50-244

STATION SERVICE WATER PUMPS

ROBERT EMMETT GINNA

NUCLEAR POWER STATION

UNIT NO. 1

WESTINGHOUSE ELECTRIC CORPORATION

ATOMIC POWER DIVISION

PITTSBURGH, PENNSYLVANIA

REQUIREMENT OUTLINE

BROOKWOOD PROJECT

RO-2204

September 16, 1966

GILBERT ASSOCIATES, INC., ENGINEERS
525 Lancaster Avenue
Reading, Pennsylvania

8466
EBT

TABLE OF CONTENTS

1:00 GENERAL REQUIREMENTS

1:01 General

1:01.1 This Requirement Outline includes the essential information required by the manufacturers of power plant equipment to submit a proposal for furnishing the equipment covered by the DETAIL REQUIREMENTS, section 2:00. The equipment will be part of a nuclear-electric generating station having a nominal capacity of 450 MWe.

1:01.2 This equipment will be installed as part of the No. 1 Unit as the Ginna Project, Rochester Gas and Electric Corporation, located in Wayne County, approximately 18 miles east of Rochester, New York.

1:01.3 This electric generating unit is scheduled for commercial operation on June 1, 1969.

1:02 PROPOSALS

1:02.1 Proposals shall be drawn in the name of Gilbert Associates, Inc. as Consulting Engineers and Agent for the Westinghouse Electric Corporation, Atomic Power Division, the Prime Contractor.

1:02.2 Proposals shall be submitted as follows:

Original and five (5) copies to:

GILBERT ASSOCIATES, INC.
525 Lancaster Avenue
Reading, Pennsylvania 19603

Attention: Mr. H. F. Ulmer
Chief Purchasing Agent

1:03 DEFINITIONS

1:03.1 OWNER shall mean the Rochester Gas and Electric Corporation.

1:03.2 PRIME CONTRACTOR shall mean the Westinghouse Electric Corporation, Atomic Power Division.

1:03.3 ENGINEER shall mean Gilbert Associates, Inc., an Agent for the PRIME CONTRACTOR.

1:03.4 MANUFACTURER shall mean the successful Bidder for all equipment covered by this Requirement Outline.

1:04 EQUIPMENT QUALITY

All equipment and services offered by the Bidder shall be of such quality as to make the equipment safe with high availability. To this end, all items offered, including all accessories, shall be of proven reliability.

1:05 CODES AND STANDARDS

1:05.1 All equipment offered shall be designed and manufactured in accordance with accepted current standards of the electric utility industry and shall satisfy all applicable codes, including state and local ordinances pertaining to the design and operation of such equipment.

1:05.2 Where required, the MANUFACTURERS shall have all pressure parts stamped by a certified insurance inspector and three (3) copies of the certified inspection report forwarded to the ENGINEER.

1:06 INSPECTION

1:06.1 Inspection

Shop fabrication and field erection shall be subject to inspection and approval by the PRIME CONTRACTOR and/or ENGINEER. Any inspection by the PRIME CONTRACTOR and/or ENGINEER shall not be considered as a waiver of any warranty or other rights. The PRIME CONTRACTOR and/or ENGINEER shall have free access to the MANUFACTURER'S shops for inspection of construction and for observing shop tests. All tests required for certification of equipment shall be made at the expense of the MANUFACTURER.

1:06.2 Factory Inspection and Tests

Prior to start of manufacture, the ENGINEER is to be notified in writing at least fifteen (15) days in advance of those tests and inspections that he and/or the OWNER wish to observe. Four (4) certified copies of all factory test data are to be furnished to the ENGINEER for all tests normally supplied or as required to satisfy codes and regulatory bodies.

1:06.3 Field Tests

After installation, the PRIME CONTRACTOR reserves the right to make tests at his expense to demonstrate the ability of the equipment furnished by the MANUFACTURER to operate under the conditions specified and to meet the guaranteed performance. These tests will be conducted in accordance with the latest applicable Test Code in effect at the time of the test with such modifications as may be mutually agreed upon between the PRIME CONTRACTOR and the MANUFACTURER. If the results of the tests conducted indicate that the equipment does not meet its guaranteed performance, the MANUFACTURER shall, at his expense, make all necessary adjustments or changes to improve the performance to meet the guaranteed performance. All subsequent tests until acceptance by the PRIME CONTRACTOR shall be made at the MANUFACTURER'S expense:

1:06.4 The Bidder shall furnish a list of any field tests of the equipment which must be made during installation and initial start-up.

1:07 DRAWINGS AND INSTRUCTION BOOKS

1:07.1 Quoted price shall include the cost of furnishing three (3) reproducibles and two (2) copies of certified drawings to be submitted for approval and three (3) reproducibles of final approved drawings for record. If reproducibles are not available, quoted price shall include cost of fourteen (14) prints for approval and fourteen (14) prints of approved drawings for record.

1:07.2 Quoted price shall include the cost of thirty (30) copies of instruction books covering all equipment being furnished.

1:08 CLEANING, PAINTING AND PROTECTION

1:08.1 Every effort shall be made in the design and fabrication of the equipment to avoid dirt traps. Internal surfaces shall be free of dirt and scale prior to shipment.

1:08.2 All exposed metal surfaces, unless otherwise finished in a manner standard to a particular manufacturer, shall be painted by the MANUFACTURER in a manner approved by the ENGINEER.

1:08.3 All machined surfaces shall be adequately protected against corrosion and damage during shipment and storage.

1:08.4 All equipment shall be shipped with adequate packing and protection provided to permit outside storage at the plant site with no additional protection.

1:09 PIECE MARKING

The separate pieces of equipment shall have matching marks to facilitate assembly during erection. To facilitate unloading and erection, the weight of each major component shall be marked in a conspicuous location thereon with painted numerals at least three (3) inches high.

1:10 MOTORS AND MOTOR CONTROLS

1:10.1 Motors

All electric motors, where specified as being furnished by the bidder, shall be in accordance with the latest revision of the ENGINEER'S Specification No. SP-5201. Bidder shall supply Thomas flexible couplings and coupling guards between the motor and driven equipment.

1:10.2 Motor Controls

All motor control equipment will be furnished by others except as specified.

2:00 DETAIL REQUIREMENTS

2:01 Equipment to be Supplied

The equipment to be supplied shall include, but is not limited to the following items.

2:01.1 Four (4) Motor Driven Vertical Station Service Water Pumps.

2:01.2 Mounting of drive motors and any required couplings.

2:02 Equipment Supplied by Others

The following items will be furnished by others:

2:02.1 Foundations, anchor bolts and shims.

2:02.2 Four (4) Westinghouse A.C. drive motors for mounting by manufacture.

2:03 Design Data

2:03.1 General

Pumps shall be of the vertical centrifugal type arranged for discharge above the mounting plate and shall be equipped with a suction strainer designed for protection of the pump internals with not less than 3/8" openings.

2:03.2 Pumps

Pumps shall be of the vertical turbine type with open line shaft type construction, enclosed type impellers, water lubricated metal shaft bearings, a structurally rigid discharge head and a packed type shaft seal. Pump shall be designed for high reliability and long bearing life.

2:03.3 Pump Materials

Discharge Head	Cast Iron or Fabricated Steel
Column Pipe	Steel
Shaft	Stainless Steel
Impellers	Bronze
Bowl	Cast Iron
Wearing Ring	Bronze
Bearings	Bronze
Strainer	Stainless Steel or Non Ferrous

2:03.4 Service Conditions

Each pump shall be designed for the following service conditions:

Capacity, GPM	5300
Pump Discharge Pressure	75 Psig
Temperature	80°F
Pump Base Elevation	253'-6"
Minimum Water Level	229'-0"
Water Source	Lake Ontario
Pump Well Bottom Elevation	212'-6"

Each pump must be capable of operating in parallel with all other pumps.

2:03.5 Alternates

BIDDER is requested to submit alternate bids for any different design features which will improve the reliability of these pumps and reduce maintenance. Particular attention is called to methods of extending bearing life.

2:03.6 Seismic Design Requirements

The Station Service Water Pumps shall be capable of withstanding seismic loads equivalent to .32 g in the vertical and horizontal directions with both motions occurring simultaneously. There shall be no loss of function of the pumps when subjected to these accelerations.

3:00 DATA REQUIRED WITH PROPOSAL

BIDDER shall submit with his proposal complete data for the equipment offered. This data shall include, but is not limited to the following:

Outline and sectional drawings showing principal dimensions, operating and maintenance clearances and weights of all components.

Statement of guarantee based on design conditions.

Tabulation of all components showing materials of construction and thickness or size.

Performance curves showing TDH, NPSH efficiency and brake horsepower for various capacities.

Weight of heaviest piece to be handled for maintenance.

Minimum flow.

Pump speed.

Description of tests which are specified or recommended.

Time required to submit certified drawings after award of contract.

Time required for delivery after award of contract .

List of recommended spare parts.

Number of shaft bearings and type.

Clearance required to remove pump for maintenance.

Statement of pumps ability to meet requirements of Section 2:03.6.

4:00 PRICE AND DELIVERY

4:01 Prices

Quotations shall be submitted on a lump sum basis including transportation to the job site. Bidder shall clearly state his detailed price policy and terms of payment.

Options

Prices shall be submitted for the following:

Price for furnishing services of field engineers to supervise pump installation and start-up.

Price for any alternates.

Price additions for any special factory or field tests which the BIDDER wishes to offer or make available.

4:02 Date for Submittion of Proposals

Proposals with prices must be in the hands of the ENGINEER'S Purchasing Department not later than Noon, October 15, 1966.

4:03 Delivery

Delivery is scheduled for October 1, 1967.

...ENT SPECIFICATION COVER SHEET

...NGHOUSE FORM 54064 A

...IPMENT SPECIFICATION	DATED	REVISION NO.	DATED	ORIGINAL ISSUE	SUPERSEDES PREVIOUS REVISIONS
676228	9/1/66	0	9/1/66	X	

ATTACHMENTS

Westinghouse Dwg. 498B932
Westinghouse EDSK 329359
Westinghouse PS-292722
Westinghouse Preliminary
Outline Sketches:

MC-1257
MC-1258
MC-1259
MC-1260
MC-1261
MC-1262
MC-1263

PROJECT: ROBERT EMMETT GINNA NUCLEAR POWER STATION - UNIT NO. 1

SHOP ORDER: RGE-210

SYSTEM: ALL SYSTEMS

EQUIPMENT: AUXILIARY HEAT EXCHANGERS

COMMONWEALTH ... REGISTERED PROFESSIONAL HOWARD S. JENKINS ENGINEER ...

FOR SUPPLIER'S CONVENIENCE

REV. NO.	REVISION ENTERED BY & DATE

WESTINGHOUSE ELECTRIC CORPORATION
Atomic Power Division
P.O. Box 355
Pittsburgh, Pennsylvania, 15230

APPROVAL

	ORIGINAL ISSUE	REV. 1	REV. 2	REV. 3	REV. 4
AUTHOR	J.R. Blanchfield				
SHOP ORDER HOLDER	E W Rutzkens 9/7/66				
PROJECT MANAGER	[illegible] for E.V. Pollock 9/8/66				

COVER SHEET

Page 1 of 1 Pages

1.0 SCOPE

The intent of this specification is to set forth the general and specific requirements of design, fabrication, inspection, testing, cleaning, and packaging for tubular heat exchangers intended for use in the auxiliary systems of a nuclear power plant.

2.0 CODES AND STANDARDS REFERENCED

The heat exchangers shall be in accordance with the referenced codes and standards which are applicable to the design, fabrication, inspection, testing, cleaning, and packaging of the equipment. All references shall refer to the latest revisions, addenda, code cases, and interpretations in force as of the date of this Equipment Specification.

2.1 References Not Attached

2.1.1 Standards of Tubular Exchanger Manufacturers' Association (TEMA).

2.1.2 ASME Boiler and Pressure Vessel Code, Section II - Material Specifications

2.1.3 ASME Boiler and Pressure Vessel Code, Section III - Nuclear Vessels

2.1.4 ASME Boiler and Pressure Vessel Code, - Section VIII - Unfired Pressure Vessels - plus addenda

2.1.5 American Standard for Pipe Threads, ASA B2.1

2.1.6 American Standard for Steel Pipe Flanges and Flanged Fittings, ASA B16.5

2.1.7 American Standard for Steel Butt Welding Fittings, ASA B16.9

2.1.8 American Standard for Steel Weld Fittings, ASA B16.11

2.2 **References Attached**

2.2.1 Westinghouse Drawing 498 B 932, "Weld Preparation for Stainless Steel Pipe"

2.2.2 Westinghouse Specification PS-292722, "Cleaning and Packaging Requirements"

2.2.3 Ⓦ APD EDSK 329359, "Tube Seal Weld Requirements"

2.2.4 Westinghouse Preliminary Outline Sketches:

Number	Equipment
MC-1257	Regenerative Heat Exchanger
MC-1258	Non-regenerative Heat Exchanger
MC-1259	Excess Letdown Heat Exchanger
MC-1260	Seal Water Heat Exchanger
MC-1261	Residual Heat Exchanger
MC-1262	Component Cooling Heat Exchanger
MC-1263	Spent Fuel Pit Heat Exchanger
MC-1264	Sample Heat Exchanger

3.0 **GENERAL DESIGN REQUIREMENTS AND CONSTRUCTION DATA**

The design and construction of the heat exchangers shall be based on the requirements given in pages 1 thru 7 of this equipment specification except as modified by specific requirements for the individual heat exchangers. Any exceptions are described on the Exchanger Specification Sheets (pages 8 thru 23) and shall apply only to the particular heat exchanger. Three (3) extra sets of main flange gaskets shall be furnished for each heat exchanger and shall be tagged "Westinghouse Erection Spares".

3.1 **ASME Boiler and Pressure Vessel Code Compliance**

The design, material, fabrication, inspection, and testing of the heat exchangers shall comply with the ASME Code. The applicable section of the Code and the classification of each of the heat exchangers are indicated by the Specification Sheets. All units shall be Code stamped and shall be assigned a National Board Number.

3.2 TEMA Standards as Basis of Design and Construction

The heat exchangers shall be designed and constructed to the requirements of the Standards for Tubular Exchanger Manufacturers' Association for Class "R" heat exchangers with the following qualifications:

3.2.1 The heat exchangers and any of their component parts shall be designed to resist earthquake forces resulting from accelerations in the horizontal and vertical directions equal to 0.52g and 0.52g respectively, applied simultaneously at the center of gravity and to receive and transmit such forces through the supports to the foundations. The seismic stresses shall be interpreted as a primary stress and the sum of the primary stresses shall not exceed those permitted in Section III of the ASME Code.

3.2.2 Heat exchangers with removable shells or bundles shall have hub type shell flanges which are butt-welded to the shell. The shell flanges shall be designed for confined gaskets.

3.2.3 Flanged joints shall be designed for through bolts using stud bolts and shall have two nuts on each side.

3.2.4 A partial wrapper shall be attached to the tube support baffles opposite the shell inlet nozzle to prevent direct impingement of the inlet flow on the tube bundle. In U-tube heat exchangers the shell shall be long enough so that flow entering the shell through the nozzle near the U-bend shall not impinge upon the tubes.

3.2.5 All tubes (except in the Component Cooling Heat Exchanger) shall be seal welded to the tube-sheet in accordance with WAPD EDSK 329359.

3.2.6 All nozzles and shells shall be designed to withstand any load that the adjacent piping could impose upon them when the piping is at its yield point.

3.2.7 The units shall be capable of withstanding full shell design pressure and temperature with atmospheric pressure on the tube side, and full tube design pressure and temperature with atmospheric pressure on the shell side.

3.2.8 Carbon steel butt-weld nozzles shall have ends prepared for welding in accordance with ASA B16.5.

3.2.9 Socket-weld nozzles shall be in accordance with ASA B16.11.

3.2.10 Flanged nozzles shall be of the raised-face type conforming to ASA B16.2.

3.2.11 Screwed connections shall be in accordance with ASA B2.1.

4.0 MATERIALS OF CONSTRUCTION

All materials used in the construction of the heat exchangers shall correspond to a specification in Section II of the ASME Code and shall be as specified on the Exchanger Specification Sheet.

5.0 INSPECTION, TESTING, AND IDENTIFICATION

5.1 Inspection

5.1.1 Material Inspection

The material inspections required by the ASME Code for the Class of vessel shall be performed. In addition, the following inspections shall be performed:

5.1.1.1 All tubing shall be ultrasonically examined in accordance with Paragraph N-324.3 of Section III of the ASME Code before bending. The supplier may, at his option, use the eddy current procedure in accordance with Paragraph N-324.4 of Section III of the ASME Code.

5.1.1.2 Hot or cold formed parts such as heads, shells, etc. shall be penetrant inspected on all surfaces following final forming and cleaning, but prior to assembly in accordance with Paragraph N-627 of Section III of the ASME Code.

5.1.2 Weld Inspection

5.1.3 The weld inspections required by the ASME Code for the Class of vessel shall be performed. In addition, the following inspections shall be performed:

5.1.2.1 All ferromagnetic welds shall be magnetic particle inspected in accordance with Paragraph N-626 of Section III of the ASME Code. Defective welds disclosed by this inspection shall be chipped out, re-welded, and re-inspected.

5.1.3.2 All paramagnetic or non-magnetic welds including tube seal welds, shall be liquid penetrant inspected with penetrant according to Paragraph N-627 of Section III of the ASME Code. Defective welds disclosed by this inspection shall be ground out, re-welded, and re-inspected.

5.2 Final Testing And Inspection

Westinghouse or its designated agent shall have free access to the supplier's shop at all times during the design, fabrication, and testing of the equipment.

5.2.1 Each heat exchanger shall be subjected to a shell side gas leak test to demonstrate the integrity of the tube to tube sheet joints. This test shall be performed before any hydrotest. Any leakage shall be grounds for rejection of the weld(s). The supplier shall submit his procedure for this test for WAPD approval.

5.2.2 Each heat exchanger shall be hydrostatically tested on the shell and tube sides in accordance with the applicable paragraph of the ASME Code except that the pressure shall be maintained a minimum of thirty (30) minutes. There shall be no detectable leakage. The test water shall have a chloride content of less than 10 ppm.

5.2.3 The following shop tests and inspections will be witnessed by WAPD or its designated agent. This list may be expanded at some later date and WAPD may elect to waive witnessing of any of these tests.

a. Shell side gas test
b. Shell side hydrostatic test
c. Tube side hydrostatic test
d. Inspection of major repairs to pressure containing members
e. Final cleaning and inspection prior to shipment
f. Dimensional check of vessel

The supplier shall notify WAPD of each of the tests at least ten (10) days prior to the test.

5.3 Identification

The supplier's nameplate shall be of stainless steel or brass and shall be permanently attached to the heat exchanger shell. If the unit is to be insulated, the plate shall be mounted so that it will be flush with the outer surface of the insulation. The nameplate shall bear the following information:

a. WAPD Equipment Item Number
b. Supplier's Name and Serial Number
c. Design Pressure

d. Design Temperature
e. Hydrostatic Test Pressure and Temperature
f. Year Built
g. ASME Code Stamp and National Board Number

6.0 CLEANING

All internal stainless steel surfaces shall be cleaned in accordance with Ⓦ PS 292722-1. All carbon steel surfaces shall be cleaned to the intent of Paragraph 2.8 of Ⓦ PS 292722-1.

7.0 PAINTING

The external carbon steel portions of the heat exchangers shall be given a coat of primer. Stainless steel portions of the heat exchangers shall not be painted.

8.0 PACKAGING

8.1 Following cleaning and drying, all nozzles shall be covered and sealed to prevent the entry of dirt or other foreign matter during transit or storage.

8.2 The heat exchangers shall be adequately skid mounted to assure delivery to the plant site in an undamaged and clean condition.

9.0 INFORMATION TO BE SUBMITTED BY SUPPLIER

9.1 With Quotation

The supplier's quotation shall include the following detailed information.

a. Preliminary outline drawing showing overall dimensions, nozzle locations and dimensions, support details, and specification of all material.

b. A completed exchanger data sheet giving surface area, tube and shell pressure drops at design flow rates, dry and flooded weights, tube diameter and wall thickness, and hydrostatic test pressures.

c. List of specific exceptions to the specification with a written justification for each exception.

d. Recommended list of spare parts with price.

9.2 Following Order Placement

9.2.1 After receiving a firm order for the specified equipment the supplier shall submit two (2) reproducible copies of certified outline and general assembly drawings for WAPD approval. The following information shall be included on the drawings:

a. Overall dimensions and general assembly details of unit
b. Location and size of all connections
c. Location and size of all foundation bolts
d. Weights (dry and flooded)
e. Design pressure and temperature
f. Test pressure and temperature
g. Surface area
h. Identification of equipment (WAPD's purchase order number, supplier's order number, equipment name and equipment item number.

9.2.2 The supplier shall submit a stress report as required by Paragraph N-142 of Section III of the ASME Code. The report shall be submitted when the outline drawings are sent for WAPD approval.

9.2.3 The supplier shall submit one (1) reproducible copy or five (5) copies of all welding and non-destructive test procedures for WAPD approval. This submittal shall include evidence of welding procedure qualification in accordance with Paragraph N-541 of Section III of the ASME Code.

9.2.4 The supplier's shall furnish one (1) complete set of detail design drawings for WAPD's information and use.

9.3 Prior To Shipment Of Equipment

Prior to shipment of the equipment the supplier shall furnish the following:

a. Two (2) reproducible copies of the drawing described in Section 9.2.1 showing certified as-built dimensions.

b. Five (5) copies of the ASME Code data form (N-1)

c. Two (2) copies of chemical and physical test reports for all materials used for the heat exchangers.

d. Two (2) reproducible copies of maintenance instructions indicating recommended torque valves for flange bolts (if used) and describing the recommended tube plugging material and procedure.

EXCHANGER SPECIFICATION SHEET - A

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

SERVICE OF UNIT REGENERATIVE HEAT EXCHANGER ITEM NO.

[3] ONE REQUIRED TYPE MULTIPLE SHELL & U-TUBE CONNECTED IN

SURFACE PER UNIT SHELLS PER UNIT SURFACE PER SHELL

PERFORMANCE OF ONE UNIT

	SHELL SIDE	TUBE SIDE
FLUID CIRCULATED	WATER	WATER
TOTAL FLUID ENTERING	19760 LB/HR	14,820 LB/HR
VAPOR		
LIQUID	19,760 LB/HR	14,820 LB/HR
STEAM		
NON-CONDENSABLES		
FLUID VAPORIZED OR CONDENSED		
STEAM CONDENSED		
GRAVITY—LIQUID		
VISCOSITY—LIQUID		
MOLECULAR WEIGHT—VAPORS		
SPECIFIC HEAT—LIQUIDS	B.T.U./#	B.T.U./#
LATENT HEAT—VAPORS	B.T.U./#	B.T.U./#
TEMPERATURE IN	553.2 °F	130.0 °F
TEMPERATURE OUT	290.0 °F	499.2 °F
OPERATING PRESSURE	2250 #/SQ. IN.A	2250 #/SQ. IN.A
NUMBER OF PASSES		
VELOCITY	FT./SEC.	FT./SEC.
PRESSURE DROP - MAX. ALLOWABLE	25 #/SQ. IN.	25 #/SQ. IN.
FOULING FACTOR HR. FT.² °F/BTU	0.0003	0.0003

HEAT EXCHANGED—B.T.U./HR. 5.65 x 10⁶ BTU/HR. M.T.D. (Corrected)

TRANSFER RATE—SERVICE CLEAN

CONSTRUCTION

	SHELL SIDE	TUBE SIDE
DESIGN PRESSURE	2485 #/SQ. IN.G	2735 #/SQ. IN.G
TEST PRESSURE	#/SQ. IN.	#/SQ. IN.
DESIGN TEMPERATURE	650 °F	650 °F

TUBES SA-213 TP304 or 316 NO. O.D. BWG. LENGTH PITCH

SHELL SA-240 TYPE 304 or 316 I.D. O.D. THICKNESS

SHELL COVER SA-240 TYPE 304 or 316 FLOATING HEAD COVER

CHANNEL SA-240 TYPE 304 or 316 CHANNEL COVER SA-240 TYPE 304 or 316

TUBE SHEETS—STATIONARY SA-240 TYPE 304 OR 316 FLOATING

BAFFLES—CROSS SA-240 TYPE 304 or 316 TYPE THICKNESS

BAFFLE—LONG TYPE THICKNESS

TUBE SUPPORTS THICKNESS

GASKETS NONE - ALL WELDED CONSTRUCTION

CONNECTIONS—SHELL—IN 2" SCH. 160 OUT 2" SCH. 160 SERIES SOCKET-WELD

CHANNEL—IN 2" SCH. 160 OUT 2" SCH. 160 SERIES SOCKET-WELD

CORROSION ALLOWANCE—SHELL SIDE TUBE SIDE

CODE REQUIREMENTS - SEE SA.1 PAGE 9 TEMA CLASS R

WEIGHTS—EACH SHELL BUNDLE FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: FOR ADDITIONAL REQUIREMENTS SEE PAGE 9 : "SUPPLEMENT TO EXCHANGER SPECIFICATION SHEET-A AND A(a)"

8-5-66

WAPD #314

REVISION NO. 0 TO E-SPEC 676228

2

EXCHANGER SPECIFICATION SHEET - A (a) (ALTERNATE SPEC. SHEET)

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

(*- INDICATES INFORMATION TO BE FILLED-IN BY SUPPLIER.)

SERVICE OF UNIT REGENERATIVE HEAT EXCHANGER		ITEM NO.
SIZE	TYPE	CONNECTED IN
SURFACE PER UNIT	SHELLS PER UNIT	SURFACE PER SHELL

PERFORMANCE OF ONE UNIT

	SHELL SIDE - WATER		TUBE SIDE - WATER	
OPERATION	PURIFICATION	HEAT- UP	PURIFICATION	HEAT- UP
TOTAL FLUID ENTERING LB/HR	29,640	29,640	24,700	14,820
VAPOR				
LIQUID LB/HR.	29,640	29,640	24,700	14,820
STEAM				
NON-CONDENSABLES				
FLUID VAPORIZED OR CONDENSED				
STEAM CONDENSED				
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS				
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	552.2	552.2 °F	130.0	130.0 °F
* TEMPERATURE OUT	*	* °F	*	* °F
OPERATING PRESSURE	2250	2250 #/SQ. IN.	2250	2250 #/SQ. IN.
NUMBER OF PASSES				
VELOCITY		FT./SEC.		FT./SEC.
* PRESSURE DROP	*	* #/SQ. IN.	*	25 #/SQ. IN.

HEAT EXCHANGED—B.T.U./HR. PURIF: 5.65×10^6 / HEAT-UP: 5.65×10^6 M.T.D. (Corrected)

TRANSFER RATE—SERVICE CLEAN

CONSTRUCTION - SEE PAGE 8.

DESIGN PRESSURE	#/SQ. IN.	#/SQ. IN.
TEST PRESSURE	#/SQ. IN.	#/SQ. IN.
DESIGN TEMPERATURE	°F	°F

TUBES	NO.	O.D. BWG.	LENGTH PITCH
SHELL		I.D. O.D.	THICKNESS
SHELL COVER			FLOATING-HEAD COVER
CHANNEL			CHANNEL COVER
TUBE SHEETS—STATIONARY			FLOATING
BAFFLES—CROSS		TYPE	THICKNESS
BAFFLE—LONG		TYPE	THICKNESS
TUBE SUPPORTS			THICKNESS
GASKETS			
CONNECTIONS—SHELL—IN		OUT	SERIES
CHANNEL—IN		OUT	SERIES
CORROSION ALLOWANCE—SHELL SIDE			TUBE SIDE
CODE REQUIREMENTS			TEMA CLASS
WEIGHTS—EACH SHELL		BUNDLE	FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: FOR ADDITIONAL REQUIREMENTS SEE PAGE 9: "SUPPLEMENT TO EXCHANGER SPECIFICATION SHEET - A AND A(a)"

NOTE: TEMP. MUST BE LESS THAN 250°F.

