

PACIFIC GAS AND ELECTRIC COMPANY

PG&E

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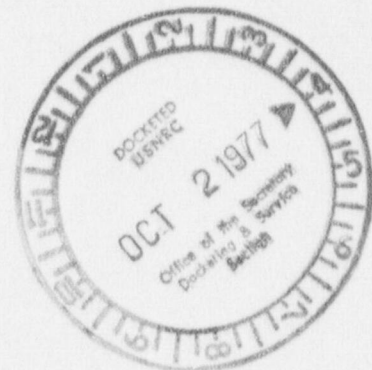
September 22, 1978

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ATTORNEYS

Mr. John F. Stolz, Chief
Light Water Reactors Branch No. 1
Division of Project Management
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555Re: Docket No. 50-275-OL
Docket No. 50-323-OL
Diablo Canyon Units 1 & 2

Dear Mr. Stolz:

Enclosed in support of our operating license application are responses to informal questions 1 through 10 transmitted to PG&E in an August 4, 1978 memorandum on the subject of seismic qualifications.

Because portions of the responses are Westinghouse proprietary information, enclosed are 30 copies of the proprietary responses and 30 copies of the non-proprietary version of the same responses. Also enclosed are an application for Withholding Proprietary Information From Public Disclosure and supporting letters from Westinghouse.

Five copies of these reports have been sent directly to Mr. Dennis Allison.

Kindly acknowledge receipt of the above material on the enclosed copy of this letter and return it to me in the enclosed addressed envelope.

Very truly yours,

Philip A. Crane, Jr.

Enclosures

CC w/encs.: Mr. Dennis Allison
Service List w/non-proprietary enclosure

7810130058

NON-PROPRIETARY

This package contains non-proprietary responses to informal questions 1 through 10 transmitted to PGandE in an August 4, 1978 memorandum on the subject of Seismic Qualifications.

Question 1 Seismic Qualification: Auxiliary Safeguards Cabinet

The Auxiliary Safeguards Cabinet contains relays that receive signals from the Solid State Protection System and upon actuation, close or open contacts that operate safeguards devices, mostly valves.

Information in regard to the electrical operability during seismic tests of the Auxiliary Safeguards Cabinet and associated relays has not been described in Section 10.3.2 of the FSAR amendment 50 or in Section 3.10 of the FSAR. The Auxiliary Safeguards Cabinet may be structurally identical to the safeguard test cabinet; however, they are not electrically identical. Provide information in regard to the electrical functions monitored during seismic shaking in order to demonstrate the seismic adequacy of the Auxiliary Safeguards Cabinet.

RESPONSE

1. Auxiliary Safeguards Cabinet

The Auxiliary Safeguards Cabinet contains rotary relays that are used to provide the same electrical function, i.e., safeguard actuation, as the relays contained in the output bay of the three-bay Solid State Protection System. WCAP-8694 describes the seismic qualification of the rotary relays, and concludes that no contact bounce occurred and that the relays operated properly before, during and after the simulated seismic event. WCAP-8941 describes the seismic qualification of these rotary relays in the Auxiliary Safeguards Cabinet, stating that the seismic levels tested in WCAP-8694 are 2 to 3 times greater than those required for this cabinet at the Diablo Canyon site.

QUESTION 2

Seismic Qualification: Instrument AC Inverter (Static Inverter)

The static inverters' function is to supply uninterrupted 118-volt, 60 Hz power to the vital AC instrument bus. The inverter operates from two power sources: a DC voltage source or a 480 volt AC source. In normal operation, the 480 volt AC source supplies power to the inverter. In the event of an AC power failure, the DC voltage source supplies power to the inverter.

It appears from the information in the FSAR that the power source's to the inverter were not changed from the AC source to the DC source during seismic shaking. Provide justification that the tests performed demonstrate the seismic adequacy of the static inverter.

RESPONSE

The inverter is designed such that during normal operation, the inverter power is derived from the AC source with the DC source assuming the load upon loss of AC voltage. The only difference in the system between the two(2) inputs is a diode, used primarily as a blocking diode. The battery supply (normal DC source) is not in the Westinghouse scope of supply and was not tested as part of the system. The diode (solid state) used is a JEDEC device and is used in many military and industrial applications. The military qualification requires that the device be subjected to G-levels much greater than required in this application and therefore the complete function of this one(1) diode was not tested. However, the blocking capability was observed during the seismic test and its integrity was maintained throughout the testing and was therefore acceptable.

During the seismic test, a small DC power supply was used in place of the normal DC power source to verify the blocking capability of the blocking diode. Had the diode shorted during the test, a protective device would have isolated the small DC power supply, thus indicating diode failure. No such indications were observed. Examination of the diode following the test indicated that no loss of integrity (open circuit) resulted. Therefore, functional operability of the diode during and after the test was demonstrated.

QUESTION 4

Seismic Qualification: Nuclear Instrumentation System

The Nuclear Instrumentation System monitors the neutron flux level and provides reactor trip signals if certain power limits are exceeded.

- a) Only the power range channel was energized and monitored during seismic testing. Therefore, it appears that the source range and intermediate range channels, required for reactor start-up and shutdown protection, have not been seismically qualified. Provide justification.

Section 7.5 of the FSAR indicates that the occurrences of a seismic event does not render the source and intermediate range channels inoperative. However, Section 3.10.2 of the FSAR (page 3.10-4) indicates that the source and intermediate range channels are not required to be seismically qualified since any design basis accident described in the FSAR can be terminated within acceptable limits by the power range channels. Provide justification for this apparent inconsistency.

- b) Section 3.10.2 of the FSAR (page 3.10-4) indicates that neutron detectors for the nuclear instrumentation system power range channel are seismically qualified. However, the seismic information for neutron detectors does not appear to be in WCAP-7821, WCAP-8021, or the seismic evaluation for postulated 7.5M Hosgri earthquake. (Amendment 50 to the FSAR). Provide the seismic qualification test information for neutron detectors associated with the power range channel as well as those detectors associated with the source and intermediate range channels.
- c) Westinghouse committed to retesting an entire typical channel of the nuclear instrumentation system (including signal conditioning circuits and bistables) to verify that the bistables have the capability to change state during a seismic event. Section 10.3.16.2 of the FSAR amendment 50 implies that only bistables have undergone additional testing versus an entire typical channel. Justify the retesting of only the bistables.
- d) Two tests were performed to demonstrate the functional operability of bistables as documented in WCAP-8831, Seismic operability demonstration testing of the Nuclear Instrumentation System Bistable Amplifiers. Test 1 (referenced as test 2 in WCAP-8831 Section 5-15) indicates all bistables tripped as

required except for the negative rate bistable. The negative bistable was not tested during the seismic shaking. Test 2 (referenced as test 5 in WCAP-8831 section 5-18) indicates 5 of 6 bistables operated as required during the test; however, it appears that the bistables were not tripped and therefore not tested during the seismic shaking as required. The overpower-high range bistable experienced an unexplained trip. And the negative rate bistables was (again as in test 1) not tested. Provide justification that these two tests demonstrate the seismic adequacy of the Nuclear Instrumentation System.

RESPONSE

- (a) as stated in FSAR 3.10.2, all design basis accidents discussed in the FSAR can be terminated within acceptable limits by the power range channels. The source and intermediate channels therefore do not require seismic qualification and have not been qualified.

Shutdown procedures will contain the following provisions in the event that the source range channels are rendered inoperative due to a seismic event:

- (1) the operator will take appropriate action to preclude boron dilution
- (2) prior to cooldown, boric acid will be added to the reactor coolant to ensure that the concentration is sufficient to maintain the reactor in a subcritical state.

- (b) The power range neutron detectors at Diablo Canyon are of the integral mineral insulated cable design, Model Number

] b,c

Shock and vibration tests have been performed, in the past, on this type of design by the Westinghouse Electronic Tube Division.

The integral cable design was subjected to a vibration test with constant sinusoidal acceleration of 1g in the horizontal and vertical planes. A constant sweep of 2.5 minutes duration was performed from 6 to 20 Hz in the horizontal plane. Following this, another constant sweep of 2.5 minutes duration was performed from 10 to 40 Hz in the vertical direction. In addition, the design was subjected to a sinusoidal acceleration of 1g amplitude for 20 seconds, in the horizontal plane, at frequencies of 6.5 and 7.4 Hz. The performance of the detector was evaluated by checking the resistance, capacitance, and neutron sensitivity before and after the test.

Also, a shock test was performed for this design. The shock input provided a 0.15 second duration pulse which produced an acceleration with a 0.8g radial component and a 0.14g longitudinal component. The performance of the detector was evaluated as before and no detectable damage was observed.

The upper support for the neutron detectors at Diablo Canyon is approximately at elevation 96 feet of the containment interior structure. The zero period acceleration at elevation 102ft. is approximately 0.7g's. This value is less than the test accelerations achieved during the shock and vibration tests discussed previously.

Additional multifrequency and multiaxis test have been performed on a single NIS power range detector (Model) mounted in a support assembly which simulated a lower bound or worst case detector holder. The multifrequency inputs were developed in accordance with the guidelines set forth in WCAP-8624 IEEE-344-1975. The attached figure presents a comparison between the multifrequency and multi-axis test spectrum and the required Hosgri spectrum at elevation 102.0 feet of the containment interior. As can be seen in the figure, the test spectrum envelopes the required spectrum.] b,c

During the test, the detector was energized from a high voltage power supply, and an a-c signal was imposed on the high voltage electrode. This a-c signal as well as d-c leakage currents were monitored on each of the two signal electrodes to determine proper electrical operability.

At the completion of the seismic test, there was no observable mechanical damage and the electrical recordings revealed only a transient type electrical disturbance on one of the two signal electrodes. This electrical disturbance was most likely generated by electrode displacement produced by the detector assembly impacting with the holder assembly. The signal perturbations were small in amplitude (less than 10^{-8} amperes) and would not cause any loss of protection capability of the NI System during normal operation in the presence of a normal detector signal (greater than 10^{-4}

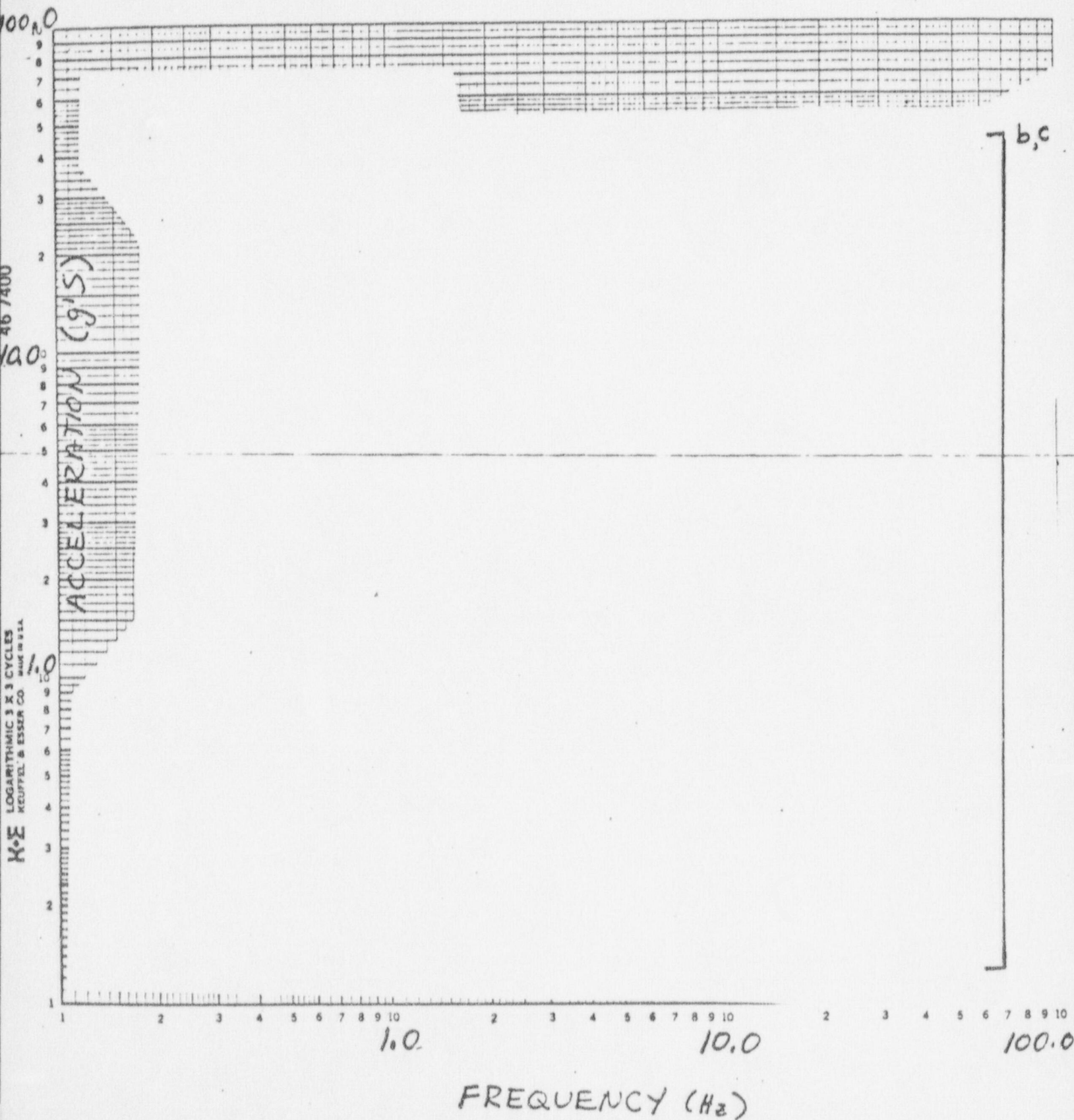
amperes) in an operating plant. Subsequent detector acceptance tests performed by the detector manufacturer did not disclose any abnormal permanent change in the electrical or neutron sensitivity characteristics. Thus it is concluded that the NIS Power Range Detector will operate as required during and after a seismic event.

It is therefore concluded that this equipment is qualified for the Hosgri 7.5M event.

- (c) The purpose of the demonstration test program was to show electrical & operability. The electrical operability was verified during Tests 2
- (d) and 5 as described in WCAP-8830 for the high seismic OBE and SSE conditions respectively. As a result of the test configuration (single rack in lieu of four) and the frame and rack damage incurred by the seismic test fixture malfunction; mechanical failures prevented the complete test run. As indicated in Section 7 of WCAP-8830, the drawer securing method is being revised for high seismic plants and the details were indicated in Westinghouse letter NS-CE-1609 dated 11/22/77.

Test 2 performed a functional operability test of the bistables by introducing manually adjustable signal into the complete instrumentation channel as indicated in Figure 2-3 of WCAP-8830. The signal profile is shown in Figure 5-8. The negative rate bistables was not exercised during this test; however, the signal conditioning equipment (same as that for positive rate bistable input) and six other bistables units with the same electrical and mechanical design performed as required.

Test 5 was performed under extremely adverse conditions with the failed drawer latches. Recordings (Figures 5-12 through 5-16) indicate that five of the six bistable units performed their required function during the simulated seismic event. The only bistable function not tested was the negative rate trip function. Post seismic test electrical evaluation indicated that all electrical functions performed as required. Further testing was not possible because of the structural damage.



K-E LOGARITHMIC 3 X 3 CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.

QUESTION 5

Seismic Qualification: Pressure and Differential Pressure Transmitters

Pressure and Differential Pressure Transmitters sense the pressurizer level and pressure, and the steam generator feedwater/system level, pressure, and flow. The output from these transmitters are sent to the process control system equipment which generates the various reactor trips and safeguards actuation signals.

- a) PG&E's response dated October 3, 1977 to an NRC Question Number 3.104 states that certain instruments are to be replaced, Steam Generator Narrow Range Level and Pressurizer Level. Confirm that these instruments are in fact the Pressures and Differential Pressure Transmitters being replaced. Provide the seismic qualification information for the replacement instruments, Steam Generator Narrow Range Level, Pressure Level, Reactor Coolant System Pressure, and Containment Sump Level.
- b) The electric test results for the transmitters, described in Section 10.3.17.2 of the FSAR Amendment, 50, demonstrated that the output oscillated around the normal signal level. These oscillations could cause trips depending on the monitored variables and the trip point. The tests do not demonstrate that the equipment is capable of meeting its performance specifications under service conditions (during seismic shaking). Provide justification that the tests performed demonstrate the seismic adequacy of the transmitters.
- c) The Fischer and Porter transmitter, No. 13D2495 measures Steam Generator Level, was not tested, but was qualified by comparison to the Steam Generator Flow transmitter No. 10B2496, that was tested. Justify the assumption, made on page 4-7 of WCAP-8021, Seismic Testing and Electrical and Control Equipment (PG&E plants), that the output of 13D2495 would offset in a similar fashion under seismic excitation as 10B2496.
- d) The transmitter were only tested at some normal valve as indicated in Section 10.3.17.2 of the FSAR Amendment 50. Define normal value and justify not testing over the full range of pressures, levels, or flows that these transmitters would be expected to operate.

RESPONSE

(a) The following transmitters are being replaced at Diablo Canyon:

Steam Generator Narrow Range Level
Pressurizer Level
Reactor Coolant System Pressure
Containment Sump Level

Replacement

b,c

The seismic tests of the pressure and differential pressure transmitters was performed using multifrequency triaxial inputs which conform to the requirements of standard IEEE-344-1975.

b,c

The multifrequency inputs were developed in accordance with the guidelines for frequency content and phasing set forth in WCAP-8624; "General method of developing multifrequency biaxial test inputs for bistables."

The transmitters were mounted to a test fixture in a manner which simulated actual field mounting. A schematic of the triaxial test setup is shown in attached Figure 1.

b,c

b, c

QUESTION 3

Seismic Qualification: Main Control Board

Provide information in regard to the seismic qualification of individual Class 1E instruments and/or controls mounted on the Main Control board.

RESPONSE

The qualifications of individual instruments and controls mounted on the Main Control board are contained in Paragraph 10.3.15.2 of the Hosgri Report.

] b,c

A summary of the seismic electrical errors are presented in Table 1.

RESPONSE

- 5(b) Signal level oscillations associated with seismic events were considered in the selection of system setpoints in order that the oscillations would not cause an invalid trip. An amendment in Section 10.3.17.2 of the Hosgri Report is being prepared to clarify that issue.

RESPONSE

- 5(c) The Fisher and Porter transmitters No. 13D2495 (Narrow Range Steam Generator Level) are being replaced. The Fisher and Porter transmitters No. 13D2495 (Wide Range Steam Generator Level) are not safety related and do not require qualification.

RESPONSE

- 5(d) The meaning of normal value, as used in Section 10.3.17.2, refers to a transmitter output between the zero and full scale operating range.

A transmitter tested for a seismic event at any given level would be representative of all other levels on the scale as long as the value selected was not so close to either end of the scale that the transmitter would be constrained, preventing the mechanical system from floating freely during the seismic event. It should be noted that the effects of the seismic forces on the transmitter do not vary according to where the scale is reading during a seismic event.

Any pressure transmitter converts pressure to forces. It then measures these forces to determine the pressure. The methods of measurement vary with design but force is always the quantity measured.

A seismic acceleration also imparts a force. This force is a function of the mass of the device and its acceleration. It will be added (or subtracted) from the other forces on the device and will thus provide a pressure deviation in the readout. This force is not a function of the other forces on the device and is therefore not a function of the scale reading before it was applied. Therefore, the deviation that it provides is not a function of the scale reading.

RESPONSE

5(d) Continued

At low pressures, the pressure forces can be small compared to the seismic forces and the relative deviation due to seismic forces will be larger than at high pressures. If, for example, the seismic forces caused a deviation equivalent to 5% of the total range of the device, the relative deviation when the reading was 5% of range would be 100% of reading. If the reading was 90% of range, the relative deviation would be only 6% of reading. For this reason, all seismic errors are considered as a percentage of span, not reading.

Thus, determination of the seismic error is independent of the instrument reading.

TABLE 1

POSITION ON SEISMIC TEST STAND
 #1 #2 SSE #3 #4

085

b,c

PRELIMINARY

NOTE: VALUES GIVEN ARE MOST ERRORS FOUND IN 3 RUNS AT EACH POSITION. PERCENT ERRORS ARE PERCENT OF SPAN.

