 1 |
| 4. Ambient relative humidity effect | Same as test No. 1 | Temperature: 110°F<br>Humidity: 80% RH for 96 h<br>90% RH for 24 h | Same as test 1 | 1 | 1 |
| 5. Drift, long term (30 day) | Same as test No. 1 | Standard test conditions | Same as test 1 | 1 | 1 |

1138 063

Equipment: The Bailey Controls Company Auxiliary Relay, P/N 6628807B1, was seismically tested providing type test data.

Test Mounting: The Auxiliary Relay Module was mounted in a standard Module Mounting Case with backplate. Two standard 32-pin blue ribbon connectors were utilized to interface the module with the voltage source. The standard Module Mounting Case was then securely attached to the Seismic Test Mounting Box. The Seismic Test Mounting Box was attached to the Qualification Test Lab 45° Biaxial Test Table. The use of the 45° Biaxial Table results in equal horizontal and vertical components. Electrical interface, hardware, and mounting were equivalent to field installtion.

Seismic Test:

Exploratory Testing: The resonant survey consisted of a sinusoidal vibration input of 0.2 g's vertical peak acceleration at frequencies from 1 to 35 Hz and back to 1 Hz. The resonant survey was conducted at a sweep rate of 1 octave/minute. The constant input was applied to the 45° Biaxial Table and continuously monitored.

Proof Testing: A biaxial multifrequency excitation was applied to the Auxiliary Relay Module for a period of 30 seconds. Each 30-second event consisted of dependent biaxial pseudorandom excitation. The random input frequencies were adjusted in 1/3 octave bandwidths until the Test Response Spectrum (TRS) enveloped the Required Response Spectrum (RRS) within the limits of the biaxial table displacement. A damping of 5 percent (Q of 10) was utilized for the control accelerometer in testing. The TRS did not envelope the RRS (below 7.0 Hz worst case) in the lowfrequency range. No resonant frequencies exist in the range not enveloped during test; therefore, this is an acceptable deviation.

Test Monitoring:

Seismic: The Auxiliary Relay Module was monitored with accelerometers through appropriate signal conditioning to determine its mechanical response. The location of the monitoring accelerometers is delineated in the seismic report. The control accelerometer was mounted directly to the biaxial test table for controlled input.

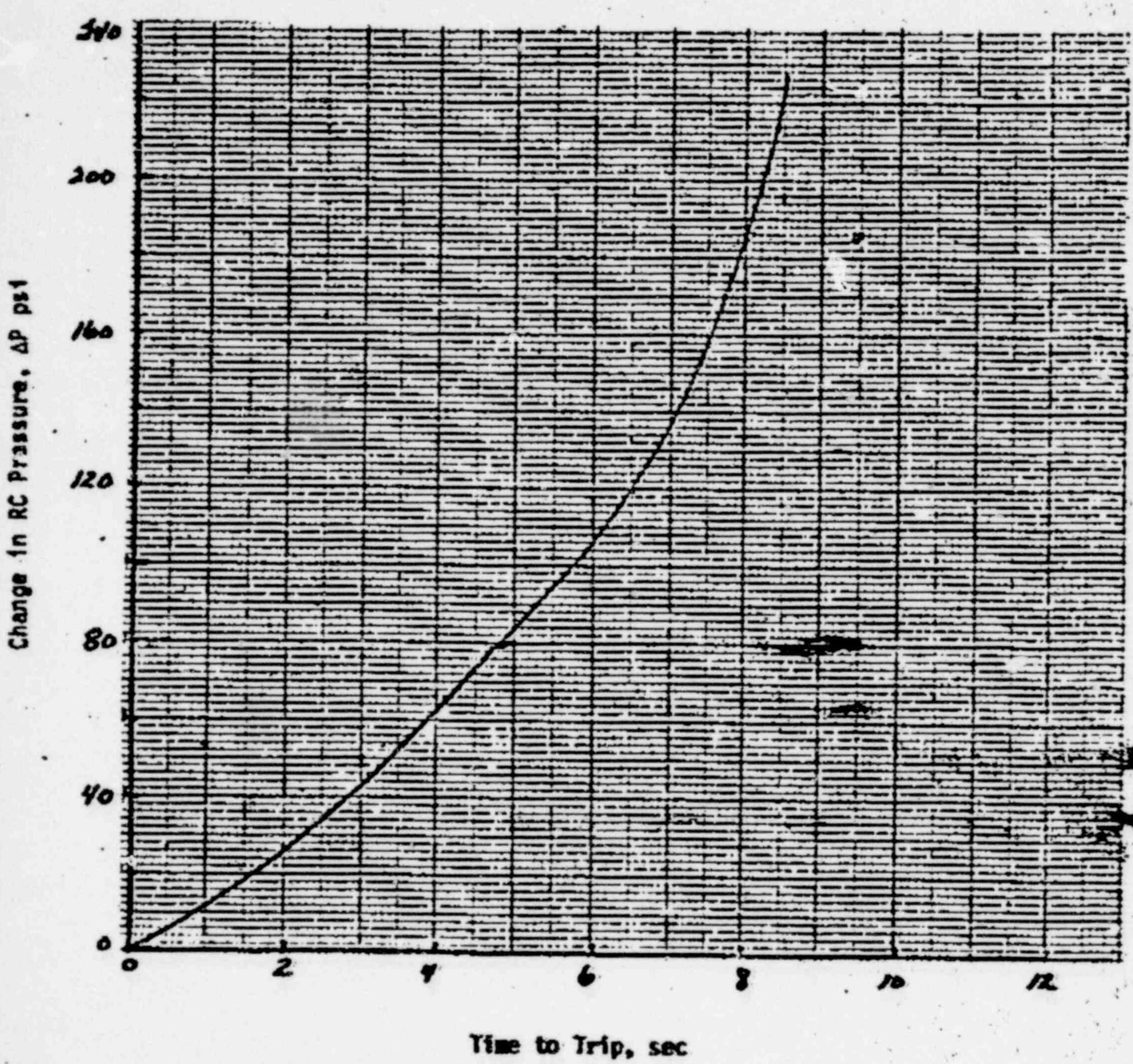
Electrical: The unit's outputs were monitored with chatter detectors per MIL-STD-202D, Method 310 during these events.

Brief Summary of Test Results: The Auxiliary Relay Module was within the specifications cited in the module test procedure acceptance criteria section during and after the SSE tests. Consequently, the Auxiliary Relays are considered qualified for nuclear applications.

Specified Features Demonstrated by Test: The purpose of this test was to satisfy seismic level testing requirements before, during, and after test of the Auxiliary Relay Module.

Module functional operability and predetermined relay state were maintained throughout the exploratory and seismic events.

CHANGE IN REACTOR COOLANT SYSTEM
PRESSURE VS TIME TO TRIP FOR
A LOSS OF MAIN FEEDWATER
FROM 100% POWER




POOR ORIGINAL

FIGURE 9a-1

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TABLE 9B-1

POWER LEVEL SENSITIVITY

| POWER LEVEL | TIME TO REACH PORV SETPOINT | TIME TO FILL PRESSURIZER |
|---|---|---|
| 100% | 3 min. | 10 min. |
| 75% | 6 min. | 11 min. |
| 50% | 12.3 min. | 13 min. |
| 25% | >>15 min. | 16.6 min. |

NOTE: RESULTS ARE FOR THE CASE OF NO AUXILIARY FEEDWATER INITIATION WHICH RESULTS IN THE SHORTEST ACTUATION TIMES. REACTOR TRIPS ON HIGH RC PRESSURE TRIP (2300 psig).

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