5-5-66

WAPD #314

REVISION NO. 0 OF E-SPEC. 676226

SUPPLEMENT

TO

EXCHANGER SPECIFICATION SHEETS - A and A(a)

SA.1 The Regenerative Heat Exchanger shall meet all the requirements of Section III of the ASME Code for a Class A Nuclear Vessel and shall be so stamped.

SA.2 The heat exchanger shall be designed to withstand the thermal stresses resulting from 24,000 step changes of shell side fluid temperature from 130°F to 552.2°F.

SA.3 Insulation clips shall be provided on the shell for 3 inches of insulation.

SA.4 The attached Westinghouse sketch MC-1257 shows the general size and arrangement of the subject heat exchanger assumed for plant layout purposes. The supplier's base proposal shall be in accordance with this sketch. However, should some other size or arrangement be more economical, the supplier shall submit his alternate design and price with his quotation.

SA.5 The supplier shall size the Regenerative Heat Exchanger based on the data presented on Page 8. He shall then indicate the outlet temperatures and pressure drops which his unit will yield when operating under the two alternate conditions set forth on page 8a.

SA.6 The three shells of the Regenerative Heat Exchanger shall be stacked vertically on saddles or brackets in the shop. All interconnecting piping shall be installed in the supplier's shop.

[illegible]

[illegible]

EXCHANGER SPECIFICATION SHEET - B

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

SERVICE OF UNIT RESIDUAL HEAT EXCHANGER		ITEM NO.
TWO REQUIRED	TYPE SHELL & U-TUBE	CONNECTED IN
SURFACE PER UNIT	SHELLS PER UNIT	SURFACE PER SHELL

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	WATER		WATER	
TOTAL FLUID ENTERING	1,375,000 LB/HR		763,000 LB/HR	
VAPOR				
LIQUID	1,375,000 LB/HR		763,000 LB/HR	
STEAM				
NON-CONDENSABLES				
FLUID VAPORIZED OR CONDENSED				
STEAM CONDENSED				
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS				
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS	-	B.T.U./#		B.T.U./#
TEMPERATURE IN	100.0	°F	160.0	°F
TEMPERATURE OUT	117.5	°F	128.4	°F
OPERATING PRESSURE	75	#/SQ. IN.G	400	#/SQ. IN.G
NUMBER OF PASSES				
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP - MAX. ALLOWABLE	15	#/SQ. IN.	15	#/SQ. IN.
FOULING FACTOR - HR·FT²·°F/BTU	0.0005		0.0005	

HEAT EXCHANGED—B.T.U./HR.	24.15 × 10⁶ BTU/HR.	M.T.D. (Corrected)	
TRANSFER RATE—SERVICE		CLEAN	

CONSTRUCTION

	SHELL SIDE		TUBE SIDE	
DESIGN PRESSURE	150	#/SQ. IN.G	500	#/SQ. IN.G
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.
DESIGN TEMPERATURE	350	°F	400	°F

TUBES SA-213 TP 304 or 316 NO.	O.D. BWG.	LENGTH PITCH
SHELL SA-106 C.S.	I.D. O.D.	THICKNESS
SHELL COVER SA-234 C.S.		FLOATING HEAD COVER
CHANNEL SA-240 TYPE 304 or 316		CHANNEL COVER SA-240 TYPE 304 or 316
TUBE SHEETS—STATIONARY SA-240 TYPE 304 or 316		FLOATING
BAFFLES—CROSS SA-285 C.S.	TYPE	THICKNESS
BAFFLE—LONG	TYPE	THICKNESS
TUBE SUPPORTS		THICKNESS
GASKETS SHELL: SS JACKETED ASBESTOS; TUBE: FLEXITALLIC OR EQUAL		
CONNECTIONS—SHELL—IN 10" SCH. 40	OUT 10" SCH. 40	SERIES 150 LB. RF FLANGE
CHANNEL—IN 8" SCH. 40S	OUT 8" SCH. 40S	SERIES BUTT-WELD
CORROSION ALLOWANCE—SHELL SIDE		TUBE SIDE
CODE REQUIREMENTS SEE SB.1 PAGE 11		TEMA CLASS R
WEIGHTS—EACH SHELL	BUNDLE	FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS:

FOR ADDITIONAL REQUIREMENTS SEE PAGE 11 : "SUPPLEMENT TO EXCHANGER SPECIFICATION SHEET - B"

8-29-66

WAPD #314

REVISION NO. 0 TO E-SPEC. 676228	

SUPPLEMENT

TO

EXCHANGER SPECIFICATION SHEET - B

SB.1 The tube side of the Residual Heat Exchanger shall meet all the requirements of Section III of the ASME Boiler and Pressure Vessel Code for a Class A Nuclear Vessel and shall be so stamped. The shell side of the Residual Heat Exchanger shall meet all the requirements of Section III of the ASME Boiler and Pressure Vessel Code for a Class C Nuclear Vessel and shall be so stamped.

SB.2 The heat exchanger shall be designed to withstand the thermal stresses resulting from 200 step changes of tube side fluid temperature from 85°F to 350°F.

SB.3 The attached Westinghouse sketch MC 1261 shows the general size and arrangement of the subject heat exchanger assumed for plant layout purposes. The supplier's base proposal shall be in accordance with this sketch. However, should some other size or arrangement be more economical, the supplier shall submit his alternate design and price with his quotation.

EXCHANGER SPECIFICATION SHEET - C

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

SERVICE OF UNIT	SEAL WATER HEAT EXCHANGER			ITEM NO.	
[illegible] ONE REQUIRED		TYPE	SHELL & U-TUBE	CONNECTED IN	
SURFACE PER UNIT		SHELLS PER UNIT		SURFACE PER SHELL	

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	WATER		WATER	
TOTAL FLUID ENTERING	32,000 LB/HR		24,700 LB/HR	
VAPOR				
LIQUID	32,000 LB/HR		24,700 LB/HR	
STEAM				
NON-CONDENSABLES				
FLUID VAPORIZED OR CONDENSED				
STEAM CONDENSED				
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS				
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	95.0	°F	152.5	°F
TEMPERATURE OUT	115.0	°F	127.0	°F
OPERATING PRESSURE		#/SQ. IN.		#/SQ. IN.
NUMBER OF PASSES				
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP MAX. ALLOWABLE	15	#/SQ. IN.	15	#/SQ. IN.
FOULING FACTOR - HR.FT.² °F/BTU	0.0005		0.0003	

HEAT EXCHANGED—B.T.U./HR.	6.40×10^5	M.T.D. (Corrected)	
TRANSFER RATE—SERVICE		CLEAN	

CONSTRUCTION

	SHELL SIDE		TUBE SIDE	
DESIGN PRESSURE	150	#/SQ. IN.G	150	#/SQ. ING
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.
DESIGN TEMPERATURE	250	°F	200	°F

TUBES SA-213 TP 304 or 316 NO.	O.D. BWG.	LENGTH	PITCH
SHELL SA-106 C.S.	I.D. O.D.	THICKNESS	
SHELL COVER SA-234 C.S.		FLOATING HEAD COVER	
CHANNEL SA-240 TYPE 304 or 316		CHANNEL COVER SA-240 TYPE 304 or 316	
TUBE SHEETS—STATIONARY		FLOATING	
BAFFLES—CROSS SA-285 C.S.	TYPE	THICKNESS	
BAFFLE—LONG	TYPE	THICKNESS	
TUBE SUPPORTS		THICKNESS	
GASKETS - SS JACKETED ASBESTOS			
CONNECTIONS—SHELL—IN 2" SCH. 40	OUT 2" SCH. 40	SERIES 150 LB R.F. FLANGES	
CHANNEL—IN 3" SCH. 40S	OUT 3" SCH. 40S	SERIES BW	
CORROSION ALLOWANCE—SHELL SIDE		TUBE SIDE	
CODE REQUIREMENTS SEC SC.I PAGE 13		TEMA CLASS R	
WEIGHTS—EACH SHELL	BUNDLE	FULL OF WATER	

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: FOR ADDITIONAL REQUIREMENTS SEE PAGE 13 : "SUPPLEMENT TO EXCHANGER SPECIFICATION SHEET - C"

8-5-66

WAPD #314

REVISION NO. 0 TO E-SPEC: 676228

SUPPLEMENT

TO

EXCHANGER SPECIFICATION SHEET - C

SC.1 The Seal Water Heat Exchanger shall meet all the requirements of Section III of the ASME Code for a Class C Nuclear Vessel and shall be so stamped.

SC.2 The attached Westinghouse sketch MC-1260 shows the general size and arrangement of the subject heat exchanger assumed for plant layout purposes. The supplier's base proposal shall be in accordance with this sketch. However, should some other size or arrangement be more economical, the supplier shall submit his alternate design and price with his quotation.

[illegible]

EXCHANGER SPECIFICATION SHEET - D

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

SERVICE OF UNIT COMPONENT COOLING HEAT EXCHANGER		ITEM NO.
[illegible] TWO REQUIRED	TYPE FIXED TUBE SHEETS	CONNECTED IN
SURFACE PER UNIT	SHELLS PER UNIT	SURFACE PER SHELL

PERFORMANCE OF ONE UNIT

	SHELL SIDE	TUBE SIDE
FLUID CIRCULATED	WATER	WATER
TOTAL FLUID ENTERING	1.475 × 10^6 LB/HR.	2.53 × 10^6 LB/HR.
VAPOR		
LIQUID	1.475 × 10^6 LB/HR.	2.53 × 10^6 LB/HR.
STEAM		
NON-CONDENSABLES		
FLUID VAPORIZED OR CONDENSED		
STEAM CONDENSED		
GRAVITY—LIQUID		
VISCOSITY—LIQUID		
MOLECULAR WEIGHT—VAPORS		
SPECIFIC HEAT—LIQUIDS	B.T.U./#	B.T.U./#
LATENT HEAT—VAPORS	B.T.U./#	B.T.U./#
TEMPERATURE IN	117.0 °F	80.0 °F
TEMPERATURE OUT	100.0 °F	89.9 °F
OPERATING PRESSURE	75 #/SQ. IN.	75 #/SQ. IN.
NUMBER OF PASSES		
VELOCITY	FT./SEC.	FT./SEC.
PRESSURE DROP MAX. ALLOWABLE	15 #/SQ. IN.	15 #/SQ. IN.
FOULING FACTOR - HR. FT.² °F/BTU	0.0005	0.001

HEAT EXCHANGED—B.T.U./HR. 25.15 × 10^6	M.T.D. (Corrected)
TRANSFER RATE—SERVICE	CLEAN

CONSTRUCTION

	SHELL SIDE	TUBE SIDE
DESIGN PRESSURE	150 #/SQ. IN.	150 #/SQ. IN.
TEST PRESSURE	#/SQ. IN.	#/SQ. IN.
DESIGN TEMPERATURE	200 °F	200 °F

TUBES ADMIRALTY	NO.	O.D. BWG.	LENGTH PITCH
SHELL SA-106 C.S.		I.D. O.D.	THICKNESS
SHELL COVER NONE			FLOATING HEAD COVER
CHANNEL ADMIRALTY			CHANNEL COVER ADMIRALTY
TUBE SHEETS—STATIONARY ADMIRALTY			FLOATING
BAFFLES—CROSS SA-285 C.S.		TYPE	THICKNESS
BAFFLE—LONG		TYPE	THICKNESS
TUBE SUPPORTS			THICKNESS
GASKETS: [illegible] JACKETED ASBESTOS			
CONNECTIONS—SHELL—IN 10" SCH. 40		OUT 10" SCH. 40	SERIES PW
CHANNEL—IN 16" SCH. 40		OUT 16" SCH. 40	SERIES PW
CORROSION ALLOWANCE—SHELL SIDE			TUBE SIDE
CODE REQUIREMENTS - [illegible]			TEMA CLASS R
WEIGHTS—EACH SHELL		BUNDLE	FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: [illegible] SEE PAGE [illegible] "SUPPLEMENT TO EXCHANGER SPECIFICATION SHEET - D"

WAPD #314

REVISION NO. 0 TO E-SPEC. 676228	PAGE 14 OF 33 PAGES

SUPPLEMENT

TO

EXCHANGER SPECIFICATION SHEET - D

SD.1 The Component Cooling Heat Exchanger shall meet all the requirements of Section III of the ASME Code for a Class C Nuclear Vessel and shall be so stamped.

SD.2 The attached Westinghouse sketch MC-1262 shows the general size and arrangement of the subject heat exchanger assumed for plant layout purposes. The supplier's base proposal shall be in accordance with this sketch. However, should some other size or arrangement be more economical, the supplier shall submit his alternate design and price with his quotation.

EXCHANGER SPECIFICATION SHEET - E

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

SERVICE OF UNIT EXCESS LETDOWNHEAT EXCHANGER		ITEM NO.
E?? ONE REQUIRED	TYPE SHELL & U-TUBE	CONNECTED IN
SURFACE PER UNIT	SHELLS PER UNIT	SURFACE PER SHELL

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE	
FLUID CIRCULATED	WATER		WATER	
TOTAL FLUID ENTERING	53,700 LB/HR		4940 LB/HR	
VAPOR				
LIQUID	53,700 LB/HR		4940 LB/HR	
STEAM				
NON-CONDENSABLES				
FLUID VAPORIZED OR CONDENSED				
STEAM CONDENSED				
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS				
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#		B.T.U./#
TEMPERATURE IN	95.0	°F	552.2	°F
TEMPERATURE OUT	130.0	°F	195.0	°F
OPERATING PRESSURE		#/SQ. IN.	2250	#/SQ. IN.
NUMBER OF PASSES				
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP- MAX. ALLOWABLE	15	#/SQ. IN.	50	#/SQ. IN.
FOULING FACTOR- HR. FT.² °F/BTU	0.0005		0.0003	

HEAT EXCHANGED—B.T.U./HR. 1.881 x 10⁶ BTU/HR	M.T.D. (Corrected)
TRANSFER RATE—SERVICE	CLEAN

CONSTRUCTION

	SHELL SIDE		TUBE SIDE	
DESIGN PRESSURE	150	#/SQ. IN.G	2485	#/SQ. IN.G
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.
DESIGN TEMPERATURE	250	°F	650	°F

TUBES SA-213 TP 304 or 316 NO.	O.D.	BWG.	LENGTH / PITCH
SHELL SA-106 C.S.	I.D.	O.D.	THICKNESS
SHELL COVER SA-234 C.S.			FLOATING HEAD COVER
CHANNEL SA-240 TYPE 304 OR 316			CHANNEL COVER SA-240 TYPE 304 OR 316
TUBE SHEETS—STATIONARY SA-240 TYPE 304 OR 316			FLOATING
BAFFLES—CROSS SA-285 C.S.	TYPE		THICKNESS
BAFFLE—LONG	TYPE		THICKNESS
TUBE SUPPORTS			THICKNESS
GASKETS SHELL: SS JACKETED ASBESTOS			TUBE: FLEXITALLIC OR EQUAL
CONNECTIONS—SHELL—IN 2" SCH. 40	OUT 2" SCH. 40		SERIES 150# R.F. FLANGES
CHANNEL—IN 3/4" SCH. 160	OUT 3/4" SCH. 160		SERIES SW
CORROSION ALLOWANCE—SHELL SIDE			TUBE SIDE
CODE REQUIREMENTS SEE SE-1 PAGE 17			TEMA CLASS R
WEIGHTS—EACH SHELL	BUNDLE		FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: FOR ADDITIONAL REQUIREMENTS SEE PAGE 17 : "SUPPLEMENT TO EXCHANGER SPECIFICATION SHEET - E"

8-2-66

WAPD #314

REVISION NO. 0 TO E-SPEC. 676228

SUPPLEMENT

TO

EXCHANGER SPECIFICATION SHEET - E

SE.1 The tube side of the Excess Letdown Heat Exchanger shall meet all the requirements of Section III of the ASME Boiler and Pressure Vessel Code for a Class A Nuclear Vessel and shall be so stamped. The shell side of the Excess Letdown Heat Exchanger shall meet all the requirements of Section III of the ASME Boiler and Pressure Vessel Code for a Class C Nuclear Vessel and shall be so stamped.

SE.2 The heat exchanger shall be designed to withstand the thermal stresses resulting from 12,000 step changes of tube side fluid temperature from 85°F to 555°F.

SE.3 The attached Westinghouse sketch MC 1259 shows the general size and arrangement of the subject heat exchanger assumed for plant layout purposes. The supplier's base proposal shall be in accordance with this sketch. However, should some other size or arrangement be more economical, the supplier shall submit his alternate design and price with his quotation.

EXCHANGER SPECIFICATION SHEET- F

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

SERVICE OF UNIT SPENT FUEL PIT HEAT EXCHANGER		ITEM NO.
[illegible] ONE REQUIRED	TYPE SHELL & U-TUBE	CONNECTED IN
SURFACE PER UNIT	SHELLS PER UNIT	SURFACE PER SHELL

PERFORMANCE OF ONE UNIT

	SHELL SIDE	TUBE SIDE
FLUID CIRCULATED	WATER	WATER
TOTAL FLUID ENTERING	349,000 LB/HR.	272,000 LB/HR
VAPOR		
LIQUID	349,000 LB/HR.	272,000 LB/HR
STEAM		
NON-CONDENSABLES		
FLUID VAPORIZED OR CONDENSED		
STEAM CONDENSED		
GRAVITY—LIQUID		
VISCOSITY—LIQUID		
MOLECULAR WEIGHT—VAPORS		
SPECIFIC HEAT—LIQUIDS	B.T.U./#	B.T.U./#
LATENT HEAT—VAPORS	B.T.U./#	B.T.U./#
TEMPERATURE IN	80.0 °F	120.0 °F
TEMPERATURE OUT	95.2 °F	100.5 °F
OPERATING PRESSURE	#/SQ. IN.	#/SQ. IN.
NUMBER OF PASSES		
VELOCITY	FT./SEC.	FT./SEC.
PRESSURE DROP MAX. ALLOWABLE	15 #/SQ. IN.	10 #/SQ. IN.
FOULING FACTOR- HR.FT.² °F/BTU	0.001	0.0005

HEAT EXCHANGED—B.T.U./HR. 5.3 × 10⁶	M.T.D. (Corrected)
TRANSFER RATE—SERVICE	CLEAN

CONSTRUCTION

	SHELL SIDE	TUBE SIDE
DESIGN PRESSURE	150 #/SQ. IN.G	150 #/SQ. IN.
TEST PRESSURE	#/SQ. IN.	#/SQ. IN.
DESIGN TEMPERATURE	200 °F	200 °F

TUBES SA-213 TP304 or 316 NO.	O.D.	BWG.	LENGTH / PITCH SQUARE
SHELL SA-106 C.S.	I.D. O.D.		THICKNESS
SHELL COVER SA-234 C.S.			FLOATING HEAD COVER
CHANNEL SA-240 TYPE 304 or 316			CHANNEL COVER SA-240 TYPE 304 or 316
TUBE SHEETS—STATIONARY SA-240 TYPE 304 or 316			FLOATING
BAFFLES—CROSS SA 285 C.S.	TYPE		THICKNESS
BAFFLE—LONG	TYPE		THICKNESS
TUBE SUPPORTS			THICKNESS
GASKETS - SHELL: SS JACKETED ASBESTOS			TUBE: FLEXITALLIC OR EQUAL
CONNECTIONS—SHELL—IN 4" SCH. 40	OUT 4" SCH. 40		SERIES 150 LB RF FLANGES
CHANNEL—IN 4" SCH. 40S	OUT 4" SCH. 40S		SERIES BW
CORROSION ALLOWANCE—SHELL SIDE			TUBE SIDE
CODE REQUIREMENTS SEE SF.1, PAGE 19			TEMA CLASS R
WEIGHTS—EACH SHELL	BUNDLE		FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: [illegible] REQUIREMENTS SEE PAGE 19: "SUPPLEMENT TO [illegible] SPECIFICATION SHEET- F"

S.S.A.G.

WAPD #314

REVISION NO. 0 TO E-SPEC. 676228

SUPPLEMENT

TO

EXCHANGER SPECIFICATION SHEET - F

SF.1 The Spent Fuel Pit Heat Exchanger shall meet all the requirements of Section III of the ASME Code for a Class C Nuclear Vessel and shall be so stamped.

SF.2 The attached Westinghouse sketch MC 1263 shows the general size and arrangement of the subject heat exchanger assumed for plant layout purposes. The supplier's base proposal shall be in accordance with this sketch. However, should some other size or arrangement be more economical, the supplier shall submit his alternate design and price with his quotation.

[illegible]

EXCHANGER SPECIFICATION SHEET - G

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

SERVICE OF UNIT SAMPLE HEAT EXCHANGER ITEM NO.

[illegible] ONE REQUIRED TYPE ONE SHELL; 3 COILED TUBES CONNECTED IN PARALLEL

SURFACE PER UNIT SHELLS PER UNIT SURFACE PER SHELL

PERFORMANCE OF ONE UNIT

	SHELL SIDE		TUBE SIDE		
FLUID CIRCULATED	WATER		TUBE "A"	TUBE "B"	TUBE "C"
TOTAL FLUID ENTERING - LB/HR	20,000		209	209	209
VAPOR					
LIQUID (WATER) - LB/HR.	20,000			209	209
STEAM (SAT.) - LB/HR.			209		
NON-CONDENSABLES					
FLUID VAPORIZED OR CONDENSED					
STEAM CONDENSED - LB/HR.			209		
GRAVITY—LIQUID					
VISCOSITY—LIQUID					
MOLECULAR WEIGHT—VAPORS					
SPECIFIC HEAT—LIQUIDS		B.T.U./#			B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#			B.T.U./#
TEMPERATURE IN	105.0	°F	653.0	653.0	653.0 °F
TEMPERATURE OUT	130.0	°F	127.0	127.0	127.0 °F
OPERATING PRESSURE	75	#/SQ. IN.A	2250	2250	2250 #/SQ. IN.A
NUMBER OF PASSES					
VELOCITY		FT./SEC.			25 FT./SEC.
PRESSURE DROP - MAX. ALLOWABLE	25	#/SQ. IN.	~~10~~ 25	~~10~~ 25	~~10~~ #/SQ. IN.
FOULING FACTOR - HR.FT.²°F/BTU	0.0005		0.0003	0.0003	0.0003

HEAT EXCHANGED—B.T.U./HR. (TOTAL TUBES A B & C) 4.67×10^5 M.T.D. (Corrected)

TRANSFER RATE—SERVICE EACH TUBE: 2.14×10^5 BTU/HR (DESIGN [illegible]) CLEAN

CONSTRUCTION

	SHELL SIDE		TUBE SIDE	
DESIGN PRESSURE	150	#/SQ. IN.G	2485	#/SQ. IN.G
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.
DESIGN TEMPERATURE	350	°F	680	°F

TUBES SA-213 TP 304 or 316 NO. 3 O.D. 3/8" BWG. 16 LENGTH PITCH

SHELL SA-106 C.S. I.D. O.D. THICKNESS

SHELL COVER SA-234 C.S FLOATING HEAD COVER

CHANNEL NONE CHANNEL COVER

TUBE SHEETS—STATIONARY NONE FLOATING

BAFFLES—CROSS TYPE THICKNESS

BAFFLE—LONG TYPE THICKNESS

TUBE SUPPORTS THICKNESS

GASKETS NONE - ALL WELDED CONSTRUCTION

CONNECTIONS—SHELL—IN 2" OUT 2" SERIES SOCKET-WELD

CHANNEL—IN 3/8" O.D. TUBE OUT 3/8" O.D. TUBE SERIES SOCKET-WELD

CORROSION ALLOWANCE—SHELL SIDE TUBE SIDE

CODE REQUIREMENTS SEE SG.1 PAGE 21 TEMA CLASS R

WEIGHTS—EACH SHELL BUNDLE FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: FOR ADDITIONAL REQUIREMENTS SEE PAGE 21 - "SUPPLEMENT TO EXCHANGER SPECIFICATION SHEET - G"

5-3-66

WAPD #314

REVISION NO. 0 TO E-SPEC. 676228

SUPPLEMENT

TO

EXCHANGER SPECIFICATION SHEET - G

SG.1 The tube side of the Sample Heat Exchanger shall meet all the requirements of Section III of the ASME Boiler and Pressure Vessel Code for a Class A Nuclear Vessel and shall be so stamped. The shell side of the Sample Heat Exchanger shall meet all the requirements of Section III of the ASME Boiler and Pressure Vessel Code for a Class C Nuclear Vessel and shall be so stamped.

SG.2 The heat exchanger shall be designed to withstand the thermal stresses resulting from 36,000 cycles of step changes of tube side fluid temperature from 85°F to 665°F.

SG.3 The heat exchanger shall have three separate tube side flow paths coiled within a single shell. Each tube shall be suitable for the heat transfer duty specified on page 20.

SG.4 The tubes shall be seal welded at the tube-to-shell joints.

SG.5 The attached Westinghouse sketch MC 1264 shows the general size and arrangement of the subject heat exchanger assumed for plant layout purposes. The supplier's base proposal shall be in accordance with this sketch. However, should some other size or arrangement be more economical, the supplier shall submit his alternate design and price with his quotation.

EXCHANGER SPECIFICATION SHEET - J

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

SERVICE OF UNIT NON-REGENERATIVE HEAT EXCHANGER		ITEM NO.
SIZE ONE REQUIRED	TYPE SHELL & U-TUBE	CONNECTED IN
SURFACE PER UNIT	SHELLS PER UNIT	SURFACE PER SHELL

PERFORMANCE OF ONE UNIT (HEAT-UP)

	SHELL SIDE	TUBE SIDE
FLUID CIRCULATED	WATER	WATER
TOTAL FLUID ENTERING	246,500 LB/HR.	29,640 LB/HR.
VAPOR		
LIQUID	246,500 LB/HR	29,640 LB/HR.
STEAM		
NON-CONDENSABLES		
FLUID VAPORIZED OR CONDENSED		
STEAM CONDENSED		
GRAVITY—LIQUID		
VISCOSITY—LIQUID		
MOLECULAR WEIGHT—VAPORS		
SPECIFIC HEAT—LIQUIDS	B.T.U./#	B.T.U./#
LATENT HEAT—VAPORS	B.T.U./#	B.T.U./#
TEMPERATURE IN	95 °F	371 °F
TEMPERATURE OUT	127 °F	127 °F
OPERATING PRESSURE	#/SQ. IN.	#/SQ. IN.
NUMBER OF PASSES		
VELOCITY	FT./SEC.	FT./SEC.
PRESSURE DROP (MAX. ALLOWABLE)	25 #/SQ. IN.	25 #/SQ. IN.
FOULING FACTOR - HR.FT.²°F/BTU	0.0005	0.0003

HEAT EXCHANGED—B.T.U./HR. 7.4 × 10⁶	M.T.D. (Corrected)
TRANSFER RATE—SERVICE	CLEAN

CONSTRUCTION

	SHELL SIDE	TUBE SIDE
DESIGN PRESSURE	150 #/SQ. IN.	500 #/SQ. IN.
TEST PRESSURE	#/SQ. IN.	#/SQ. IN.
DESIGN TEMPERATURE	250 °F	400 °F

TUBES SA-213 TP 304 or 316 NO.	O.D. BWG.	LENGTH PITCH
SHELL SA-106 C.S.	I.D. O.D.	THICKNESS
SHELL COVER SA-234 C.S.		FLOATING HEAD COVER
CHANNEL SA-240 TYPE 304 or 316		CHANNEL COVER SA-240 TYPE 304 or 316
TUBE SHEETS—STATIONARY SA-240 TYPE 304 or 316		FLOATING
BAFFLES—CROSS SA-285 C.S.	TYPE	THICKNESS
BAFFLE—LONG	TYPE	THICKNESS
TUBE SUPPORTS		THICKNESS
GASKETS SHELL: SS JACKETED ASBESTOS.		TUBE: FLEXITALLIC OR EQUAL
CONNECTIONS—SHELL—IN 4" SCH. 40	OUT 4" SCH. 40	SERIES 150 LB RF FLANGE
CHANNEL—IN 2" SCH. 40S	OUT 2" SCH. 40S	SERIES SW
CORROSION ALLOWANCE—SHELL SIDE		TUBE SIDE
CODE REQUIREMENTS - SEE SJ.1 PAGE 23		TEMA CLASS R
WEIGHTS—EACH SHELL	BUNDLE	FULL OF WATER

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: FOR ADDITIONAL REQUIREMENTS SEE PAGE 23 "SUPPLEMENT TO EXCHANGER SPECIFICATION SHEET - J"

3-5-66

WAPD #314

REVISION NO. 0 TO E-SPEC. 676228

EXCHANGER SPECIFICATION SHEET - J (a) (ALTERNATE SPEC. SHEET)

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

(*- INDICATES INFORMATION TO BE FILLED IN BY SUPPLIER.)