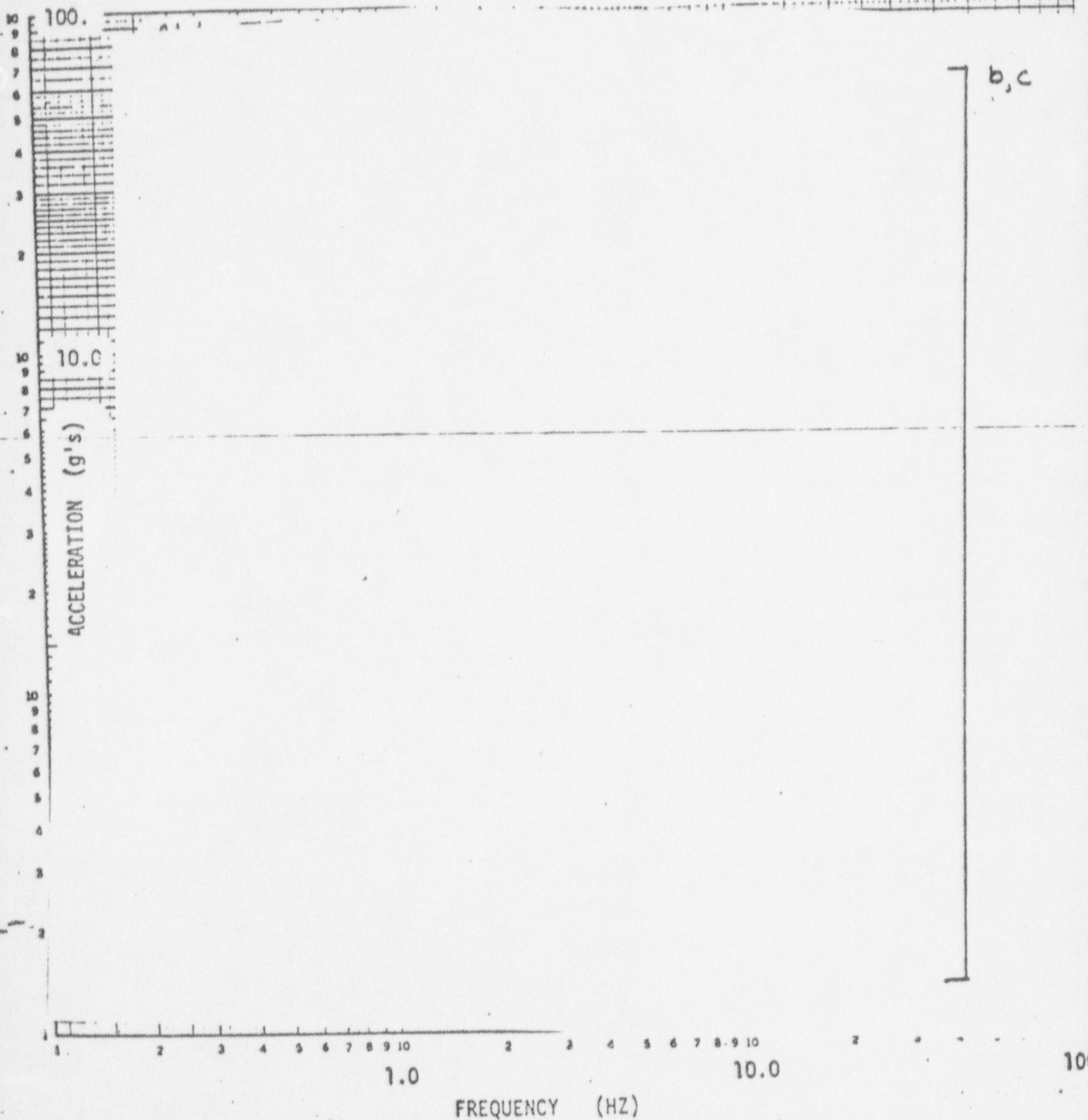
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Figure 2.3 Schematic of Biaxial Test Setup

Ho

14

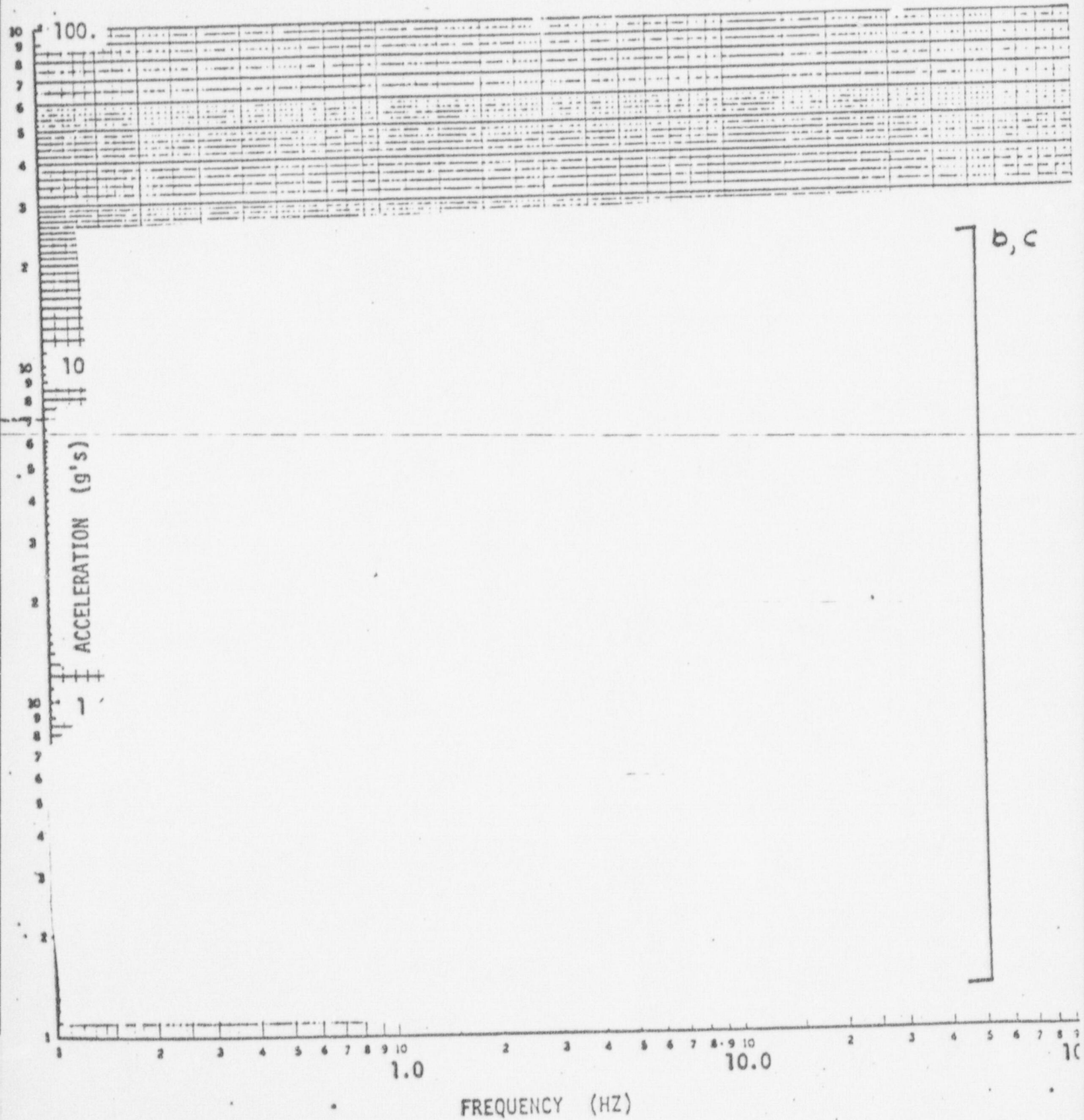


Control Accelerometer

Position _____ Run _____

FIGURE 2

INPUT B (OBE)



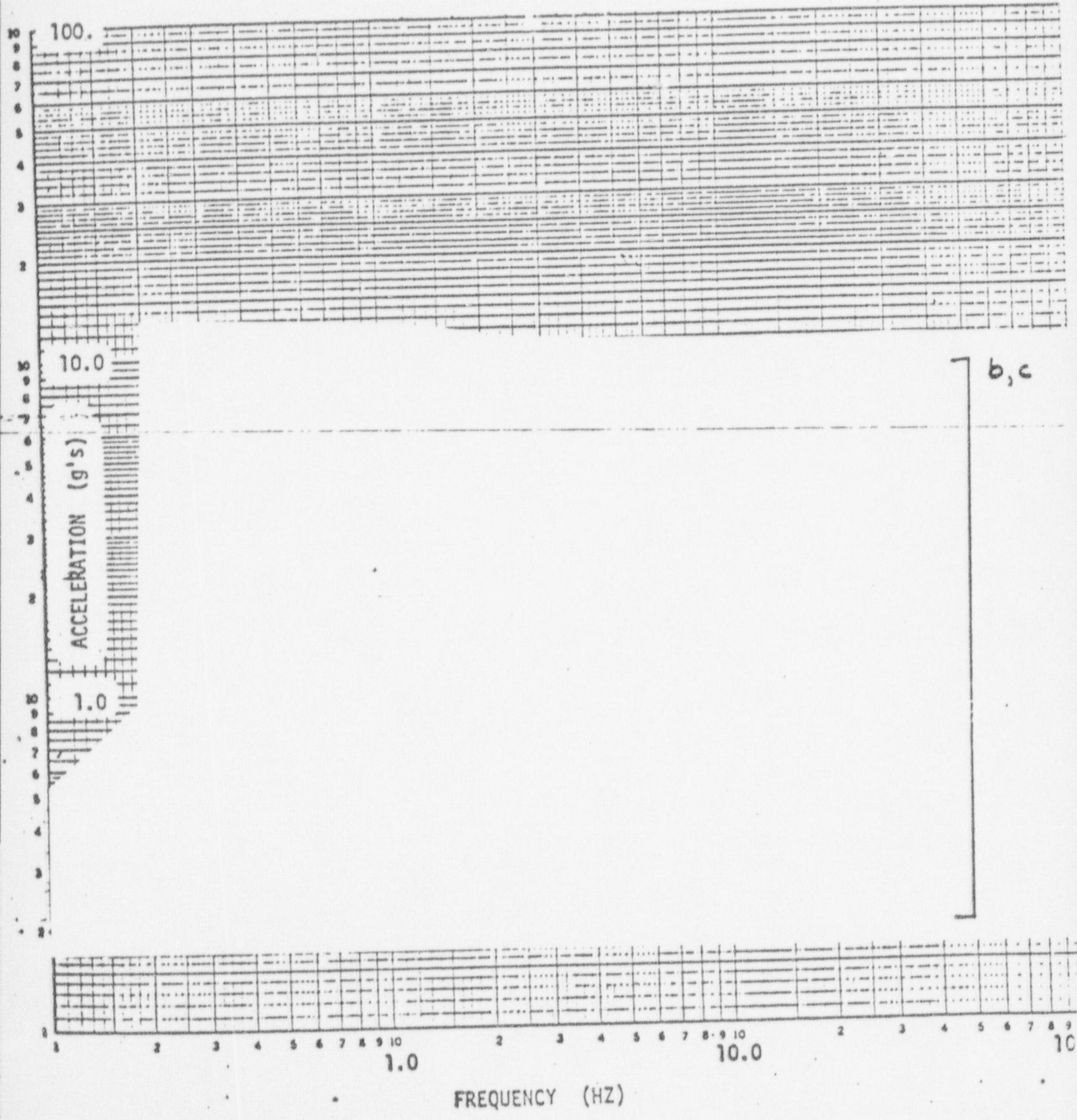
Control Accelerometer
SPAN #2 - 5.0
6-3-78

FREQUENCY (HZ)

Position 1 Run 1
0° DAMPING 5%

Fig. 3

INPUT B (OBE)



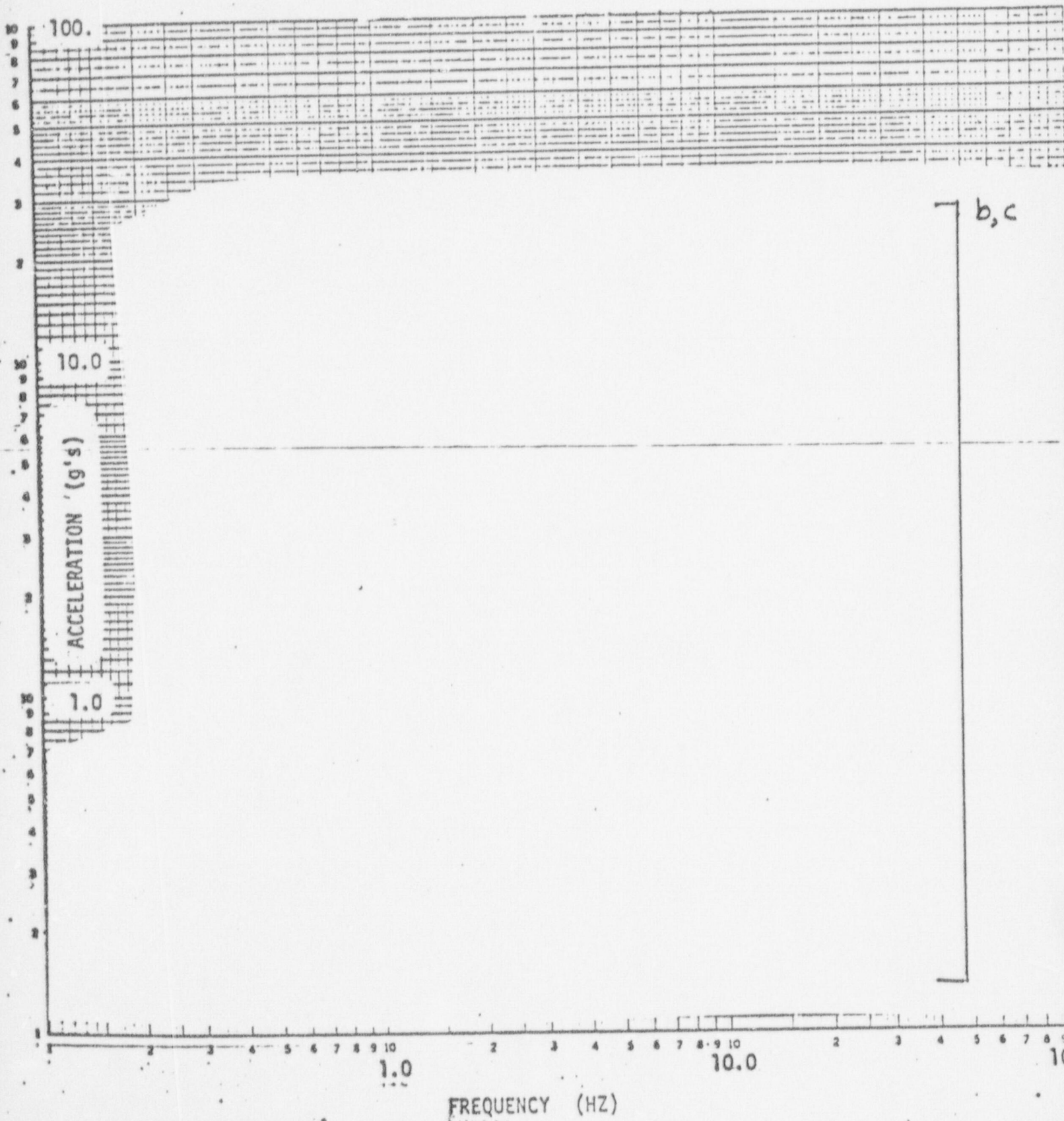
Control Accelerometer
SPAN #2 - 5.0
6-3-78

FREQUENCY (HZ)

Fig. 4

Position 1/ Run 4
0° DAMPING 5%

INPUT B (OBE)



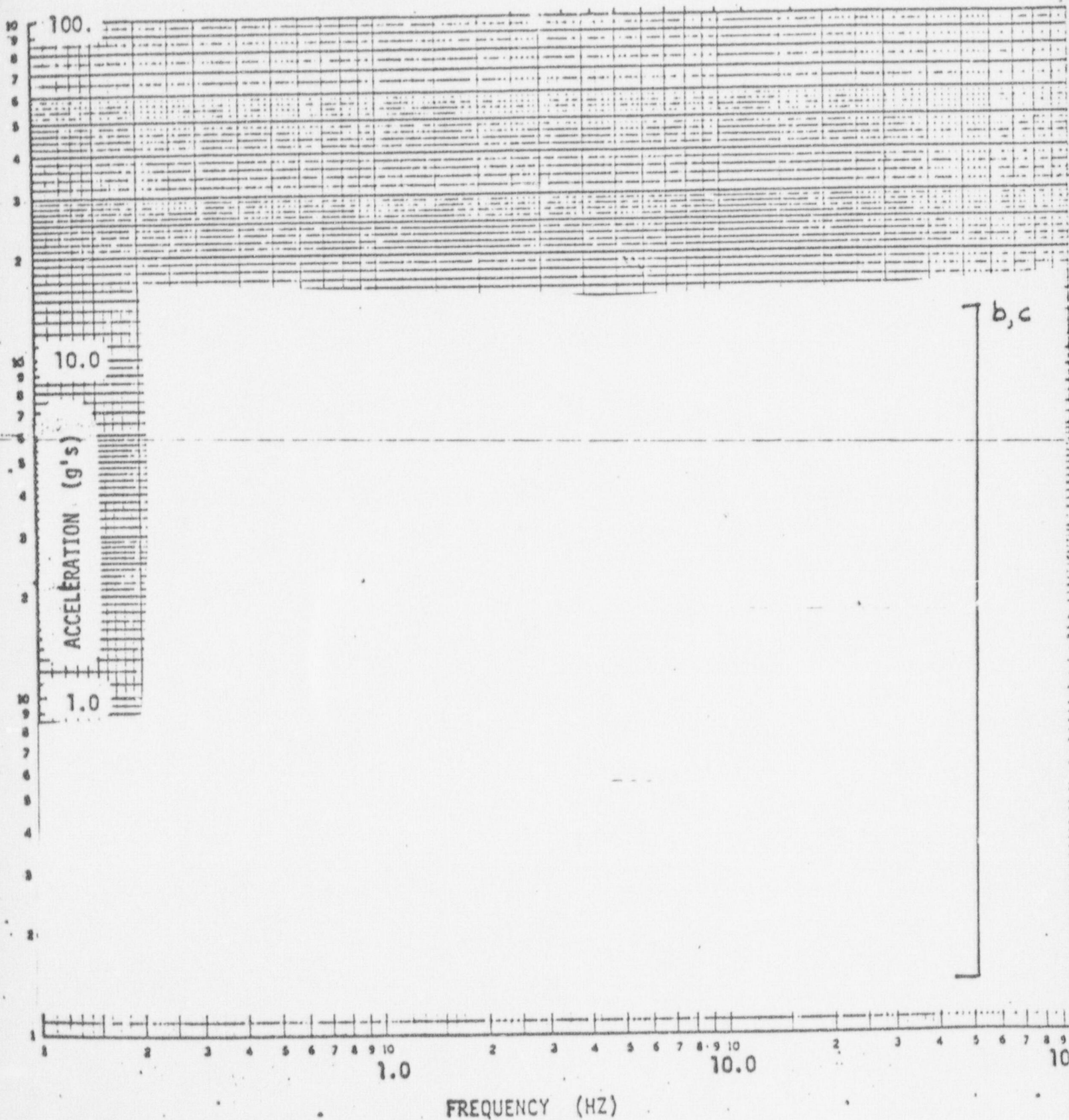
Control Accelerometer
SPAN #2 - 5.0
6-3-78

FREQUENCY (HZ)

Position 1 Run 5
0° DAMPING -5%

Fig. 5

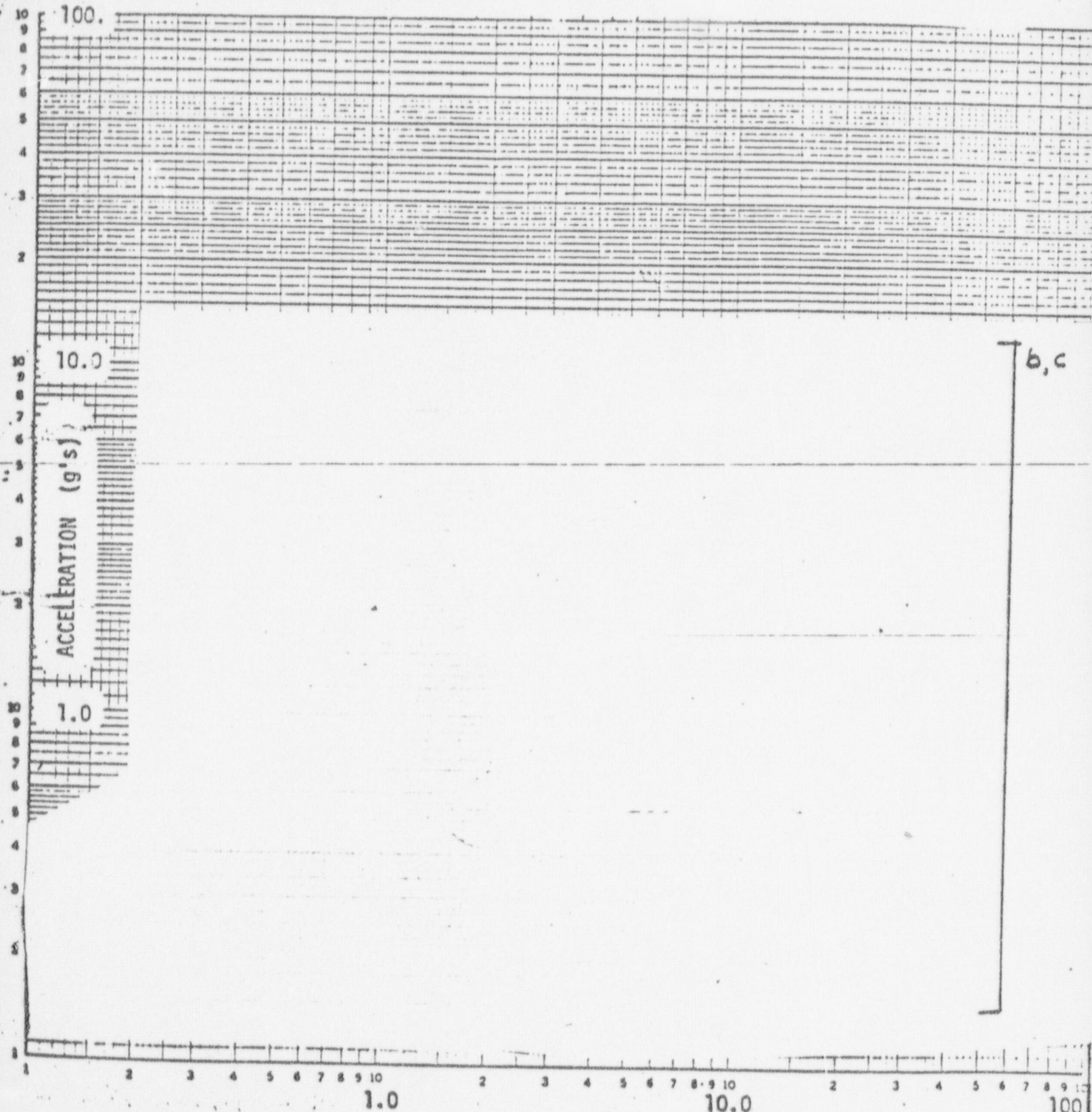
INPUT B (OBE)



Control Accelerometer
SPAN #2 5.0 -
6-5-78

Position 1 Run 6
0° DAMPING 5%

Fig. 6

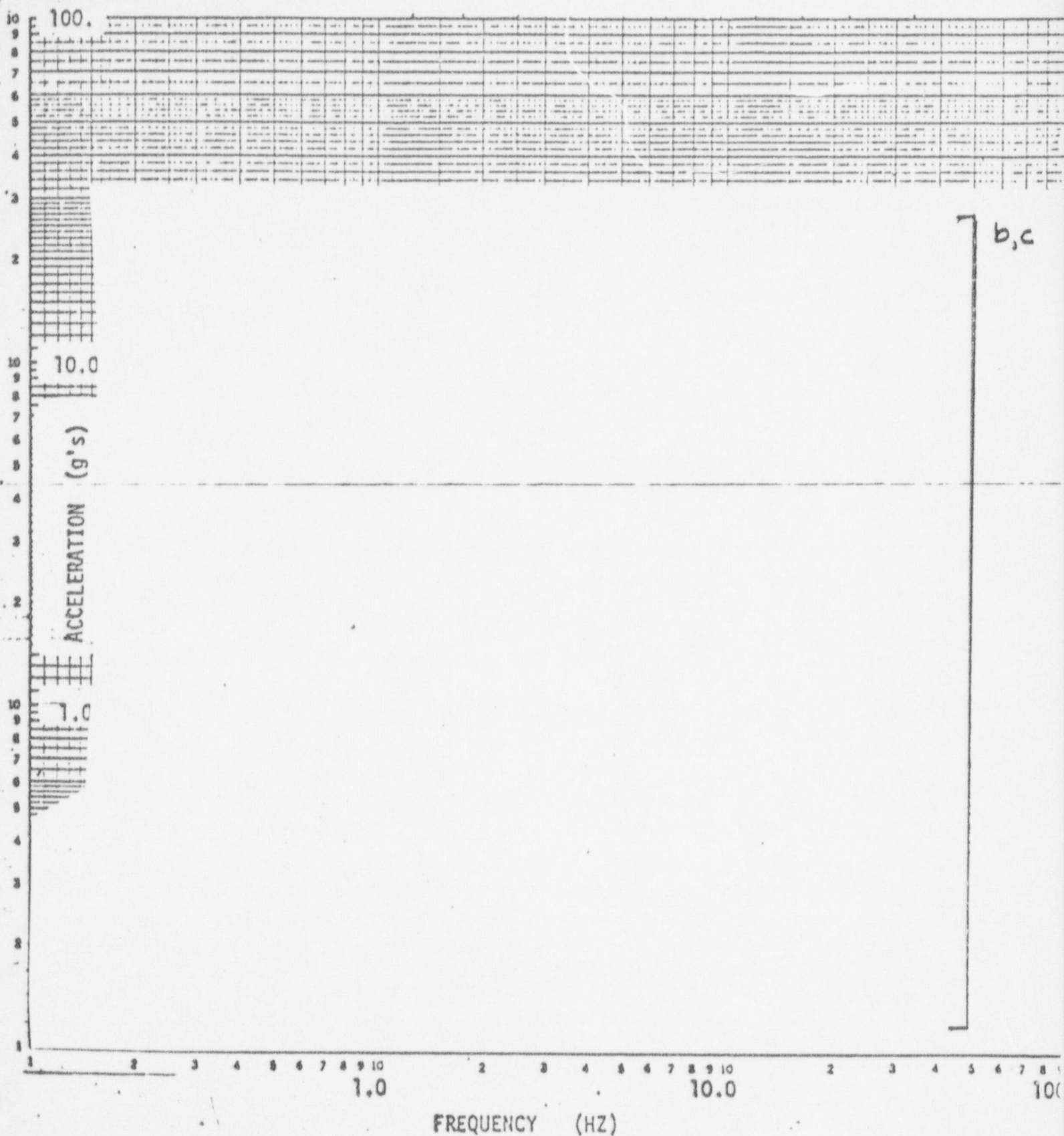


Control Accelerometer
6-5-78
SPAN #2 - 5.0

FREQUENCY (HZ)