SERVICE OF UNIT NON-REGENERATIVE HEAT EXCHANGER		ITEM NO.
SIZE	TYPE	CONNECTED IN
SURFACE PER UNIT	SHELLS PER UNIT	SURFACE PER SHELL

PERFORMANCE OF ONE UNIT

	SHELL SIDE - WATER		TUBE SIDE - [illegible]	
~~[illegible]~~ OPERATION	PURIFICATION	NORMAL	PURIFICATION	NORMAL
* TOTAL FLUID ENTERING LB/HR	*	*	29,640	19,760
VAPOR				
* LIQUID LB/HR	*	*	29,640	19,760
STEAM				
NON-CONDENSABLES				
FLUID VAPORIZED OR CONDENSED				
STEAM CONDENSED				
GRAVITY—LIQUID				
VISCOSITY—LIQUID				
MOLECULAR WEIGHT—VAPORS				
SPECIFIC HEAT—LIQUIDS		B.T.U./#		B.T.U./#
LATENT HEAT—VAPORS		B.T.U./#	SEE NOTE (1)	B.T.U./#
* TEMPERATURE IN	95.0	95.0 °F	*	293.4 °F
TEMPERATURE OUT.	127.0	127.0 °F	127.0	127.0 °F
OPERATING PRESSURE	100	100 #/SQ. IN.	300	300 #/SQ. IN.
NUMBER OF PASSES				
VELOCITY		FT./SEC.		FT./SEC.
PRESSURE DROP		#/SQ. IN.		#/SQ. IN.

* HEAT EXCHANGED—B.T.U./HR. PURIF: * // NORMAL: 3.29×10⁶	M.T.D. (Corrected)
TRANSFER RATE—SERVICE	CLEAN

CONSTRUCTION - SEE PAGE 22

DESIGN PRESSURE		#/SQ. IN.		#/SQ. IN.
TEST PRESSURE		#/SQ. IN.		#/SQ. IN.
DESIGN TEMPERATURE		°F		°F
TUBES NO.	O.D.	BWG.	LENGTH	PITCH
SHELL	I.D. O.D.		THICKNESS	
SHELL COVER			FLOATING-HEAD COVER	
CHANNEL			CHANNEL COVER	
TUBE SHEETS—STATIONARY			FLOATING	
BAFFLES—CROSS	TYPE		THICKNESS	
BAFFLE—LONG	TYPE		THICKNESS	
TUBE SUPPORTS			THICKNESS.	
GASKETS				
CONNECTIONS—SHELL—IN	OUT		SERIES	
CHANNEL—IN	OUT		SERIES	
CORROSION ALLOWANCE—SHELL SIDE			TUBE SIDE	
CODE REQUIREMENTS			TEMA CLASS	
WEIGHTS—EACH SHELL	BUNDLE		FULL OF WATER	

NOTE: INDICATE AFTER EACH PART WHETHER STRESS RELIEVED (S. R.) AND WHETHER RADIOGRAPHED (X-R)

REMARKS: [illegible] ADDITIONAL REQUIREMENTS - SEE PAGE [illegible] "SUPPLEMENT TO EXCHANGER SPECIFICATION SHEET - J AND J(a)"

NOTE [illegible] SUPPLIER'S TEMP OUT FROM SHELL OF REGENERATIVE HX DURING [illegible] TEMP. INCREASE DUE TO PRESSURE REDUCTION.

[illegible]-8-66

WAPD #314

REVISION NO. 0 TO E-SPEC. 676226

SUPPLEMENT

TO

EXCHANGER SPECIFICATION SHEET - J and J(a)

SJ.1 The tube side of the Non-Regenerative Heat Exchanger shall meet all the requirements of Section III of the ASME Boiler and Pressure Vessel Code for a Class A Nuclear Vessel and shall be so stamped. The shell side of the Non-Regenerative Heat Exchanger shall meet all the requirements of Section III of the ASME Boiler and Pressure Vessel Code for a Class C Nuclear Vessel and shall be so stamped.

SJ.2 The Non-Regenerative Heat Exchanger shall be designed to withstand the thermal stresses resulting from 24,000 step changes in tube step changes in tube side fluid temperature from 85°F to 300°F.

SJ.3 The supplier shall size the Non-Regenerative Heat Exchanger based on the data presented on Page 22. He shall then indicate the outlet temperatures and pressure drops which his unit will yield when operating under the two alternate conditions set forth on page 22a.

SJ.4 The attached Westinghouse sketch MC 1258 shows the general size and arrangement of the subject heat exchanger assumed for plant layout purposes. The supplier's base proposal shall be in accordance with this sketch. However, should some other size or arrangement be more economical, the supplier shall submit his alternate design and price with his quotation.

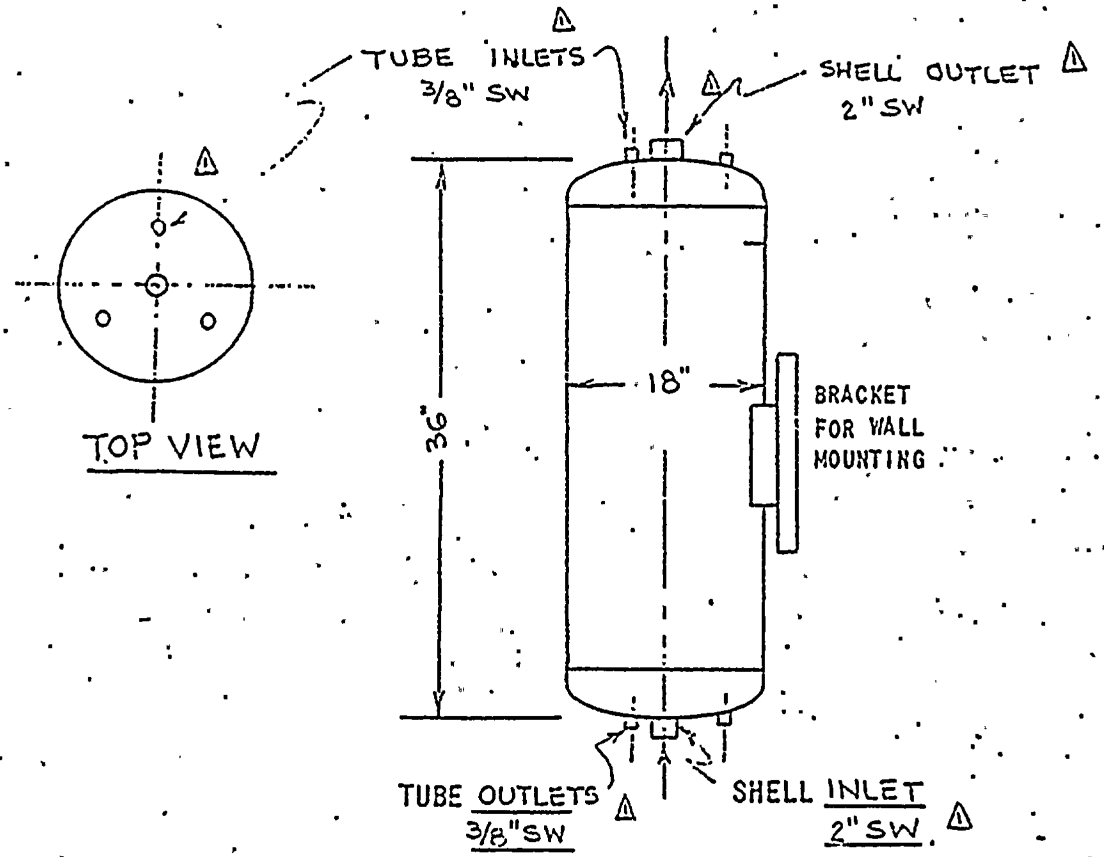
WESTINGHOUSE ELECTRIC CORPORATION
ATOMIC POWER DIVISION

PRELIMINARY OUTLINE SKETCH

DUTY REQUIREMENTS

EQUIPMENT SAMPLE HEAT EXCHANGER
SYSTEM SAMPLING
PROJECT GINNA
ITEM NO.

SPECIAL REQUIREMENTS, & FEATURES



NOTE: DIMENSIONS SHOWN ARE APPROXIMATE AND ARE GIVEN FOR REFERENCE ONLY. SKETCH IS NOT TO SCALE.

APPROX. DRY WT. 500 LBS.

SKETCH NO. MC-1264
DATE 3-24-66 / REV. 1
ENGINEER JRB

SKETCH REFERENCE

WESTINGHOUSE FORM 54319 A

WESTINGHOUSE ELECTRIC CORPORATION
ATOMIC POWER DIVISION

PRELIMINARY OUTLINE SKETCH

DUTY REQUIREMENTS

UA = 70,800 BTU/HR. °F

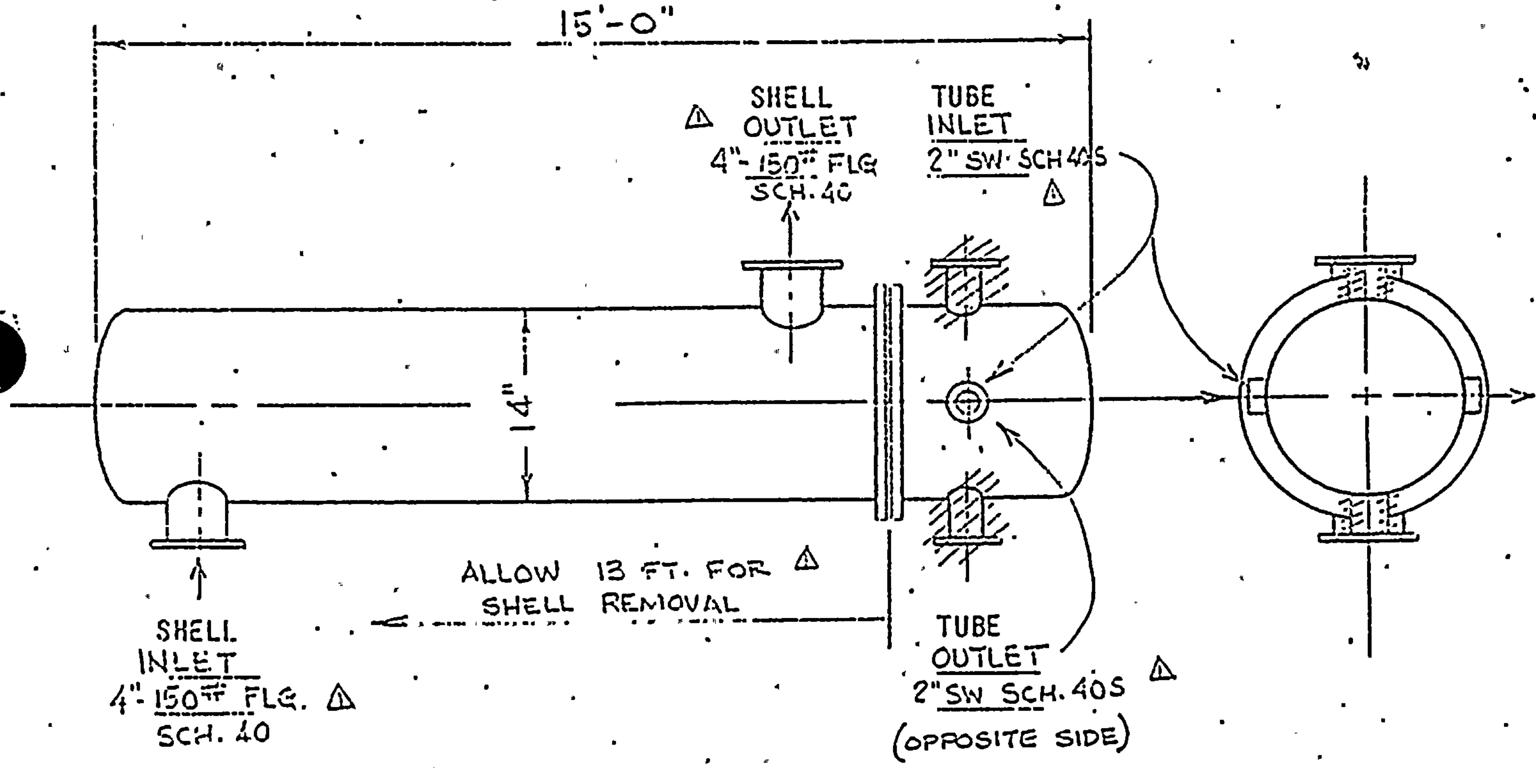
EQUIPMENT Non-Regenerative HX

SYSTEM Chemical & Volume Contl

PROJECT Ginna △

ITEM NO. ______

SPECIAL REQUIREMENTS, & FEATURES



~~CAN BE~~ INSTALLED VERTICALLY ~~OR HORIZONTALLY~~ △

APPROX. DRY WT. 1700 LBS.

NOTE: DIMENSIONS SHOWN ARE APPROXIMATE
AND ARE GIVEN FOR REFERENCE ONLY
SKETCH IS NOT TO SCALE

SKETCH NO. MC-1258

DATE 3-24-66 / REV. △ 8-5-66

SKETCH REFERENCE XA

ENGINEER JRB

WESTINGHOUSE FORM 54316

WESTINGHOUSE ELECTRIC CORPORATION
ATOMIC POWER DIVISION

PRELIMINARY OUTLINE SKETCH

DUTY REQUIREMENTS

UA = 8400 BTU/HR·°F.

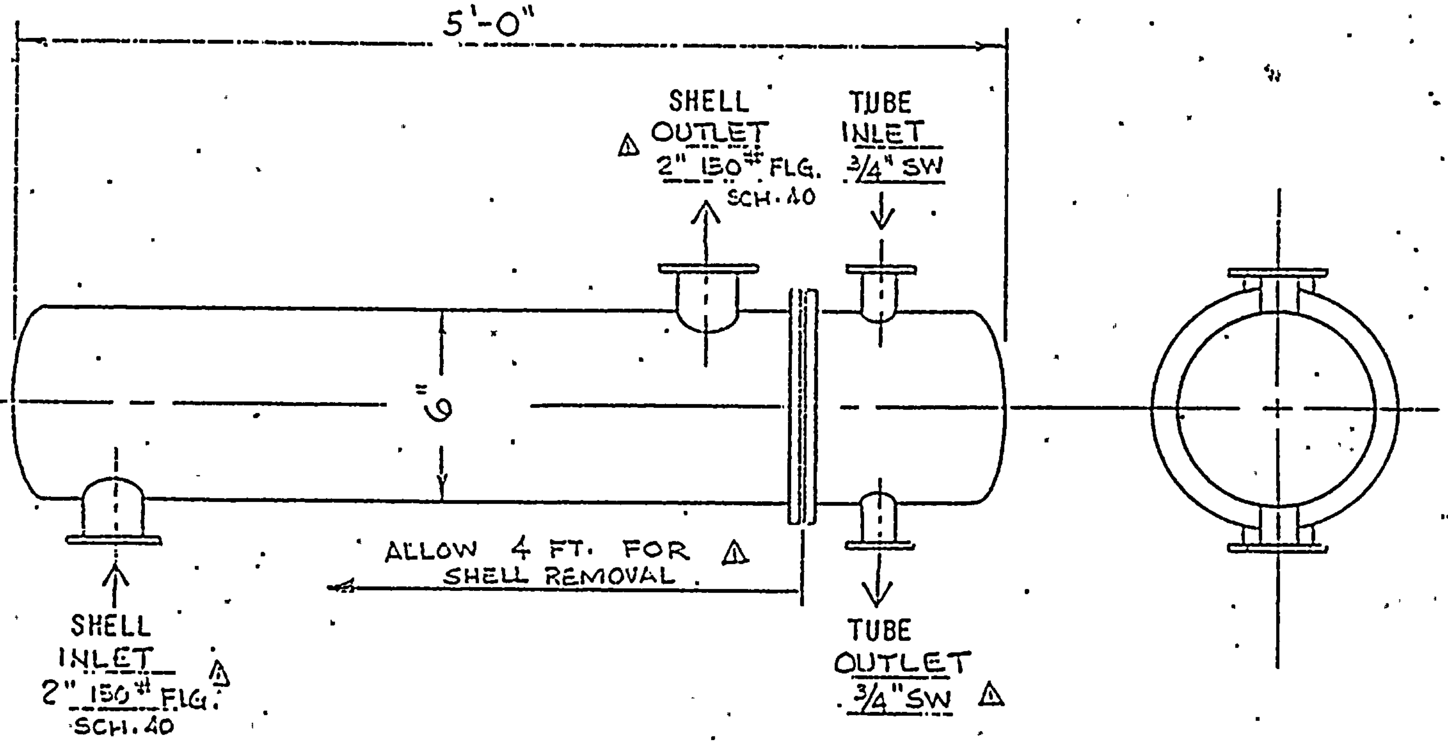
SPECIAL REQUIREMENTS. & FEATURES

EQUIPMENT Excess Letdown Heat Exchr.

SYSTEM Chemical & Volume Contl.

PROJECT Ginna

ITEM NO.



~~MAY BE~~ INSTALLED ~~VERTICALLY OR~~ HORIZONTALLY

APPROX. DRY WT. 200 LBS.

NOTE: DIMENSIONS SHOWN ARE APPROXIMATE AND ARE GIVEN FOR REFERENCE ONLY. SKETCH IS NOT TO SCALE

SKETCH REFERENCE XA

SKETCH NO. MC-1259

DATE 3-24-66 / REV. 8-5-66

ENGINEER JRB

WESTINGHOUSE FORM 54316

WESTINGHOUSE ELECTRIC CORPORATION
ATOMIC POWER DIVISION

PRELIMINARY OUTLINE SKETCH

DUTY REQUIREMENTS

UA = 271,000 BTU/HR·°F

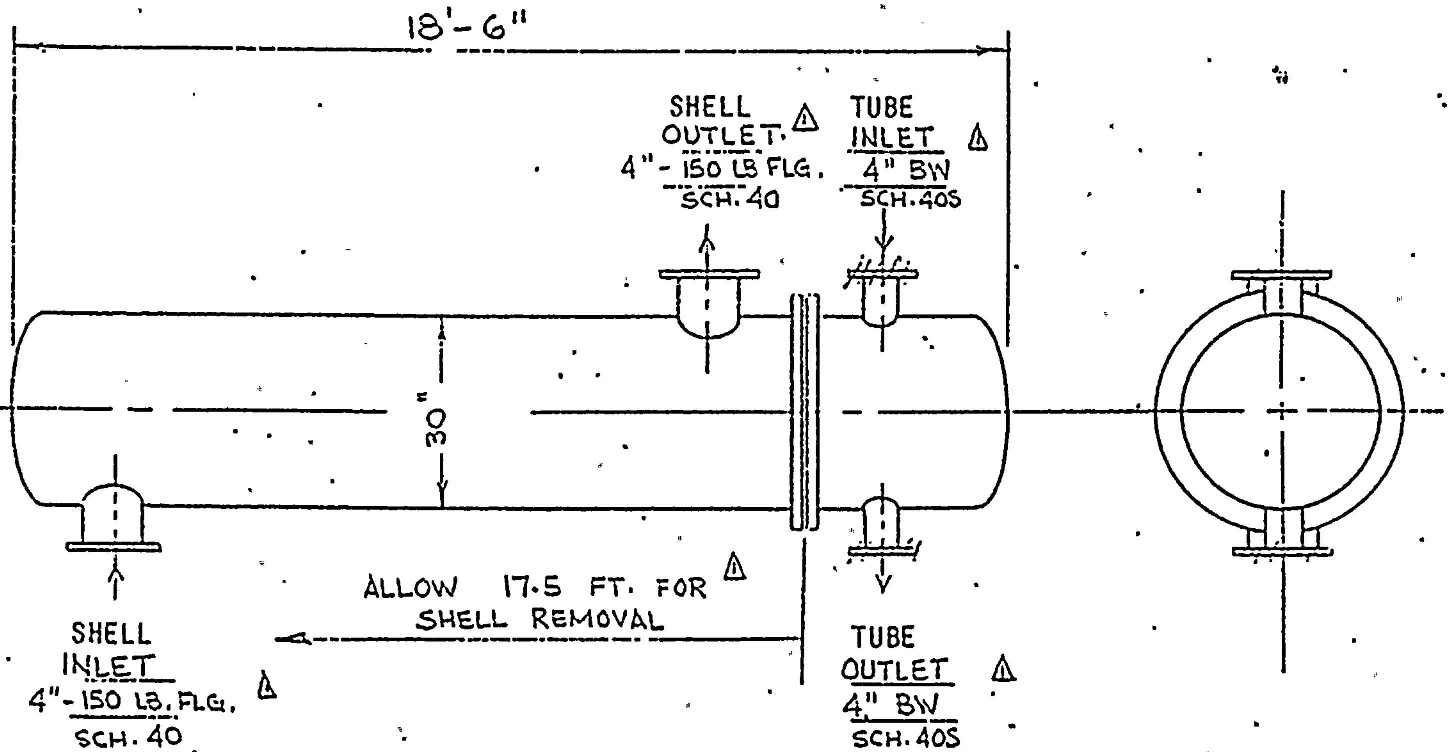
EQUIPMENT Spent Fuel Pit Heat Exc

SYSTEM Auxiliary Coolant

PROJECT Ginna △

ITEM NO.

SPECIAL REQUIREMENTS, & FEATURES



~~MAY BE~~ INSTALLED ~~VERTICALLY OR~~ HORIZONTALLY △

APPROX. DRY WT. 7600 LBS. (FLOODED: 12,500 LBS.)

NOTE: DIMENSIONS SHOWN ARE APPROXIMATE
AND ARE GIVEN FOR REFERENCE ONLY
SKETCH IS NOT TO SCALE

SKETCH NO. MC-1263

DATE 3-24-66 / REV. △ 8-5-66

SKETCH REFERENCE CASF

ENGINEER JRB

WESTINGHOUSE FORM 54316

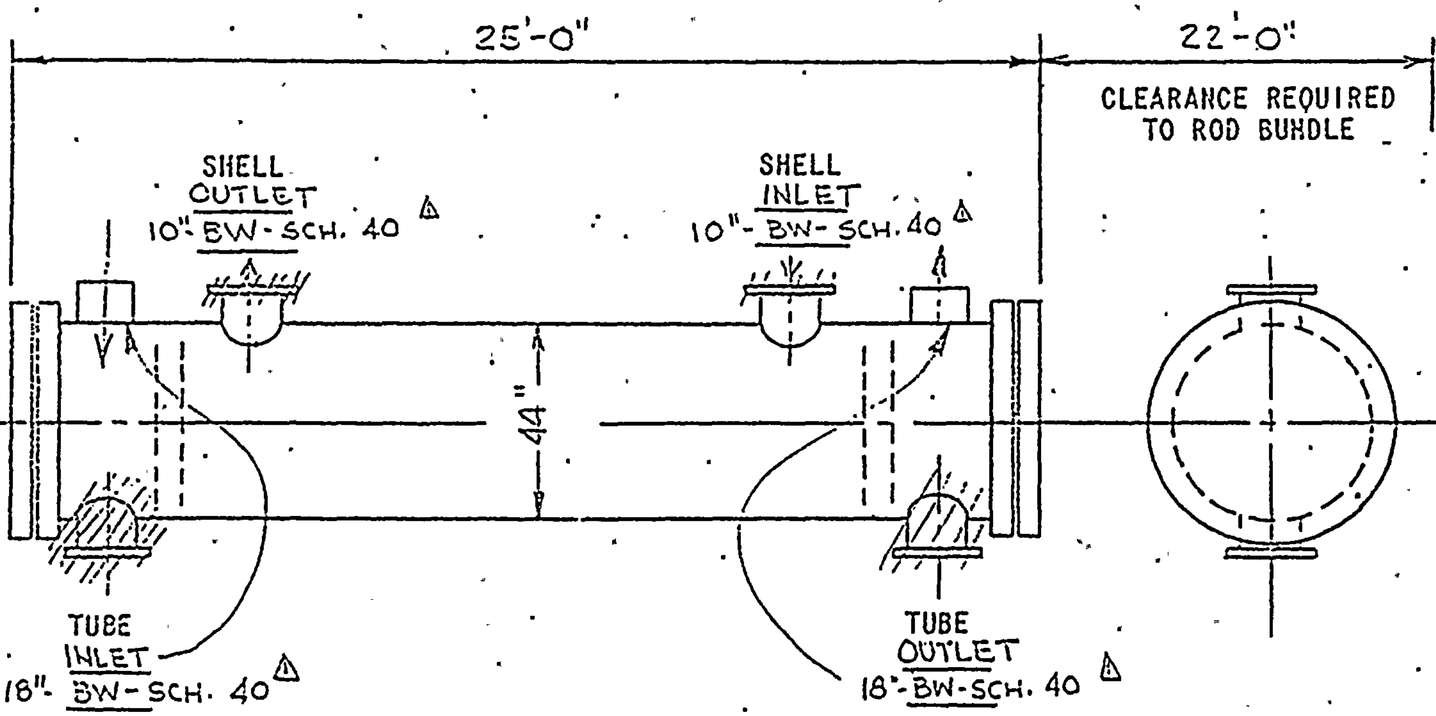
WESTINGHOUSE ELECTRIC CORPORATION
ATOMIC POWER DIVISION

PRELIMINARY OUTLINE SKETCH

DUTY REQUIREMENTS
$UA = 10.74 \times 10^5$

SPECIAL REQUIREMENTS, & FEATURES

EQUIPMENT COMPONENT COOLING HX
SYSTEM AUXILIARY COOLANT
PROJECT GINNA △
ITEM NO.



UNIT ~~MAY BE~~ MOUNTED ~~EITHER~~ HORIZONTALLY ~~OR VERTICALLY~~. △

APPROX. DRY WT. 27,000 LBS. △

NOTE: DIMENSIONS SHOWN ARE APPROXIMATE AND ARE GIVEN FOR REFERENCE ONLY. SKETCH IS NOT TO SCALE

SKETCH REFERENCE CACC

SKETCH NO. MC-1262
DATE 3-24-66 / REV. △ 8-29-66
ENGINEER JRB.