Position 1 Run 7
0° DAMPING 5%

Fig 7



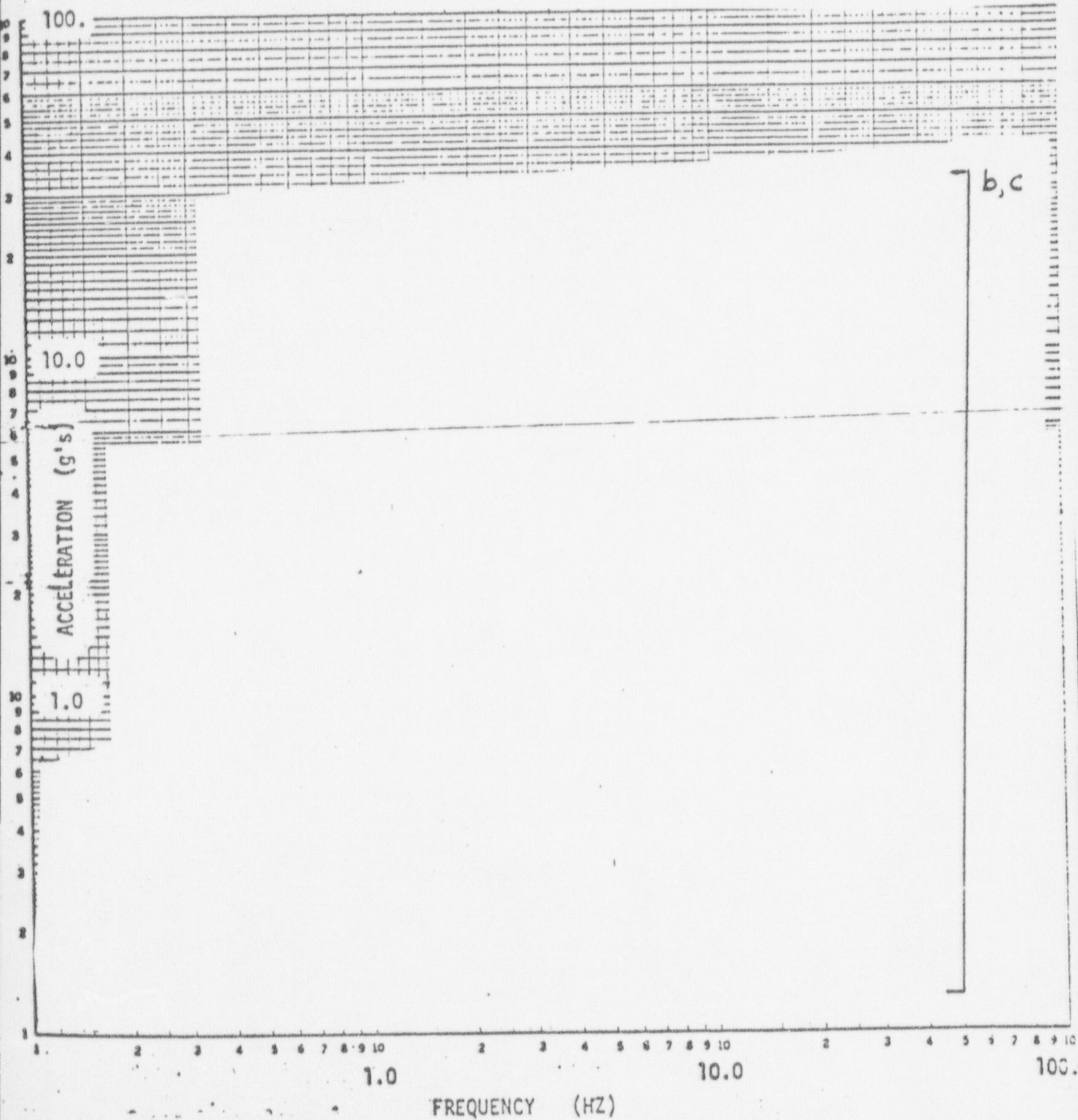
Control Accelerometer
6-5-78
SPAN #2 - 9.5

FREQUENCY (HZ)

Position Y Run 10
0° DAMPING 5%

FIG. 8

INPUT B (SSE)



Control Accelerometer

6-5-78

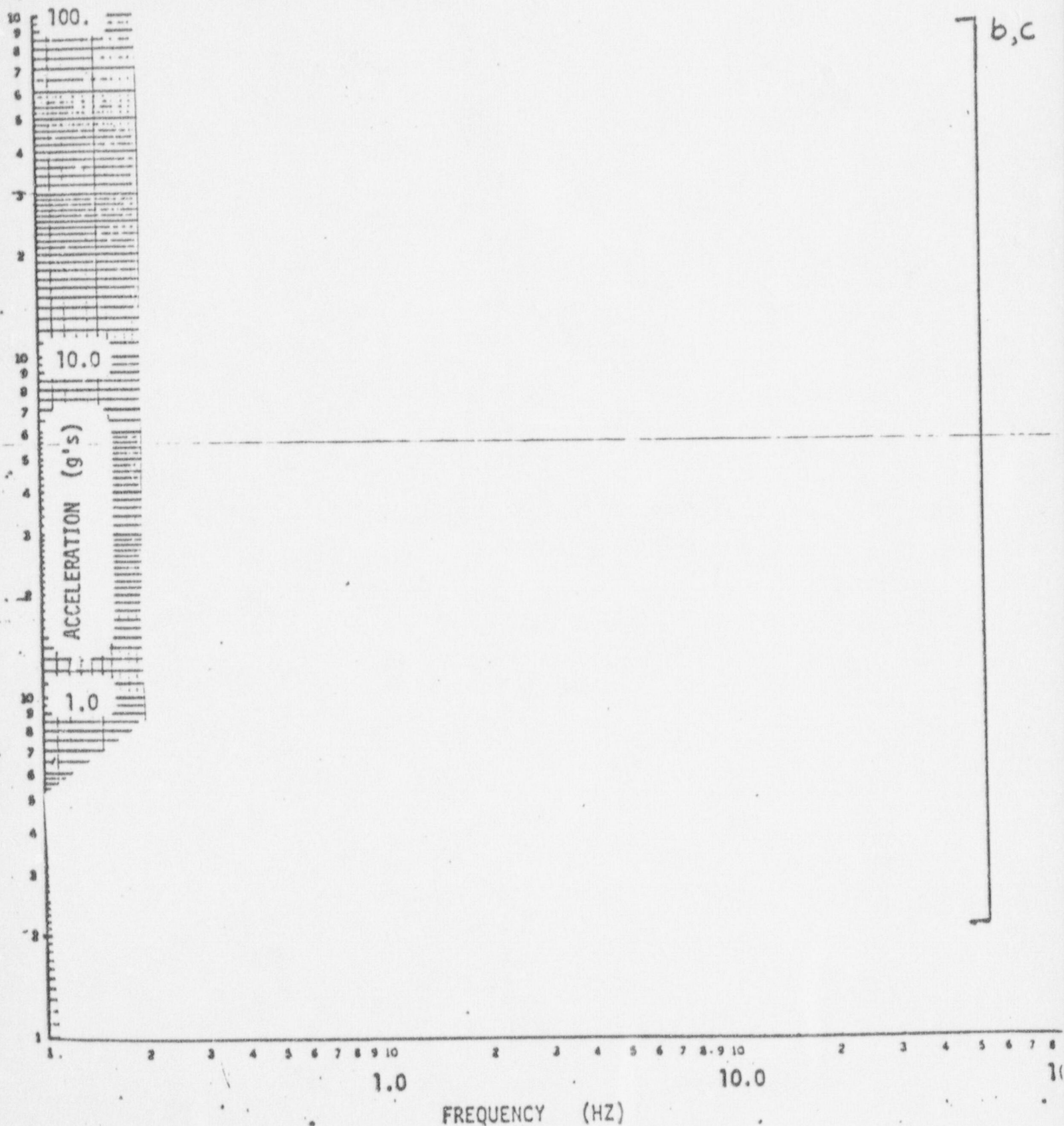
SPAN 0.0

FREQUENCY (HZ)

Position 1 Run 8

0° DAMPING 5%

Fig. 89



Control Accelerometer

6-5-78
SPAN #2 - 9.0

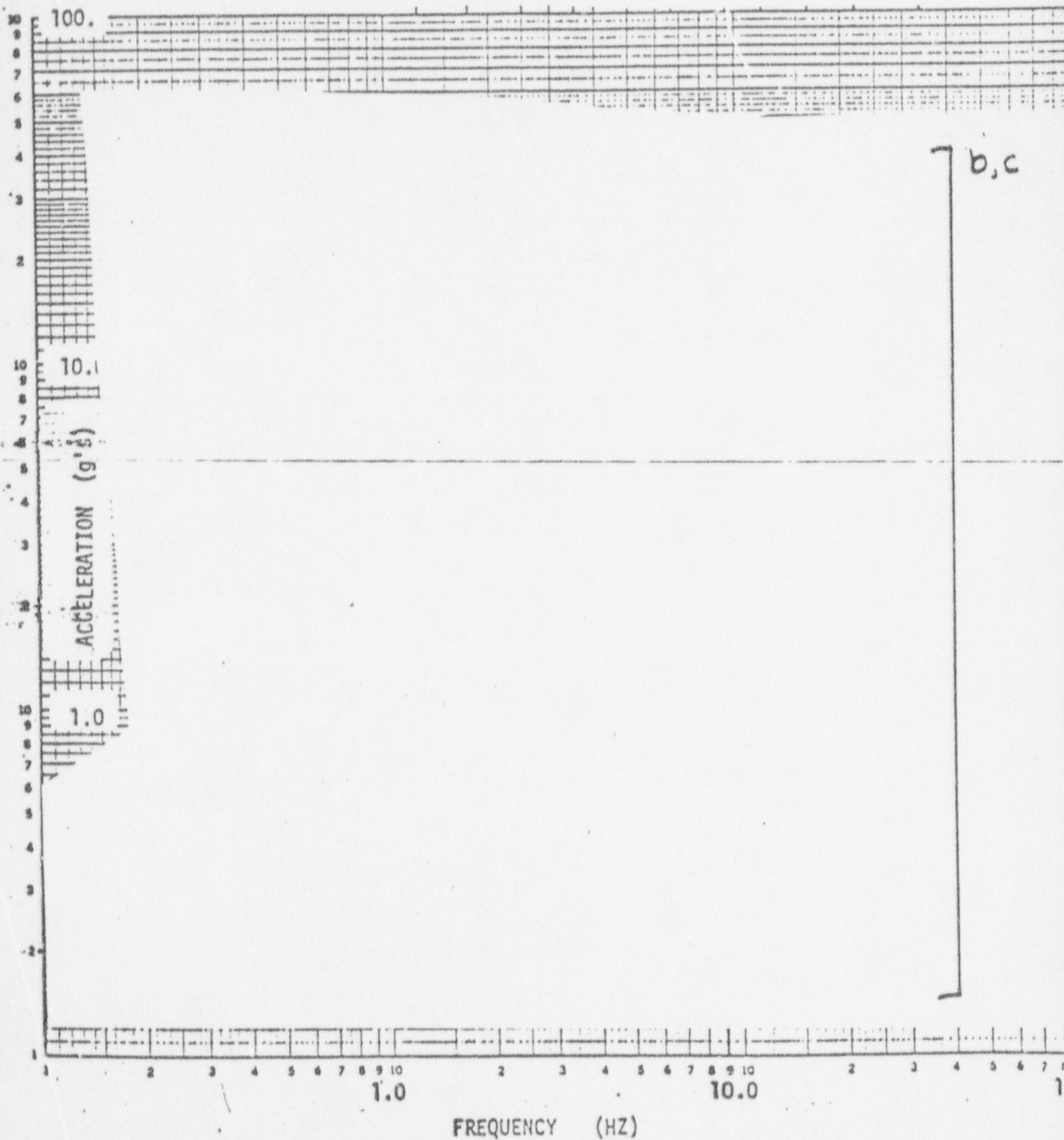
FREQUENCY (HZ)

Fig. 910

Position 1 Run 9

0° DAMPING 5%

INPUT A (SSE)



Control Accelerometer

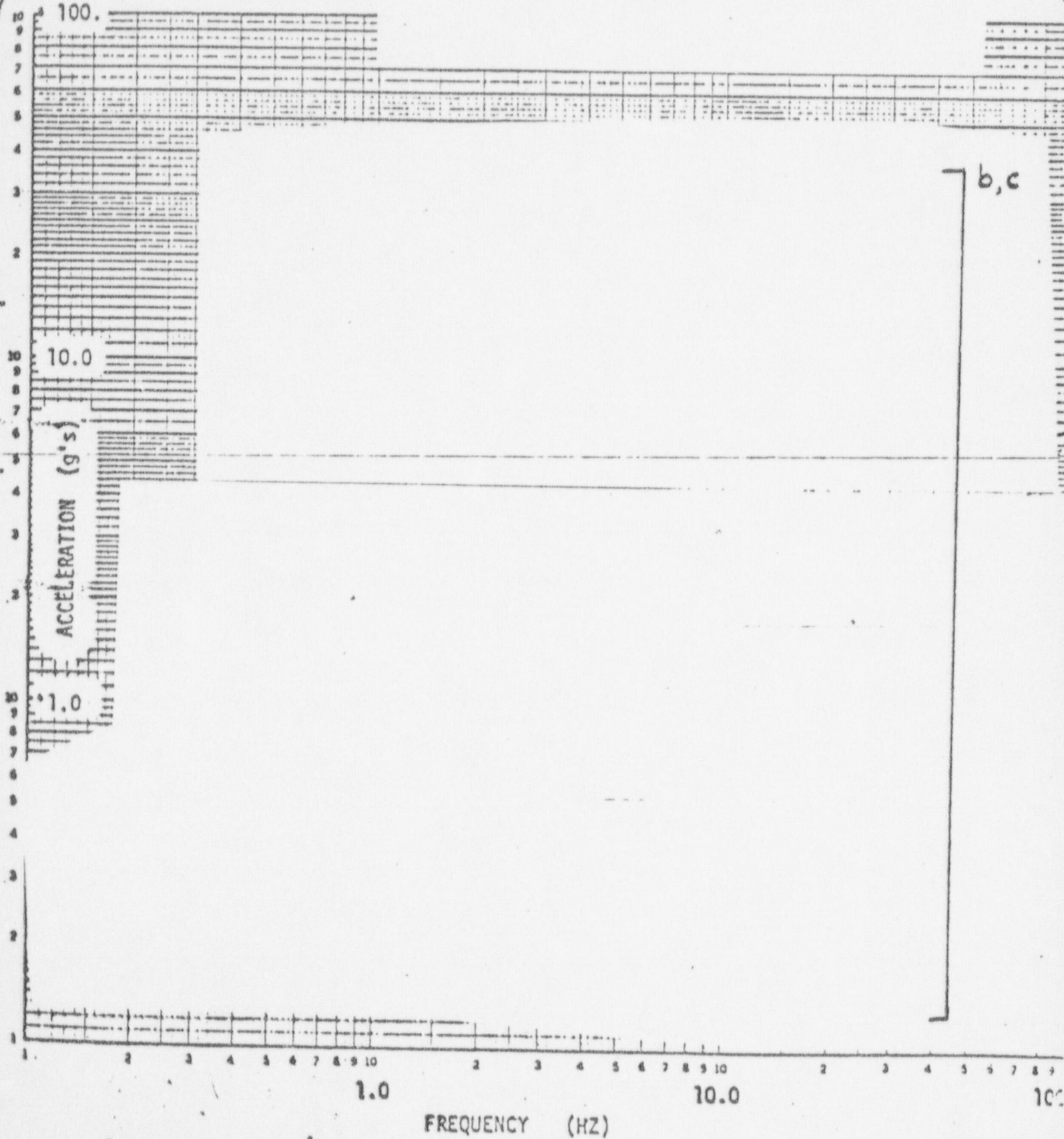
6-5-78
SPAN - 9.5

Position 2 Run 11

270° DAMPING 5%

FIG. 1A

INPUT B (SSE)



Control Accelerometer

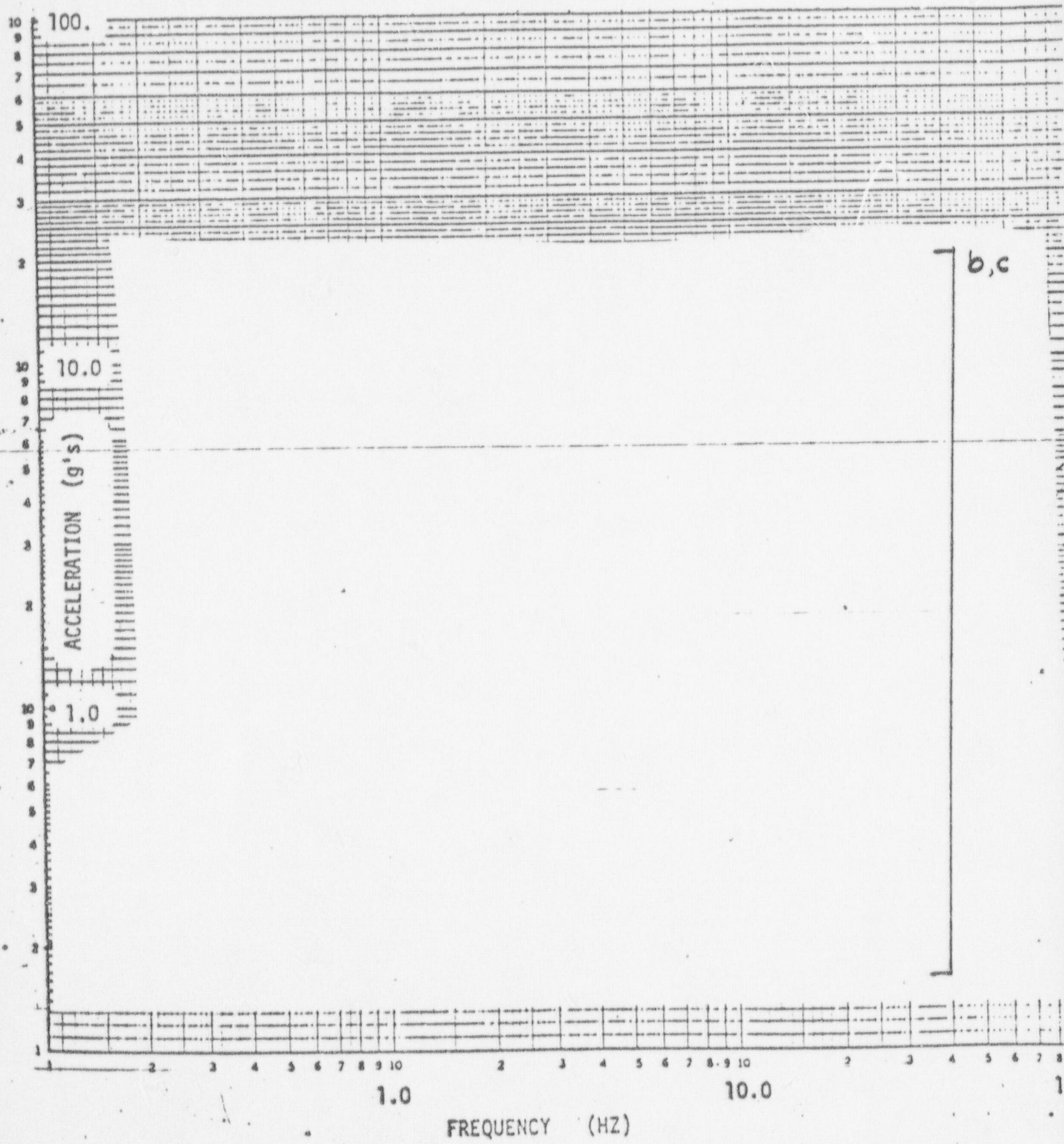
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SPAN - 9.9

FREQUENCY (HZ)

FIG. 12

Position 2 Run 12
270° DAMPING 5%

INPUT C (SSE)

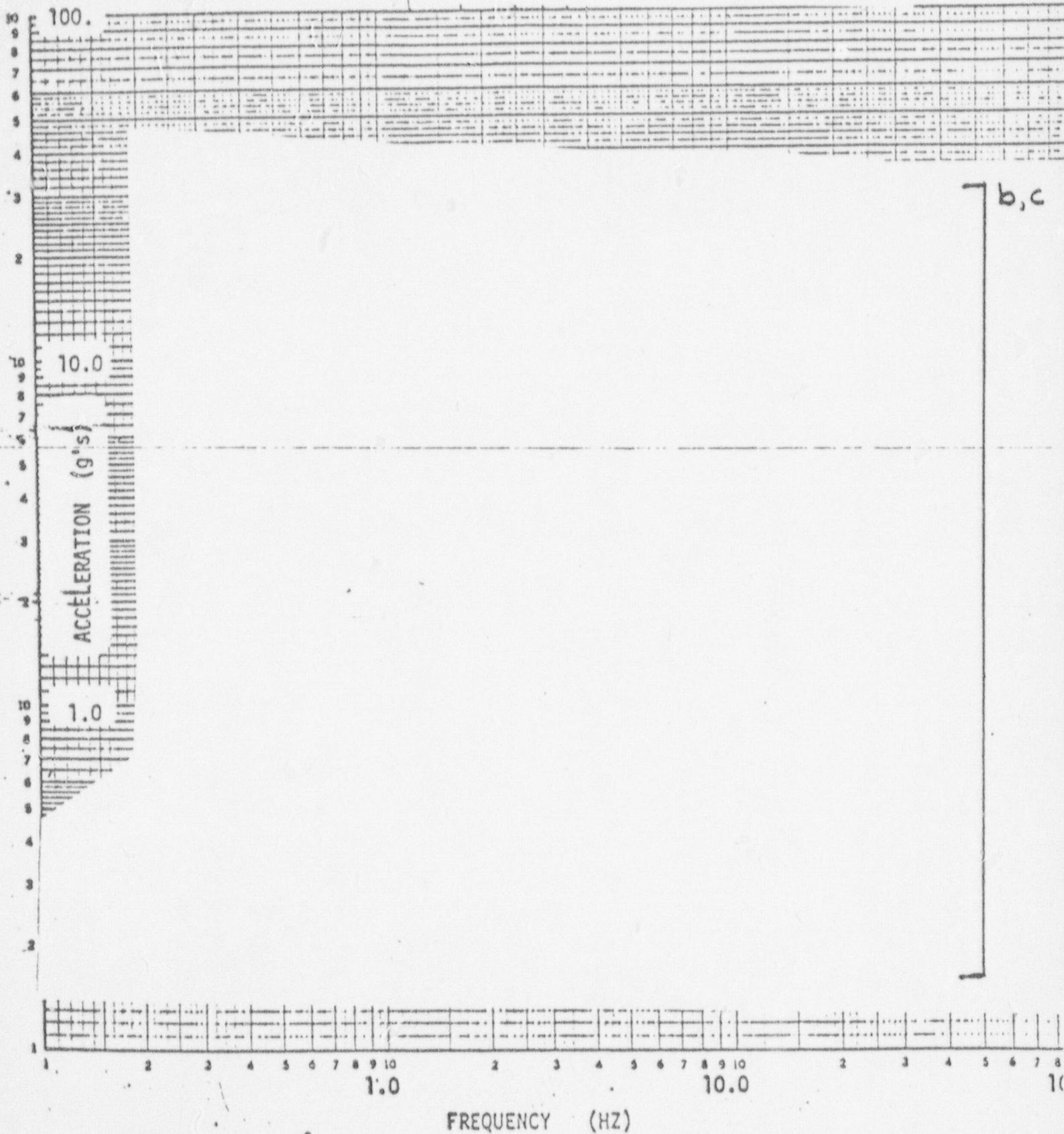


Control Accelerometer
6-5-78
SPAN #2 - 9.0

Fig. 13

Position 2 Run 13
270°
DAMPING 5%

INPUT A (SSE)

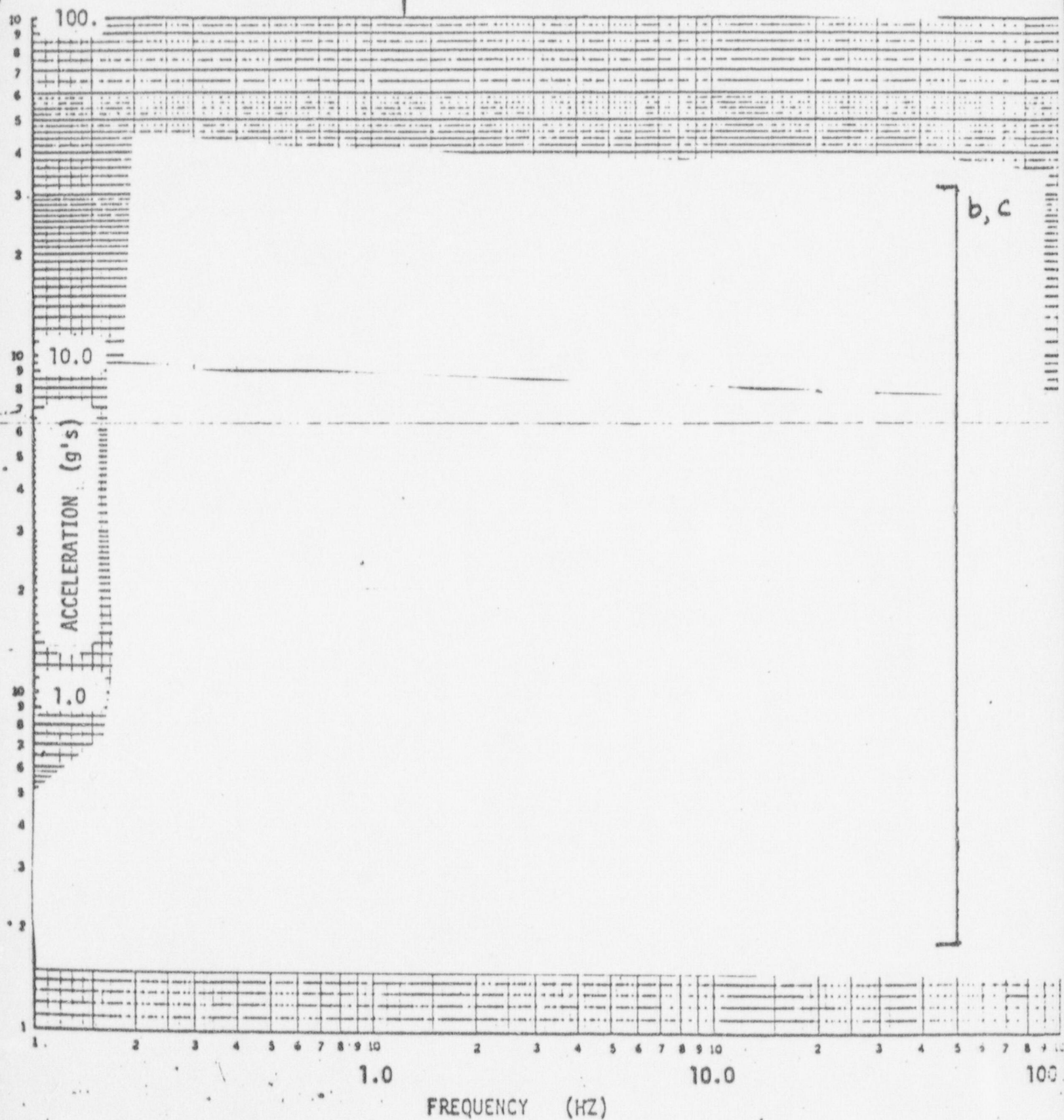


Control Accelerometer
6-5-78
SPAN #2 - 9.5

FIG. 14

Position 3 Run 17
180°
DAMPING 5%

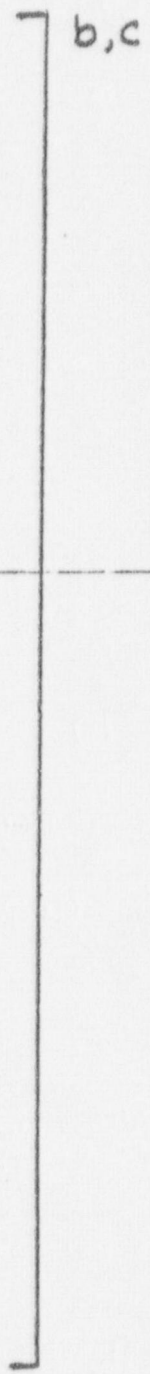
INPUT B (SSE)



Control Accelerometer

6-5-78
SPAN #2 - 9.9Position 3 Run 18180°
DAMPING 5%

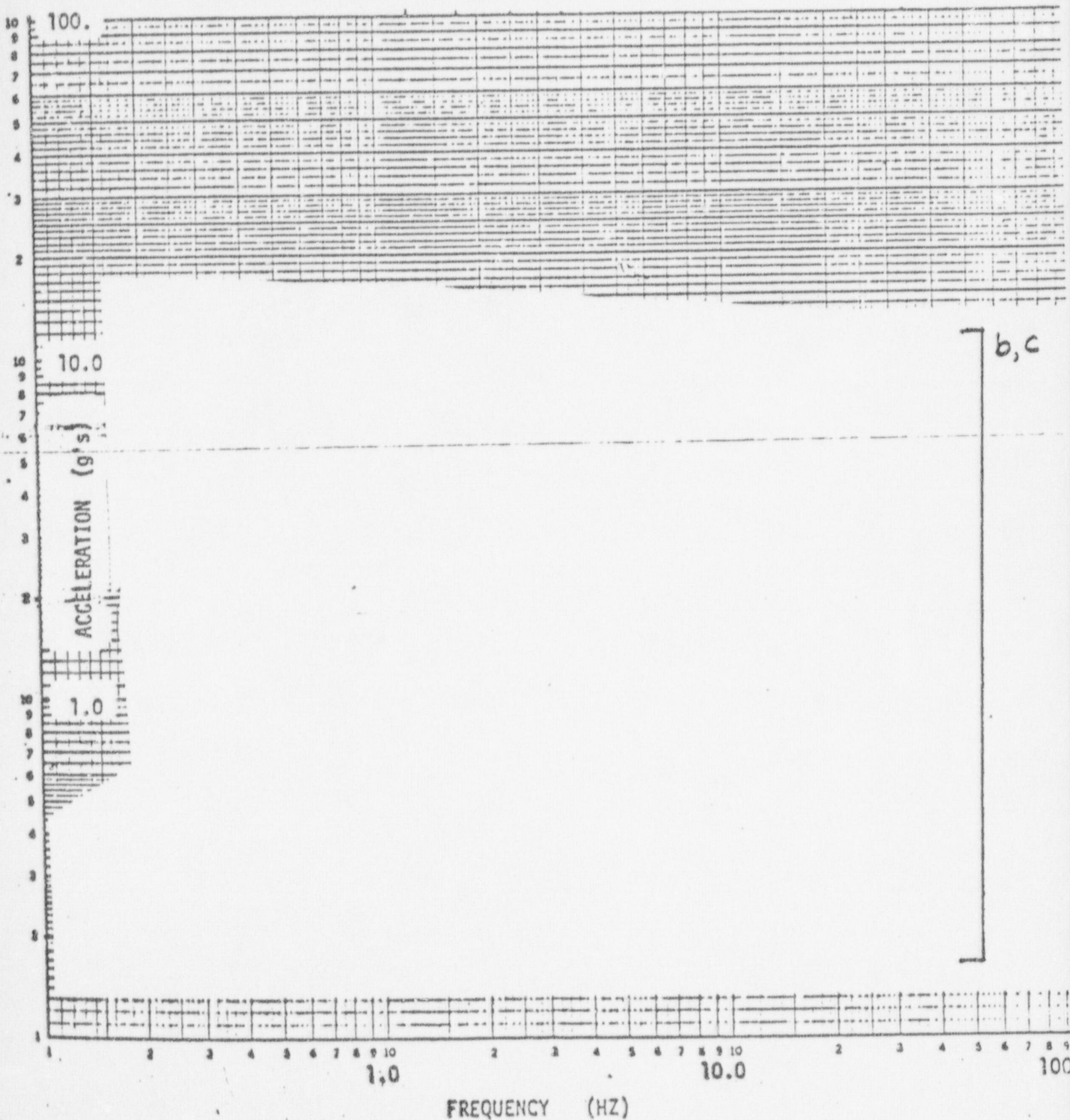
ACCT 1001 300

Position 3 Run 20

180° ---
DAMPING 5%

Fig. 15

INPUT A (SSE)



Control Accelerometer

6-5-78
SPAN #2 - 9.5

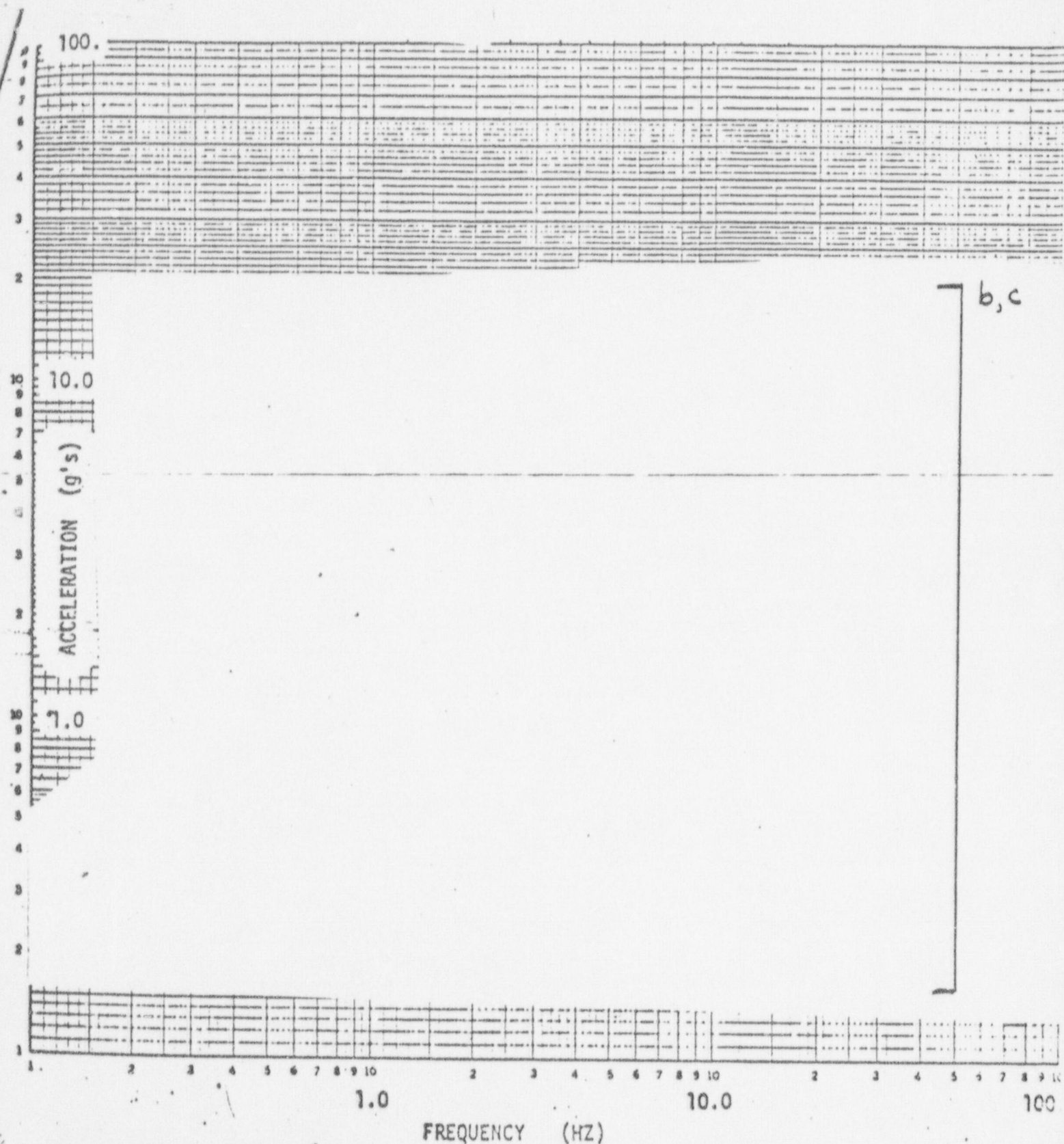
FREQUENCY (HZ)

FIG. 10

Position 4 Run 16

90°
DAMPING 5%

INPUT B (SSE)



Control Accelerometer

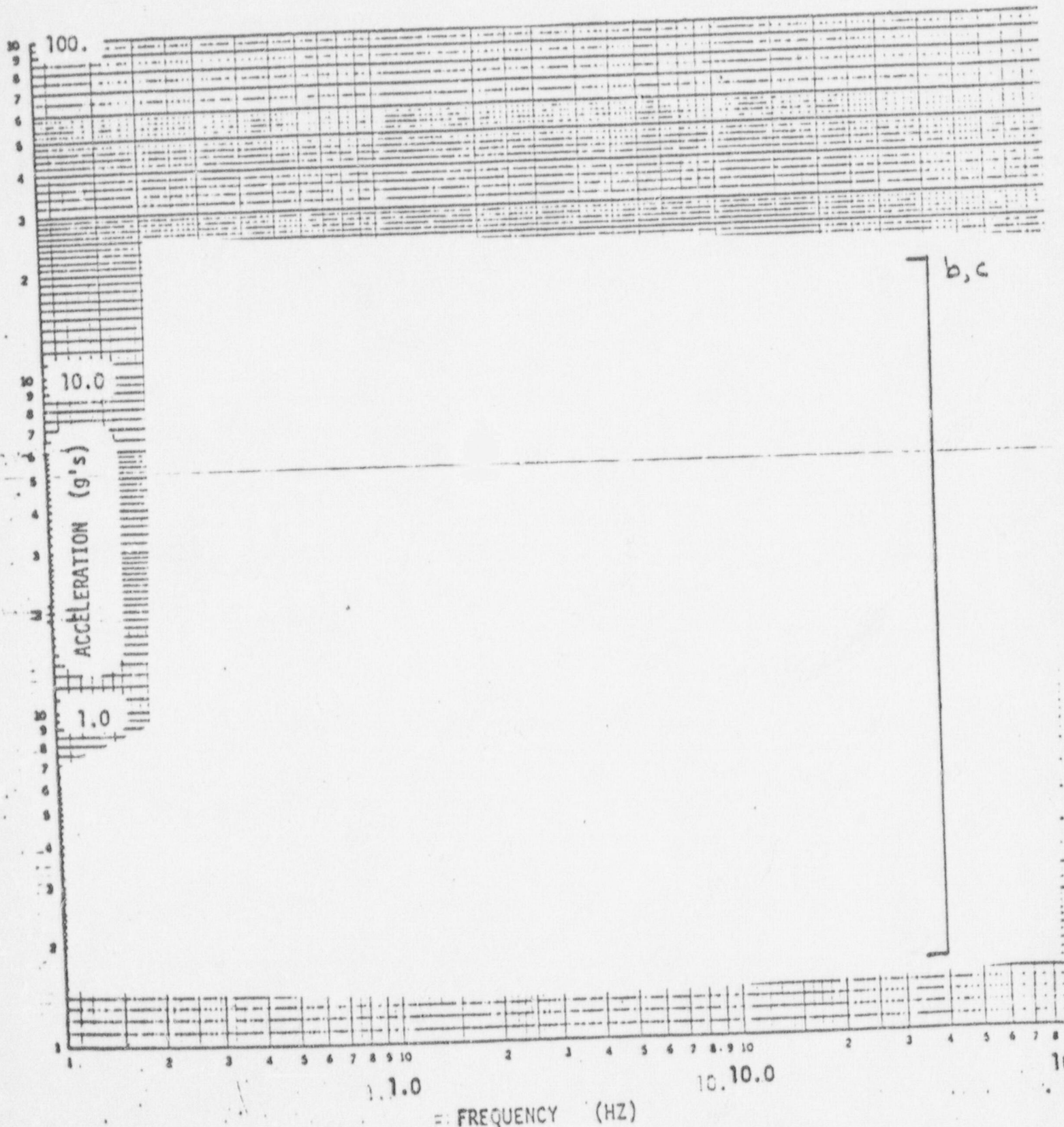
6-5-78
SPAN #2 - 9.9

FREQUENCY (HZ)

FIG. 18

Position 4 Run 15
90°
DAMPING 5%

INPUT C (SSE)

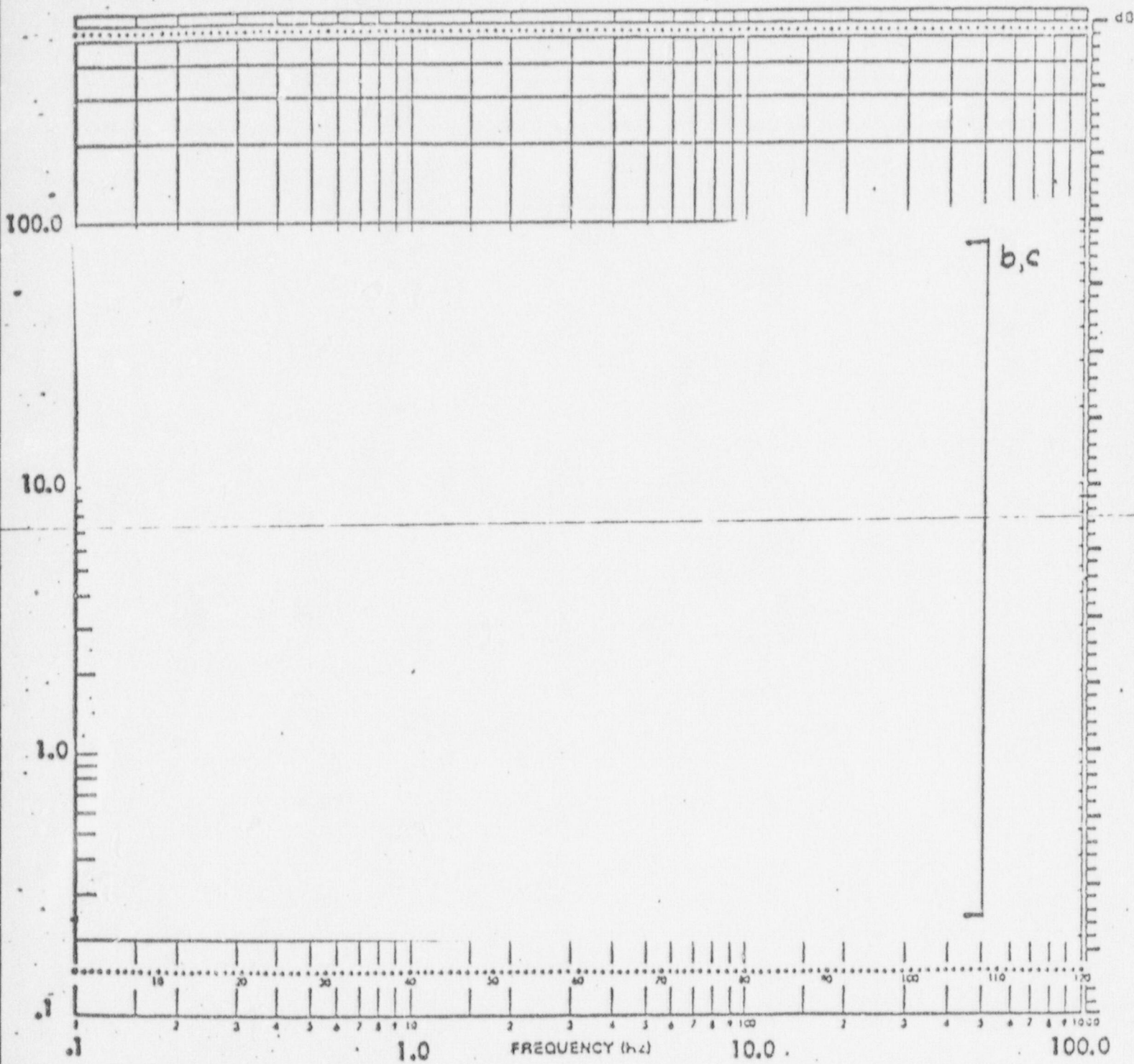


Control Accelerometer
6-5-78
SPAN #2. - 9.0

FREQUENCY (HZ)

Position 4 Run 14
90°
DAMPING 5%

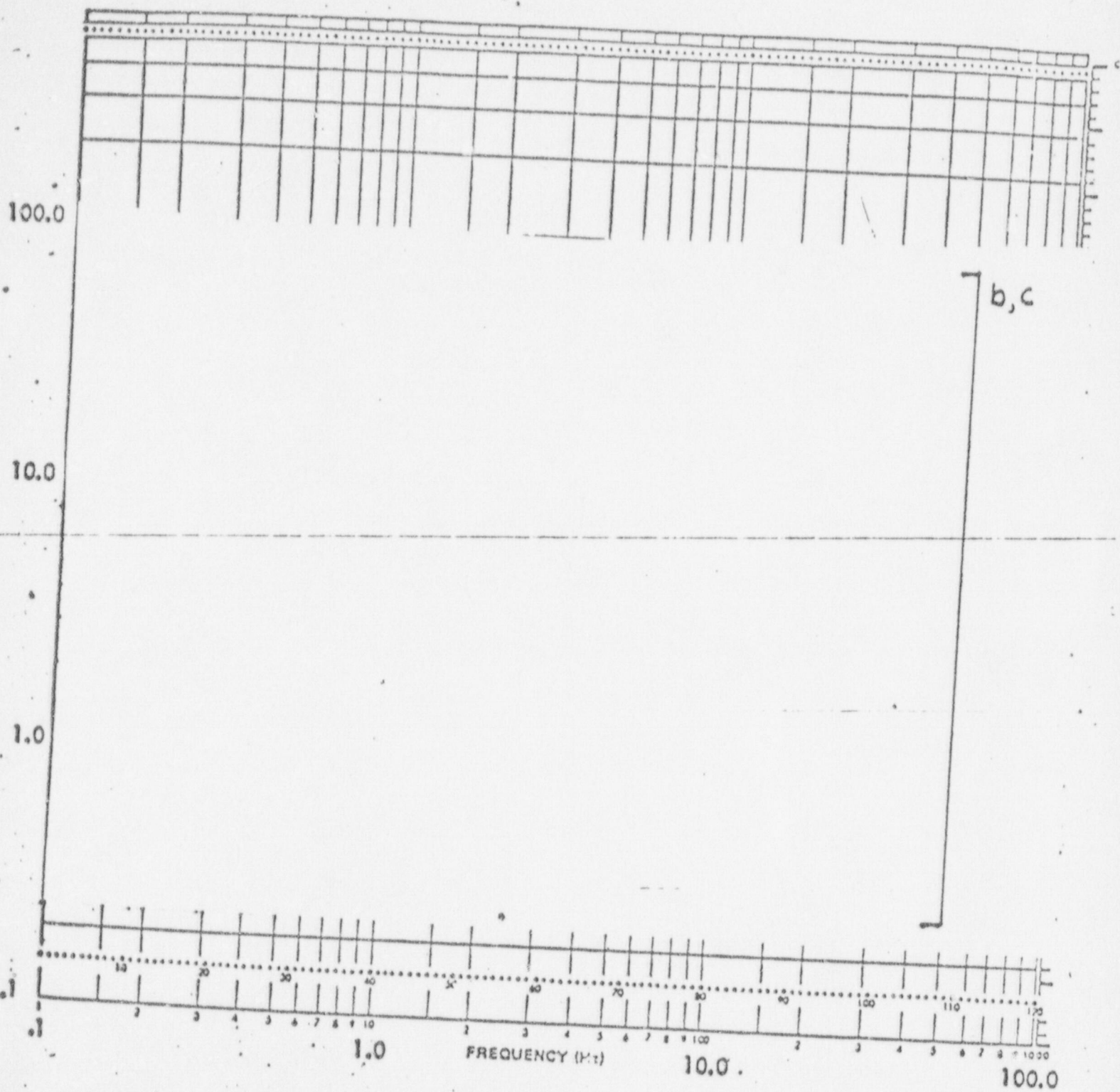
Fig. 19



REQUIRED RESPONSE SPECTRUM (RRS)

OPERATING BASIS EARTHQUAKE (OBE)

Fig. 20



REQUIRED RESPONSE SPECTRUM (RRS)

SAFE SHUTDOWN EARTHQUAKE (SSE)

Fig. 21

QUESTION 6

Seismic Qualification: Process Control and Protection Equipment

The Process Control and Protection equipment contains signal conditioning equipment for monitoring pressurizer water level and pressure, containment pressure, reactor coolant flow and temperature, and steam generator water level and pressure, etc.