WESTINGHOUSE FORM 54315

WESTINGHOUSE ELECTRIC CORPORATION
ATOMIC POWER DIVISION

PRELIMINARY OUTLINE SKETCH

DUTY REQUIREMENTS

UA = 7.48 10^5 BTU/HR·°F

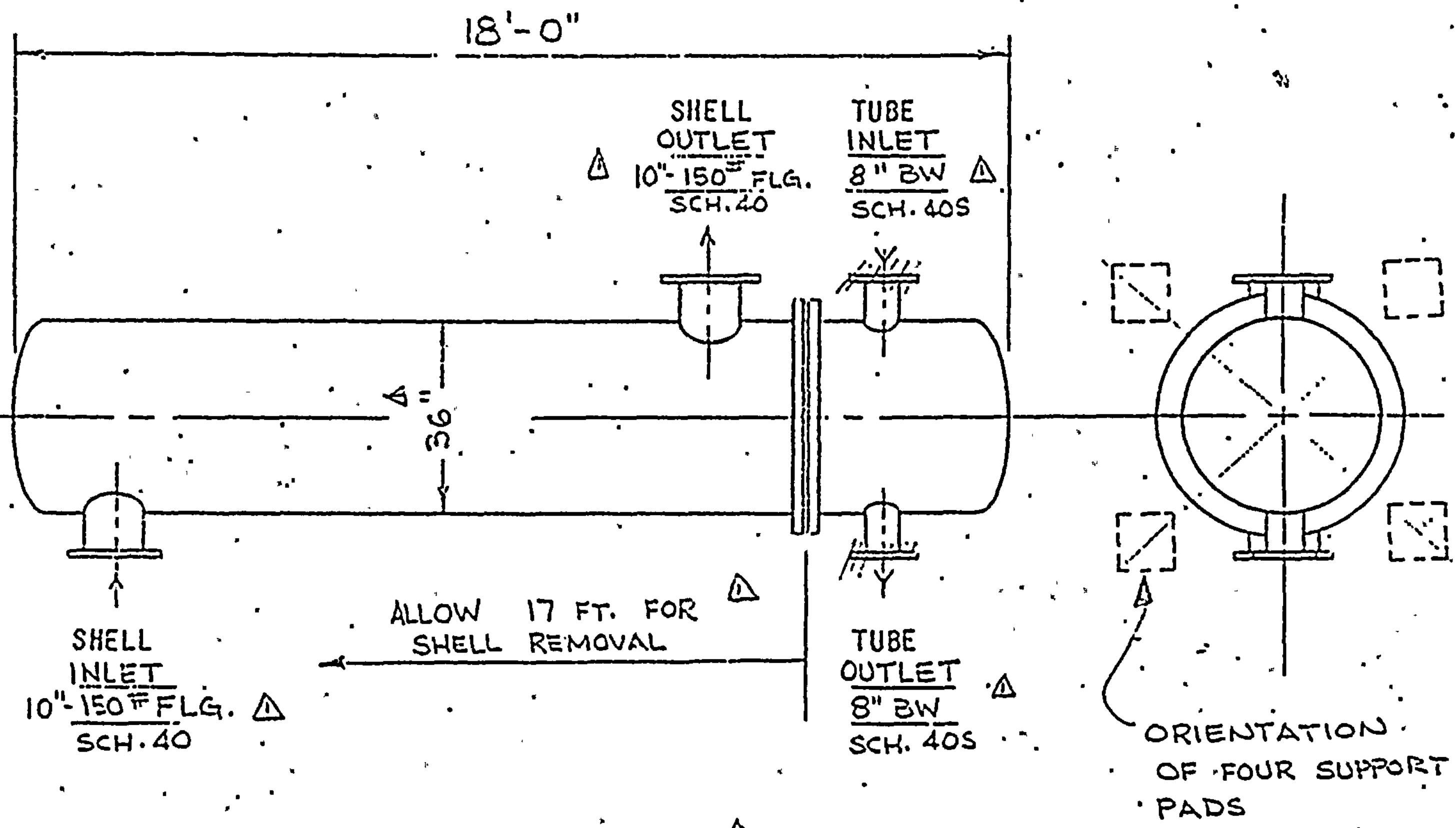
EQUIPMENT Residual Heat Exchanger

SYSTEM Auxiliary Coolant

PROJECT Ginna △

ITEM NO.

SPECIAL REQUIREMENTS, & FEATURES



~~MAY BE~~ INSTALLED VERTICALLY ~~OR HORIZONTALLY~~ △
ON FOUR FEET △

APPROX. DRY WT. 9000 LBS. (FLOODED: 13,800 LBS)

NOTE: DIMENSIONS SHOWN ARE APPROXIMATE
AND ARE GIVEN FOR REFERENCE ONLY.
SKETCH IS NOT TO SCALE

SKETCH NO. MC-1261

DATE 3-24-66 / REV. △ 8-29-66

ENGINEER JRB

SKETCH REFERENCE CASF

WESTINGHOUSE FORM 54316

WESTINGHOUSE ELECTRIC CORPORATION
ATOMIC POWER DIVISION

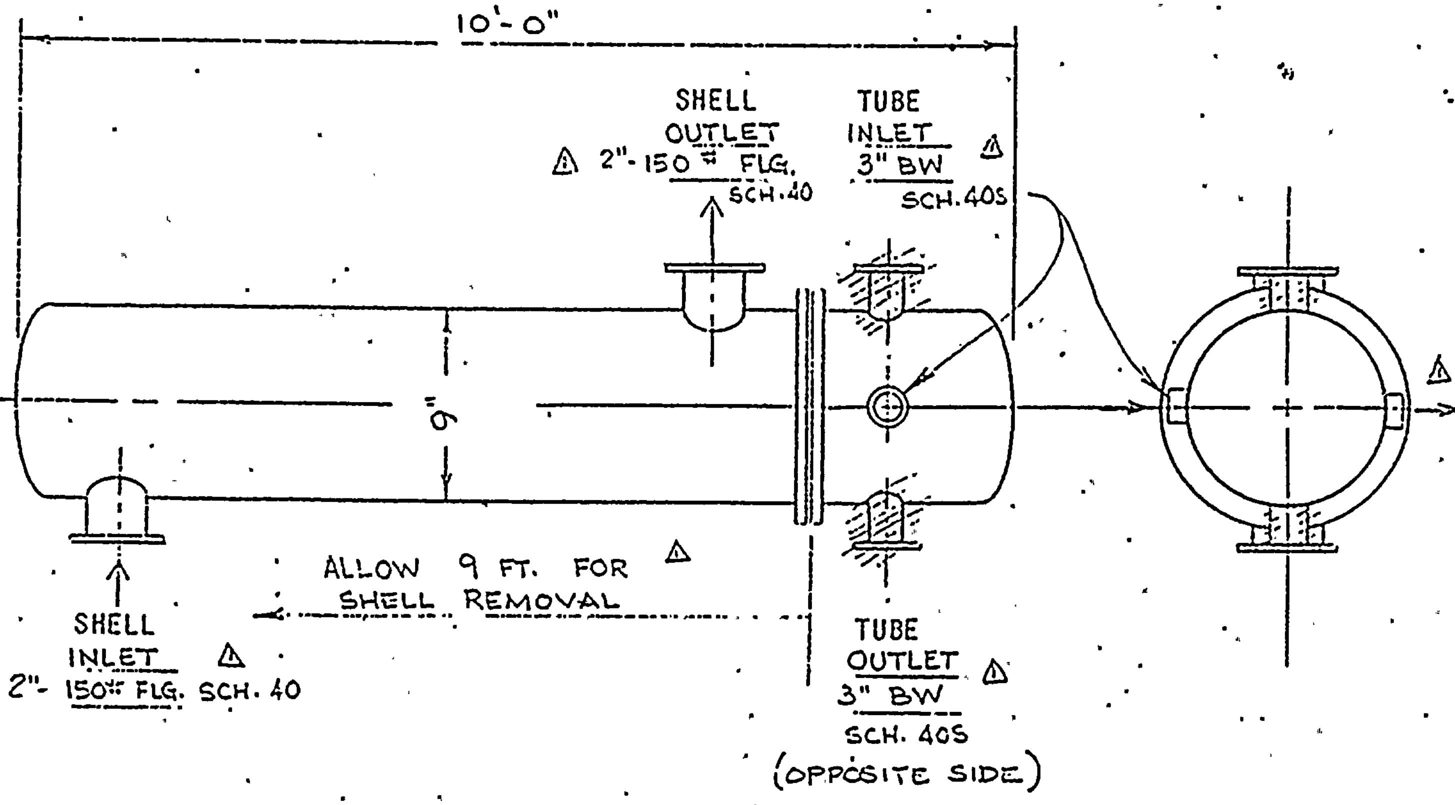
PRELIMINARY OUTLINE SKETCH

DUTY REQUIREMENTS

UA = 19,230 BTU/HR. °F

EQUIPMENT Seal Water Heat Exchr.
SYSTEM Chemical & Volume Contl.
PROJECT Ginna △
ITEM NO.

SPECIAL REQUIREMENTS, & FEATURES



~~MAY BE~~ INSTALLED VERTICALLY ~~OR HORIZONTALLY~~ △

APPROX. DRY WT. 800 lbs.

NOTE: DIMENSIONS SHOWN ARE APPROXIMATE AND ARE GIVEN FOR REFERENCE ONLY SKETCH IS NOT TO SCALE

SKETCH REFERENCE XA

SKETCH NO. MC-1260
DATE 3-24-66 / REV. △ 8-5-66
ENGINEER JRB

WESTINGHOUSE FORM 54316

[illegible]

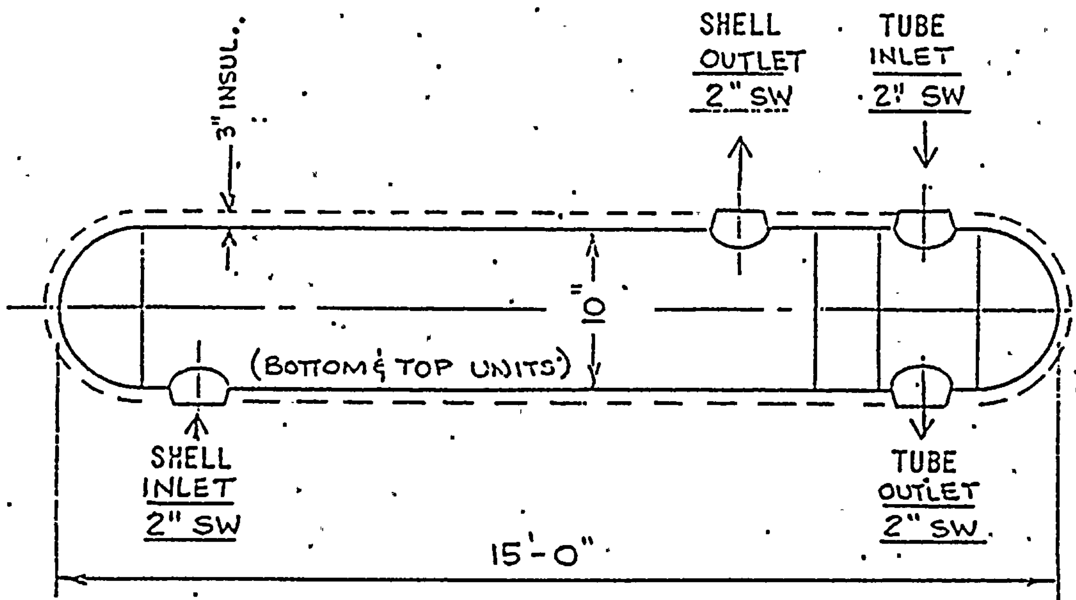
WESTINGHOUSE ELECTRIC CORPORATION
ATOMIC POWER DIVISION

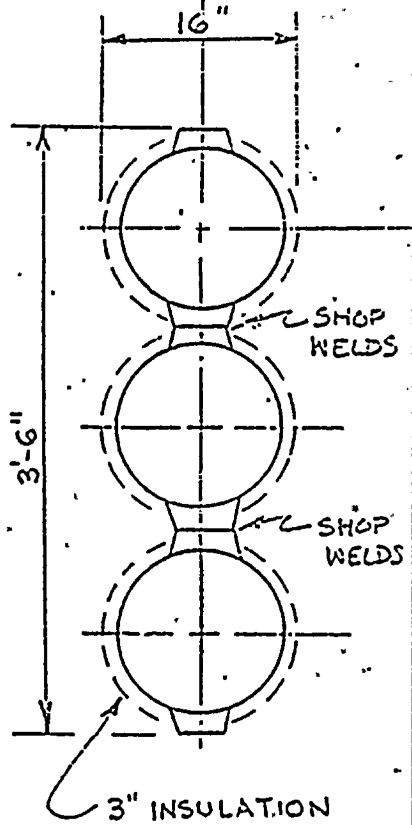
PRELIMINARY OUTLINE SKETCH

DUTY REQUIREMENTS
UA = 78,600 BTU/HR·°F (TOTAL) ⚠

EQUIPMENT REGENERATIVE HEAT EXCHANGER
SYSTEM CHEMICAL & VOLUME CONTROL
PROJECT GINNA ⚠
ITEM NO.

SPECIAL REQUIREMENTS, & FEATURES
ASME SECTION III, CLASS A





1. 3 UNITS REQUIRED. TO BE PIPED IN SERIES.
2. UNITS ~~MAY BE~~ MOUNTED ~~EITHER~~ HORIZONTALLY ~~OR VERTICALLY~~. ⚠
3. UNITS TO BE STACKED VERTICALLY AND INTERCONNECTIONS MADE BY SUPPLIER.

NOTE: DIMENSIONS SHOWN ARE APPROXIMATE AND ARE GIVEN FOR REFERENCE ONLY. SKETCH IS NOT TO SCALE

APPROX. DRY WT. 2000 LB. (2200 LB FLOODED)

SKETCH NO. MC- 1257
DATE 3-24-66 / REV. ⚠ 8-5-66
ENGINEER JRB

SKETCH REFERENCE SCB

WESTINGHOUSE FORM 54314A

TUBE SEAL WELD REQUIREMENTS

Scope: This document sets forth the minimum requirements for the design, procedure, materials, inspection, and testing of tube to tube sheet seal welds of auxiliary heat exchangers.

Design: Acceptable seal weld configurations are shown below. In all cases, the seal weld must have a minimum weld throat thickness at least equal to the tube wall thickness. All tubes must be rolled before seal welding.

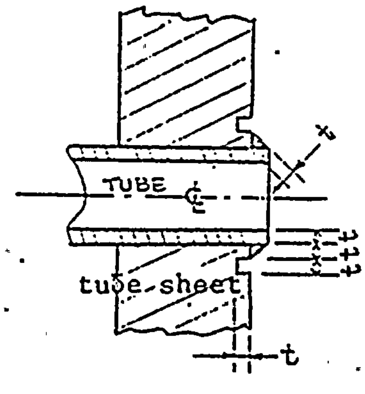


Fig. 1
(Preferred)

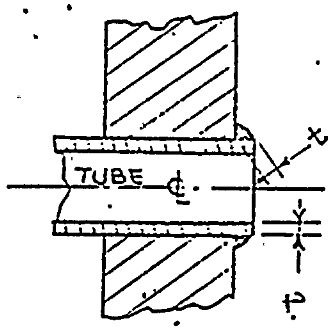


Fig. 2

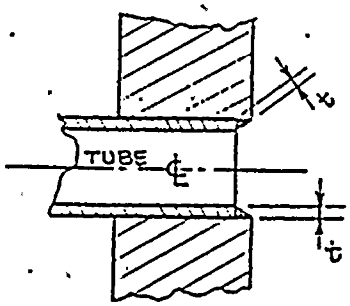


Fig. 3

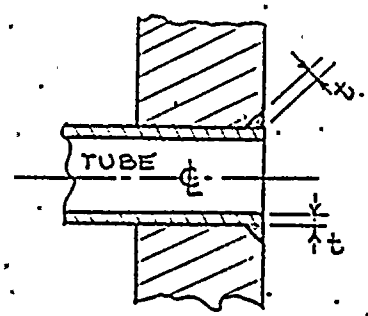


Fig. 4

NOTE: Tube sheet hole shall not be grooved.

JRB 7-27-66

Procedure: The welding procedure to be used shall be approved by WAPD and shall be in accordance with the following general requirements:

Filler metal is required when the following materials are used:

Tube Sheet	Tubes
SA-106 or any Carbon Steel (No Cladding)	SA-213 TP 304 SA-213 TP 316 SA-83 Carbon Steel
SA-240 type 304 or Type 316	Inconel
Inconel	Inconel

Filler metal is not required when the following material combinations are used:

Tube Sheet	Tubes
SA-240 Type 304 or 316	SA-213 TP 304 or 316
Carbon steel plate clad with either type 304 or 316 stainless steel on the seal welded side	SA-213 TP 304 or 316

NOTE: Although not required, should the supplier elect to use filler metal for the above material combinations, the filler metal shall be in accordance with SA-371.

Before welding, the seal weld areas shall be cleaned to the intent of Westinghouse PS-292722.

Qualification: Qualification of the procedure to be used shall be in accordance with the following:

1. For Class A heat exchangers: per Paragraph N-540 of Section III of the ASME Code.

2. For Class C heat exchangers: per Paragraphs N-541.1; N-541.1a(1), (2) and (3); N-541.1c(1), (2), (3), (5), (6), and (7); N-541.2; N-541.3; and N-541.4 of Section III of the ASME Code.

Inspection: The root and final pass of each seal weld shall be liquid penetrant inspected in accordance with Paragraph N-627 of Section III of the ASME Code. Any defects disclosed shall be ground out re-welded and re-inspected. Defects are defined as any slag or porosity.

<u>Testing</u>: Both a gas leak test and a hydrostatic pressure test shall be performed to demonstrate leak tightness of the seal welds.

1. A gas leak test procedure shall be proposed by the supplier and submitted for <u>WAPD</u> approval. The gas leak test shall be performed prior to any hydrotest.

2. The hydrostatic test pressure required by the applicable section of the ASME Code shall be maintained for not less than thirty (30) minutes. There shall be no leakage.

Enclosure II

Status of Seismic Review of Electrical and Instrumentation and Control Systems

The Seismic Review being performed on the R. E. Ginna Nuclear Plant electrical systems is intended to establish a technically justifiable level of confidence in the seismic capability (with respect to the integrated functional capability) of these systems. In particular, emphasis is being placed on the identification, and modification or repair of any components with low seismic fragility. The attached table shows the status of the information retrieval phase of this review, which is essentially complete.

TABLE OF CONTENTS FOR TABLE I

SYSTEM

Referenced Documents

1. Worthington Corp. letter from R.R. Zeferjahn to R.E. Smith
2. G.A.I. Requirement Outline RO-2239 (Diesel Generators)
3. G.A.I. Preliminary Spec. (Battery Chargers)
4. G.A.I. Tech. Spec. SP-5375 (Cable Trays)
5. G.A.I. Requirement Outline RO-2612 (Aux. Relay Racks)
6. Foxboro Test Report T1-1070A
7. Foxboro Test Report T4-1030
8. Westinghouse Seismic Report on Type W-2 Control Switch
9. Seismic Certification for Motor Control Centers 1L and 1M
10. G.A.I. Tech. Spec. SP-5466 (Instrument Bus Dist. Panels)
11. G.A.I. Requirement Outline RO-2400 (Batteries and Racks)
12. Wyle Laboratories Report No. 49343-1
13. Limitorque Valve Actuators Seismic Qualification (Report on file)
14. Letter from H.G. Saddock to D.L. Ziemann (Enclosure on file)

TABLE I

CLASS 1E ELECTRICAL SYSTEMS

I. EMERGENCY POWER SYSTEMS

ITEM	MANUFACTURER	TYPE	SPECIFICATION	REMARKS
Low Voltage Switchgear (600 V)	Westinghouse Electric Corp.	DB-15, 25, 50, 75	-	WCAP 7821 Supp. 4 (1)
Motor Control Center	Westinghouse Electric Corp.	Type "W" w/HFA & HFB units		Tested to IEEE 344-1975 (1). Ref. 9.
MOV Motor Operators (AC/DC)	Limitorque	SMB	-	Seismic Qualification per IEEE 344-75 Limitorque Corp. (4/1/75). Ref. 13.
D.C. Motor Starter	Westinghouse Electric Corp.	A200 Series	Cat. No. A210527 Style No. 43E4985	(4)
Inst. Dist. Panel 1A & 1C	Westinghouse Electric Corp.	Type WEB 2 EB-100 18 EB-15 Ckt. Breakers	GAI SP-5466 Ref. 10.	West. WCAP-7821 Supp. 2, Add. 1 (3)
Inverter/CVT	Solidstate Controls Inc.	SV 12075/TSNB/TSMB/ RLR 12075	WYLE Report No. 43 943-1	Tested to IEEE 344-1975 (1). Ref. 12.
Batteries	Gould National Batteries, Inc.	FTA-19	GAI RO-2400 Ref. 11.	(2)
Battery Racks	Gould National Batteries, Inc.	S-44372	GAI RO-2400 Ref. 11.	Low Seismic Design Rack (1)
Battery Charger 150A	Westinghouse Electric Corp.	150 AMP Rectomatic	GAI Tech. Spec. Ref. 3.	(1)
Battery Charger 75A	Gould	GRF 120T75	GAI Tech. Spec.	(1). Ref. 3.
Diesel Generators	Alco Products Inc.	Model 16-251-E	GAI RO-2239 Ref. 2.	Worthington Corp. Letter. Ref. 1.
Reactor Bldg. Cable Penetrations	Crouse-Hinds	-	-	Ref. Penetration Fault Study. Ref. 14.

TABLE I (Cont'd)

CLASS 1E ELECTRICAL SYSTEMS

I. EMERGENCY POWER SYSTEMS

ITEM	MANUFACTURER	TYPE	SPECIFICATION	REMARKS
Conduit and Tray Supports			GAI SP-5375 Ref. 4.	Ref. Fukushima Earthquake Report & ANCO Report #1053-21.1-4
Electrical Equipment Anchors	(See individual item for anchoring details)			

Notes: (1) Equipment anchored to floor four places with ½" expansion bolts
(2) Jars strapped to rack
(3) Anchored to wall
(4) Unistrut supports

TABLE I (Cont'd)

II(a). CONTROL ROOM - MAIN CONTROL BOARD

ITEM	MANUFACTURER	TYPE	SPECIFICATION	REMARKS
Switch	Westinghouse	W-2		West. Astronuclear Lab Test Report (2/9/70). Ref. 8.
Switch (P.B.)	Westinghouse	OT2		Not Seismic Cat. I
Ind. Light	Westinghouse	Minilite		Not Seismic Cat. I
Ind. Light	Micro-Switch	2F203		Not Seismic Cat. I
Ind. Light	Micro-Switch	2F207/2B4/2A70		Not Seismic Cat. I
Ind. Light	Master Specialties Company	800 SERIES TELLITE		Not Seismic Cat. I
Indicator	Foxboro	65-PX-W252-V		Not Seismic Cat. I
Voltmeter	Westinghouse	KA-241		Not Seismic Cat. I
Ammeter	Westinghouse	KA-241		Not Seismic Cat. I
Wattmeter	Westinghouse	KP-241		Not Seismic Cat. I
Freq. Meter	Westinghouse	KX-241		Not Seismic Cat. I
Synchroscope	Westinghouse	KI-241		Not Seismic Cat. I
Switch	Basler Elec.			Not Seismic Cat. I
Variable Transformer	Basler Elec.			Not Seismic Cat. I
Rheostat	Basler Elec.			Not Seismic Cat. I
Switch (P.B.)	Basler Elec.			Not Seismic Cat. I
Electronic Controller	Foxboro	M/67 HTG		Foxboro Test Ref. 7. Report T4-1030
Electronic Controller	Foxboro	M/62H-5E		Foxboro Test Ref. 7. Report T4-1030
Indicator	Westinghouse	VX-252		Foxboro Test Ref. 6. Report T1-1070A

TABLE I (Cont'd)
II(b). CONTROL ROOM - REACTOR TRIP RACKS

STRUCTURAL: The Reactor Trip Racks in the Control Room consist of 2 four cabinet assemblies, with dimensions of each cabinet being 90 11/16" X 22 1/16" X 30". The cabinets are bolted to each other at the sides and anchored to the floor in each of four corners with 3/8" expansion bolts. Seismic qualification by WCAP-7817, (12/71).

INTERNAL MODULES:

MANUFACTURER	TYPE	SPECIFICATION	REMARKS
Foxboro	M/66G		WCAP-7817
Foxboro	T/66		WCAP-7817
Foxboro	# 2860		WCAP-7817
Foxboro	Hi-Low Current Selector		WCAP-7817
Foxboro	M/63		WCAP-7817
Foxboro	Impulse		WCAP-7817
Foxboro	Summing Amp		WCAP-7817
Foxboro	Lead-Lag		WCAP-7817
Foxboro	M/610A		WCAP-7817
Foxboro	M/66B		WCAP-7817
Foxboro	610		WCAP-7817
Foxboro	M/63U		Foxboro Test Report TI-1070A. Ref. 6.
Foxboro	M/66		Foxboro Test Report TI-1070A. Ref. 6.
Foxboro	T/66A		WCAP-7817
Foxboro	Delta T/Lag		WCAP-7817
Foxboro	Controller		WCAP-7817

TABLE I (Cont'd)

III(a). RELAY ROOM - RELAY LOGIC AND TEST RACKS

FUNCTIONAL: The Relay Logic and Test Racks are associated with steam flow and pressure, feedwater flow, primary coolant flow, pressurizer level and pressure, and turbine first stage pressure.

STRUCTURAL: The Relay Logic and Test Racks in the Relay Room consist of 2 five cabinet assemblies, each cabinet measuring approximately 90" x 24" x 30". The cabinets are bolted to each other along the sides and anchored to the floor in each of four corners with 3/8" expansion bolts.

INTERNAL COMPONENTS:

ITEM	MANUFACTURER	TYPE	SPECIFICATION	REMARKS
Relay	Westinghouse	BF66F		WCAP-7817(2)
Relay	Westinghouse	BFD66		WCAP-7817(2)
Relay	Westinghouse	BFD66S	GAI-RO-2612(1).Ref.5.	
Relay	Westinghouse	BF22F	GAI-RO-2612(1).Ref.5.	
Relay	Westinghouse	5072A49G12		
Ind. Light	Dialco			WCAP-7817(2)
Switch (P.B.)	Rees			WCAP-7817(2)
Recorder	Rustrak Inst.	Model 92		

Note (1): In reference to Auxiliary Relay Racks
Note (2): In reference to Safeguards Racks

TABLE I (Cont'd)
III(b). RELAY ROOM - MISCELLANEOUS RACKS

FUNCTIONAL: The Miscellaneous Racks are associated with motor operated valves, boric acid blending, and nuclear instrumentation.

STRUCTURAL: The Miscellaneous Racks in the Relay Room consist of a two cabinet assembly, each cabinet measuring approximately 90" X 24" X 30". The cabinets are bolted to each other along the sides and anchored to the floor in each of four corners with 3/8" expansion bolts.

INTERNAL COMPONENTS:

ITEM	MANUFACTURER	TYPE	SPECIFICATION	REMARKS
Relay	Westinghouse	BF66F		WCAP-7817(2)
Relay	Westinghouse	BFD66		WCAP-7817(2)
Relay	Westinghouse	BF44F		
Relay	Westinghouse	BFD120		
Latch	Westinghouse	BFLF		
Relay	Agastat	2400 series	GAI RO-2612(1) Ref. 5.	WCAP-7817(2)

NOTE (1): In reference to Auxiliary Relay Racks
NOTE (2): In reference to Safeguards Racks

TABLE I (Cont'd)

III(c). RELAY ROOM - AUXILIARY RELAY RACKS

STRUCTURAL: The Auxiliary Relay Racks in the Relay Room consist of one single cabinet assembly and one two cabinet assembly, each cabinet measuring approximately 90" X 24" X 30". The cabinets are bolted to each other, and to adjoining units, along the sides and anchored to the floor in each of four corners with 3/8" expansion bolts.

INTERNAL COMPONENTS:

ITEM	MANUFACTURER	TYPE	SPECIFICATION	REMARKS
Relay	Westinghouse	BFD-44	GAI-RO-2612. Ref. 5.	
Relay	Westinghouse	BFD-44S	GAI-RO-2612. Ref. 5.	
Relay	Westinghouse	BF-22F	GAI-RO-2612. Ref. 5.	
Relay	Westinghouse	MG-6	GAI-RO-2612. Ref. 5.	
Relay	Westinghouse	BFD-84	GAI-RO-2612. Ref. 5.	
Relay	Westinghouse	44E4919	GAI-RO-2612. Ref. 5.	
Relay	C.P. Clare	HG2A	GAI-RO-2612. Ref. 5.	
Relay	Agastat	2400 Series	GAI-RO-2612. Ref. 5.	WCAP-7817(1)
Latch	Westinghouse	BFDLS	GAI-RO-2612. Ref. 5.	
Relay	Westinghouse	BFD66S	GAI-RO-2612. Ref. 5.	