- a) Confirm that the process control and protection equipment referenced in Section 10.3.9 of the FSAR Amendment 50, and page 3.10-6 of the FSAR is the same as Westinghouse CID Process Equipment referenced in WCAP-8021 Section 2-4.
- b) Westinghouse committed to retesting entire typical channels of the process control and protection equipment (including signal conditioning circuits and bistables) to verify that the bistables have the capability to change state during a seismic event. Section 10.3.19.1 of the FSAR Amendment 50 implies that only bistablers have undergone additional testing versus an entire typical channel. Justify that the retesting of only bistables demonstrates the seismic adequacy of the process control and protection equipment.

RESPONSE

- a) The process control and protection equipment used in the Diablo Canyon plant is the Westinghouse CID 7100 Process Equipment. This is the same equipment discussed in Section 10.3.9 of the FSAR Amendment 50 and page 3.10-6 of the FSAR.
- b) Entire typical channel of the process control and protection equipment were tested. The FSAR will be revised to clarify this.

QUESTION 7

Seismic Qualification: Reactor Trip Switchgear

This equipment consists of two circuit breakers in series which interrupt power to the control rod drives. This interruption of power releases the rods, which fall by gravity to shut down the nuclear reactor.

The basis for determining the functional integrity of the equipment (as indicated in WCAP-7821 supplement #4) was that all breaker outputs, including secondary contact outputs to the various protection systems, electrically maintain proper contact condition of open or closed position. It appears that the capability of the contacts to change position during a seismic event was not tested. Provide justification for monitoring only proper contact conditions of open or closed versus test with contacts open, with contacts closed, and with contacts changing position.

RESPONSE

The primary function of the circuit breakers is to interrupt power and therefore (trip) release the rods. This function was checked during and after the seismic testing, and found to be acceptable. The secondary contacts are used to maintain normal plant control and therefore were monitored during the testing. Once the primary function (trip) was performed, the secondary contacts have no consequence on the operation (trip) of the system. However, the outputs from the breaker's secondary contacts are supplied to various protection systems to provide for safety injection block logic, feedwater isolation logic and turbine trip logic. These inputs and outputs were continuously monitored during the testing sequence and are shown schematically in WCAP-7821 Supplement #4 in figure 4. Therefore, the capability of the contacts to change position during a seismic event was tested.

QUESTION 8

Seismic Qualification: Solid State Protection System

The solid state protection system provides reactor trip and/or engineered safety feature action. The equipment tested consists of three cabinets and represent one logic train of the protection system. The input cabinet containing relays, the logic cabinet, and the output cabinet containing master and slave relays.

- a) The solid state protection system also consists of process instrumentations bistables and field contacts that appear not be contained in the three cabinets tested as indicated in Section 10.3.22 of the FSAR Amendment 50. Describe the seismic qualification for the subject process instrumentations bistables and field contacts.
- b) The functional integrity of the solid state protection system was demonstrated, as indicated in Section 10.3.22 of the FSAR Amendment 50, contacts that provide signals for undervoltage trip, train trouble, and safety injection. Justify how the functional integrity of the solid state protection system is demonstrated by only monitoring three relay contacts.
- c) Provide the seismic qualification test results which demonstrates the electrical functionability for the relays located in the input cabinet and for the master relays located in the output cabinet of the solid state protection system.
- d) Provide the seismic qualification test results which demonstrate the electrical functionability of the solid state protection system logic cabinet.

RESPONSE

- a) Not True - Process instrumentation bistables are contained in the Process Control System equipment and have been seismically qualified. See WCAP-8021, Section 2-4 and WCAP-8828.
- b, The functional integrity of the system was demonstrated during the
- c, simulated seismic event as follows: Eight simulated input signals
- & were fed into the relays of the four compartments of the input
- d cabinet, four to initiate a reactor trip condition and four to

initiate a safety injection condition. The contacts of the input relays were wired to the Logic Cabinet where one group of four contacts were connected to a 2/4 logic circuit to form a reactor trip signal, and the second group of four contacts were connected to another 2/4 logic circuit to form a safety injection signal. The reactor trip signal coming out of the logic cabinet, was a 48 volt d.c. voltage signal and was connected to an undervoltage coil assembly, identical to one used in the reactor trip switchgear. The reactor trip signal was also connected to a relay, where contacts were recorded. The safety injection signal coming out of the logic cabinet energizes the master relays in the output cabinet, which in turn energizes the slave relays also located in the output cabinet. Contacts from the slave relays were monitored by recorders to ascertain correct action.

Before each test all eight input signals were present, setting the circuitry in a pre-trip condition. During the actual shaking, two input signals, in each group of four, were turned off simulating a 2/4 condition, which were monitored by recorders. Thus, the input relays, logic circuitry, and master and slave relays were demonstrated to function properly before, during, and after each simulated seismic event.

QUESTION 9

Seismic Qualification: Resistance Temperature Detectors

Resistance temperature detectors sense the temperature in the main coolant loops.

- a) Section 3.10 of the FSAR and 10.3.2.8 of the FSAR Amendment 50 do not provide descriptive information as to this safety function of resistance temperature detectors installed at Diablo Canyon. Provide descriptive information.
- b) Identify by manufacturer and model number Class 1E Resistance Temperature Detectors (RTD) being used at Diablo Canyon.
- c) Section 10.3.27 of the FSAR Amendment 50 implies that a much more severe function-verification test was performed on resistance temperature detectors than was reported in WCAP-8234A, Seismic testing and Functional Verification of By-Pass Loop Reactor Coolant RTD's. For this much more severe test, provide the test set up details and test results.
- d) Verify that RTD's at Diablo Canyon are installed in the Reactor Coolant By-Pass Loop.

RESPONSE

- a) The Narrow Range RTD's provide the following safety function trips:

Overtemperature ΔT

Overpower ΔT

Lo-Lo T_{avg} coincident with high steam line flow

The Wide Range RTD's provide Post Accident Monitoring.

- b) Narrow Range RTD's - Sostman Model # 11834B-1

Wide Range RTD's - Sostman Model # 11901B

- c) WCAP-8234A discusses both the seismic test and the more severe functional verification test performed on RTD's. Implication that this second test is in addition to testing discussed in the WCAP is incorrect. The FSAR will be revised for clarity.
- d) At Diablo Canyon the Narrow Range RTD's are installed in the reactor coolant By-Pass Loop; the Wide Range RTD's are installed directly into the main coolant piping through the use of thermal wells.

QUESTION 10 Seismic Qualification: Safeguards Test Cabinet

Selected relays, switches, and components were continuously monitored during seismic testing as indicated in WCAP-8021, Supplement 1 Seismic Testing of Electrical and Control Equipment (Engineered Safeguards test Cabinet for PG&E Plants), May 1977.

Provide electrical schematic diagrams of the test cabinet circuitry, describe the test set up, and identify the selected relays, switches, and components monitored during testing. Justify the seismic adequacy of relays, switches, and components that were not monitored during seismic testing.

RESPONSE

Figure 4 shows the electrical test setup for monitoring selected switches, relays, and resistor-light-diode combinations of the Safeguards Test Cabinet during its seismic test. You will note that normally open and normally closed contacts of switches S804, S807, S818 and S821 were monitored, as were normally open and normally closed contacts of relays K801, K804, K811, K821 and K822. Two light-diode combinations, DS8038 and DS8040 were also monitored for continuity. Component location is shown in Figure 5.

Switches located in the top row (middle and side) and 3rd row (middle) were monitored. Relays located in the top row (side and middle), 2nd row (middle) and bottom row (side) were monitored.

The switches, relays and resistor-light-diode combinations that were not monitored during the seismic tests are identical to the ones that were

monitored, therefore are considered seismically adequate. Note that the locations of the components monitored are in areas of expected highest acceleration, i.e., middle of panel, top of panel.

Schematic diagram 108D415 (Sheets 1-12) is furnished to enhance the understanding of the Safeguards Test Cabinet circuitry.

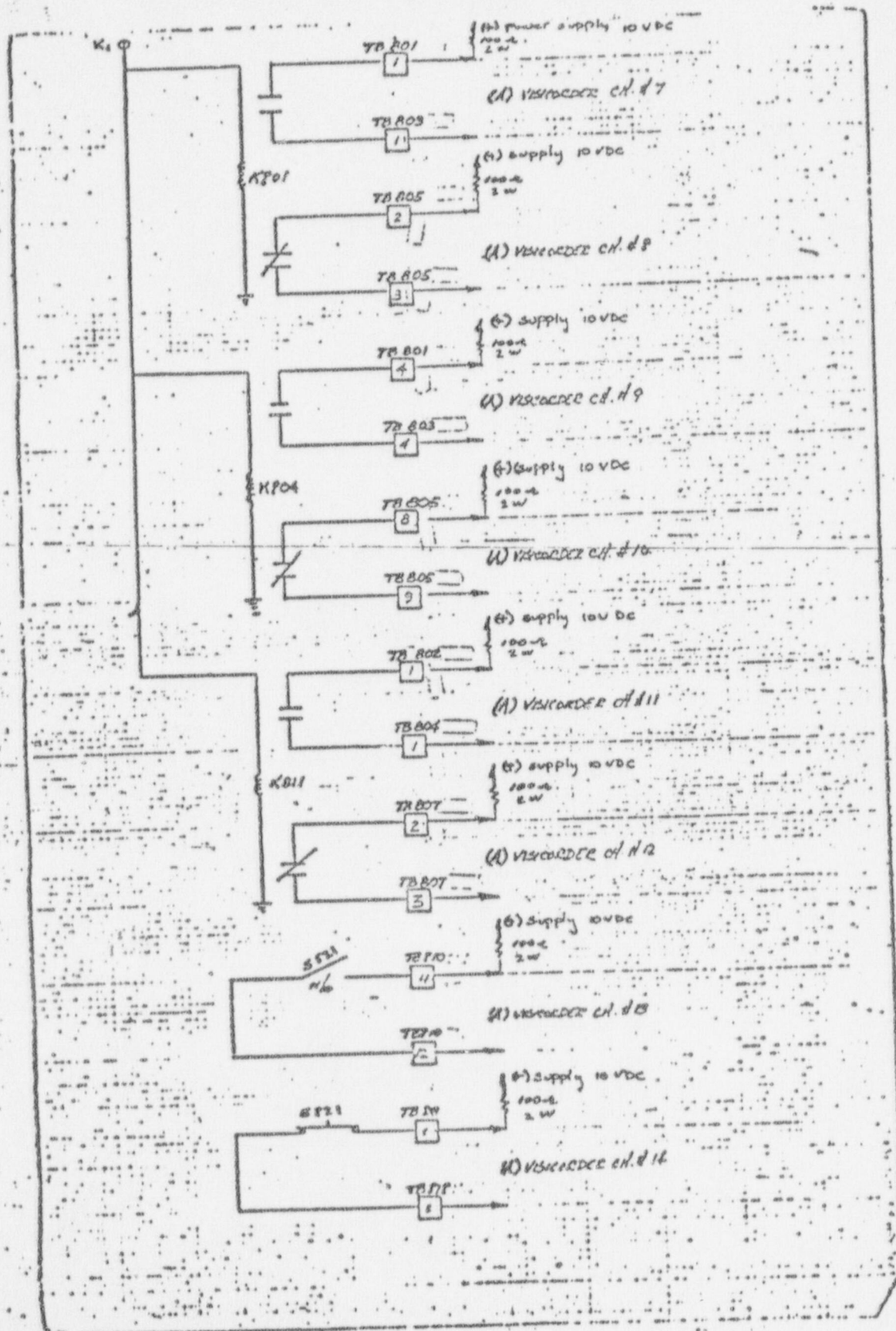


FIGURE 4 (cont'd)

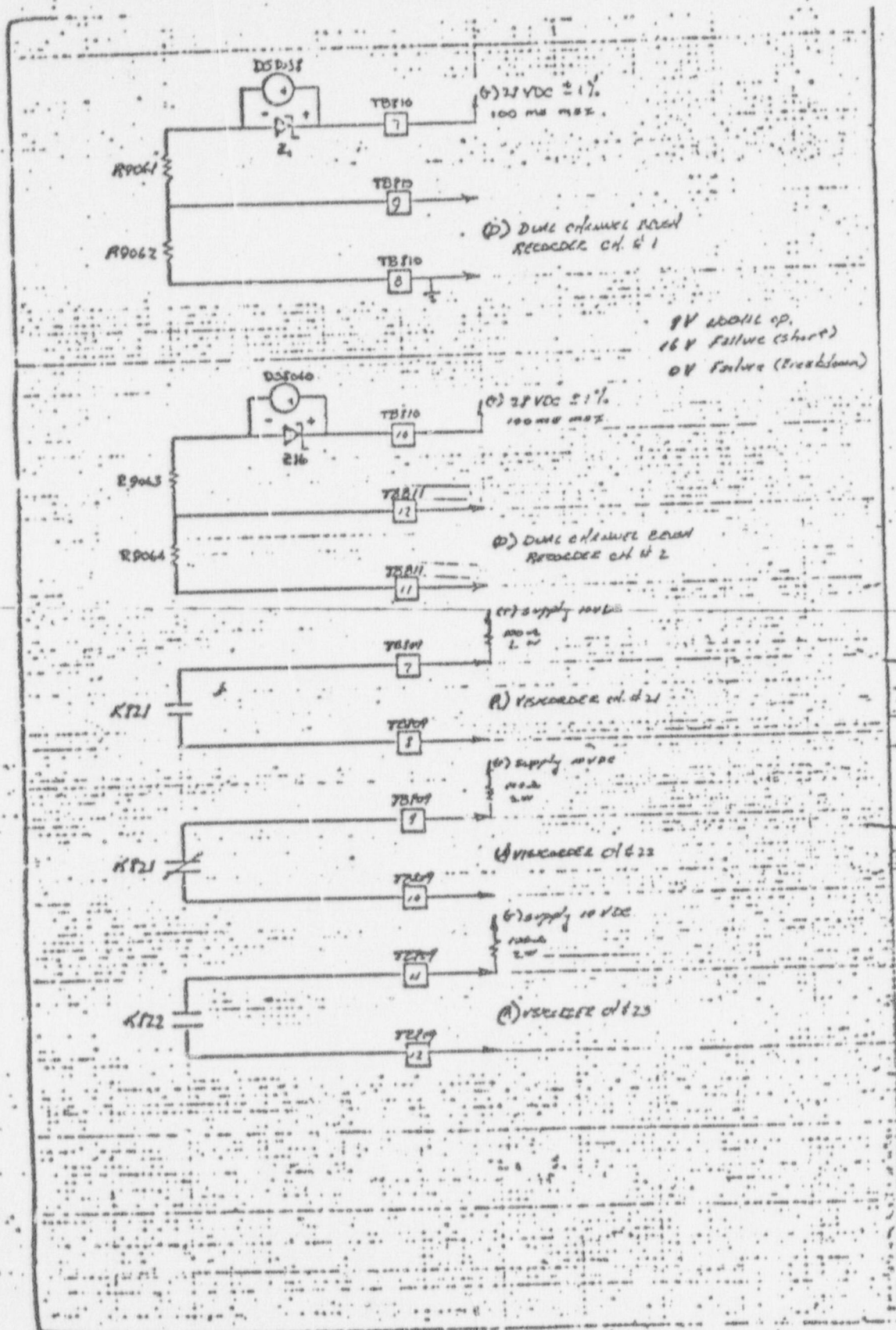


FIGURE 4 (cont'd)

070001

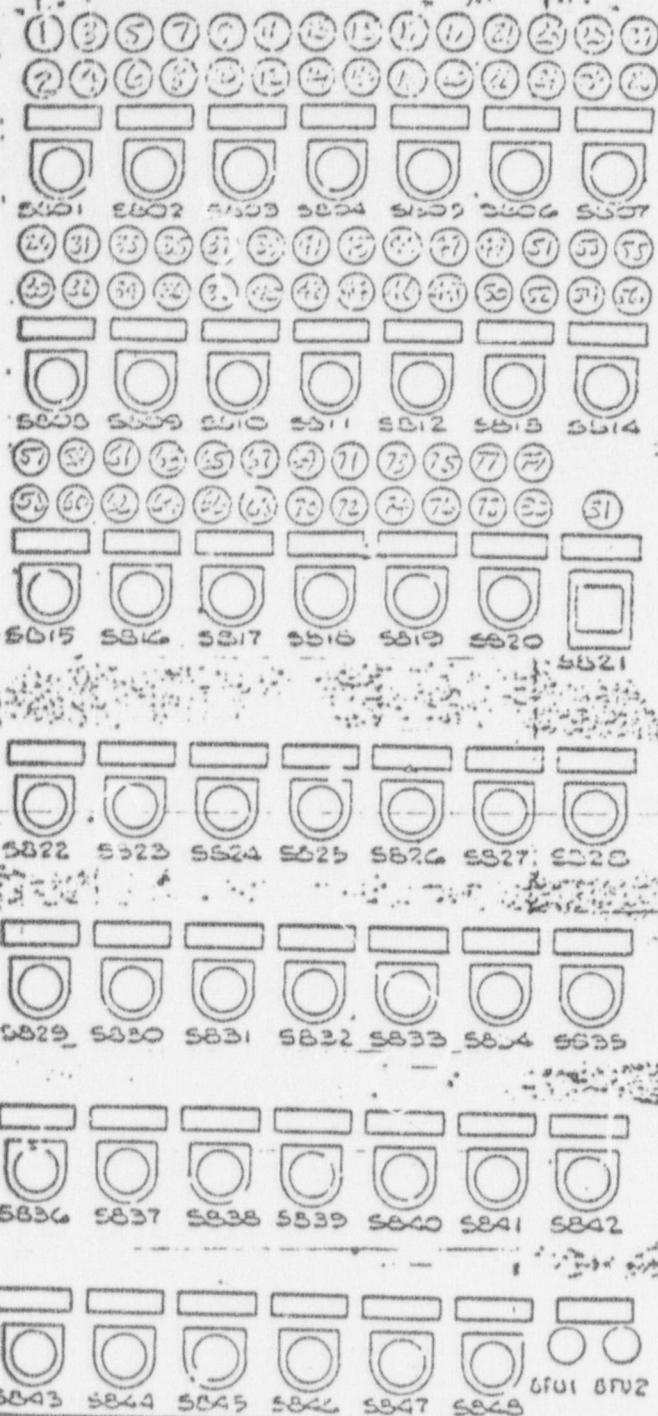


FIGURE 5

SOLID STATE PROTECTION
SYSTEM TEST CABINET

COMPONENT LOCATIONS

K801	K802	K803	K804	K805	K806	K807
K808	K809	K810	K811	K812	K813	K814
K815	K816	K817	K818	K819	K820	K821
						K822

12-85472

TEST SWITCH

54

RESET

DEV. 2

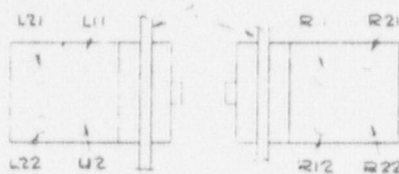
RESET

DEV. I (NOTE 5)

ACTION	SELECT - O - PUSH
TO	OPERATOR TYPE OTIMI
TO	2 POSITION, HALF STROKE
TO	WITH TYPE JMC BLOCK
POSITION	RELEASED DEPRESS

[illegible]

FRONT OF PANEL



LEFT SIDE
VIEW

RIGHT SIDE

OTIC CONTACT LOCATION SCHEME

CONTACT	DOB
A11-B11	X
A12-B12	X
A1-B	X
A5-B5	X
A6-B6	X
A7-B7	X
A11-B11	X
A12-B12	X
A1-B1	X
A5-B5	X
A6-B6	X
A7-B7	X
E11-F11	X
E12-F12	X
E1-F1	X
E5-F5	X
E6-F6	X
E7-F7	X

TYPE W-2 SWITCH 2-POS. TO
SPRING RETURN TO CENTER
BASIC SW. S# 505A68460
PISTOL GRIP FIXED HAND
S# DOES NOT INCLUDE
HANDLE AND NAMEPLATE

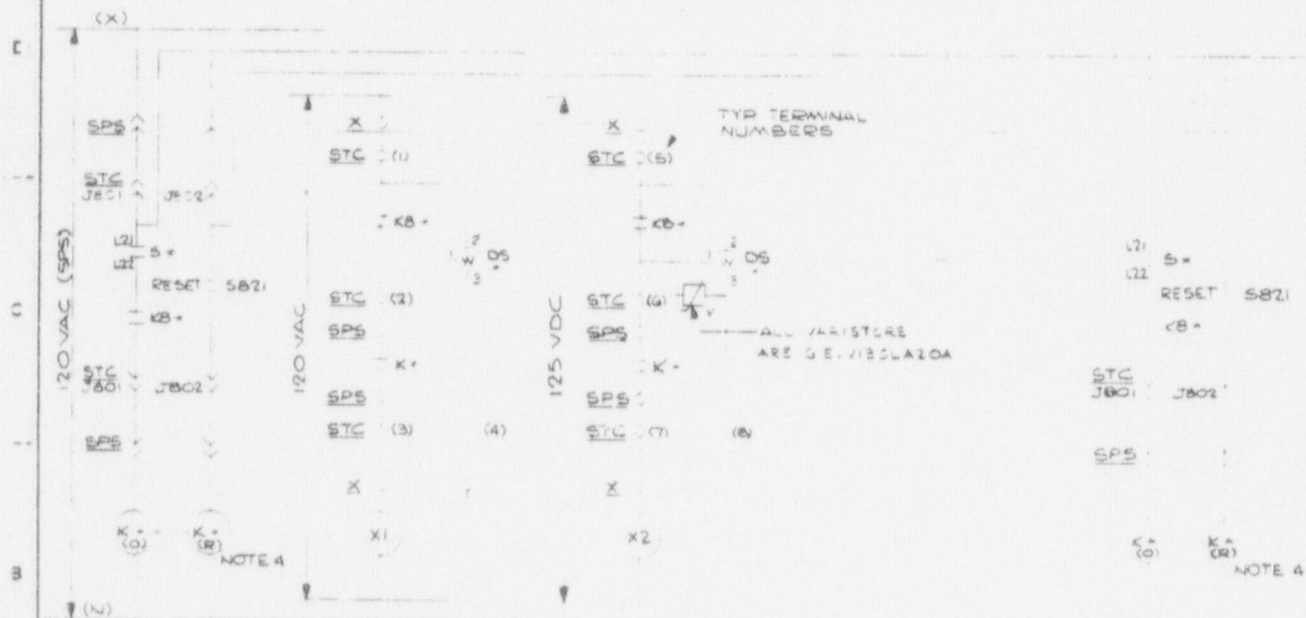
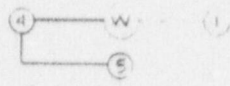