Note (1): Ref. Safeguards Racks

TABLE I (Cont'd)

III(d). RELAY ROOM — SAFEGUARDS RACKS

STRUCTURAL: The Safeguards Racks in the Relay Room consist of (2) two cabinet assemblies, each cabinet measuring approximately 90" X 24" X 30". The cabinets are bolted to each other, and to adjoining units, along the sides and anchored to the floor in each of four corners with 3/8" expansion bolts. Seismic qualification by WCAP-7817.

INTERNAL COMPONENTS:

ITEM	MANUFACTURER	TYPE	SPECIFICATION	REMARKS
Relay	Westinghouse	BF66F	-	WCAP-7817
Relay	Westinghouse	BFD66	-	WCAP-7817
Relay	Westinghouse	766A253G12	-	WCAP-7817
Relay	Westinghouse	MG-6	-	WCAP-7817
Latch	Westinghouse	SEP-1971	-	WCAP-7817
Ind. Light	Dialco	820-2701-01-502	-	WCAP-7817
Switch(P.B.)	Rees		-	WCAP-7817
Transformer	UTC	SC-5	-	WCAP-7817
Relay	Agastat	2400 Series	GAI-RO-2612(1) Ref. 5.	WCAP-7817

Note (1): Ref. Auxiliary Relay Racks

TABLE I (Cont'd)

III(e). RELAY ROOM - REACTOR COOLANT SYSTEM RACKS

STRUCTURAL: The Reactor Coolant System Racks in the Relay Room consist of a two cabinet assembly, each cabinet measuring approximately 90" X 24" X 30". The cabinets are bolted to each other, and to adjoining units, along the sides and anchored to the floor in each of four corners with 3/8" expansion bolts. Seismic qualification by WCAP-7817.

INTERNAL COMPONENTS:

MANUFACTURER	TYPE	SPECIFICATION	REMARKS
Foxboro	M/63		WCAP-7817
Foxboro	M/610A		WCAP-7817
Foxboro	M/694A		WCAP-7817
Foxboro	610		WCAP-7817
Foxboro	M/63U		Foxboro Test Report TI-1070A. Ref. 6.
Foxboro	T/66A		WCAP-7817

TABLE I (Cont'd)

III(f). RELAY ROOM - CHEMICAL AND VOLUME CONTROL SYSTEM RACKS

STRUCTURAL: The Chemical and Volume Control System Racks in the Relay Room consist of a two cabinet assembly, each cabinet measuring approximately 90" X 24" X 30". The cabinets are bolted to each other, and to adjoining units, along the sides and anchored to the floor in each of four corners with 3/8" expansion bolts. Seismic qualification by WCAP-7817.

INTERNAL COMPONENTS:

MANUFACTURER	TYPE	SPECIFICATION	REMARKS
Foxboro	M/63		WCAP-7817
Foxboro	M/610		WCAP-7817
Foxboro	T/66A		WCAP-7817
Foxboro	M/610A		WCAP-7817
Foxboro.	M/694A		WCAP-7817
Rochester Inst. Systems	ET-215 Temp. Alarm		WCAP-7817

TABLE I (Cont'd)

III(g). RELAY ROOM - FEEDWATER CONTROL RACK

STRUCTURAL: The Feedwater Control Rack in the Relay Room consists of a single cabinet measuring approximately 90" X 24" X 30". The cabinet is bolted to adjoining units along the sides and anchored to the floor in each of four corners with 3/8" expansion bolts. Seismic qualification by WCAP-7817.

INTERNAL COMPONENTS:

MANUFACTURER	TYPE	SPECIFICATION	REMARKS
Foxboro	M/66B		WCAP-7817
Foxboro	Hi-Low Current Converter		WCAP-7817
Foxboro	Dynamic Compensator		WCAP-7817
Foxboro	M/63		WCAP-7817
Foxboro	M/610A		WCAP-7817
Foxboro	610		WCAP-7817
Foxboro	M/66C		WCAP-7817
Foxboro	Ratio Unit		WCAP-7817
Westinghouse	BF44F Relay		WCAP-7817
Potter-Brumfield	KR-1483-1 Relay		WCAP-7817

TABLE I (Cont'd)

III(h). RELAY ROOM - SAFETY INJECTION SEQUENCE RACK

STRUCTURAL: The Safety Injection Sequence Rack in the Relay Room consists of a single cabinet measuring approximately 90" X 24" X 30". The cabinet is bolted to adjoining units along the sides and anchored to the floor in each of four corners with 3/8" expansion bolts. Seismic qualification by WCAP-7817.

INTERNAL COMPONENTS:

MANUFACTURER	TYPE	SPECIFICATION	REMARKS
Foxboro	M/63		WCAP-7817
Foxboro	M/610A		WCAP-7817
Foxboro	610		WCAP-7817
Foxboro	M/694A		WCAP-7817
Foxboro	M/66B		WCAP-7817
Foxboro	M/66A		WCAP-7817
Foxboro	T/66A		WCAP-7817

WORTHINGTON CORPORATION

205 Walbridge Building, 43 Court Street, Buffalo, New York 14202 Tele: 853-5150 Area 716

February 8, 1967

Rochester Gas and Electric Corp.
89 East Avenue
Rochester, New York 14604

Attention: Mr. R. E. Smith
Engineering Dept.

Reference: Diesel Generator Units
Ginna Station
Westinghouse A.P.D.
RO-2239

Gentlemen:

There were several items which were not fully answered during our recent meeting.

First, I am enclosing several copies of The Alco School Schedule for 1967. This will show the type of courses offerred, length of courses, etc. and will, I'm sure, be of interest to you.

Second, the proposed units will more than comply with the Seismic design limits specified in paragraph 2:03.2 of the specifications. Similar units, in normal locomotive service, will experience about 5 g's, and these units are of the same design.

The loading of the generator diodes is approximately 19 amps per diode. Each diode is rated 70 amps, and therefore is loaded to only 27% of this rating. Also, each diode is rated 1000 P.I.V. peak inverse voltage, which is five (5) times normal exciter voltage. If a diode should fail, it can be detected by loss of voltage or failure to build up voltage. This data applies to the Electric Machinery generator which is offerred as an alternate. The instruction manuals will, of course, cover the proper procedure to follow to test and replace any defective diodes. However, the very conservative diode ratings assure reliability.

We expect to have similar units to those proposed on test at the Alco Plant in Schenectady, N. Y. later this month and in March. I will advise you of specific dates in the near future, and I hope that we will be able to have you and anyone else interested, visit our plant to see these tests.

If you have any questions, please let me know.

Yours very truly,
WORTHINGTON CORP.

R. R. Zoferjahn

R. R. Zoferjahn

EMERGENCY DIESEL ENGINE GENERATOR SETS

ROBERT EMMET GINNA

NUCLEAR POWER STATION

UNIT NO. 1

WESTINGHOUSE ELECTRIC CORPORATION

ATOMIC POWER DIVISION

PITTSBURGH, PENNSYLVANIA

REQUIREMENT OUTLINE

BROOKWOOD PROJECT

RO-2239

NOVEMBER 2[illegible], 1966

GILBERT ASSOCIATES, INC., ENGINEERS
525 Lancaster Avenue
Reading, Pennsylvania

Addendum A
12/5/66
Addendum B
12/7/66
Revision 1
Pages 4, 6, 7, 11 & 12
3-8-67

RO-2239
11-25-66

Table of Contents

1:00 GENERAL REQUIREMENTS

1:01 General

1:01.1 This Requirement Outline includes the essential information required by the manufacturers of power plant equipment to submit a proposal for furnishing the equipment covered by the DETAIL REQUIREMENTS, section 2:00. The equipment will be part of a nuclear-electric generating station having a nominal capacity of 450 MWe.

1:01.2 This equipment will be installed as part of the No. 1 Unit as the Ginna Project, Rochester Gas and Electric Corporation, located in Wayne County, approximately 18 miles east of Rochester, New York.

1:01.3 This electric generating unit is scheduled for commercial operation on June 1, 1969.

1:02 PROPOSALS

1:02.1 Proposals shall be drawn in the name of Gilbert Associates, Inc. as Consulting Engineers and Agent for the Westinghouse Electric Corporation, Atomic Power Division, the Prime Contractor.

1:02.2 Proposals shall be submitted as follows:

Original and five (5) copies to:

GILBERT ASSOCIATES, INC.
525 Lancaster Avenue
Reading, Pennsylvania 19603

Attention: Mr. H. F. Ulmer
Chief Purchasing Agent

1:03 DEFINITIONS

1:03.1 OWNER shall mean the Rochester Gas and Electric Corporation.

1:03.2 PRIME CONTRACTOR shall mean the Westinghouse Electric Corporation, Atomic Power Division.

1:03.3 ENGINEER shall mean Gilbert Associates, Inc., an Agent for the PRIME CONTRACTOR.

1:03.4 MANUFACTURER shall mean the successful Bidder for all equipment covered by this Requirement Outline.

1:04 EQUIPMENT QUALITY

All equipment and services offered by the Bidder shall be of such quality as to make the equipment safe with high availability. To this end, all items offered, including all accessories, shall be of proven reliability.

1:05 CODES AND STANDARDS

1:05.1 All equipment offered shall be designed and manufactured in accordance with accepted current standards of the electric utility industry and shall satisfy all applicable codes, including state and local ordinances pertaining to the design and operation of such equipment.

1:05.2 Where required, the MANUFACTURERS shall have all pressure parts stamped by a certified insurance inspector and three (3) copies of the certified inspection report forwarded to the ENGINEER.

1:06 INSPECTION

1:06.1 Inspection

Shop fabrication and field erection shall be subject to inspection and approval by the PRIME CONTRACTOR and/or ENGINEER. Any inspection by the PRIME CONTRACTOR and/or ENGINEER shall not be considered as a waiver of any warranty or other rights. The PRIME CONTRACTOR and/or ENGINEER shall have free access to the MANUFACTURER'S shops for inspection of construction and for observing shop tests. All tests required for certification of equipment shall be made at the expense of the MANUFACTURER.

1:06.2 Factory Inspection and Tests

Prior to start of manufacture, the ENGINEER is to be notified in writing at least fifteen (15) days in advance of those tests and inspections that he and/or the OWNER wish to observe. Four (4) certified copies of all factory test data are to be furnished to the ENGINEER for all tests normally supplied or as required to satisfy codes and regulatory bodies.

1:06.3 Field Tests

After installation, the PRIME CONTRACTOR reserves the right to make tests at his expense to demonstrate the ability of the equipment furnished by the MANUFACTURER to operate under the conditions specified and to meet the guaranteed performance. These tests will be conducted in accordance with the latest applicable Test Code in effect at the time of the test with such modifications as may be mutually agreed upon between the PRIME CONTRACTOR and the MANUFACTURER. If the results of the tests conducted indicate that the equipment does not meet its guaranteed performance, the MANUFACTURER shall, at his expense, make all necessary adjustments or changes to improve the performance to meet the guaranteed performance. All subsequent tests until acceptance by the PRIME CONTRACTOR shall be made at the MANUFACTURER'S expense:

1:06.4 The Bidder shall furnish a list of any field tests of the equipment which must be made during installation and initial start-up.

1:07 DRAWINGS AND INSTRUCTION BOOKS

1:07.1 Quoted price shall include the cost of furnishing three (3) reproducibles and two (2) copies of certified drawings to be submitted for approval and three (3) reproducibles of final approved drawings for record. If reproducibles are not available, quoted price shall include cost of fourteen (14) prints for approval and fourteen (14) prints of approved drawings for record.

1:07.2 Quoted price shall include the cost of thirty (30) copies of instruction books covering all equipment being furnished.

1:08 CLEANING, PAINTING AND PROTECTION

1:08.1 Every effort shall be made in the design and fabrication of the equipment to avoid dirt traps. Internal surfaces shall be free of dirt and scale prior to shipment.

1:08.2 All exposed metal surfaces, unless otherwise finished in a manner standard to a particular manufacturer, shall be painted by the MANUFACTURER in a manner approved by the ENGINEER.

1:08.3 All machined surfaces shall be adequately protected against corrosion and damage during shipment and storage.

1:08.4 All equipment shall be shipped with adequate packing and protection provided to permit outside storage at the plant site with no additional protection.

1:09 PIECE MARKING

The separate pieces of equipment shall have matching marks to facilitate assembly during erection. To facilitate unloading and erection, the weight of each major component shall be marked in a conspicuous location thereon with painted numerals at least three (3) inches high.

1:10 MOTORS AND MOTOR CONTROLS

1:10.1 Motors

All electric motors; where specified as being furnished by the bidder, shall be in accordance with the latest revision of the ENGINEER'S Specification No. SP-5201. Bidder shall supply Thomas flexible couplings and coupling guards between the motor and driven equipment.

1:10.2 Motor Controls

All motor control equipment will be furnished by others except as specified.

Revision 1 [illegible]/67

2:00 DETAIL REQUIREMENT

2:01 Equipment to be Supplied

The equipment to be supplied shall [illegible] with the following:

Two (2) indoor emergency diesel-engine generator [illegible] supplying reactor safeguard auxiliaries and other [illegible] requirements. Each set shall be furnished complete [illegible] generator and accessories on a common bedplate. [illegible] starting equipment and automatic starting controls [illegible]

2:02 Equipment Supplied by Others

The following items and functions will be furnished by [illegible]:

2:02.1 Foundations for engine-generators, starting and control [illegible]

2:02.2 Housing for engine-generators, starting and control [illegible]

2:02.3 Fuel oil storage facilities and transfer other than [illegible] day-tank fuel tanks.

2:02.4 Cooling water as required for engine water circulating [illegible] cooling system heat exchanger.

2:02.5 Source of 125 volts d-c from station battery for all [illegible] of the automatic engine starting control and alarm system.

2:02.6 Alternate source of compressed air, 125 psig with check valve [illegible] charging air starting reservoirs (if used).

2:02.7 Power feed 440 volts, 3 phase, 60 cycles for battery charger (if used).

2:03 DESIGN AND OPERATING CONDITIONS

2:03.1 Capacity

2:03.1.1 Each generator unit shall be rated 480 volts, 3 phase, 60 cycles. Each unit shall be capable of sequentially starting and successfully serving the load described in paragraph 2:03.10.1, and shall have a minimum rating to supply a load of ~~[illegible]~~

2:03.1.2 Each unit shall be designed to develop its above rating ~~[illegible]~~ in addition shall be guaranteed to carry an initial peak load ~~[illegible]~~ kw for a ~~[illegible]~~ period of 1/2 hour without undue stress.
2300

2050 kw for a two hour period, and 1950 kw continuous for a maximum of 2000 hours per year.

2:03.2 Seismic Design

The generator unit and all of its appurtenances, auxiliaries and controls shall be designed, within normally accepted stress levels to resist earthquake forces resulting from an acceleration occurring simultaneously in the vertical and horizontal directions, with both components equal to 0.19g applied at the center of gravity, and to receive and transmit such forces through the support structures to the foundations. The generator unit and its components shall also be designed to ensure no loss of function (i.e. remain operable) when subjected to earthquake forces resulting from an acceleration occurring simultaneously in the vertical and horizontal directions, with both components equal to 0.47g.

2:03.3 Diesel Engine

2:03.3.1 The engine shall be assembled with the generator, accessories on a common skid type bedplate to form a self-contained unit with suitable guards for protection from rotating parts. The speed of this equipment shall not be less than 720 rpm. The engine unit shall include the following features:

2:03.3.2 Lubricating system including an engine driven lube oil pump, oil filters, immersion oil heater and water cooled oil coolers.

2:03.3.3 Complete fuel oil system including day-tank, pumps and strainers. The day-tank may be incorporated in the base or supplied as a separate tank. The day-tank shall have a capacity for a minimum of 3 hours of operation at rated load. The fuel level in the day-tank shall be automatically maintained.

2:03.3.4 Type of fuel will be No. 2 fuel oil.

2:03.3.5 Air filters and silencers for air intake. (Bidder shall specify if a minimum temperature is required of the cooling air to maintain rapid start.)

2:03.3.6 Vibration dampeners.

2:03.3.7 Exhaust muffler.

2:03.3.8 Exhaust manifold.

2:03.3.9 A standby heating system shall be installed utilizing an immersion heater and electric motor driven pump to automatically maintain engine water temperatures in readiness for fast start during shutdown.

2:03.3.10 A closed loop type of cooling system shall be provided for each engine using circulating pump mounted on the engine and separately mounted heat exchanger. Heat exchanger shall be designed to operate with 80°F and lower cooling water at a maximum pressure of 125 psig.

2:03.3.11 The engine shall be equipped with a unit ... engine speed within ... steady state band ... constant load including no load. ... within 3% of rated speed from no load to full ...

2:03.3.12 Sufficient flexible pipe for exhaust ... to customer's exhaust line shall be furnished.

2:03.3.13 All engine mounted devices necessary for automatic ... shall be terminated to a suitably marked terminal block ... accommodate customer's control wiring.

2:03.4 Engine Starting

2:03.4.1 Air motor, air injection or battery starting system ... will be considered. Each starting system shall be ... ating the respective unit in a cold start from ... speed and voltage with a maximum elapsed time of 10 ... initiation of the starting sequence and complete ... generator for loading.

2:03.4.2 If compressed air starting is used, an air ... tank shall be furnished with each unit. The Diesel ... motor or air injection system shall be capable of ... on a minimum of 125 pound air pressure. Provision ... connections into the customer's 125 pound station serv... through a check valve. The air receiver shall be of sufficient volume to ~~///~~ k the engine ~~///////////~~ or 45 seconds without recharging tanks when the ... starting pressure equal to the minimum starting ... dictated by the engine manufacturer. Tanks shall be ... plate and shall conform to ASME Unfired Pressure Vessel Code ... fications. Each tank shall be hydrostatically tested to 150% ... maximum working pressure. Pressure gauges, safety valves, and bottom drain valves shall be provided as well as other fittings ... mounting and connecting the tanks. Air reservoir shall be equ... with an adjustable low pressure alarm switch for customer's ...

2:03.4.3 An electric starting system, if used, shall include a battery ... drive on each engine. The starting motor shall be of the required voltage recommended by the engine manufacturer. Batteries with necessary battery cables and connections shall be furnished, ... on each unit or in a separate rail located near the engine. The batteries shall have sufficient capacity for five cranking cy... as specified in 2:03.7.4. A completely automatic battery charg... shall be furnished with each battery to maintain starting batt... full charge. It shall have a high charging rate compatible w... battery and, when the battery is brought up to full charge, it automatically reduce the charge rate to a continuous trickle ... An ammeter to indicate the charge rate shall be included. The ... shall be designed to prevent damage to itself or tripping of the protective circuit breaker during engine cranking. A 480 volt, 3 phase, 60 cycle power supply for the charger will be furnished by others.

2:03.5 Generator

2:03.5.1 The generator shall be designed to carry its full rat... load [illegible]tinuously at normal voltage with an armature temperature [illegible] exceeding 70°C above an ambient of 40°C by resistance [illegible]. The generator shall be equipped with sleeve bearings [illegible] with Class B, power house insulation. A higher rating [illegible] system may be used in the rotor. It shall be of the [illegible] drip-proof construction. The generator with its controls and [illegible] regulator shall be so designed that successful parallel operation may be obtained with another generator of equal or larger rating and with similar controls and regulation.

2:03.5.2 Rated output - Minimum peak or overload rating ~~////~~ 2300 kw at [illegible] power factor in accordance with 2:03.1.2; Continuous rating [illegible] for requirements of 2:03.1.1.

2:03.5.3 Rated voltage - 480 V., 3 phase, 60 cycle.

2:03.5.4 Connection - Delta.

2:03.5.5 Speed - Same as diesel engine

2:03.5.6 Excitation - From static exciter with necessary equipment. ~~[illegible]~~

2:03.6 Controls and Accessories

2:03.6.1 A free-standing control cubicle, NEMA type 1A enclosure with ground lug provided on bottom shall be furnished and shall contain the following control features:

2:03.6.1.1 Voltage regulator with a maximum sensitivity of plus or minus [illegible] percent and with voltage regulator rheostat control. The regulator should provide field forcing of the generator for rapid starting of the large motors.

2:03.6.1.2 Voltage adjusting rheostat for remote mounting 2:03.6.2.

2:03.6.1.3 Field switch and discharge resistor.

2:03.6.1.4 Generator or exciter field rheostat (motor operated).

2:03.6.1.5 Shunt for exciter ammeter.

2:03.6.1.6 Reverse power relay.

2:03.6.1.7 Running time meter.

2:03.6.1.8 All current and potential transformers necessary for the required instrumentation.

2:03.6.2 The following will be provided by others on panels in the central control room for remote testing as detailed in paragraph 2:03.7.7:

(a) Selector Switch (Stop-Auto-Test)
(b) Voltage regulator selector switch, auto-manual
(c) Voltmeter with phase selector switch
(d) Ammeter with phase selector switch
(e) Wattmeter
(f) Exciter ammeter (energized from shunt 2:03.6.1.4)
(g) Frequency meter
(h) Manual synchronizing switch with Synchroscope
(i) Generator breaker control switch, for use in manual synchronizing
(j) Mounting for voltage adjuster item 2:03
(k) Control switch for rheostat item 2:03
(l) Governor motor control switch

2:03.7 Automatic Engine Starting Control

2:03.7.1 An automatic engine starting control shall be provided to automatically start and stop the unit.

2:03.7.2 This starting control shall be located in the engine-generator control cubicle.

2:03.7.3 The automatic engine starting control shall be manufactured by Automatic Switch Company, Bulletin 1025-134, or approved equal. It shall operate from an engine starting contact furnished by others. When engine fires, starting control shall automatically disconnect cranking controls. The cranking disconnect means shall be electrically self regulating to prevent recranking for a definite time after source voltage has reduced to a low value.

2:03.7.4 Starting control circuits shall be arranged so that cranking will commence immediately after the remote starting contact closes on failure of normal power, and/or a safety injection signal contact closure. Five cranking cycles shall be provided by a motor driven instantaneous reset type timer. Time intervals of cranking shall be in accordance with the engine manufacturer's recommendations.

2:03.7.5 Fault indicating lights shall be provided for the following together with output contacts from each for a common remote alarm:

(a) Water High Temperature

(b) Lube Oil High Temperature

(c) Fuel Oil Low Pressure

(d) Fuel Oil Low Level

(e) Failure to start

(f) Lube Oil Low Pressure

(g) Overspeed

(h) Reverse Power

The control shall be arranged so that items "a", "b", "c", "d" and "e" will alarm only, item "f" will alarm at low pressure and stop the engine at a lower pressure while items "g" and "h" will alarm and also stop the engine, locking out the controls and requiring remote manual resetting. Contacts from "f", "g", "h" and the associated lockout and resetting relays shall be wired to terminal blocks for use in safeguard logic circuits.

2:03.7.6 Provisions shall be incorporated for periodic testing of the complete sequence of starting and loading of the units from the plant main control room. A three position selector switch in the control room will provide for (1) stop, (2) automatic, and (3) engine test positions. In the test position of the switch, the starting control circuits shall simulate an automatic start signal, bring the unit up to rated speed and voltage. A governor control switch in the control room will permit the operator to synchronize to the 480 volt system and load the unit.

2:03.7.7 All components of the automatic engine starting control and alarm system shall function on 125 volts, d-c available from customer's station battery. Operating limits will be from 90 to 140 volts. Indicating lamps, push buttons and selector switch shall be accessible from the front with enclosure door closed. Feature "G" (SR relay) and Feature "D" (FR relay) shall be included with the controls.

2:03.8 <u>Engine Instrument Panel</u>

2:03.8.1 The engine instrument panel shall be furnished and equipped with gauges and instruments as follows:

2:03.8.1.1 Exhaust gas pyrometer for each cylinder.

2:03.8.1.2 Lube oil pressure gauge.

2:03.8.1.3 Air manifold pressure gauge.

2:03.8.1.4 Fuel oil pressure gauge.

2:03.8.1.5 Jacket water pressure gauge.

2:03.8.1.6 Turbocharger lube oil pressure gauge (If the engine is turbocharged).

2:03.8.1.7 Manual start push button.

2:03.8.1.8 Air start valve, 125 V, d-c.

2:03.8.1.9 Throttle control.

2:03.9 Standards

2:03.9.1 The following standards shall form a part of this requirement outline where they are applicable and as stipulated in paragraph 1:05.1.

Diesel Engine Manufacturers' Association (DEMA)

Standard Practices for Stationary Diesel Engines

American Society for Testing Materials (ASTM)

Structural Steel Plates

Diesel Fuel Oils

American Standards Association (ASA)

B31.1 Piping

C-50.1 Generators

C-37 Switchgear

American Society of Mechanical Engineers (ASME)

Unfired Pressure Vessel Code

National Electrical Manufacturer's Association (NEMA)

MG-1-1963 Motors

MG-1-1963 Generators

IC-4-1958 Industrial Enclosures

IC-1-1959 Industrial Controls

SG-4-1953 Power Circuit Breakers

SG-5-1959 Power Switchgear Assemblies

EI-1-1959 Electrical Indicating Instruments, Panels and Switchboard

2:03.10 Load To Be Served

2:03.10.1 The following loads shall be started ~~[illegible]~~ by each of the two units separately. [illegible] loads must be in operation as rapidly as [illegible] starting will be automatically controlled [illegible] under this requirement outline. ~~[illegible]~~

(A) Miscellaneous Small Motors in block loads - 50 HP Total

~~[illegible]~~

(B) Residual Heat Pump (1) - 150 ~~[illegible]~~ HP

~~[illegible]~~

(C) Safety Injection Pump (2) - 350 ~~[illegible]~~ HP (each)

~~[illegible]~~

(D) Service Water Pump (1) - 300 HP

~~[illegible]~~

(E) Containment Fan (2) - 250 HP (each)

~~[illegible]~~

(F) Aux. Feedwater Pump (1) ~~[illegible]~~ - 250 HP

~~[illegible]~~

(G) Containment Spray Pump (1) - [illegible] HP

~~[illegible]~~

Other loads may be started manually at any time after the above items A to G. These include:

(a) Fire Pump - 200 HP

(b) Battery Charger - 15 KW

(c) Emergency Lighting - [illegible] KW

(d) Reactor Aux. Bldg. Char. Filter Exh. Fan - 5 HP

These loads will be started in three sequential load applications of approximately 800 hp maximum for each application. The initial application to be within 10 10 seconds in accordance with 2:03.4.1. On each application of 800 hp, the voltage dip shall be limited to 31% below normal with voltage recovery to 90% of normal in one second.

(e) Heating Boiler Auxiliaries - [illegible]

(f) Turbine Bldg. M.C.C. - 50 HP

(g) Turbine Turning Gear - [illegible] HP

(h) Turbine T.G. Oil Pump - [illegible] HP

(i) Turbine Seal Oil Backup Pump - [illegible] HP

(j) Service Water Pump - [illegible] HP *

(k) Component Cooling Pump - [illegible] HP *

(l) Charging Pump - 125 HP

* These items started after containment [illegible]

(m) B.A. Transfer Pump - 7-1/2 HP

3:00 DATA REQUIRED WITH PROPOSAL

Bidders shall submit with his proposal complete data for the equipment offered. This data shall include, but not necess[illegible] be limited to the following:

3:01.1 Descriptive data on all equipment to be furnished as [illegible]

(a) Continuous full load rating of engine in BHP: [illegible] and/or emergency rating

(b) Safety 2 hr overload capability

(c) Rated speed

(d) Number of cylinders

(e) Bore and stroke

(f) Piston displacement

(g) Type of fuel injection and type of air charger

(h) Type of governor

(j) Type of lubrication system

(k) Method of piston cooling

(l) Method of starting including requirements and control sy[illegible]

3:01.2 Preliminary dimensional drawings or sketches of proposed equipment and accessories.

3:01.3 Estimated net and shipping weights.

3:01.4 Time required for delivery of equipment after approval of manufacturer's drawings.

3:01.5 Fuel requirements for engine at 50, 75, 100, 110% H.P. load and peak ratin

3:01.6 Lubrication oil rate.

3:01.7 Cooling water required with 80° cooling water temperature.

3:01.8 Governor speed regulation range.

3:01.9 Complete characteristics for generator and exciter, including a description of insulation system for stator and rotor.

3:01.10 Time required for engine to reach operating speed from standstill.

3:01.11 Recommendations concerning fuel tank supply piping.

3:01.12 Recommendations regarding weekly trial run of unit unloaded. The manufacturer shall clearly state in his proposal what effects periodic unloaded test runs will have on his engine and include recommendations regarding loading if necessary, maintenance work involved, etc.

3:01.13 Experience record of diesel engines of the type proposed in order to allow evaluation of rapid start, loading and reliability. Evaluation of proposals will consider history of units and components.

3:01.14 Noise level of the unit operating at rated kw output in db at a specified distance, unenclosed.

3:01.15 Bidder shall specify a minimum temperature, if any, that is required of the cooling air to maintain rapid start.

3:01.16 Bidder shall specify whether air filters and silencers 2:03.3.5 and exhaust muffler 2:03.3.7 will adversely affect the rapid starting of the unit.

4:00 <u>EQUIPMENT TESTS</u>

4:01 Prior to shipment, the engine, generator and exciter shall be given their regular commercial tests at their place of manufacture. These tests shall include the following:

(a) Operation at rated load for a minimum period of 2 hours

(b) Operation at peak or overload rating for a minimum of 1/2 hour

(c) Starting time check

(d) Capability of starting system to provide the required number of starts

(e) Motor starting capability, utilizing a motor or motors of HP rating no less than the maximum rating listed under 2:05.10.1

(f) Voltage recovery upon application of motor or motors (e) above.

(g) Governor stability and droop for test (a) above

These factory tests are subject to witness in accordance with paragraph 1:01.1. Any of the above tests that cannot be performed in the factory shall be demonstrated in the field as part of the tests after installation.

4:02 After installation of the equipment is made, the contractor with the assistance of the engine manufacturer's representative shall operate the equipment, including auxiliaries, at partial load for such period as necessary to determine it is functioning properly. Such adjustments as are necessary shall be made to place the equipment in first-class operating condition. Before final approval, the units shall show that they will start automatically within the specified time, pick up and carry load, and be capable of satisfactorily starting the motors under 2:03.10.1. They shall also be manually synchronized. Voltage and frequency variations during both steady-state and transient operation shall be measured by suitable instruments as agreed upon.

5:00 PRICE AND DELIVERY

5:01 Prices

5:01.1 Quotations shall be submitted on a lump sum basis, complete with the detailed price makeup used in arriving at the lump sum prices.

5:01.2 The basic proposal shall cover the main engine-generator set and specified accessories and special tools, including all stationary and removable parts whether specified herein or not, to provide a completely operable installation, and shall include delivery to plant site. The basic proposal shall also include a list of recommended spare parts and a separate price therefor.

5:02 Field Representative

The per diem rate for furnishing a qualified field representative shall be quoted.

5:03 Alternatives

Any suggested alternatives by which the bidder believes he may offer a superior equipment or a functionally comparable equipment will be considered.

5:04 <u>Date for Submission of Proposals</u>

Proposals with prices must be in the hands of the ENGINEER'S Purchasing Department not later than ______________________

____.

5:05 <u>Delivery</u>

This equipment must be available at the site for installation ____.

EMERGENCY DIESEL ENGINE-GENERATOR SETS

FOR ROBERT EMMETT GINNA

NUCLEAR POWER STATION

UNIT NO. 1

WESTINGHOUSE ELECTRIC CORPORATION

ATOMIC POWER DIVISION

PITTSBURGH, PENNSYLVANIA

REQUIREMENT OUTLINE

BROOKWOOD PROJECT

RO-2239

NOVEMBER [illegible], 1966

GILBERT ASSOCIATES, INC., ENGINEERS
525 Lancaster Avenue
Reading, Pennsylvania

Addendum A
12/5/66

MO-2239
11-25-66

ADDENDUM A

December 5, 1966

Addendum:

5:03.1 Bidder is requested to advise on the possibility of his unit as quoted to start all of the loads (A) through (G), as detailed in 2:03.10.1, simultaneously in lieu of in sequence as called for in 2:03.10.1. If the required capability for simultaneous starting of the loads can be provided through modifications or additional equipment, the bidder is requested to list the modifications and price addition required.

ADDENDUM B

December 7, 1966

Section 2:03.1.2, page 4, last line; delete the word "minimum"

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] GAS AND [illegible]

ROCHESTER, NEW YORK

[illegible]

WESTINGHOUSE ELECTRIC CORPORATION

ATOMIC POWER DIVISION

PITTSBURGH, PENNSYLVANIA

[illegible]

[illegible]

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1:00 SCOPE OF WORK

General

This specification covers two battery chargers for use on the d-c control system.

The chargers are to be installed as part of the No. 1 Unit at the Robert Emmett Ginna Station, Rochester Gas and Electric Corporation. Located in Wayne County, approximately 16 miles east of Rochester, New York.

This electric generating unit is scheduled for commercial operation on June 1, 1969.

The battery chargers specified herein shall be as manufactured by the Westinghouse Electric Corporation and shall be in accordance with these specifications. No substitutions will be allowed.

2:00 REQUIREMENTS

2:01 Codes and Standards

All material furnished shall be of modern design in all respects and shall be manufactured with materials and workmanship of first quality and in accordance with accepted electric utility standards and the standards of IPCEA, ASA, IEEE (AIEE) and NEMA.

2:02 Inspection and Testing

2:02.1 The material covered by this Specification shall be completely assembled in the factory and thoroughly tested in accordance with the latest applicable standards of IPCEA, IEEE (AIEE) and NEMA.

2:02.2 Certified test reports shall be submitted to the ENGINEER prior to shipment.

2:02.3 The ENGINEER reserves the right to inspect this equipment at point of manufacture and to witness routine factory tests and such other tests as may be required to prove the correctness of operation. Any inspection by the ENGINEER shall not be considered as a waiver of any warranty or other rights.

2:03 Warranty

The material supplied under this specification shall be fully warranted against faulty material and factory workmanship. The warranty period shall be for a period of (1) year after Plant Acceptance; and the warranty on any repaired or replaced item shall be extended for (1) year from date of repair or replacement.

2:04 Drawings

Fifteen copies of outline and connection diagrams shall be submitted to the ENGINEER for approval before release for manufacture.

2:05 Instruction Books and Spare Parts List

2:05.1 Quoted price shall include the cost of fifteen (15) copies of instruction books covering all equipment and items being furnished.

2:05.2 Fifteen copies of recommended spare parts list shall be furnished.

2:06 Proposals

2:06.1 Proposals shall be drawn in the name of Gilbert Associates, Inc. as consulting Engineers and Agent for the Westinghouse Electric Corporation, Atomic Power Division, the Prime Contractor.

2:06.2 Proposals shall be submitted as follows:

Original and (5) copies to: Gilbert Associates, Inc.
525 Lancaster Avenue
Reading, Pennsylvania 19603

Attention: Mr. H. F. Ulmer
Chief Purchasing Agent

3:00 DESIGN AND OPERATING CONDITIONS

3:01 General

3:01.1 Battery chargers shall be the silicon rectifier type with hermetically sealed silicon diodes for full wave rectification which will withstand a peak inverse voltage of three times normal d-c operating voltage.

3:01.2 Chargers shall consistently maintain the d-c output voltage constant within plus or minus 1% from no load to full load, with plus or minus 10% a-c line voltage variation and within the limits of their current rating.

3:01.3 The output current shall be automatically limited to safe values. A short circuit across the d-c output shall not result in an instantaneous trip nor cause damage to the charger.

3:01.4 Controls shall be provided for float or equalizing operation.

3:01.5 The chargers shall be provided with the following minimum complement of accessories:

(a) Output voltmeter
(b) Output ammeter
(c) A-C circuit breaker

(d) Power failure alarm relay
(e) D-C line fuse
(f) Potentiometer for voltage adjustment under load
(g) 0-24 hour equalize - charge timer
(h) Pilot light
(i) Low d-c voltage alarm relay
(j) Toggle switch for equalizing charge

3:01.6 Chargers shall be designed so that they may be operated in parallel. Equalizing terminals and adjustment devices, if required, shall be provided.

3:01.7 Chargers shall be provided with surge suppression to protect against voltage transients.

3:01.8 The rectifier shall be protected against battery feedback in case of a-c power failure and the charger shall automatically resume its proper charging rate when a-c power is restored.

3:01.9 Rectifiers shall be furnished with fuses which protect against inadvertent connection to the wrong battery polarity upon installation.

3:01.10 Battery chargers shall be furnished in NEMA I general purpose enclosures. All steel parts shall be thoroughly cleaned and bonderized or phosphorized after fabrication, followed immediately by a priming coat of rust resisting paint. All exterior surfaces shall be finished in ASA #61 light gray.

3:02 Detail Requirements

The two (2) chargers covered by this specification shall be the Rectomatic regulated type for floating service with a 60 cell lead acid battery. They shall be W.E. Co. Model No. 130RC150, designed for 460 volt, 3 phase, 60 cycle a-c input and 150 ampere, 130 volt d-c nominal output.

Returns to
Tom Schlegel
1/3/74

TECHNICAL SPECIFICATION

CABLE TRAYS

FOR

ELECTRICAL CIRCUITS + conduit spec attached

POWER, CONTROL AND INSTRUMENTATION

GINNA STATION - UNIT NO. 1

ROCHESTER GAS & ELECTRIC CORPORATION

ROCHESTER, NEW YORK

PRIME CONTRACTOR
WESTINGHOUSE ELECTRIC CORPORATION
ATOMIC POWER DIVISION
PITTSBURGH, PENNSYLVANIA

GILBERT ASSOCIATES, INC.
525 LANCASTER AVENUE
READING, PENNSYLVANIA

Specification SP- 5375
T.A S
W.O. 4155
3-17-67

TABLE OF CONTENTS

1:00 SCOPE OF WORK

1:01 General

1:01.1 This specification covers cable trays for indoor use, and for use in a cable tunnel.

1:01.2 The trays are to be installed in connection with the installation of Unit No. 1 of the Robert Emmett Ginna Station, Rochester Gas and Electric Corp., located in Wayne County, approximately 18 miles east of Rochester, New York.

1:01.3 The trays are to be procured and installed by the Bechtel Corporation, hereafter referred to as the CONTRACTOR. The trays shall be scheduled for delivery as required by the CONTRACTOR.

1:01.4 The cable trays will be used to support single layers of 4 kv triplexed power cables; multiple layers of 480 volt power, 120/208 volt power, 120 volt a-c and 125 volt d-c multiconductor control and instrumentation cables intermingled; or multiple layers of low level analog signal instrumentation cables. The 4kv power cables are not to be run in the same tray with any other voltage. Low voltage analog circuits are not to be in trays with any power circuits or ON-OFF control circuits. The CONTRACTOR will install all cables in trays designated by the ENGINEER.

1:01.5 The cable trays specified herein are to be furnished in strict accordance with these specifications.

2:00 REQUIREMENTS

2:01 Codes and Standards

The equipment furnished shall be designed and manufactured in accordance with accepted electric utility standards and the standards of ASME, IEEE, (AIEE), NEMA, ASA, ASTM and with particular attention to NEMA No. VE1-1965.

2:02 Vendor Warranties

The material supplied under this specification shall be fully warranted by the vendor against faulty material and factory workmanship. The warranty period shall be for a period of one (1) year after plant acceptance; and the warranty on any repaired or replaced item shall be extended for one (1) year from date of repair or replacement.

2:03 Design Data and Drawings

Drawings submitted by the vendor shall provide all information required to erect the complete tray systems and shall include the following:

2:03.1 Physical drawings showing outlines and mounting details of all the various tray sections, fittings and accessories with piece markings and support locations as required to facilitate erection.

2:03.2 Material specifications for each item

2:03.3 Necessary instructions for field assembly and spare parts lists

2:03.4 Installation design information (deflection and load data)

2:03.5 In addition to approvals required by the CONTRACTOR, the Vendor shall furnish the foregoing drawings for approval by the PRIME CONTRACTOR and/or the ENGINEER.

3:00 <u>MATERIAL AND FINISH</u>

3:01 All trays are to be galvanized steel. (hot dipped galvanized after fabrication)

3:02 Steel used for cable trays shall meet the minimum mechanical properties of AISI "Standard Steels", C-1008 as listed in the Steel Products Manual covering Carbon Steel Sheets.

3:03 Cable trays for all service shall be protected against corrosion by being hot-dip galvanized after fabrication in accordance with the ASTM "Specifications for Zinc Coating (Hot Dip) on Assembled Steel Products", A-386.

4:00 <u>DETAIL REQUIREMENTS OF CABLE TRAYS</u>

4:01 All trays shall be of the ventilated bottom trough type (not ladder type). Ventilation slots shall extend across the bottom of the tray at a sufficient number of intervals to provide adequate ventilation. The slots shall be no wider than 3 inches.

4:02 Minimum strengths for construction shall be Class 1 for 6" and 9" widths, Class II for 12" and 18" widths, Class III for 24", 30" and 36" widths.

4:03 The gage of metal for each tray type shall be specified in the proposals. No material thickness less than #14 gage will be acceptable.

4:04 Cable trays shall be assembled with the highest standards of workmanship.

4:05 The design and construction of the cable trays shall be such that a cable loading of 100 pounds per lineal foot for any of the specified cable tray widths can be carried by the tray without more than 1/4 in. deflection at the mid-span when calculated on a simple beam basis. The cable tray and supports shall be designed to support cable loads plus a 200 pound man standing at any position in the tray. The proposal shall indicate the distance allowable between support center-lines in order to stay within the specified deflection at the specified loading. The proposal shall indicate the required number of support

centerlines for the entire cable tray installation. The Vendor shall note that the widths and depths of all cable trays are listed as inside dimensions. Side bar members shall not exceed 1 in. in width.

4:06 All 4 kv power cable trays shall be provided with covers. All cable trays used for 600 volt cable service and for control cables shall be provided with covers on all vertical runs, on all sections under platform grating and in areas considered hazardous, and other areas as specified on the drawings. The covers shall be such that there is a total of four in. or six in. clear as required under the cover to the tray cable support rib. Cover fasteners shall be approved by the ENGINEER.

4:07 The joint closure between sections of cable tray shall be accomplished by a reliable, fast method using self-aligning bolts and nuts or other means approved by the ENGINEER. This joint closure shall be capable of carrying the specified load without exceeding the specified maximum deflection.

4:08 Four kv power trays shall be 4" nominal total depth with standard 18" radii unless otherwise noted on the drawings.

4:09 Trays for low voltage power and control cables shall be 6" nominal total depth with standard 8" radii unless otherwise noted on the drawings.

4:10 Fittings shall be provided for horizontal bends for all corners. Tees, reducers, crosses, vertical inside and outside bends, box connectors and dropouts (end type, bottom frame type and side type) shall be provided as required. Hex nuts, washers, bolts, splice plates and all necessary hardware shall be included for tray splices and all of the above fittings, tees, etc. All hardware and devices shall be hot dipped galvanized.

4:11 Hangers and all necessary materials for supporting the cable trays will be furnished by the CONTRACTOR.

4:12 Cable tray widths shall be as noted on the drawings.

5:00 SPECIFICATION DRAWINGS

5:01 The following preliminary drawings are hereby made a part of this Specification and serve as a basis for the quotation:

D-214-011 Turbine Area - Mezz. Floor, West & Cable Tunnel
D-214-012 Turbine Area - Mezz. Floor, East & Cable Tunnel

D-214-021	Reactor Containment - Mezz. Floor
D-214-022	Reactor Aux. Building - Mezz. Floor
D-214-031	Turbine Area - Oper. Floor - West
D-214-032	Turbine Area - Oper. Floor - East
D-214-041	Reactor Containment - Oper. Floor, Int. Building Elev. 278'-4" and Cable Tunnel
D-214-042	Reactor Aux. Building - Oper. Floor
D-214-043	Intermediate Building - Upper Elevations
D-214-033	Control and Relay Room

5:02 These drawings are not final and quantities may vary in final installation. Bidders shall include unit prices for items quoted as a basis for adjusting final order or adding additional items.

Electrical Conduit Specifications
For
Robert Emmett Ginna Nuclear Power Plant

1:01 Conduit and fittings for use on the Robert Emmett Ginna Nuclear Power Station shall be in accordance with the following:

1:02 Indoor Conduit

1:02.1 Conduit for general power, control and instrument circuits shall be rigid thick wall hot dipped galvanized steel in accordance with specifications and dimensions for standard thick wall hot dipped galvanized conduit as set forth in Federal Specification WW-C-581 d (3).

1:02.2 Aluminum conduit shall be used only when specified on the drawings. Aluminum conduit, when used, shall be made of 6063-T42 aluminum and shall be in accordance with specifications and dimensions for rigid thick wall conduit as set forth in Federal Specification WW-C-540a. Under no circumstances shall aluminum conduit be embedded or encased in concrete.

1:02.3 Flexible conduit when required for motor box connections or equipment connections shall be galvanized steel and shall be in accordance with specifications and dimensions as set forth in Federal Specification WW-C-566a.

1:02.4 Conduit for lighting and receptacle circuits shall be rigid thick wall hot dipped galvanized steel, the same as for other circuits, in all areas where the conduits are exposed and subject to physical damage. In unexposed areas such as walls and ceilings in the service building or the control room ceiling, thin wall conduit (Electrical Metallic Tubing) may be used. Electrical metallic tubing shall be electrogalvanized on the outside and enameled on the inside and shall be in accordance with specifications and dimensions for standard electrical metallic tubing as set forth in Federal Specification WW-C-563.

1:03 Conduit Fittings

1:03.1 All conduit fittings including conduit bodies, bushings, locknuts conduit clamps, etc. shall be galvanized. Ninety degree elbows for 5" and 4" conduit shall have 30" and 18" radius respectively to the center of the conduit for conduits carrying cables rated under 5 kv. The elbow radius shall be 50" and 40" respectively for 5" and 4" conduits carrying cables rated [illegible] kv or higher.

1:03.2 Conduit fittings such as elbows and couplings, for use on rigid steel conduit when fabricated from steel tubings shall conform in all respects to the specification for "Rigid Thick Wall" hot dipped galvanized steel conduit. Cast fittings, such as condulets, shall be made of rust resisting alloys of iron or steel. All cast fittings shall be provided with heavy threaded hubs to fit the conduit to be used. All fittings shall be thoroughly coated with metallic zinc or cadmium inside and outside [illegible] [illegible] is completed.

1:03.3 Fittings for electrical metallic tubing shall be of the type especially adapted for this purpose and should conform with the requirements of the National Electrical Code.

1:04 <u>Outlet and Switch Boxes</u>

1:04.1 All outlet and switch boxes for use in lighting circuits shall be galvanized. Gasketed covers shall be provided where outlet is exposed to weather or moisture.

1:04.2 Concealed boxes shall be of pressed steel not less than four inches square, zinc coated and provided with the proper size knock-outs for conduits to be used. All unused knock-outs must remain closed. Boxes shall be provided with approved covers or plaster rings.

1:04.3 Rectangular boxes shall be provided for outlets in finished tile, brick, concrete or cinder block walls. No sectional switch boxes shall be permitted. Boxes shall be of unit construction of a size required for the number of switches or other outlets shown. The shape of the box shall be such as to permit tile to be cut in straight lines and to fit closely around the box and shall be so placed that the cover plate will be flush with finished wall surfaces. No plaster covers will be required for these boxes.

1:04.4 All boxes for light outlets shall be provided with fixture studs of a size suitable for the weight of the fixture to be supported but in no case less than three-eighths inch. The stud shall be of integral construction with the box.

1:05 <u>Outdoor Conduit</u>

1:05.1 All above ground conduit for use outdoors shall be rigid thick wall hot dipped galvanized steel in accordance with the same requirements as the conduit for indoor use.

1:05.2 Metallic conduit for use in underground duct banks, where specified on the drawings, shall be rigid thick wall hot dipped galvanized steel in accordance with the same requirements as the conduit for indoor use.

1:05.3 Non-metallic conduit for use in underground duct banks shall be rigid plastic conduit, asbestos-cement conduit or bituminized fiber conduit, unless otherwise specified on the drawings, and shall be encased in concrete

1:05.4 Plastic conduit shall be rigid polyvinyl chloride (light wall for concrete encasement) unless otherwise specified as heavy wall for seismic requirements.

1:05.5 Asbestos-cement conduit (Korduct), shall be in accordance with specifications and dimensions for asbestos-cement conduit as set forth in Federal Specification [illegible].

1:56.6 Bituminized fiber conduit (Orangeburg, Fibre Co. & Bermico Type 1) shall be in accordance with specifications and dimensions for bituminized fiber conduit as set forth in Federal Specification W-C-581 (2).

1:56.7 Flexible conduit when required for outdoor installations shall be "liquid tight" flexible steel conduit.

TFS:ge

R

AUXILIARY RELAY RACKS

ROBERT EMMETT GINNA

NUCLEAR POWER PLANT

UNIT NO. 1

WESTINGHOUSE ELECTRIC CORPORATION

ATOMIC POWER DIVISION

PITTSBURGH, PENNSYLVANIA

REQUIREMENT OUTLINE

BROOKWOOD PROJECT

RO-2612

FEBRUARY 21, 1968

GILBERT ASSOCIATES, INC., ENGINEERS
525 Lancaster Avenue
Reading, Pennsylvania

RO-2612
2-21-68

TABLE OF CONTENTS

1:00 GENERAL REQUIREMENTS

1:01 General

1:01.1 This Requirement Outline includes the essential information required by the manufacturers of power plant equipment to submit a proposal for furnishing the equipment covered by the DETAIL REQUIREMENTS, section 2:00. The equipment will be part of a nuclear-electric generating station having a nominal capacity of 450 MWe.

1:01.2 This equipment will be installed as part of the No. 1 Unit at the Ginna Project, Rochester Gas and Electric Corporation, located in Wayne, County, approximately 18 miles east of Rochester, New York.

1:01.3 This electric generating unit is scheduled for commercial operation on June 1, 1969.

1:02 Proposals

1:02.1 Proposals shall be drawn in the name of Gilbert Associates, Inc. as Consulting Engineers and Agent for the Westinghouse Electric Corporation, Atomic Power Division, the Prime Contractor.

1:02.2 Proposals shall be submitted as follows:

Original and five (5) copies to:

GILBERT ASSOCIATES, INC.
525 Lancaster Avenue
Reading, Pennsylvania 19603

Attention: Mr. H. F. Ulmer
Chief Purchasing Agent

1:03 Definitions

1:03.1 OWNER shall mean the Rochester Gas and Electric Corporation.

1:03.2 PRIME CONTRACTOR shall mean the Westinghouse Electric Corporation, Atomic Power Division.

1:03.3 ENGINEER shall mean Gilbert Associates, Inc., an Agent for the PRIME CONTRACTOR.

1:03.4 MANUFACTURER shall mean the successful Bidder for all equipment covered by this Requirement Outline.

1:04 Equipment Quality

All equipment and services offered by the Bidder shall be of such quality as to make the equipment safe with high availability. To this end, all items offered, including all accessories, shall be of proven reliability.

1:05 Codes and Standards

1:05.1 All equipment offered shall be designed and manufactured in accordance with accepted current standards of the electric utility industry and shall satisfy all applicable codes, including state and local ordinances pertaining to the design and operation of such equipment.

1:06 Tests and Inspection

1:06.1 Inspection

Shop fabrication shall be subject to inspection and approval by the PRIME CONTRACTOR and/or ENGINEER. Any inspection by the PRIME CONTRACTOR and/or ENGINEER shall not be considered as a waiver of any warranty or other rights. The PRIME CONTRACTOR and/or ENGINEER shall have free access to the MANUFACTURER'S shops for inspection of construction and for observing shop tests. All tests required for certification of equipment shall be made at the expense of the MANUFACTURER.

1:06.2 Factory Inspection and Tests

1:06.2.1 The MANUFACTURER shall conduct tests to verify the integrity of the design and construction. These shall include production testing, wiring checking and electrical testings of relays.

1:06.2.2 Potential tests shall be conducted by the supplier on all equipment in accordance with NEMA Standard IC 1-2.42, 1965.

1:07 Drawings and Instruction Books

1:07.1 Quoted price shall include the cost of furnishing three (3) reproducibles and two (2) copies of certified drawings to be submitted for approval and three (3) reproducibles of final approved drawings for record.

1:07.2 Quoted price shall include the cost of thirty (30) copies of instruction books covering all equipment being furnished.

2:00 DETAIL REQUIREMENTS

2:01 Equipment To Be Supplied

2:01.1 The equipment to be furnished consists of three relay racks, complete with relays and all rack wiring, for miscellaneous auxiliary relays required for control, interlocking and computer input circuits.

2:01.2 The MANUFACTURER shall be responsible for procurement of all relays as called for in this Requirement Outline, and the MANUFACTURER shall be responsible for the mechanical design of the racks and enclosure, physical arrangement of relays and the design of interconnecting wiring between relays and/or from relays to outgoing circuit terminal blocks, testing, cleaning, packaging and shipping.

2:02 <u>Design Requirements</u>

2:02.1 The racks shall consist of vertical pre-fabricated enclosures, series FX-78-19-25 manufactured by AMCO Engineering Company, with the relays arranged on internal supports, (desired grouping is shown on reference 2:09.1) and wired in accordance with drawings as tabulated in references 2:09.2 and 2:09.3.

2:02.2 Each rack shall be provided with a fabricated 4-inch channel iron base.

2:02.3 Hinged doors shall be provided front and rear and each door shall be provided with a key locked handle. One key shall open all rack doors.

2:02.4 One duplex convenience outlet (120 Volt, a-c, 15 amp) shall be installed in each rack module.

2:02.5 A 1-inch by 1/4-inch copper ground bus shall be run lengthwise of each rack module at a convenient location just above the mounting base.

2:03 <u>Seismic Design</u>

The racks shall be assembled and the mounting and wiring of all relays and components shall be designed so that the functions of the relays and wiring will perform when subjected to seismic accelerations of 0.21 g in the horizontal direction and in the vertical direction simultaneously. In addition, the mounting and wiring of all relays shall not dislodge or result in any loss or changes of function of circuits or relays when subjected to seismic accelerations of 0.52 g acting in the vertical and horizontal planes simultaneously.

2:04 <u>Finish</u>

2:04.1 All steel parts shall be thoroughly cleaned after fabrication and primed with duPont No. 65-3055 DuLux Gray primer-surfacer. Finish paint to be duPont No. 207 Light Green, Semi-gloss, 53% reflectance value paint reduced to proper consistency with duPont No. T-3180 DuLux thinner.

2:04.2 Exterior surfaces shall be free from warps, buckles, sags, dents and blemishes.

2:05 <u>Wiring</u>

2:05.1 All wiring shall have a minimum of 600 volt insulation with flame-resistant insulation (GE "Vulkene" type SIS or approved equivalent) and shall be adequately sized based on current carrying capacities as set forth by the National Electric Code. In no case shall wire smaller than No. 14 A.W.G., stranded be used.

2:05.2 All wiring for external circuits shall terminate on terminal blocks for field connections. A minimum of 10% spare terminals, evenly distributed throughout the board, shall be provided.

2:05.3 Terminal blocks shall be so arranged as to allow interconnections to to enter the control enclosure from both the top and bottom of each cabinet. One side of each field connection terminal block shall be reserved exclusively for field use. Terminal blocks shall be located in a conveniently accessible area for ease in maintenance or testing. They shall not impair the accessibility to the rear of any rack mounted relay.

2:05.4 Terminal blocks for field connections shall be States type NT or Stanwick Electric Products sliding link with marker strip.