FIG A TYPICAL PROTECTION ACTUATION CIRCUIT BLOCKING SCHEMES
(CONTACT CLOSURE FOR ACTUATION)

FIG. 8. TYPICAL. P

1	SO DE/REG 385 D EG 385/571	IT	CHANGE	1
2	ECN 8180		PG/REG 385	3
3	THIS DMC SUPERSEDES DMG 1080415 SUB?		PG/REG 385	4
4	ECN 8248		PG/REG 385	5
5	AVSB. SUB BLOCK		PG/REG 385	6
6	D PETROCELL 3/3/72		PG/REG 385	7
7	ECN 8253		PG/REG 385	8
8	AVSB. SUB BLOCK		PG/REG 385	9
9	ECN 8258		PG/REG 385	10
10	AVSB. SUB BLOCK		PG/REG 385	11
11	ECN 8263		PG/REG 385	12
12	AVSB. SUB BLOCK		PG/REG 385	13
13	ECN 8268		PG/REG 385	14
14	AVSB. SUB BLOCK		PG/REG 385	15
15	ECN 8273		PG/REG 385	16
16	AVSB. SUB BLOCK		PG/REG 385	17
17	ECN 8278		PG/REG 385	18
18	AVSB. SUB BLOCK		PG/REG 385	19
19	ECN 8283		PG/REG 385	20
20	AVSB. SUB BLOCK		PG/REG 385	21
21	ECN 8288		PG/REG 385	22
22	AVSB. SUB BLOCK		PG/REG 385	23
23	ECN 8293		PG/REG 385	24
24	AVSB. SUB BLOCK		PG/REG 385	25
25	ECN 8298		PG/REG 385	26
26	AVSB. SUB BLOCK		PG/REG 385	27
27	ECN 8303		PG/REG 385	28
28	AVSB. SUB BLOCK		PG/REG 385	29
29	ECN 8308		PG/REG 385	30
30	AVSB. SUB BLOCK		PG/REG 385	31
31	ECN 8313		PG/REG 385	32
32	AVSB. SUB BLOCK		PG/REG 385	33
33	ECN 8318		PG/REG 385	34
34	AVSB. SUB BLOCK		PG/REG 385	35
35	ECN 8323		PG/REG 385	36
36	AVSB. SUB BLOCK		PG/REG 385	37
37	ECN 8328		PG/REG 385	38
38	AVSB. SUB BLOCK		PG/REG 385	39
39	ECN 8333		PG/REG 385	40
40	AVSB. SUB BLOCK		PG/REG 385	41
41	ECN 8338		PG/REG 385	42
42	AVSB. SUB BLOCK		PG/REG 385	43
43	ECN 8343		PG/REG 385	44
44	AVSB. SUB BLOCK		PG/REG 385	45
45	ECN 8348		PG/REG 385	46
46	AVSB. SUB BLOCK		PG/REG 385	47
47	ECN 8353		PG/REG 385	48
48	AVSB. SUB BLOCK		PG/REG 385	49
49	ECN 8358		PG/REG 385	50
50	AVSB. SUB BLOCK		PG/REG 385	51
51	ECN 8363		PG/REG 385	52
52	AVSB. SUB BLOCK		PG/REG 385	53
53	ECN 8368		PG/REG 385	54
54	AVSB. SUB BLOCK		PG/REG 385	55
55	ECN 8373		PG/REG 385	56
56	AVSB. SUB BLOCK		PG/REG 385	57
57	ECN 8378		PG/REG 385	58
58	AVSB. SUB BLOCK		PG/REG 385	59
59	ECN 8383		PG/REG 385	60
60	AVSB. SUB BLOCK		PG/REG 385	61
61	ECN 8388		PG/REG 385	62
62	AVSB. SUB BLOCK		PG/REG 385	63
63	ECN 8393		PG/REG 385	64
64	AVSB. SUB BLOCK		PG/REG 385	65
65	ECN 8398		PG/REG 385	66
66	AVSB. SUB BLOCK		PG/REG 385	67
67	ECN 8403		PG/REG 385	68
68	AVSB. SUB BLOCK		PG/REG 385	69
69	ECN 8408		PG/REG 385	70
70	AVSB. SUB BLOCK		PG/REG 385	71
71	ECN 8413		PG/REG 385	72
72	AVSB. SUB BLOCK		PG/REG 385	73
73	ECN 8418		PG/REG 385	74
74	AVSB. SUB BLOCK		PG/REG 385	75
75	ECN 8423		PG/REG 385	76
76	AVSB. SUB BLOCK		PG/REG 385	77
77	ECN 8428		PG/REG 385	78</



ILLUMINATED PUSH BUTTON
SWITCH WITH 26V LAMP
NO 827
(EXCEPT AS NOTED)

REAR OF PANEL



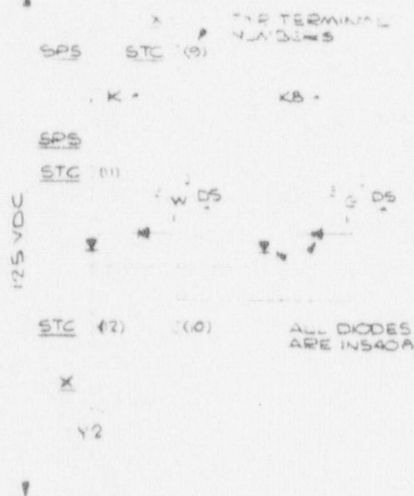
CONTACT LOCATION SCHEME

GENERAL NOTES

1. CIRCUITRY AND HARDWARE FOR EQUIPMENT PROTECTION TRAINS "A" AND "B" TEST CABINETS ARE IDENTICAL EXCEPT AS NOTED:
- A. TRAIN "A" ONLY
B. TRAIN "B" ONLY
2. FIGURES A & B IN THE SYMBOL * REPRESENTS THE SURF. A NUMBER OF THE DEVICE REFERENCED.
- EXAMPLE:
- A. SP5 RELAY K601, K602, ETC.
B. STD TEST SWITCH, S622, S834, ETC.
K8. STD RELAY, K811, K817, ETC.
L. STD LIGHT, D58009, D58077, ETC.
3. FIGURE A & B TYPE CIRCUITS ARE DETAILED ON THE SCHEMATICS. FIGURE B CIRCUITS WILL BE SUBSTITUTED FOR FIGURE A CIRCUITS WHERE REQUIRED.
4. THE OUTPUT RELAYS IN THE SOLID STATE PROTECTION SYSTEM THAT ARE LATCH TYPE ARE DESIGNATED BY AN "X" IN THE L COLUMN ON SHEET 2.
5. SWITCHES S801 THRU S848 TO BE EQUIPPED WITH SPRING RETURN FROM RIGHT TO LEFT POSITION WHEN DESIGNATED BY AN "X" IN THE SR COLUMN ON SHEET 2.
6. UNUSED CIRCUIT DEVICES AND WIRING WILL NOT BE FURNISHED, AND BLANK PANEL OPENINGS WILL BE CARPED.
7. MINIMUM TEST CURRENT ON STANDARD FIG. A AND D CIRCUITS IS 25 AMP.

LOCATION LEGEND

SPS - SOLID STATE PROTECTION SYSTEM
STC - SAFEGUARDS TEST CABINET
X - SWGR, MCC, AUXILIARY RELAY RACK, ETC.
ASC - AUXILIARY SAFEGUARDS CABINET



PROTECTION ACTUATION CIRCUIT BLOCKING SCHEMES
(CONTACT OPENING FOR ACTUATION)

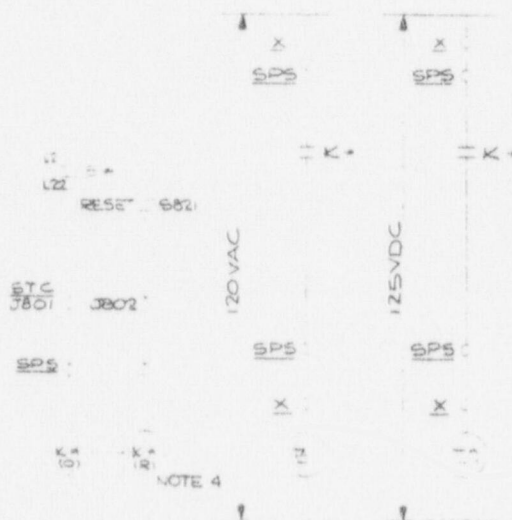


FIG. 5. TYPICAL PROTECTION ACTUATION
CIRCUIT WITHOUT BLOCKING SCHEMES

SHEET		SUB	
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10
11	11	11	11
12	12	12	12
13	13	13	13
14	14	14	14
15	15	15	15
16	16	16	16
17	17	17	17
18	18	18	18
19	19	19	19
20	20	20	20
21	21	21	21
22	22	22	22
23	23	23	23
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25	25	25	25
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27	27	27	27
28	28	28	28
29	29	29	29
30	30	30	30
31	31	31	31
32	32	32	32
33	33	33	33
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40	40	40	40
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42	42	42	42
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44	44	44	44
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46	46	46	46
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90	90	90	90
91	91	91	91
92	92	92	92
93	93	93	93
94	94	94	94
95	95	95	95
96	96	96	96
97	97	97	97
98	98	98	98
99	99	99	99
100	100	100	100

FOR TYPICAL STEAM CONDENSER COOLING WATER
CIRCUIT FLOW SEE CH. 4.

TYPICAL CIRCUITS,
NOTES AND LEGENDS

DRAWN BY: [blank] CHECKED BY: [blank] DESIGNED BY: [blank] DATE: [blank]	DATE		Westinghouse Electric Corporation H. LAR INCORPORATED SYSTEMS PITTSBURGH, PA. U.S.A. TITLE: DABO CANYON GAS SELECTORS DABO CANYON UNITS 1 & 2 SAFEGUARDS TEST CABINET NTS SCALE DIMENSIONS IN INCHES DO NOT SCALE SUB: 0000000000
	CHECK		
	DESIGN		
	DWG. NO.		
	REV. NO.		
	APP.		
	APP.		
	APP. SUPV.		

2 38345
5173815

G

F

E

D

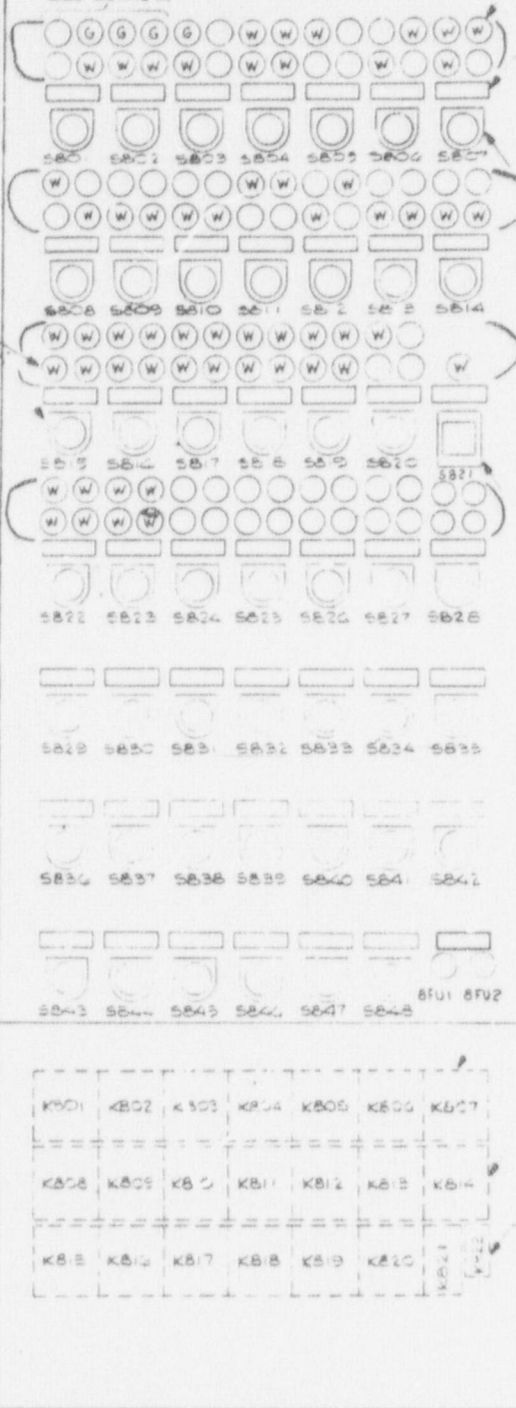
C

B

A

SEE DETAIL "A"

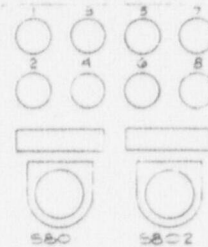
NOTE C
SH. 1



FRONT PANEL

* 31 TRAIN A * 32 TRAIN A * 33 TRAIN A
32 TRAIN B 37 TRAIN B 34 TRAIN B

DETAIL "A"



TYPICAL LIGHT NUMBERING
LIGHT NUMBERS REPRESENT
LAST NOS. OF LIGHT DES-
IGNATION
EXAMPLE: 7 = D58007

NOTE C
SH. 1

LIST OF MATERIALS

ITEM	QTY	DESCRIPTION
1	*	TEST SWITCH, 4 TYPE ST1 (DEV 1, SH. 1) (NOTE 5)
2	A	TEST LIGHT WITH 28V LAMP NO. 527 (DEV 2, SH. 1)
3	1	RESET SWITCH, 4 TYPE W2 (DEV 2, SH. 1)
4	13	RELAY, 120VAC, 10 AMP, 1 BRUMFIELD SERIES MCF
5	1	RELAY, 120VAC, 10 AMP, NO. 6P121A6000
6	1	TAG, FUNCTION

ITEM	FUNCTION
K501	
K502	
K503	
K504	
K505	
K506	
K507	
K508	
K509	
K510	
K511	TEST (FUNCTION BLOCKING) RELAYS
K512	
K513	
K514	
K515	
K516	
K517	
K518	
K519	
K520	
K521	TEST AUXILIARY RELAY
K522	RESET MONITOR RELAY
58F1	FUSE, 120 VAC SUPPLY
58F1/2	FUSE, SPARE

** NOTE THESE LIGHTS

IT	CHANGE
1	DEFINITION OF ECN-8180
2	THIS LAMP
3	DEFINITION OF ECN-8180
4	DEFINITION OF ECN-8180
5	DEFINITION OF ECN-8180
6	DEFINITION OF ECN-8180
7	DEFINITION OF ECN-8180
8	DEFINITION OF ECN-8180
9	DEFINITION OF ECN-8180
10	DEFINITION OF ECN-8180
11	DEFINITION OF ECN-8180
12	DEFINITION OF ECN-8180
13	DEFINITION OF ECN-8180
14	DEFINITION OF ECN-8180
15	DEFINITION OF ECN-8180
16	DEFINITION OF ECN-8180
17	DEFINITION OF ECN-8180
18	DEFINITION OF ECN-8180
19	DEFINITION OF ECN-8180
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21	DEFINITION OF ECN-8180
22	DEFINITION OF ECN-8180
23	DEFINITION OF ECN-8180
24	DEFINITION OF ECN-8180
25	DEFINITION OF ECN-8180
26	DEFINITION OF ECN-8180
27	DEFINITION OF ECN-8180
28	DEFINITION OF ECN-8180
29	DEFINITION OF ECN-8180
30	DEFINITION OF ECN-8180

11

10

9

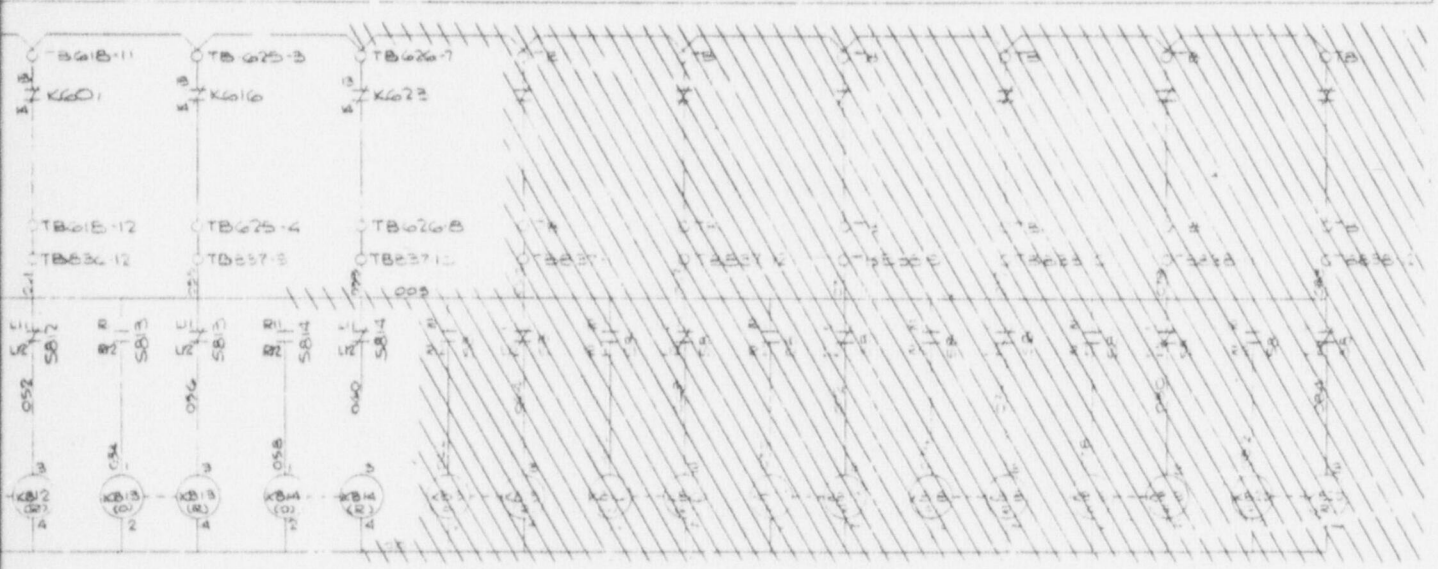
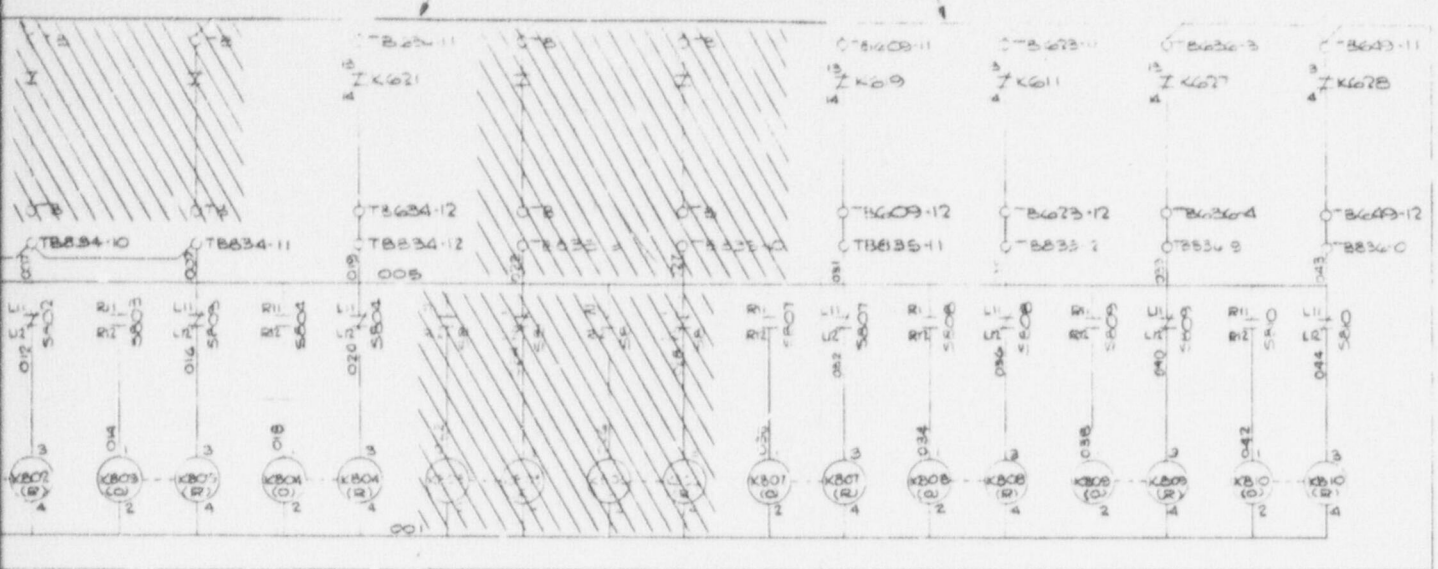
8

7

TESTS ARE TESTED IN CONJUNCTION WITH TEST SWITCH GROUP

6	5	4	3	2	1
---	---	---	---	---	---

- 24 PBRs IN SPE TERMINAL BLOCKS -



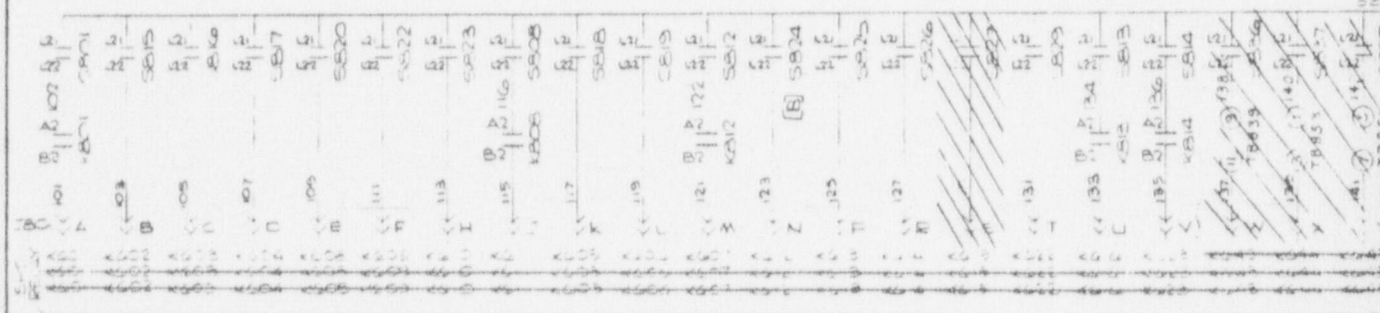
TEST RELAY COIL SCHEMATIC

WESTINGHOUSE ELECTRIC CORPORATION NUCLEAR ENERGY SYSTEMS, PITTSBURGH, PA. U.S.A. TITLE: LANCIE C GAS ELECTRIC CO DIABLO CANYON UNITS 1&2 SAFEGUARDS TEST CABINET		
NTS SCALE DIMENSIONS IN INCHES DO NOT SCALE		
SHEET 3 SUB 1 345		

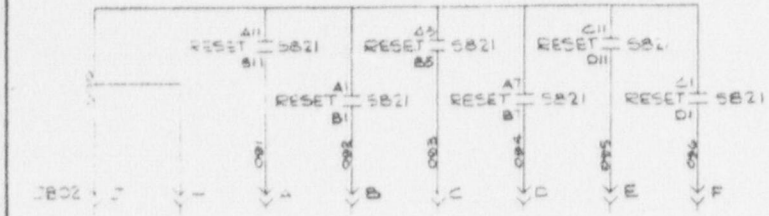
6 5 4 3 2 1

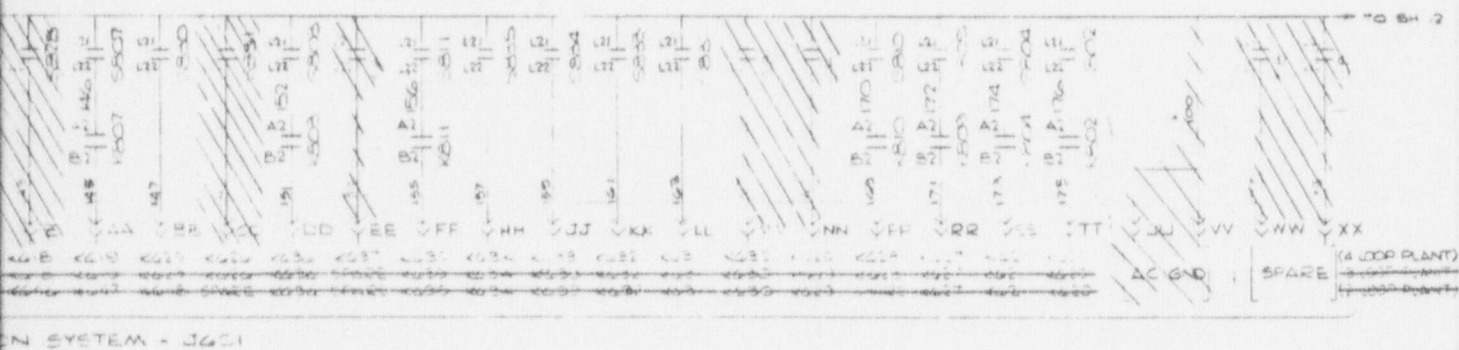
11 10 9 8 7

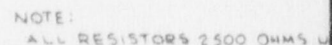
1	CHANGE	1784-1975
2	CHANGE	ECN-1980
3	CHANGE	THIS ENGINEERING DEPARTMENT HAS BEEN REDESIGNED TO BE A SUB 2
4	CHANGE	ECN-1985
5	CHANGE	ECN-1985
6	CHANGE	ECN-1985
7	CHANGE	ECN-1985
8	CHANGE	ECN-1985
9	CHANGE	ECN-1985
10	CHANGE	ECN-1985
11	CHANGE	ECN-1985



TO SOLID STATE PROTECTION SYS - J602



HDS RELAY ACTUATION[illegible]



REVISIONS ARE
CIRCLED
MCCAFFERTY 1/3/76
JAN 5 1976
C. M. 1-7-76



LESS OTHERWISE SPECIFIED.