2:05.5 Wires shall be identified by individual wire numbers or letters at all terminal points. This shall be accomplished by painted or printed lettering on or adjacent to terminals or by individual wire markers on the end of each wire at each termination. Sleeves, if used, shall be flame-resistant, non-conducting, a minimum of one (1) inch in length and lettered lengthwise. As an alternate, continuous wire marking may be used. Whichever method is selected, it shall than be used throughout. Wire identification shall correspond to that shown on the elementary diagrams supplied.

2:05.6 Wiring shall be installed in a neat and orderly manner. Lacing of wiring or the use of wire-ways such as "Panel Channel" or equivalent shall be used.

2:05.7 Alarm contact wires with the same wire marks shall be connected together internally and a single wire for each wire mark shall then be brought to the outgoing terminal block.

2:06 <u>Nameplates</u>

2:06.1 Nameplates of laminated micarta with white lettering on a black background shall be provided for each relay and each pair of fuses. They are to be fastened securely to the panels in a manner so they cannot become dislodged during shipment or installation.

2:06.2 Nameplate and lettering size shall be suitable to adequately display the engraved information.

2:07 Relays

2:07.1 Westinghouse relays shall be used except where other relays have been specified in the relay tabulation or have been specifically approved.

2:07.2 D-C control power will be furnished from either of two 125 volt d-c batteries. All d-c relay coils must be suitable for 129 volt normal operating voltage with operating limits from 90 to 140 volts. Periodically the voltage will be maintained at 140 volts for approximately 8 hours to equalize the charge on the batteries.

2:07.3 All Westinghouse BFD type relays shall be 4 pole minimum.

2:07.4 All timing relays, except where specified in the tabulation, shall be "Agastat" 2400 series electrically actuated, pneumatically timed relays with front terminals and front mounting bracket.

2:08 Drawings to be furnished by the manufacturer shall include the following:

2:08.1 Wiring diagrams of all panels, including grouping of outgoing leads and identification by circuit number in accordance with cable schedule which will be furnished to the MANUFACTURER by the ENGINEER.

2:08.2 Complete panel arrangement drawings showing front and rear views.

2:08.3 Outline drawing showing weight, location of electrical connections, provisions for entry of electrical cables, and methods of securing the equipment to the floor.

2:08.4 Nameplate engraving list per attached relay tabulation. Nameplate and lettering to conform to 2:06.2.

2:09 References Attached

2:09.1 Desired relay arrangement, sketch SS-JS-22068.

2:09.2 Elementary diagrams 499B425, sheets 315,316,317, 318, 320, 321, 266, 267, 268, 32, 33, 34, 114, 116, 155, 156, 165, 166, 238, 299, 269

2:09.3 Auxiliary Relay Table Sketch SS-SK-EG-003

Sheets 1 to 6

DEPT. 383 TEST REPORT NO. T1-1070A

Test Report

of

Seismic Vibration Testing

of Specific Foxboro Instruments

This report is an excerpt from Test Report No. T1-1070. It is a more detailed report than the original and will be submitted to Bechtel as qualification of the included H-line instruments.

LWH

L. W. Hewey

DEPT. 383 TEST REPORT NO. T1-1070A
(Supplement to Test Report T1-1070)

Test Report of Seismic Vibration Testing of Specific Foxboro Instrumentation

June 25, 1974

Test Conducted By:
L. W. Hewey
Senior Test & Evaluation Engineer
The Foxboro Company

Approved By: K. G. Mc
K. G. McCasland, Supervisor
Test & Evaluation Laboratory
Department 383

INDEX

1.0 Test Items

1.1 Manufacturer: FOXBORO CO.

	Model	Serial No.
a.	M/62HF-5E-OH-L, Style C, Controller	2532962
b.	M/62HB-4E-OH, Style C, Batch Controller	2423454
c.	M/6420HF-O, Style A, Recorder	2462637
d.	M/63U-AC-OHAA, Style B, Alarm	2532963
e.	M/66DC-OH-4, Style B, Multiplier/Divider	2533089
f.	M/66, Special Low Selector	2407569
g.	M/66AC-OH-XP, Style E, Sq. Rt. Converter	2532960
h.	M/693AT-OA-6, Style C, Converter	2532961
i.	M/610AC-OH, Style C, Power Supply	2533160
j.	NO140AB, Power Supply	
k.	NO140MA, Distribution Panel	
l.	EH4-D, Consotrol Shelf	
m.	2075-E, Thermocouple Assembly	

1.2 Manufacturer: WESTINGHOUSE

Model

a. VX-252, Vertical Indicator

1.3 Manufacturer: GENERAL ELECTRIC

Model

a. SBM Type Switch

2.0 Test Objective

To determine the ability of the instrumentation specified within to function during and after subjection to the following Seismic environments:

Tests were conducted in the vertical and two orthogonal horizontal planes at frequencies from 1 to 30 Hz with accelerations of 1g at 1 Hz, ramped to 2g's at 1.5 Hz and constant at 2g's to 30 Hz. Sweep rate was 1 octave/min. Refer to Diagram No. 1.

3.0 Conclusions

The outputs of all electronic rack or shelf mounted instruments, with the exception of the M/6420HF-O Recorder and VX-252 Vertical Indicator, changed less than 0.1 percent during vibration tests in all three planes. See Section 5-N and 5-L for results on the recorder and indicator. With the exception of the M/6420H Recorder, M/66D-OH-4 Multiplier/Divider and VX-252 Vertical Indicator the maximum calibration changes noted on all other electronic instruments after tests were completed were less than 0.1 percent. The maximum calibration changes noted on those instruments were -0.90, -0.45, and +1.7 percent, respectively.

No permanent electrical or physical damage was noted on any of the instrumentation after tests were completed.

Where the function of the unit under test provided analog inputs and/or output signals which could be monitored continuously, these were monitored by oscillographic recorders with span settings of ±5% of full signal span. Due to the length of these recorder charts, they are not included in this report. Rather, the data are summarized under Section 5.0 Test Results. Copies of the recordings are on file in Dept. 383 and are available for review.

4.0 Comments

4.1 The shelf-mounted units (62HF Controller, 62HB Controller, 6420 Recorder) were restrained at their front faces by a special retaining bar used on other seismic applications. (See Drawing No. 1.) The use of this retaining method along with another hold-down assembly at the rear of the units is recommended.

5.0 Test Results

a. M/62HF-5E-OHL Controller

The controller was tested per Drawing No. 2. The local set point, remote set point (derived from a d/p transmitter powered from the controller's Force Balance Power Supply) and controller output were set at 100%, 50% and 50% respectively. These signals were monitored on strip chart recorders during all tests and were calibrated for spans of 10% (i.e. 100 ±5%, 50 ±5% and 50 ±5% for the three signals). All monitored signals changed less than 0.1% during seismic tests in any of the three planes. The maximum calibration change of the local set point and controller outputs after testing was less than 0.1%.

b. M/62HB-4E-OH Controller

The controller was tested per Drawing No. 2. The local set point, remote set (derived from a d/p transmitter powered from the controller's Force Balance Power Supply) and controller output were set at 100%, 50% and 50% respectively. These signals were monitored on strip chart recorders during all tests and were calibrated for spans of ±5% (i.e. 100 ±5%, 50 ±5% and 50 ±5% for the three signals). All monitored signals changed less than 0.1% during tests in any of the three planes. The maximum calibration change of the local set point and controller outputs after testing was less than 0.1%.

c. M/66D-OH-4 Multiplier/Divider

The multiplier/divider was tested per Drawing No. 3. Both inputs (one input was derived from a d/p transmitter powered from the multiplier/divider's Force Balance Power Supply) and the output were set at 80%, 25% and 50% respectively. These signals were monitored on strip chart recorders calibrated for spans of 10%. All monitored signals changed less than 0.1% during seismic test in any of the three planes. The maximum calibration change noted after testing was completed was -0.45%.

d. M/66 Low Selector

The low selector was tested per Drawing No. 3. Input Nos. 1 and 2 and the output were set at 52%, 50% and 50% respectively. All three signals were monitored on strip chart recorders with spans of 10%. The output of the selector changed less than 0.1% during seismic tests in any of the three planes. The maximum calibration change noted after completion of all tests was less than 0.1%.

e. M/66A-OH-XP Sq. Rt. Converter

The sq. rt. converter was tested per Drawing No. 4. The input (derived from a d/p transmitter powered from the converter's internal Force Balance Power Supply) and the output was set at 55% and 75% respectively. Both signals were monitored on a strip chart recorder calibrated for spans of 10%. Neither signal changed more than 0.1% during any seismic test in any of the three planes. The maximum calibration change noted after testing was completed was less than 0.1%.

f. M/693AT-OH-6 Converter

The converter was tested per Drawing No. 4. The input and output were both set at 50%. The input was supplied by an Electronic Development Corporation Millivolt Standard and the output was monitored on a strip chart recorder calibrated to 50 ±5% of span. The output changed less than 0.1% during seismic tests in any of the three planes. The maximum calibration change noted after all tests were completed was less than 0.1%.

g. M/63U-AC-OHAA Alarm

The alarm was tested per Drawing No. 5. The set point and input were set at 50% and 48% respectively, and the alarm was deenergized. The input and output were monitored on strip chart recorders. The input recorder was calibrated to 48 ±5% while the output recorder monitored any alarm firing. The alarm did not fire during any seismic test in any of the three planes. The maximum firing point calibration change noted after testing was completed was less than 0.1%.

h. M/610AC-OH Power Supply

The Power Supply was tested per Drawing No. 5. During tests, the power supply was loaded with one d/p transmitter. The transmitter output current was monitored on a strip chart recorder calibrated for 50 ±5% of span. The output current changed less than 0.1 percent during vibration test in any of the three planes. The unit functioned properly after all tests were completed.

i. NO140AB Multiple Power Supply

The Power Supply was tested per Drawing No. 6. During tests, the power supply was loaded with one d/p transmitter. The transmitter output current changed less than 0.1 percent during vibration test in any of the three planes. The unit functioned properly after all tests were completed.

j. NO140MA Distribution Panel

The distribution panel functioned properly before and after vibration tests in all three planes. The panel was not monitored during tests.

k. 2075-E Thermocouple Assembly

The thermocouple assembly functioned properly before and after vibration tests in all three planes. The thermocouple was not monitored during tests.

l. VS-252 Vertical Indicator

Calibrations were made before and after vibration tests in all three planes. The results are as indicated below:

	Before Tests	After Tests
Zero Error, %	+0.2	+0.8
Span Error, %	-0.9	-0.5
Maximum Error, %	-0.9	+0.8

m. G.E. Type SBM Switch

Contacts 1, 3, 5, & 6 were wired in series and monitored in the closed position during testing. The contacts did not break during vibration tests in any of the three planes.

n. M/6420HF Recorder

1. Vertical Plane

During vibration in this plane the following happened:

a) The pen lifter and bracket assembly lifted causing the whole chart drive assembly to vibrate against the front face plate.

b) The retaining clip on the right side plate assembly (P/N G103TK) released the chart guide bar causing the chart paper to lift off the sprocket assembly. The pens therefore inked in only one spot leaving large blotches. One pen, the red, actually wore a hole in the paper.

c) The red and green pens shifted a maximum of +4.2 and -3.2 percent, respectively during vibration tests.

d) After testing was completed in this plane the chart drive assembly was opened for inspection. Numerous screws were found loose, notably those on the right side plate. No visual physical damage was noted. The screws were tightened and tests were resumed.

n. M/6420HF Recorder (Cont.)

2. Horizontal Plane (Motion Parallel to Instrument Face)

The red and green pens oscillated during vibration in this plane. The maximum oscillation bandwidths were ±3.2 percent for the red pen and ±2.8 percent for the green pen. The maximum pen shift for either pen was less than 0.5 percent during the vibration tests.

3. Horizontal Plane (Motion Perpendicular to the Instrument Face)

The red and green pens oscillated during vibration in this plane. The maximum oscillation bandwidths were ±2.6 percent for the red pen and ±2.8 percent for the green pen. The maximum pen shift for either pen was less than 0.5 percent during the vibration tests.

4. After Tests

The maximum calibration changes noted after tests were completed were -0.9 percent on the green pen and less than 0.1 percent on the red pen.

Calibration or function of the test items were checked prior to start of vibration tests and repeated at the completion of testing in all planes.

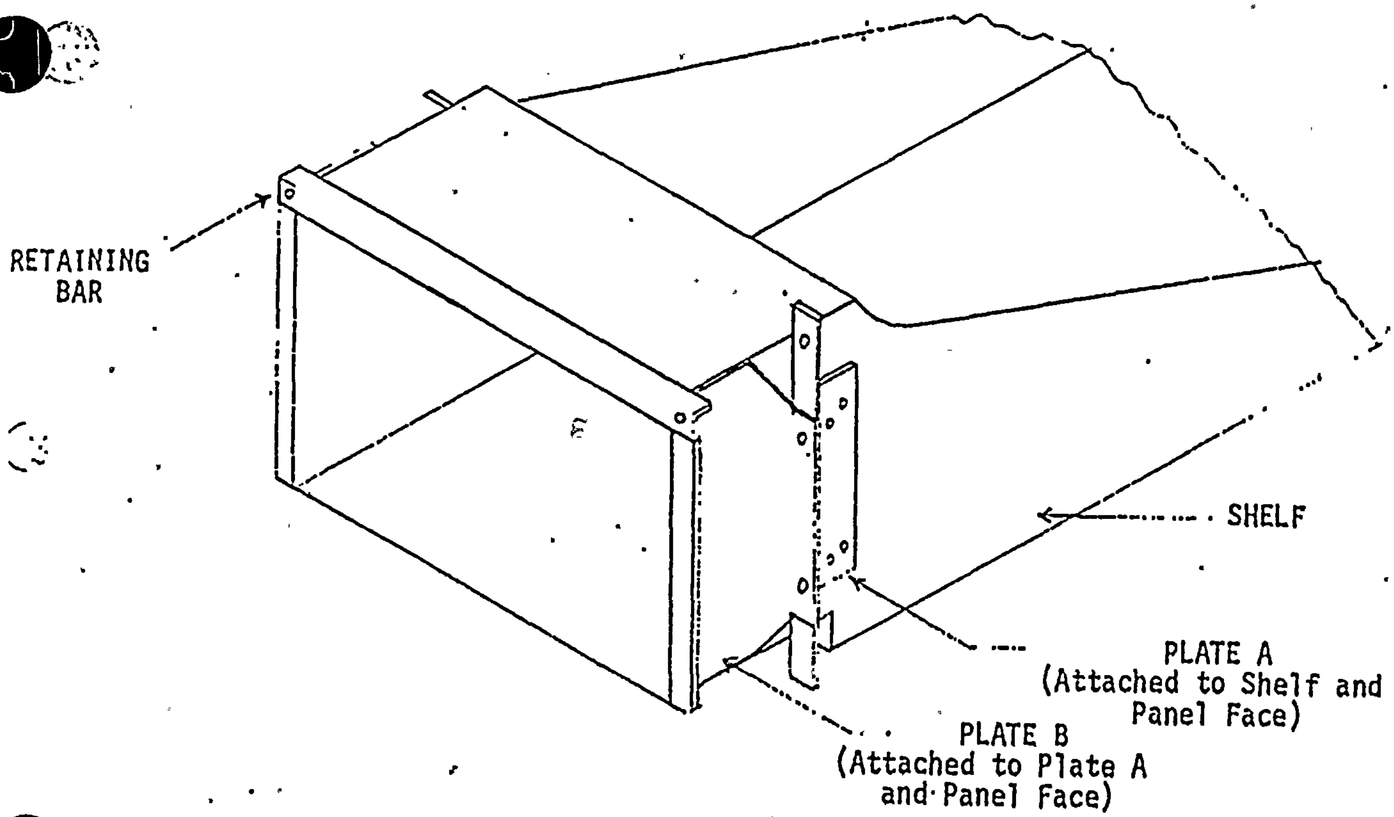
Inputs and outputs were monitored per enclosed drawings during the vibration tests in each plane.

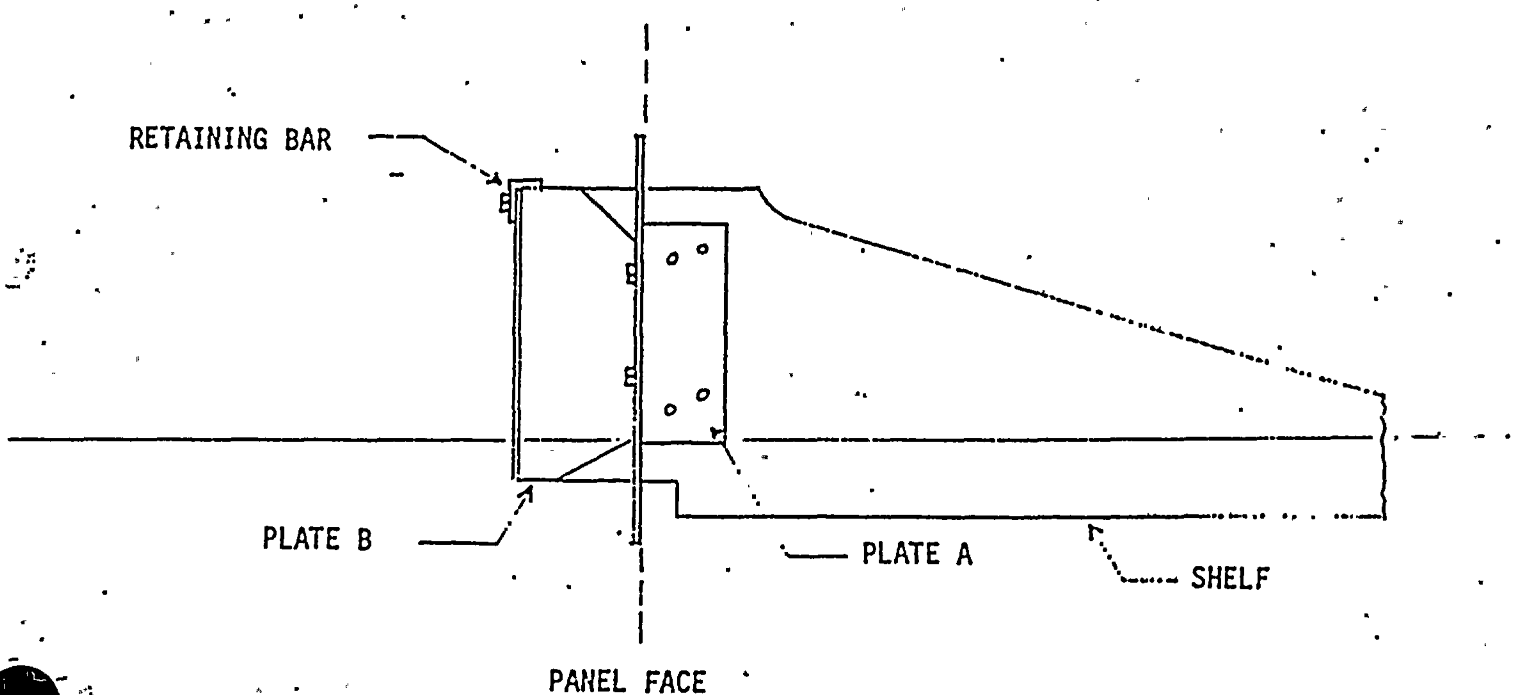
All the test items were subjected to the following tests in the vertical and two orthogonal horizontal planes:

Frequency Range:	1 to 30 Hz
Sweep Rate:	1 octave/min.
Acceleration:	1g at 1 Hz ramped to 2g's at 1.5 Hz and constant at 2g's to 30 Hz

The M/62HF Controller, M/62HB Controller and M/6420HF Recorder were mounted in a EH4-D Consotrol Shelf which was placed in a fixture made by Acton Environmental Testing Corporation. The fixture had a transmissibility ratio of 1. All other instruments were mounted in test fixtures made by Acton Environmental Testing Corporation such that the fixture had a transmissibility of 1.

DRAWING NO. 1

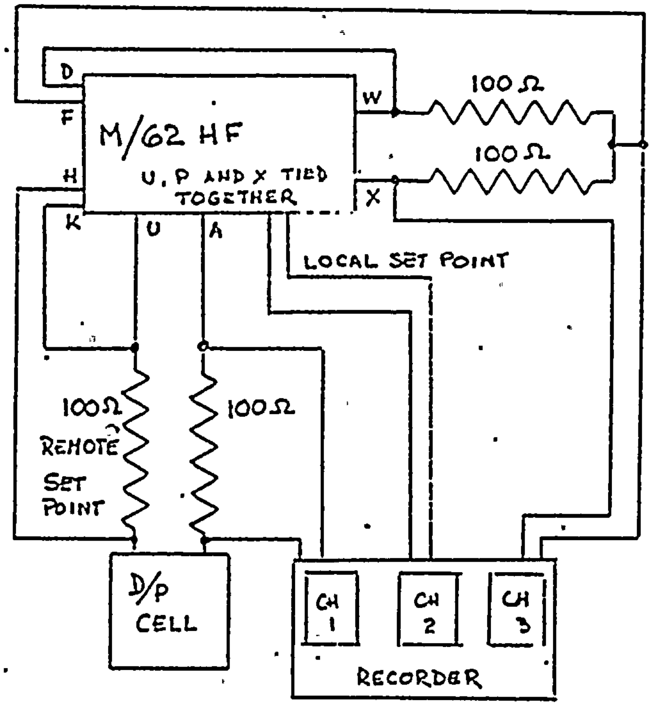

RETAINING BAR
SHELF
PLATE A
(Attached to Shelf and Panel Face)
PLATE B
(Attached to Plate A and Panel Face)