AC/DC TEST CIRCUIT SCHEMATIC - FIGURE A

Westinghouse Electric Corporation

TYPE: DC FLOW GAS ELECTRIC

DIABLE CANYON LUTS 142

SAFEGUARD "B" CABINET

SCALE: 100/415

DIMENSIONS IN INCHES

DO NOT SCALE

5/5/78/667

0

A

i

B

C

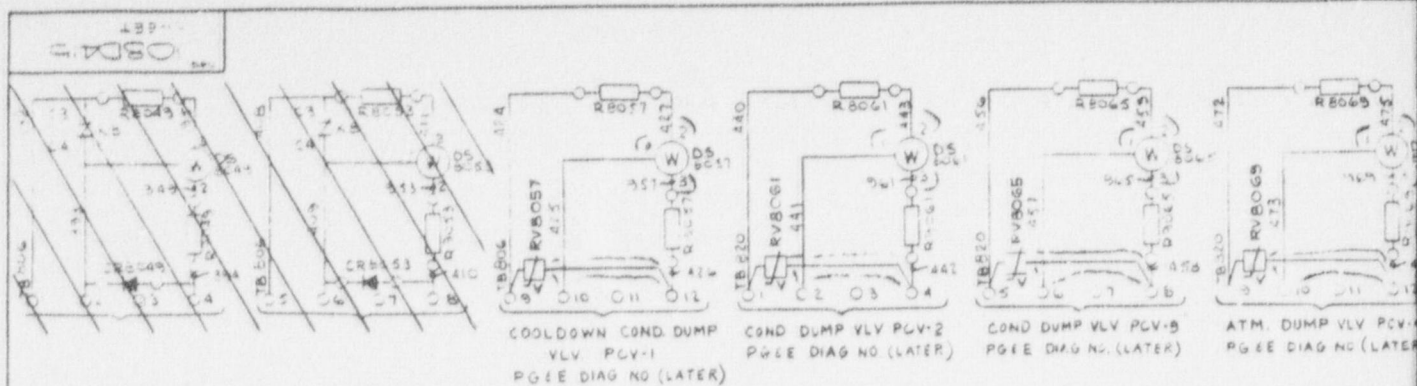
i

24

D

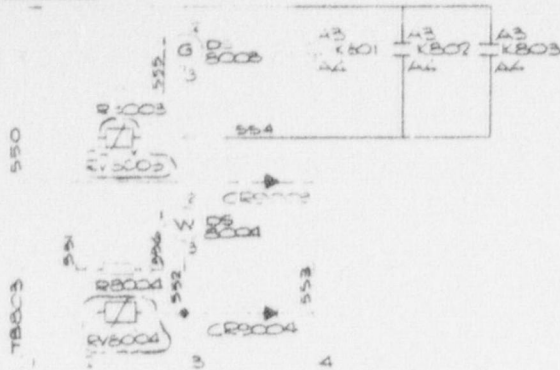
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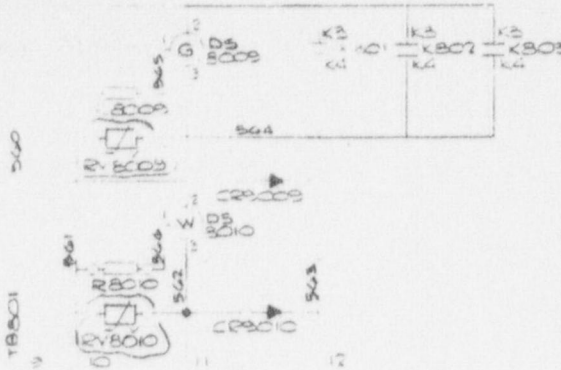


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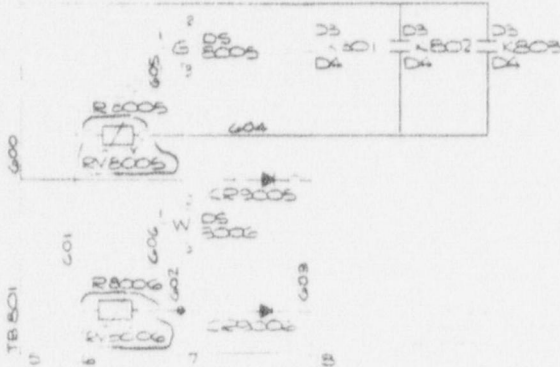


LOOP 1 FEEDWATER
CONTROL VALVE
FCV-510
PAGE DIAG NO 437583



LOOP 4 FEEDWATER
CONTROL VALVE
FCV-540
PAGE DIAG NO 437585

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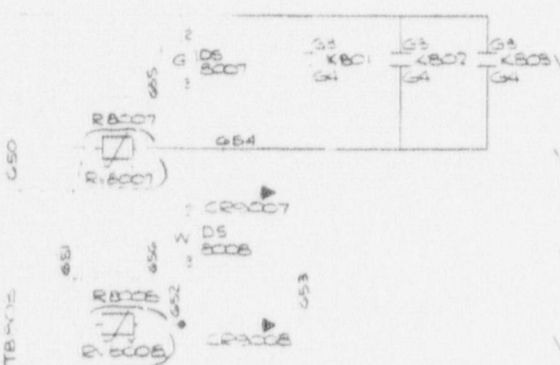


LOOP 2 FEEDWATER
CONTROL VALVE
FCV-520
PAGE DIAG NO 437585



VALVE FCV-557
VALVE FCV-750
PAGE DIAG NO 437681

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LOOP 3 FEEDWATER
CONTROL VALVE
FCV-530
PAGE DIAG NO.

A

1	CHANGE	1
2	ECN-8180	2
3	THIS UNIT SUPERSEDES LONG 108015 SUP-2	
4	REVISION 1-11-72	
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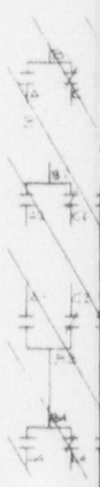
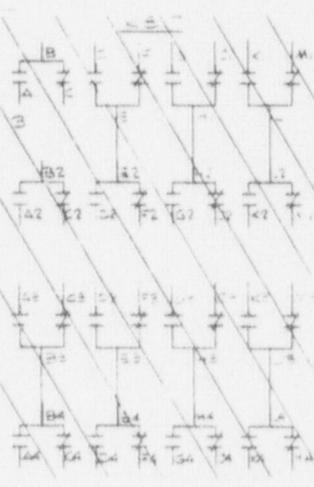
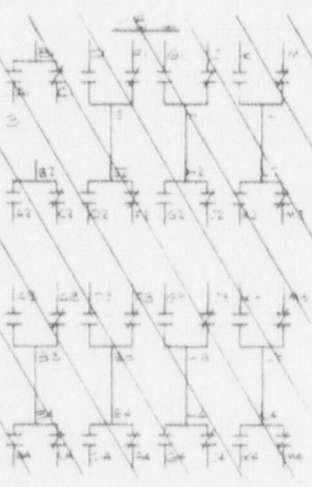
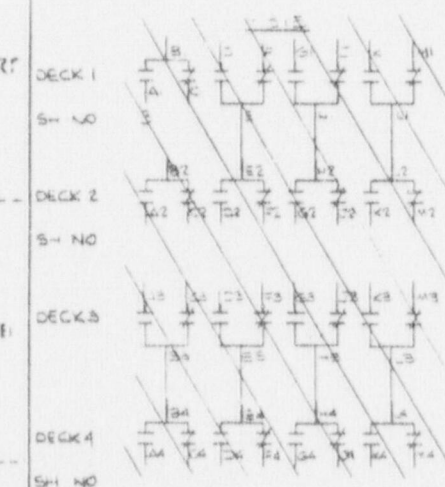
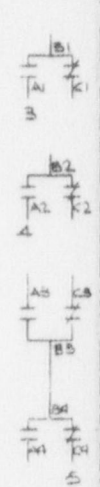
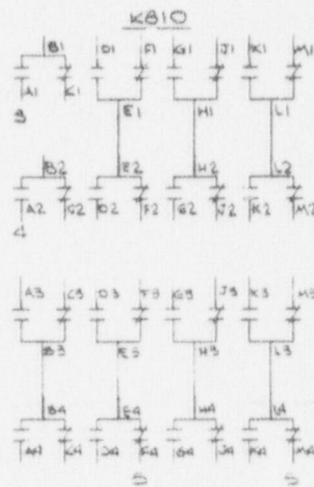
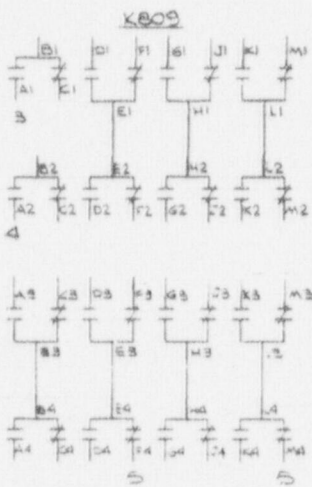
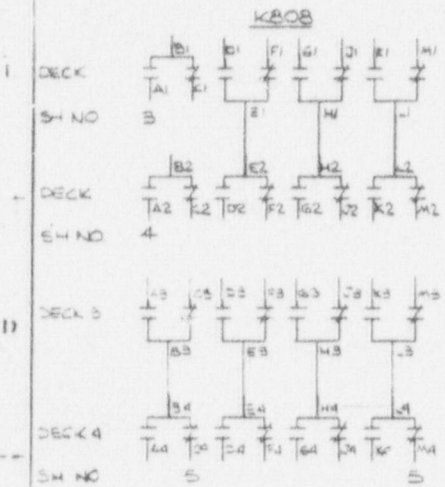
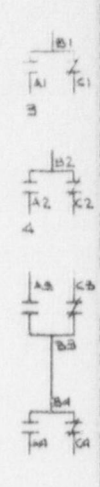
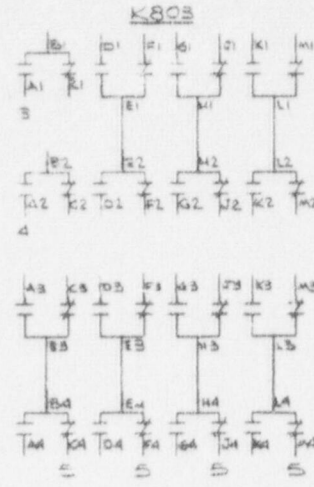
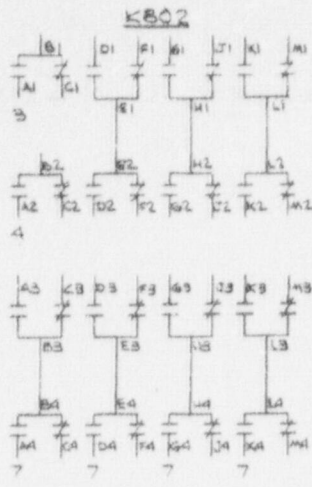
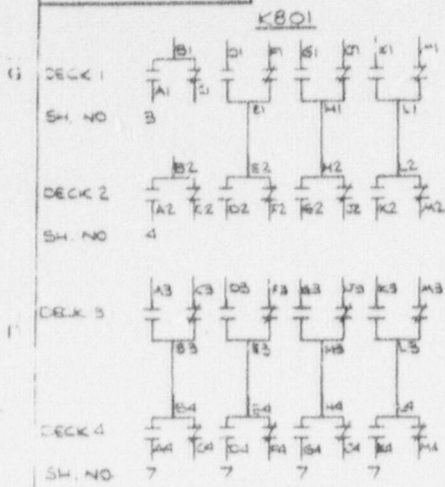
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DC TEST CIRCUIT SCHEMATICS- FIGURE B

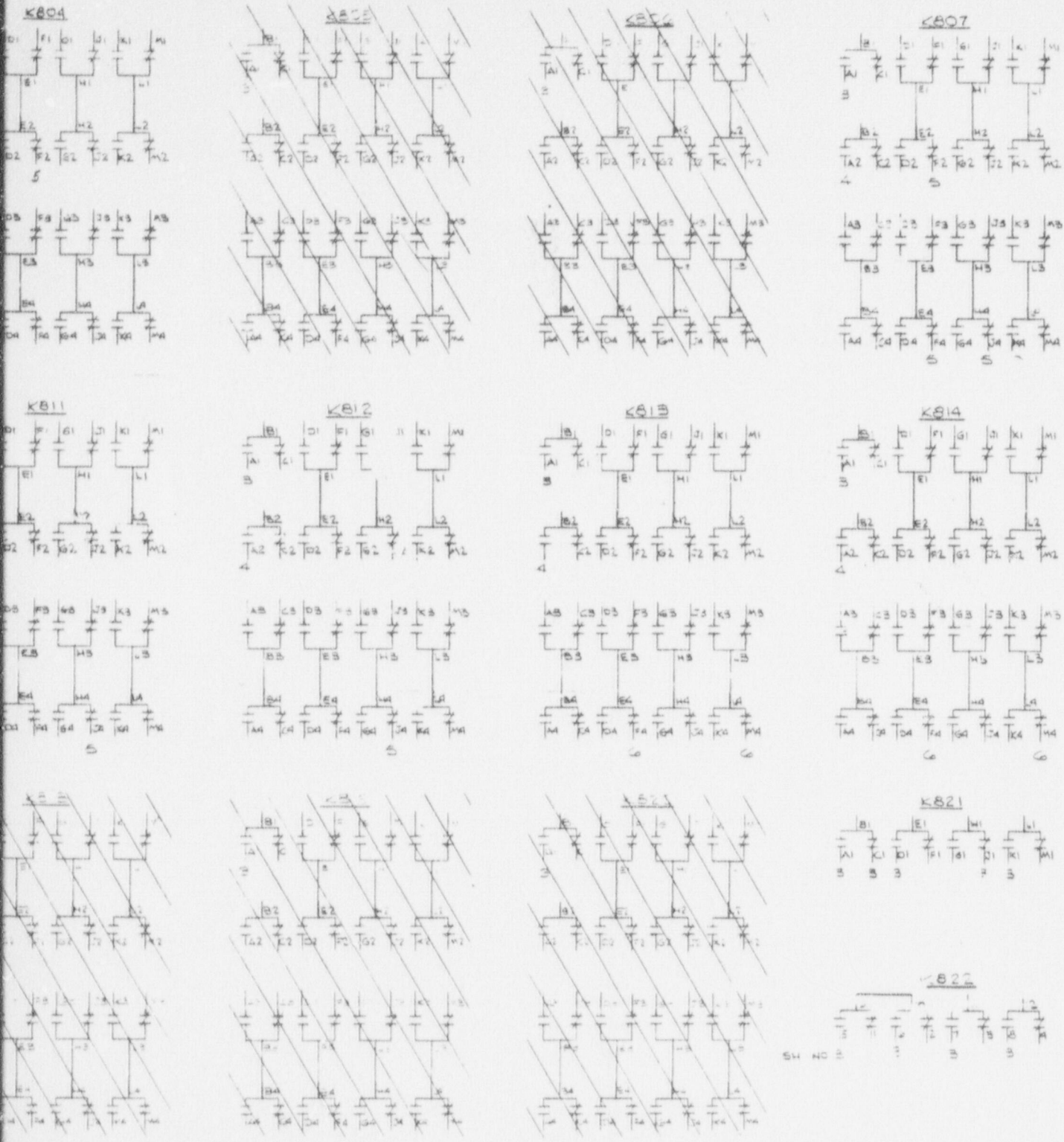
WESTINGHOUSE ELECTRIC CORPORATION 1000 WESTINGHOUSE BUILDING PITTSBURGH, PA. 15222 U.S. PATENT OFFICE PATENT NO. 2,811,111	DESIGNED BY DRAWN BY CHECKED BY APPR. BY APPR. BY DATE	Westinghouse Electric Corporation (W) TITLE: PACIFIC GAS & ELECTRIC DIABLO CANYON UNITS 1 & 2 SAFEGUARDS TEST CABINET SCALE: NTS DIMENSIONS IN INCHES DO NOT SCALE SHEET 7 OF 7

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TEST RELAY CONNECTION DIAG - TRAIN A

WESTINGHOUSE ELECTRIC CORPORATION PITTSBURGH, PA. U.S.A. TITLE: DIAL F'S GAS-ELECTRIC CO DIABLO CANYON UNITS 1 & 2 SAFEGUARDS TEST CABINET		NTS SCALE DIMENSIONS IN INCHES DO NOT SCALE	
		SHEET 6 SUB 1 X 15	

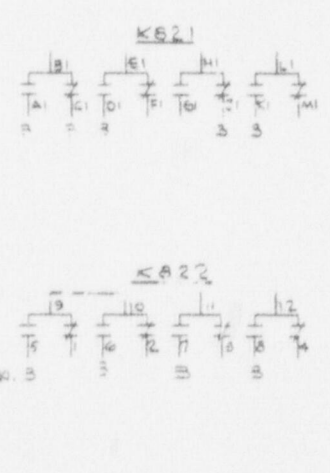
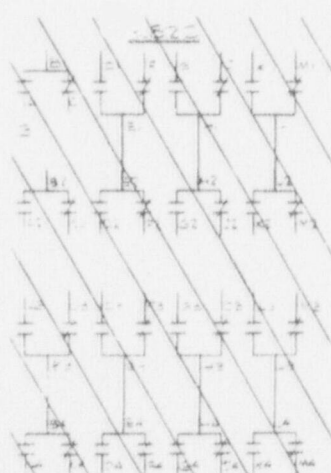
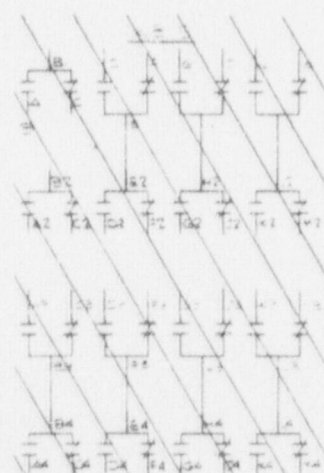
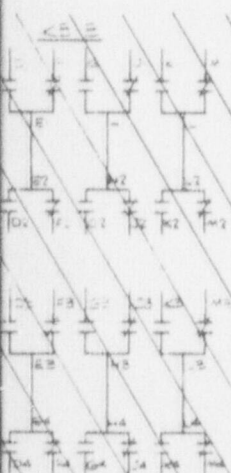
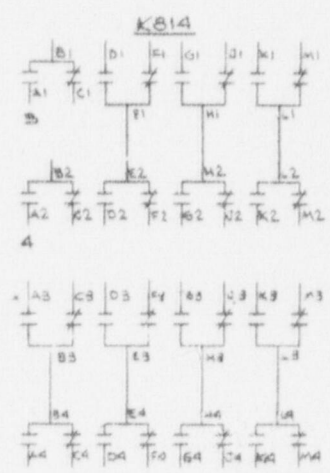
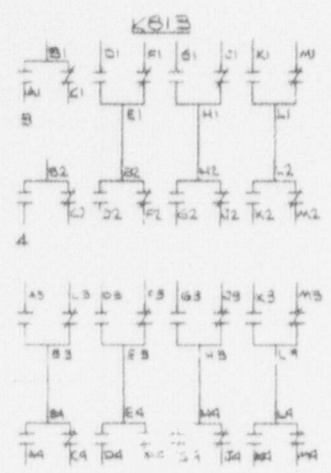
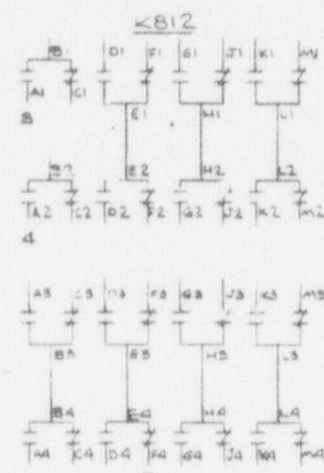
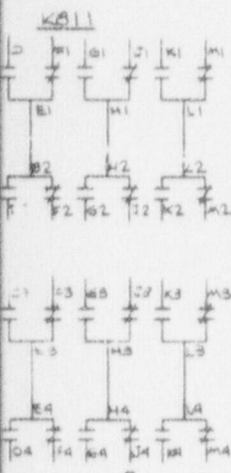
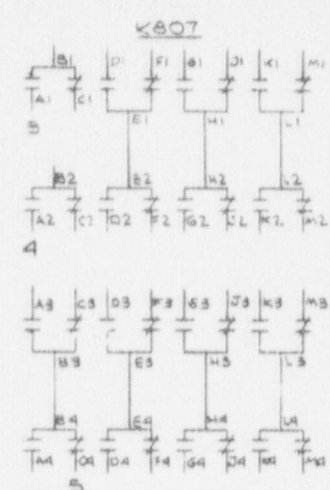
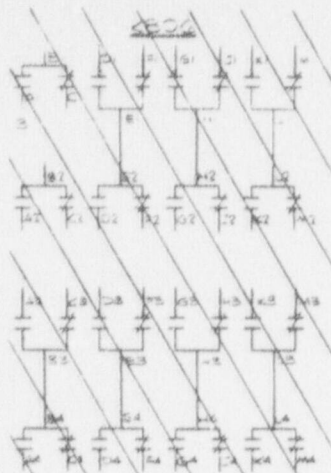
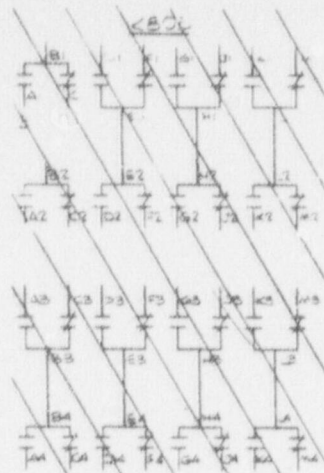
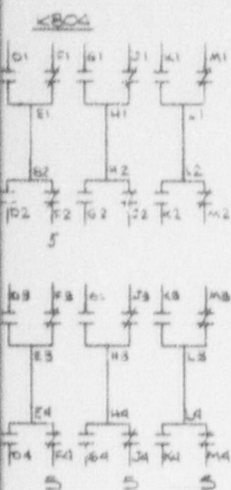
ECN-8152



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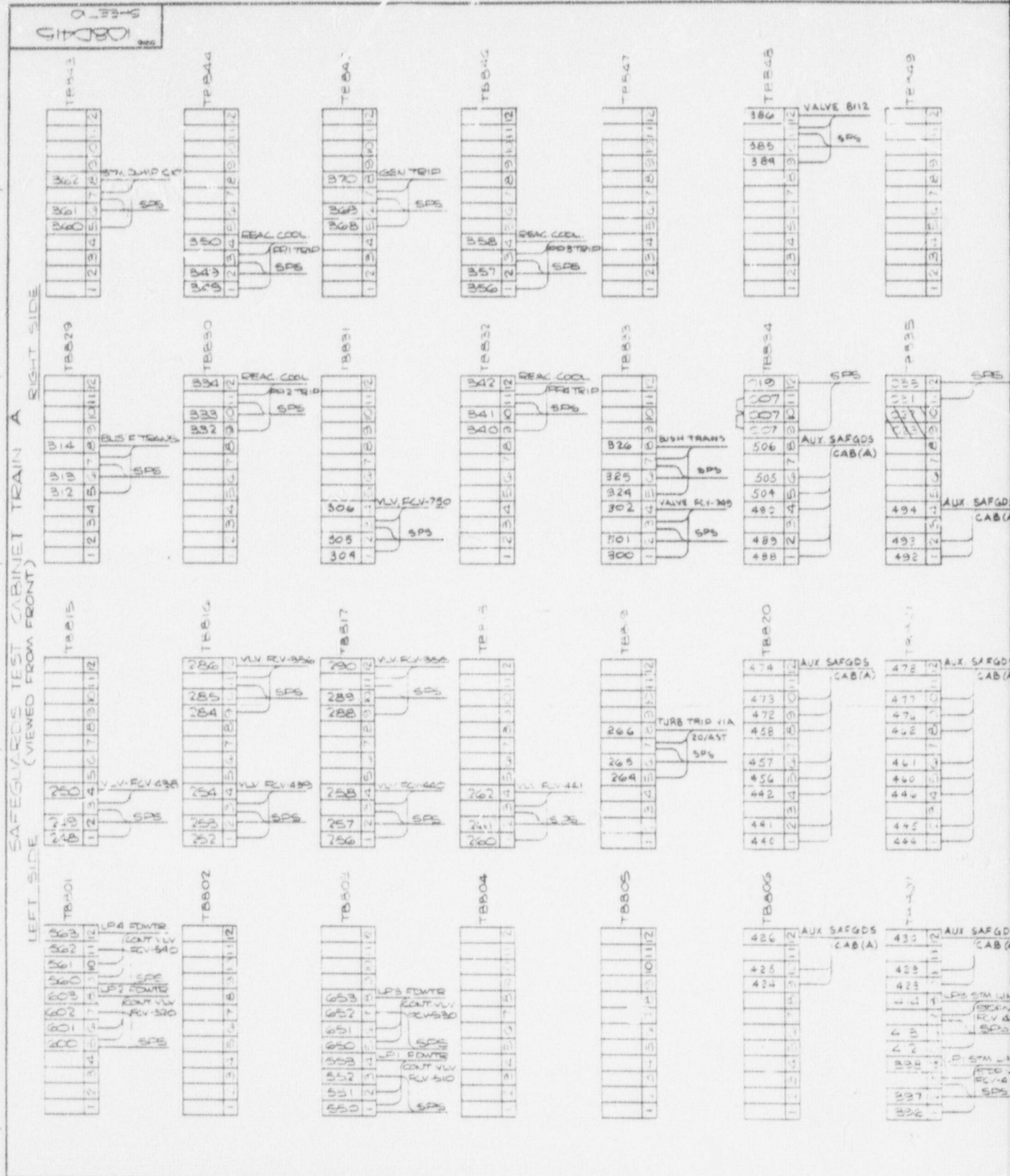
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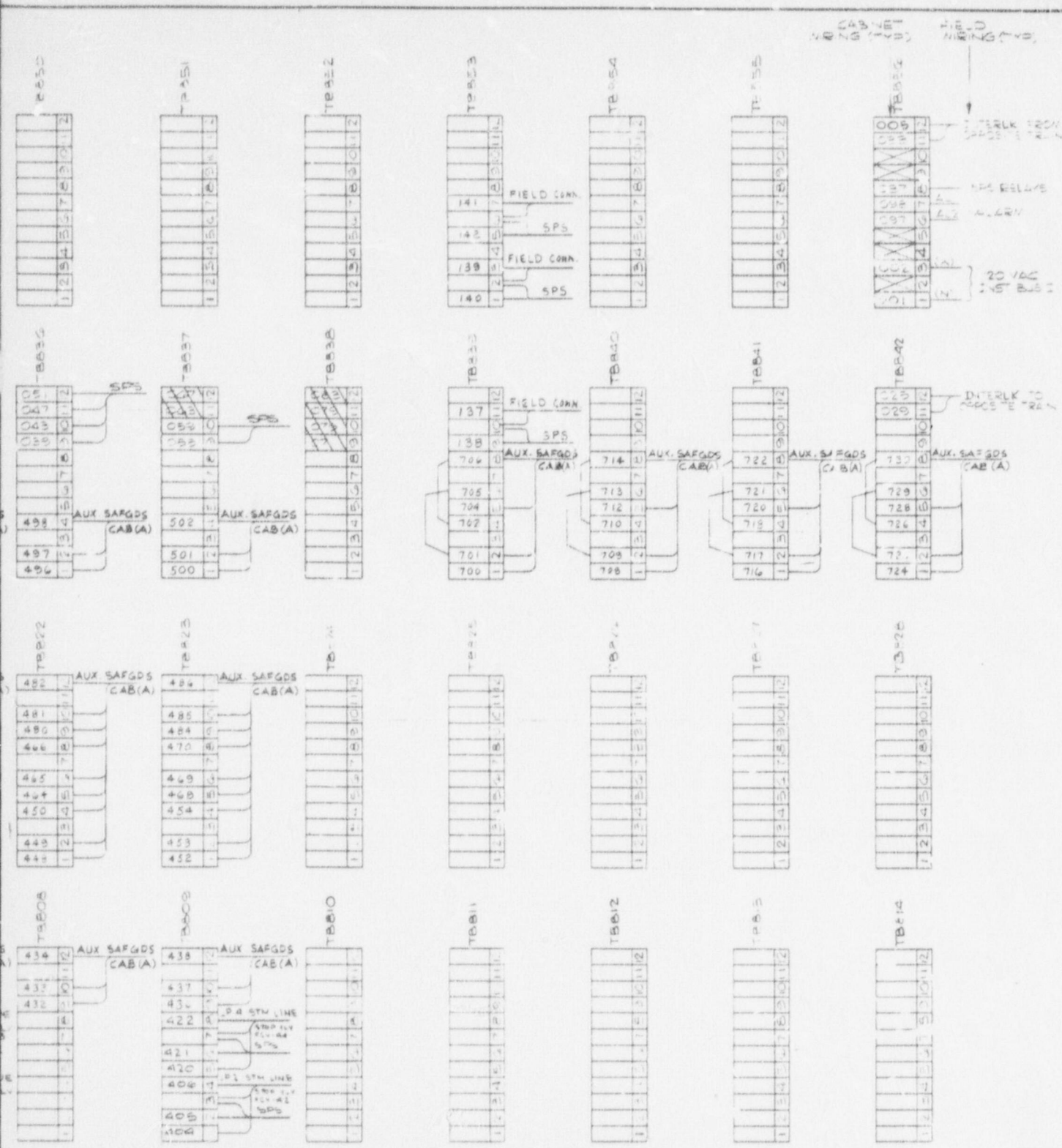


TEST RELAY CONNECTION DIAG - TRAIN B

WESTINGHOUSE ELECTRIC CORPORATION PITTSBURGH, PA. U.S.A.		TITLE: PACIFIC GAS & ELECTRIC CO. DIABLO CANYON UNITS 1&2 SAFEGUARDS TEST CABINET	
DES. ENG. APP. ENG. MTL. ENG. APP. APP. DES. SUPV.		SCALE: NTS DIMENSIONS IN INCHES: 1/8" = 1'-0" DO NOT SCALE	
SHEET NO. 3		SHEET 9	

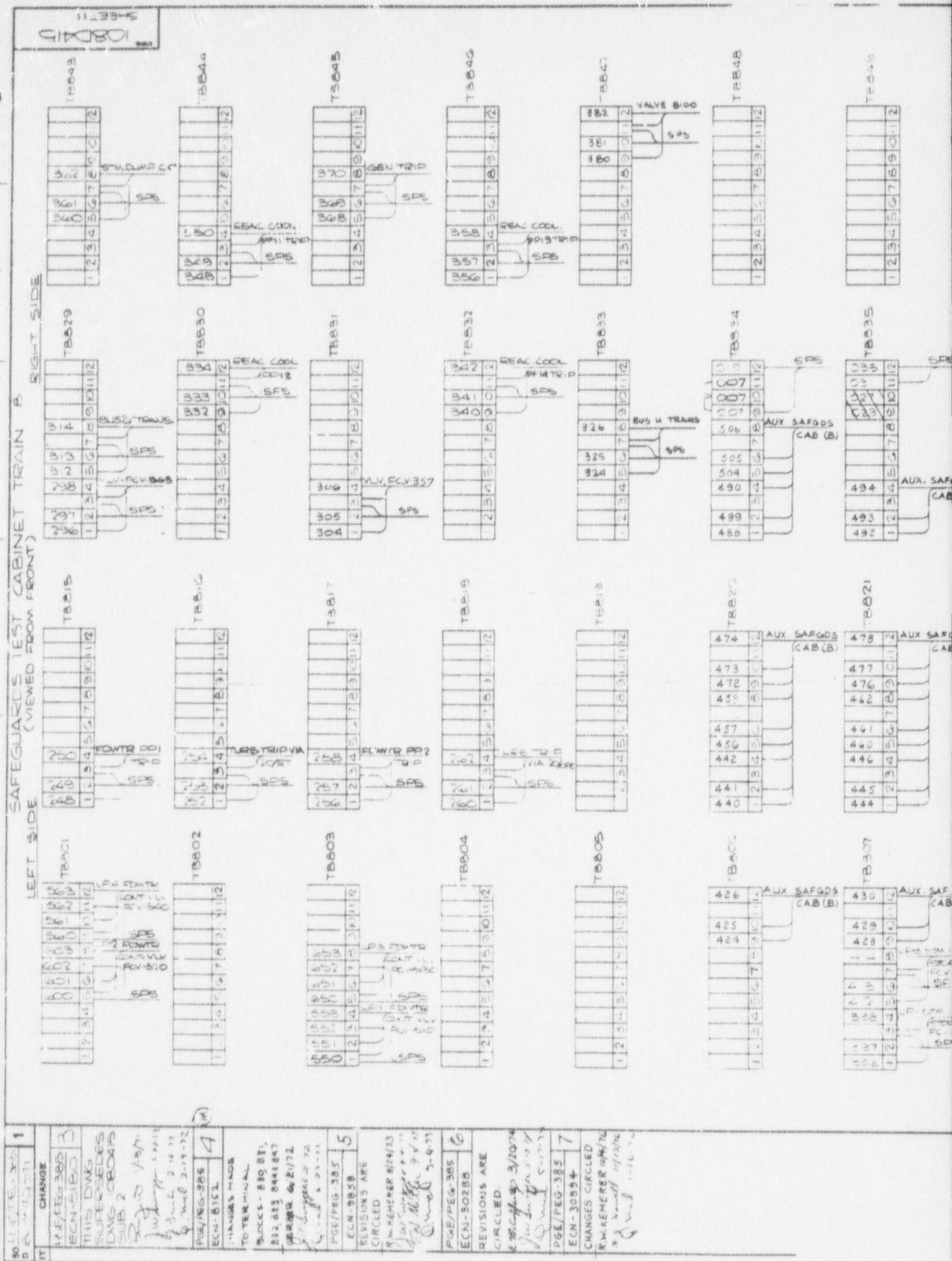
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5	02-11-71		SUITE DES
6	02-11-71		DNG DES
7	02-11-71		SUB 2
8	02-11-71		02-11-71
9	02-11-71		02-11-71
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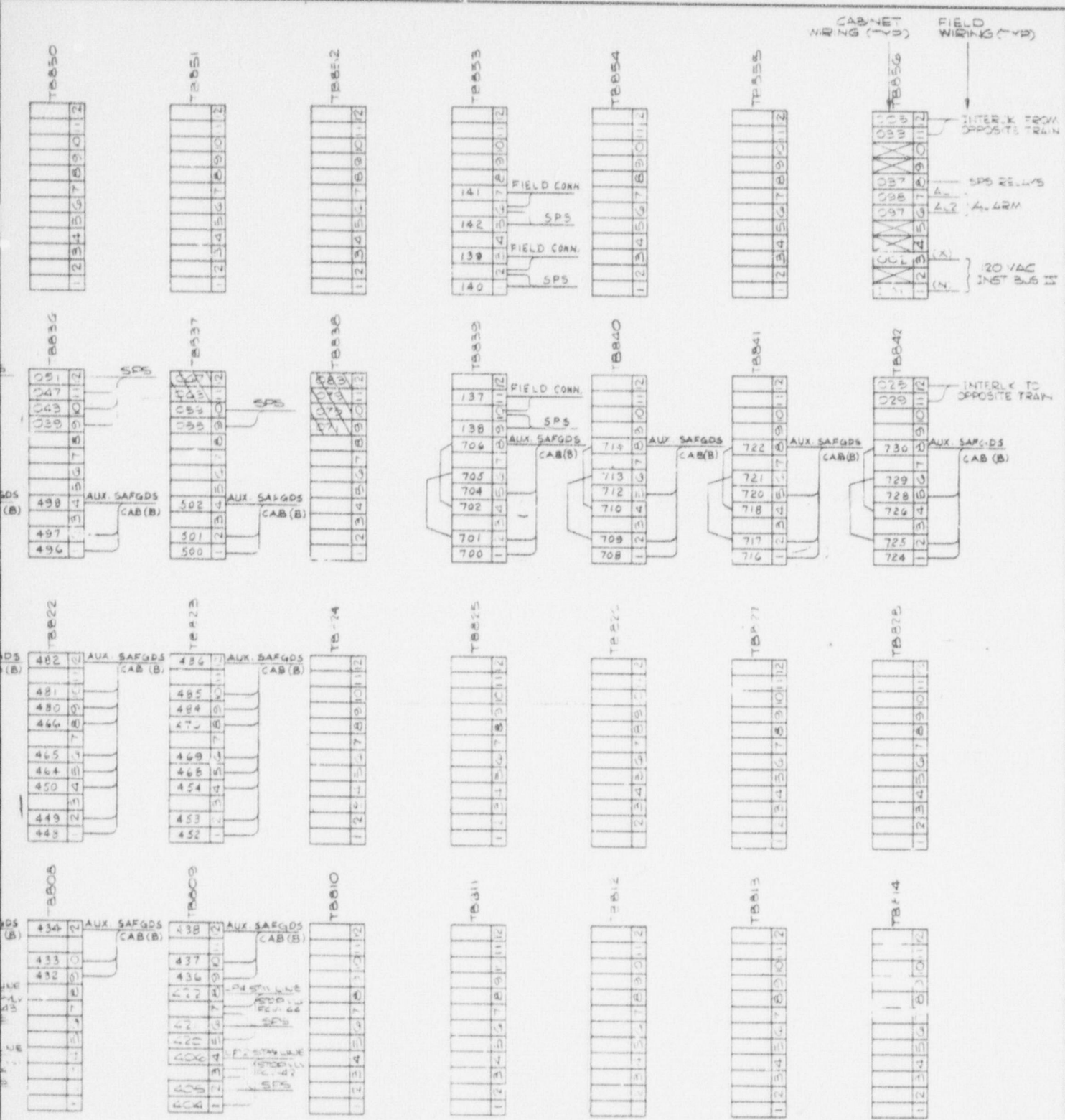




TERMINAL BLOCK CONNECTION DIAG - TRAIN A

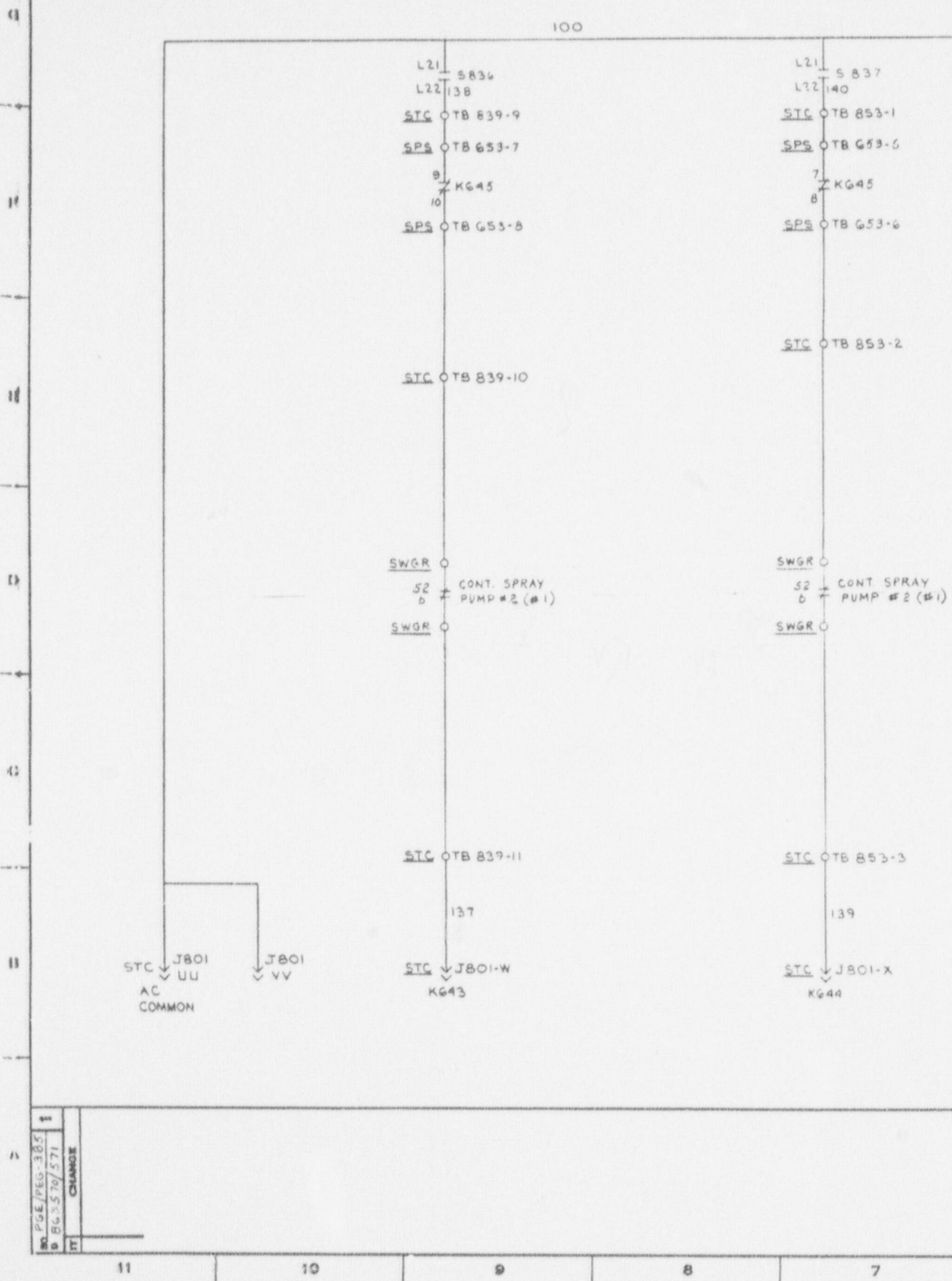
WESTINGHOUSE ELECTRIC CORPORATION NUCLEAR ENERGY SYSTEMS, PITTSBURGH, PA. U.S.A. TITLE: PACIFIC GAS & ELECTRIC CO. Diablo Canyon Units 1 & 2 SAFEGUARDS TEST CABINET		NTS SCALE DIMENSIONS IN INCHES DO NOT SCALE	10SD4'S SP1210 SUB 1X46678
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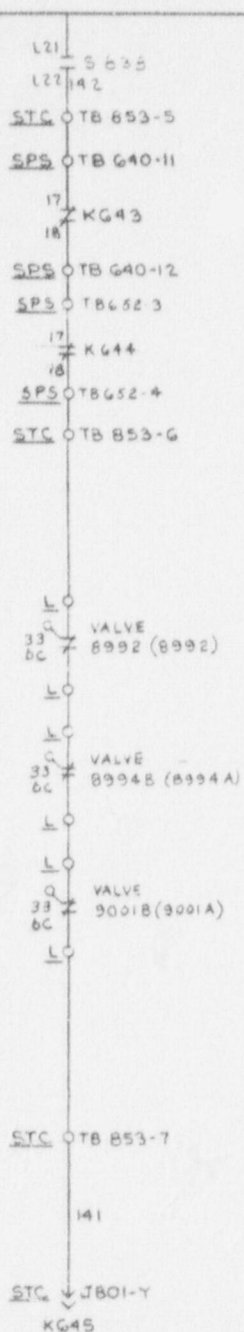




TERMINAL BLOCK CONNECTION DIAG - TRAIN B

WESTINGHOUSE ELECTRIC CORPORATION NUCLEAR ENERGY SYSTEMS DIVISION - P.O. BOX 108415 PITTSBURGH, PA. 15236-0415	
TITLE: PACIFIC GAS & ELECTRIC CO., DIABLO CANYON UNITS 1 & 2 SAFEGUARDS TEST CABINET	
NTS	108D415
SCALE	SHEET 11
DIMENSIONS IN INCHES	DWG. NO. 108D415
DO NOT SCALE	





NOTE:
SHOWN FOR TRAIN "A" INTERLOCKS. TRAIN "B" INTERLOCKS
ARE IN PARENTHESIS.

CONTAINMENT SPRAY TEST
INTERLOCK CIRCUITRY

CHECKED BY: [] DESIGNED BY: [] DRAWN BY: [] APPROVED BY: [] DATE: []	DESIGNED BY: RWKEMERER DATE: 8/2/75	Westinghouse Electric Corporation WESTINGHOUSE ELECTRIC SYSTEMS, PITTSBURGH, PA., U.S.A.
	DESIGNED BY: [] DATE: []	TITLE: PACIFIC GAS & ELECTRIC CO DIABLO CANYON UNITS 1 & 2 SAFEGUARDS TEST CABINET
	DESIGNED BY: [] DATE: []	SCALE: NTS 108 D 415 SHEET-12
	DESIGNED BY: [] DATE: []	DIMENSIONS IN INCHES DO NOT SCALE
	DESIGNED BY: [] DATE: []	SUB: 1