RETAINING BAR
PLATE B
PLATE A
SHELF
PANEL FACE

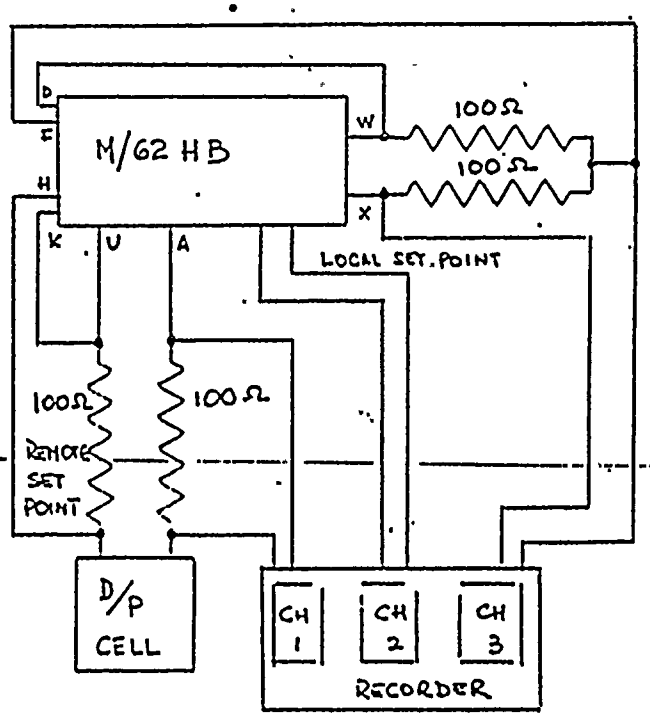
2

DRAWING No 2

1 TEST SETUP FOR M/62HF

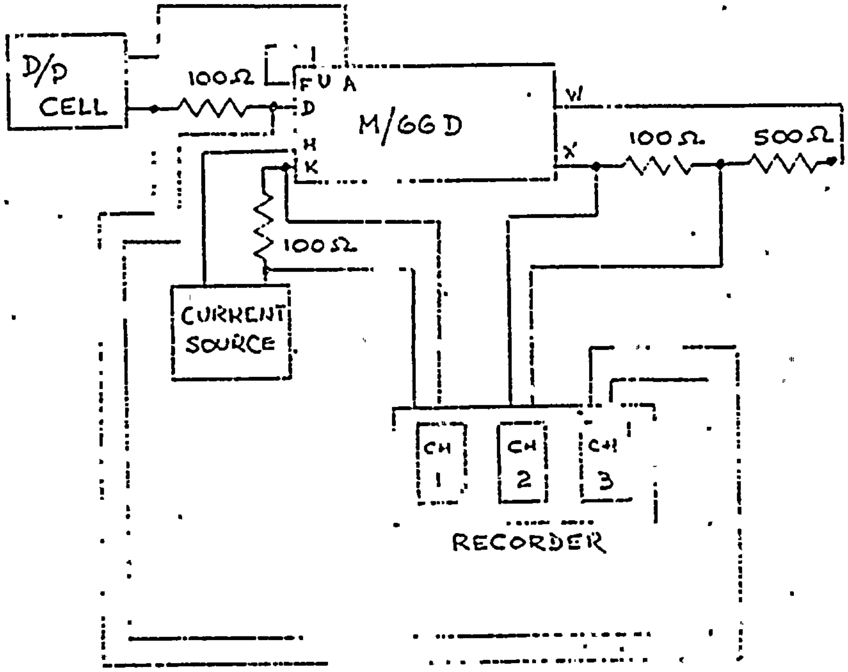


2 TEST SETUP FOR M/62 HB

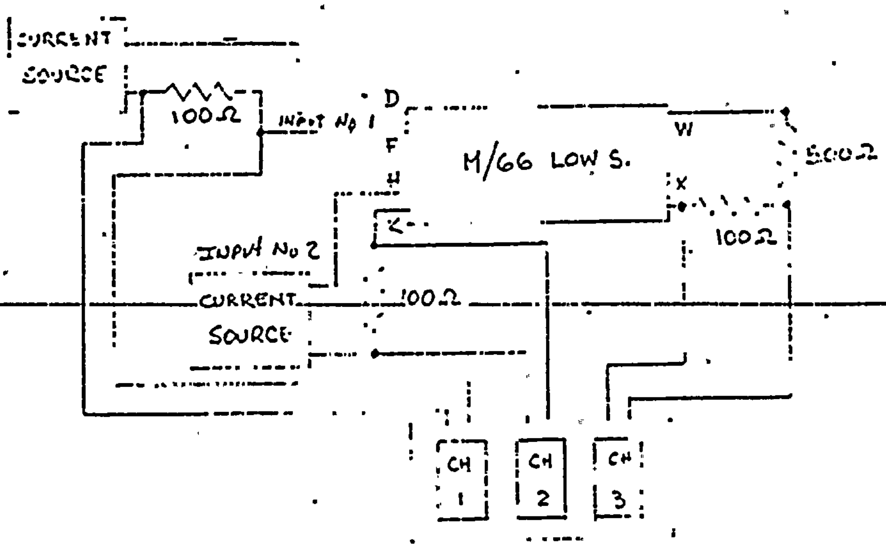


DRAWING No 3

TEST SETUP FOR M/66 D



TEST SETUP FOR M/66 LOW SELECTOR

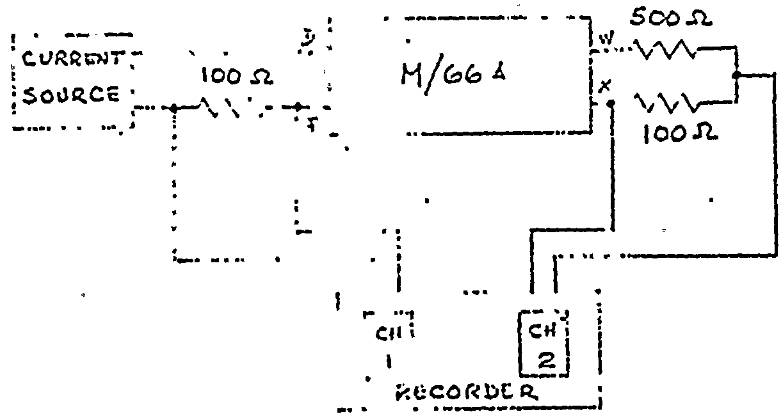


INPUT #1 - SET AT 52%

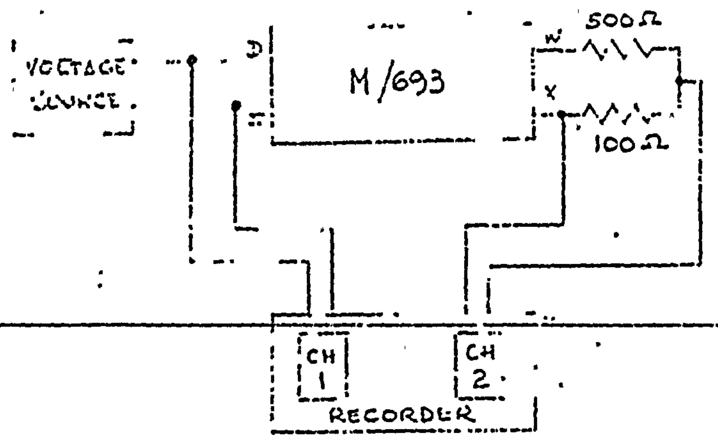
INPUT #2 SET AT 50%

DRAWING No 4

TEST SETUP FOR M/66A

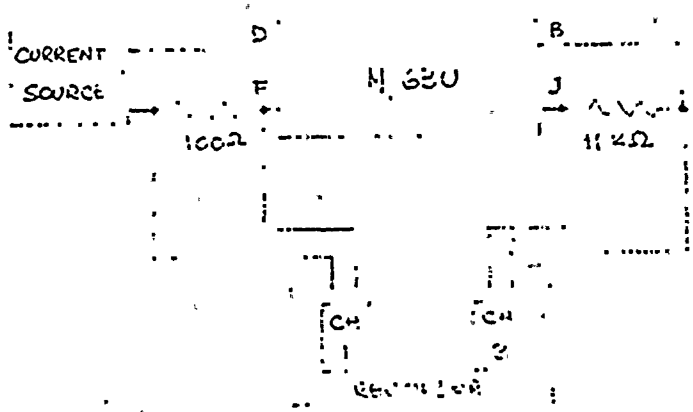


TEST SETUP FOR M/693

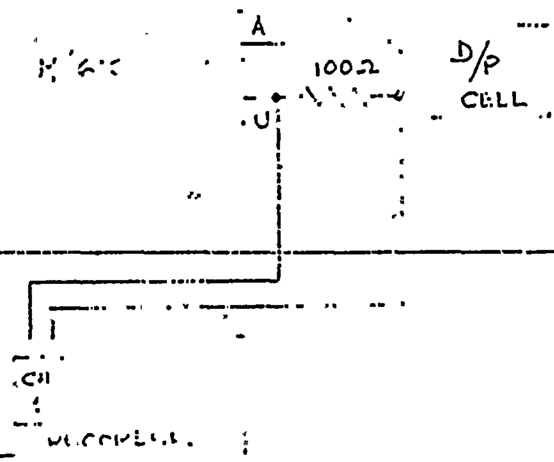


DRAWING No 5

TEST SETUP FOR M/63U

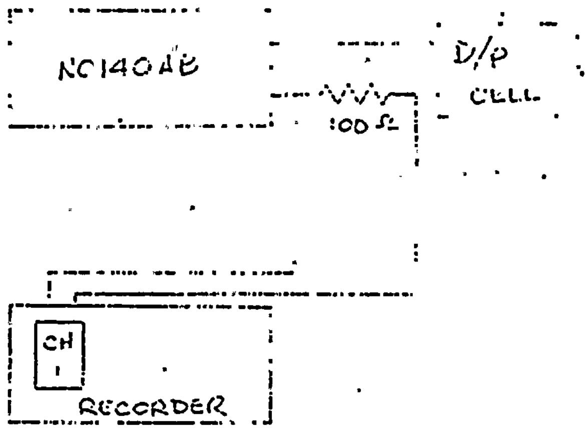


TEST SETUP FOR M/61C

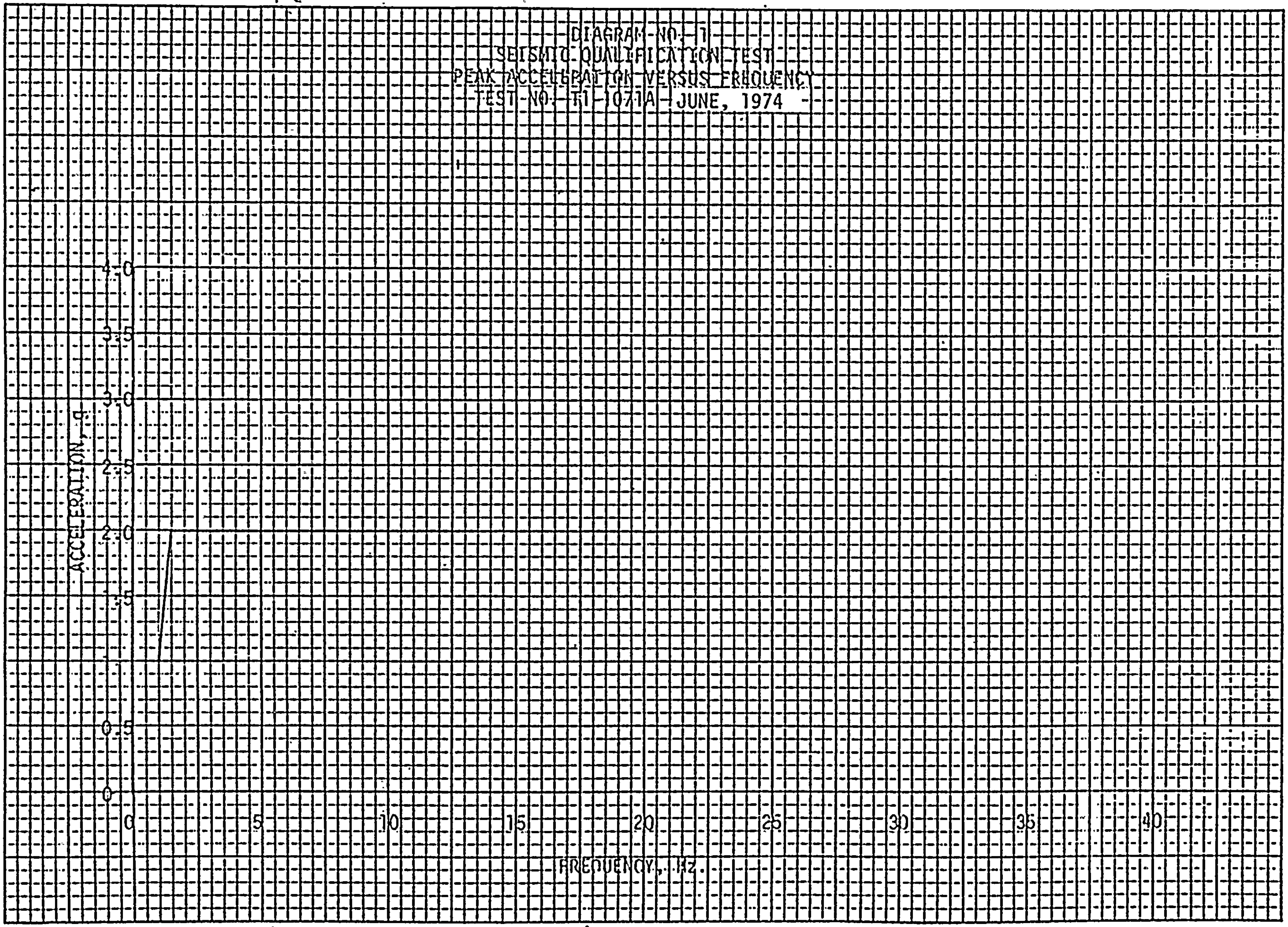


DRAWING No 6

TEST SETUP FOR NC140AB MULTIPLE P. SUPPLY



K+E 5 X 5 TO ½ INCH 46 0862
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



Test Report No. 9154 No. of Pages 6

Report of Test on

SEISMIC VIBRATION
of
SELECTED FOXBORO COMPANY COMPONENTS
for
FOXBORO COMPANY
under
PURCHASE ORDER NO. 681841A

ENVIRONMENTAL
ACTON TESTING
CORPORATION

Date February 23, 1972

	Prepared	Checked	Approved
By	R.Gilfoy	A.Giroux	M.L.Tolf
Signed	R. Gilfoy	A. Giroux	M.L.Tolf
Date	29 FEB 72	2-29-72	2/29/72

MLT:RG/hmf

Administrative Data

1.0 Purpose of Test:	Qualification Seismic Vibration of selected Foxboro Company instruments.
2.0 Manufacturer:	FOXBORO COMPANY FOXBORO, MASS.
3.0 Manufacturer's Type or Model No:	See list in paragraph 2.0 below.
4.0 Drawing, Specification or Exhibit:	Foxboro Co. Test Procedure for Seismic Vibration Testing of specific Foxboro instruments for Gulf General Atomic Co. Test No. T1-1070, dated Dec. 1971.
5.0 Quantity of Items Tested:	See list in paragraph 2.0 below.
6.0 Security Classification of Items:	NONE
7.0 Date Test Completed:	February 4, 1972
8.0 Test Conducted By:	A.Giroux/R.Gilfoy
9.0 Disposition of Specimens:	Returned to Foxboro Company.

10.0 Abstract: There was no evidence of damage or deterioration to any of the Foxboro Company components as a result of the Seismic Vibration Test specified in paragraph 2.0 below.

1.0 TEST REQUIREMENTS

The Foxboro Company instruments specified in para. 2.0 below are required to pass the Seismic Vibration Test specified in paragraph 2.0 below without evidence of damage or deterioration.

The Foxboro Company instruments must be capable of operating within their specified parameters before and after the specified vibration test.

2.0 TEST PROCEDURES

For the purpose of the subsequent Seismic Vibration Test, the Foxboro Company instruments were separated into the following groups. Each group was tested as a single unit on special vibration test fixtures manufactured by Acton Environmental Testing Corporation under this purchase order.

GROUP 1

MODEL NUMBER	SERIAL NUMBER
a) M/62HF-5E-OH-L,Style C,Controller	2532962
b) M/62HB-4E-OH,Style C,Batch Controller	2423454
c) M/6420HF-0,Style A,Recorder	2462657
d) EH4-D,Consotrol Shelf	------
e) 2075-E130WO,Thermo Couple Assembly	------

GROUP 1 (continued)

MODEL NUMBER	SERIAL NUMBER
f) M/57SRG2-H,Style B,Consotrol Subpanel	--------
g) M/58P4-FWC-SCC,Style F,Controller	2533161
h) VX-252,Vertical Indicator	--------

GROUP 2

a) M/13HA1-HK2,Style C,d/p Transmitter	2532964

GROUP 3

a) E11GH	--------

GROUP 4

a) M/63U-AC-OHAA,Style B,Alarm	2532963
b) M/66,Special Low Selector	2407569
c) M/693AT-OA-6,Style C,Converter	2532961
d) M/610AC-OH,Style C,Power Supply	2533160
e) NO140MA,Distribution Panel	-------

GROUP 5

a)-M/66DC-OH-4, Style B,Multiplier/Divider	2533089
b) M/66AC-OH-XP,Style E,Sq.Rt.Converter	2532960
c) N)14CAB,Power Supply	------
d) General Electric SBM Type Switch	------

GROUP 6

a) B114YL,Selector Relay	---------

Report No. 9154

ENVIRONMENTAL TESTING CORPORATION
ACTON

Each test group was individually mounted to its specific test fixture and the test fixture/test item assembly was mounted on the moving element of the AETC MTS Model 204-63 Hydraulic Actuator.

Prior to the start of the vibration test, the test items were operated by Foxboro Company personnel present at the time of test.

Following the initial operation, the following test was performed:

FREQUENCY	TEST LEVEL
1 to 1.5 Hz	20" DA
1.5 Hz to 30 Hz	2g's peak

One (1) accelerometer was mounted on the test fixture and monitored the applied vibration.

The above specified test was performed in each of three (3) mutually perpendicular axes.

All the vibration on all units was completed in one axis before switching to the next axis.

Following completion of the vibration test in each

axis, the test items were operated by Foxboro Company personnel present at the time of test.

3.0 TEST RESULTS

There was no evidence of damage or deterioration to any of the Foxboro Company instruments as a result of the vibration test specified in paragraph 2.0 above.

During the course of Group 4 testing in the first axis, a catastrophic failure of a hydraulic coupling occurred. The test was aborted at this point while the area was cleaned up and the line was repaired.

Following completion of the clean-up and repair, the first run on Group 4 test items was re-performed.

All operational data on the Foxboro Company instruments subjected to the above specified test were monitored by Foxboro Company personnel on Foxboro Company instrumentation.

TEST EQUIPMENT LIST

NAME	MFGR.	MODEL	SER.NO.	RANGE	ACCURACY	INV.#	CAL. FREQ.
Accelerometer	B&K	4335	135036	2 Hz to 6 KHz	±2%	AC326	1 yr
Sweep Oscillator	Spec.Dynamics	SD104-5	21	.005 Hz to 50 KHz	2%	SG315	3 mont
Oscilloscope	Tektronix	564	9027	DC to 10MC Hz	±2%	OS311	"
Amplifier Charge	Unh-Dickie	011MGSV	1-12	1-1000g 2 Hz - 20 KHz	±5%	AM333	6 mont
Hydraulic Actuator	MTS	204.63		DC to 300 Hz 25,000 force pounds 25" DA max.	2% Freq. 5% Ampl.		
Hydraulic Actuator Controller	MTS	443.115		DC to 2000 Hz	1%		
Hydraulic Power Supply	Vickers	PVA120		120 GPM to 170 GPM Max. 3000 to 5000 psi max. 250 HP	N/A		
VTVM	Ballintine	310A	5580	1.0 Hz to 2 MHz 0-100 volts	±5%	MV305	3 month

The Foxboro Company
Test Report No. T4-1030
26 AUG 75

Seismic Vibration Test
of
Specific "H" Line Instrumentation
Foxboro Company
S.O. No. 73N-55013

BECHTEL SAN FRANCISCO | JOB NO. 6600

QUALITY DOCUMENTATION REVIEW

1 [x] ACCEPT - Manufacturing may proceed.
2 [ ] ACCEPT - Please resubmit on reproducible vellum.
3 [ ] ACCEPT WITH COMMENTS - Make changes and submit corrected documentation. Manufacturing may proceed.
4 [ ] NOT ACCEPTABLE - See comments.
5 [ ] REMARKS:

By: [signature] Date: 10/17/75

- Tested at -

Acton Environmental Testing
Corporation, Acton, Mass.

Reviewed by: [signature]
J. C. Childs, Staff Engineer
Nuclear Power Products

Test Conducted by:
L. Hewey [signature]
Senior Test & Evaluation Engineer
Test and Evaluation Laboratory

and

Approved by: [signature]
K.G. McCasland, Supervisor
Test and Evaluation Laboratory

K. Prior
Test Technician
Test and Evaluation Laboratory
[signature]

OCT 1 1975

6600 M2204AC-027-8
including Addendum dtd. 9/9/75. (M/64H Recorder & M/63U Alarm)

INDEX

LIST OF ILLUSTRATIONS

1.0 Test Items

The test items were as follows:

Item	Instrument	Style	Serial No.		Weight
1	M/62H-4E-OJ	C	2943024	Controller	10 lbs.
2	M/67HTG-OJ	C	2943031	Auxillary Station	9 lbs.
3	M/610AT-OI	C	3086130	Power Supply	6 lbs.

Note: This was a specially modified unit, manufactured per ECEP 8262

Item	Instrument	Style	Serial No.		Weight
4	M/6403HF-OJ	A	3091846	Recorder	30 lbs.

Note: This was a specially modified unit, manufactured per ECEP 8847

Item	Instrument	Style	Serial No.		Weight
5	M/66AT-OJ	E	2943008	Sq. Root Converter	9 lbs.
6	M/63U-BT-OJER	B	3103851	Alarm	8 lbs.
7	M/66BT-2J	D	3005446	Current Repeater	3 lbs.
8	M/EH4-D	NA	NA	Shelf	

1.1 Instrument Weight & Center of Gravity

Item	Weight (lbs.)	Center of Gravity (In.) Height	Width	Length
1	10	2 5/8"	1 1/8"	12"
2	9	3 1/8"	1 1/4"	12"
3	6	2 5/8"	1 1/4"	5 1/2"
4	30	2 1/8"	2 3/4"	10 7/8"
5	9	2 1/2"	1"	10 5/8"
6	8	2 3/4"	1 1/8"	7 5/8"
7	3	2 5/8"	1"	8"
8	NA			

Note: Height measured from base of instrument, Width measured from left side when facing front of instrument and Length measured from front plate.

2.0 Test Objective

To determine if the instruments listed under Test Items perform per Acceptance Criteria of Bechtel Specification 0000-J820, Rev. 0, dated 9/74 when tested in accordance with Foxboro Test Program for a Seismic Vibration Qualification Test of Specific "H" Line Instrumentation, Rev. 2, dated April 7, 1975 and approved by Bechtel Corporation under No. 6600 M 2204-AC-027-5C.

3.0 Observations & Conclusions

With the exception of M/6403H-F-OJ, Style C, Recorder, all of the instruments listed in Section 1.0 Test Items operated within their rated accuracy both during and after all resonance search and random tests and performed within the acceptance criteria stated in Test Objective.

The largest calibration shifts after each test or output shift during each test for the M/66B Current Repeater, M/67HTG Auxillary Station and M/62H Controller were less than 0.2%. Also, the output current of d/p transmitter supplied by the M/610 Power Supply changed <0.2% during any test.

The M/66A Sq. Root Converter and M/63U Alarm calibration shifts after each test were less than 1.0%. The output shifts during each test also were less than 1.0%.

The M/64H Recorder had calibration shifts after each test of greater than its rated accuracy of ±0.5% with maximum shifts of 2.8%, 2.5% and 1.8% for the green, red and blue pens, respectively during any one test. However, the majority of the calibration shifts were less than 0.5% (see Section 4.7).

The pen tension on all three pens changed during each test causing the pens to lift from the paper. The tension was readjusted after each test before calibration data could be taken.

Two screws (P/N X0116CM) which hold the chart drive motor assembly to the motor mounting plate were found loose during the tests. This caused the chart drive to become inoperative. Neither screw had locking hardware.

4.0 Summary of Test Results

Note: All calibration shifts after each particular test are referenced to data taken before each test and all data are listed in order of testing.

4.1 M/62H-4E-0J Controller

Rated Accuracy: 0.5%

4.1.1 Resonance Search

Plane	50% Point Shift During Test, %	Calibration Shifts After Test, % 0%	50%	100%
Vertical	<0.1	+0.1	<0.1	<0.1
Side-to-Side	<0.1	-0.1	<0.1	<0.1
Front-to-Back	<0.1	+0.1	-0.2	+0.1

4.1.2 Random Tests

Plane	50% Point Shift During Test, %	Calibration Shifts After Test, % 0%	50%	100%
Five 1/2 SSE's Vertical/Horizontal (Back-to-Front)	-0.2	-0.2	-0.2	-0.2
Five 1/2 SSE's Vertical/Horizontal (Front-to-Back)	+0.1	<0.1	<0.1	<0.1
Five 1/2 SSE's Vertical/Horizontal (Right-to-Left)	<0.1	<0.1	<0.1	<0.1
Five 1/2 SSE's Vertical/Horizontal (Left-to-Right)	<0.1	<0.1	<0.1	<0.1
One SSE Vertical/Horizontal (Back-to-Front)	<0.1	<0.1	<0.1	<0.1

4.0 Summary of Test Results (Cont.)

4.1 M/62H-4E-OJ Controller (Cont.)

4.1.2 Random Tests (Cont.)

Plane	50% Point Shift During Test, %	Calibration Shifts After Tests, % 0%	50%	100%
One SSE Vertical/ Horizontal (Front-to-Back)	+0.1	+0.1	<0.1	<0.1
One SSE Vertical/ Horizontal (Right-to-Left)	+0.1	<0.1	<0.1	<0.1
One SSE Vertical/ Horizontal (Left-to-Right)	-0.1	<0.1	+0.1	<0.1

4.1.3 Comment

During all resonant search and random tests the internal force balance power supply of the M/62H Controller was supplying a E13 d/p transmitter. The transmitter current changed less than 0.1% during any one test.

4.2 M/66AT-OJ Sq. Root Converter

Rated Accuracy: above 50% output ±0.5%
25 to 50% output ±0.75%
10 to 25% output ±1.0%
below 10% output ±3.0%

4.2.1 Resonance Search

Plane	70% Point Shift During Test, %	Calibration Shifts After Tests, % 0%	50%	100%
Vertical	<0.1	+0.5	<0.1	-0.1
Side-to-Side	<0.1	-0.2	<0.1	+0.2
Front-to-Back	<0.1	-1.0	<0.1	<0.1

4.0 Summary of Test Results (Cont.)

4.2 M/66AT-OJ Sq. Root Converter (Cont.)

4.2.2 Random Tests

Plane	70% Point Shift During Test, %	Calibration Shifts After Test, % 0%	50%	100%
Five 1/2 SSE's Vertical/Horizontal (Back-to-Front)	<0.1	+0.5	<0.1	<0.1
Five 1/2 SSE's Vertical/Horizontal (Front-to-Back)	<0.1	-0.3	<0.1	<0.1
Five 1/2 SSE's Vertical/Horizontal (Right-to-Left)	<0.1	-0.3	<0.1	<0.1
Five 1/2 SSE's Vertical/Horizontal (Left-to-Right)	<0.1	+0.5	<0.1	<0.1
One SSE Vertical/ Horizontal (Back-to-Front)	<0.1	+0.3	<0.1	<0.1
One SSE Vertical/ Horizontal (Front-to-Back)	<0.1	-0.8	<0.1	<0.1
One SSE Vertical/ Horizontal (Right-to-Left)	<0.1	+0.7	<0.1	<0.1
One SSE Vertical/ Horizontal (Left-to-Right)	<0.1	-0.7	<0.1	<0.1

4.0 Summary of Test Results (Cont.)

4.3 M/66BT-2J Current Repeater

Rated Accuracy: 0.5%

4.3.1 Resonance Search

Plane	50% Point Shift During Test, %	Calibration Shift After Test, % 0%	50%	100%
Vertical	<0.1	<0.1	<0.1	<0.1
Side-to-Side	<0.1	<0.1	<0.1	<0.1
Front-to-Back	<0.1	<0.1	<0.1	<0.1

4.3.2. Random Tests

Plane	50% Point Shift During Test, %	Calibration Shift After Test, % 0%	50%	100%
Five 1/2 SSE's Vertical/Horizontal (Back-to-Front)	<0.1	<0.1	+0.1	<0.1
Five 1/2 SSE's Vertical/Horizontal (Front-to-Back)	<0.1	<0.1	<0.1	<0.1
Five 1/2 SSE's Vertical/Horizontal (Right-tO-Left)	<0.1	<0.1	<0.1	<0.1
Five 1/2 SSE's Vertical/Horizontal (Left-to-Right)	<0.1	<0.1	<0.1	<0.1
One SSE Vertical/Horizontal (Back-to-Front)	<0.1	<0.1	<0.1	<0.1
One SSE Vertical/Horizontal (Front-to-Back)	<0.1	<0.1	<0.1	<0.1

4.0 Summmary of Test Results (Cont.)

4.3 M/66BT-2J Current Repeater (Cont.)

4.3.2 Random Tests (Cont.)

Plane	50% Point Shift During Test, %	Calibration Shifts After Test, %		
		0%	50%	100%
One SSE Vertical/ Horizontal (Right-to-Left)	<0.1	<0.1	<0.1	<0.1
One SSE Vertical/ Horizontal (Left-to-Right)	<0.1	<0.1	<0.1	<0.1

4.4 M/67HTG-0J Auxillary Station

Rated Accuracy: 0.5%

4.4.1 Resonance Search

Plane	50% Point Shift During Test, %	Calibration Shifts After Test, %		
		0%	50%	100%
Vertical	<0.1	<0.1	<0.1	<0.1
Side-to-Side	<0.1	<0.1	<0.1	<0.1
Front-to-Back	<0.1	+0.2	<0.1	<0.1

4.4.2 Random Tests

Plane	50% Point Shift During Test, %	Calibration Shifts After Test, %		
		0%	50%	100%
Five 1/2 SSE's Vertical/Horizontal (Back-to-Front)	+0.1	<0.1	<0.1	<0.1
Five 1/2 SSE's Vertical/Horizontal (Front-to-Back)	+0.1	<0.1	<0.1	<0.1

4.0 Summary of Test Results (Cont.)

4.4 M/67HTG-0J Auxillary Station (Cont.)

4.4.2 Random Tests (Cont.)

Plane	50% Point Shift During Test, %	Calibration Shifts After Test, % 0%	50%	100%
Five 1/2 SSE's Vertical/Horizontal (Right-to-Left)	<0.1	<0.1	<0.1	<0.1
Five 1/2 SSE's Vertical/Horizontal (Left-to-Right)	+0.2	<0.1	<0.1	<0.1
One SSE Vertical/ Horizontal (Back-to-Front)	+0.1	<0.1	<0.1	<0.1
One SSE Vertical/ Horizontal (Front-to-Back)	+0.1	<0.1	<0.1	<0.1
One SSE Vertical/ Horizontal (Right-to-Left)	+0.1	<0.1	<0.1	<0.1
One SSE Vertical/ Horizontal (Left-to-Right)	+0.1	<0.1	<0.1	<0.1

AT-OHAD

4.5 M/63U-BT-0JER Alarm

Rated Accuracy: 2%

4.5.1 Resonance Search

	Calibration Shift After Test, %					
	Low Alarm (Green)			High Alarm (Red)		
Plane	0%	50%	100%	0%	50%	100%
Vertical	+0.6	<0.1	<0.1	<0.1	<0.1	<0.1
Side-to-Side	<0.1	-0.2	<0.1	-0.3	-0.3	-0.8
Front-to-Back	-0.1	+0.5	<0.1	+0.4	+0.2	<0.1

4.0 Summary of Test Results (Cont.)

4.5 M63U-BT-OJER Alarm (Cont.)

4.5.1 Resonance Search (Cont.)

During all tests the low and high set points were set at 49 and 51%, rspectively. The input was at 50% and both outputs were monitored with equipment capable of detecting 100 us openings or closures. No closure, opening or chattering of either alarm occurred during any resonance search test.

4.5.2 Random Tests

Plane	Calibration Shift After Test, %					
	Low Alarm			High Alarm		
	0%	50%	100%	0%	50%	100%
Five 1/2 SSE's Vertical/Horizontal (Back-to-Front)	+0.3	+0.1	-0.6	-0.3	+0.3	+0.3
Five 1/2 SSE's Vertical/Horizontal (Front-to-Back)	-0.3	-0.4	+0.5	-0.2	-0.3	<0.1
Five 1/2 SSE's Vertical/Horizontal (Right-to-Left)	<0.1	+0.4	-0.2	+0.4	<0.1	+0.1
Five 1/2 SSE's Vertical/Horizontal (Left-to-Right)	+0.2	<0.1	<0.1	+0.5	+0.4	-0.1
One SSE Vertical/ Horizontal (Back-to-Front)	<0.1	-0.1	-0.3	-0.3	+0.2	+0.2
One SSE Vertical/ Horizontal (Front-to-Back)	+0.2	-0.3	+0.3	-0.4	-0.3	+0.2
One SSE Vertical/ Horizontal (Right-to-Left)	-0.3	<0.1	-0.1	+0.6	<0.1	-0.6
One SSE Vertical/ Horizontal (Left-to-Right)	<0.1	<0.1	-0.6	+0.3	+0.4	+0.3

4.0 Summary of Test Results (Cont.)

4.5 M/63U-BT-OJER Alarm (Cont.)

4.5.2 Random Tests (Cont.)

During all tests the low and high set points were set at 49 and 51%, respectively. The input was at 50% and both outputs were monitored with equipment capable of detecting 100 us openings or closures. No closure, opening or chattering either alarm occurred during any random test.

4.6 M/610AT-0I Power Supply

Rated Accuracy: Not Applicable

Note: The M/610 was supplying a d/p transmitter (to simulate normal use) during all tests. The current output was monitored throughout all tests. (See Figure No. 4)

4.6.1 Resonance Search

Plane	12 mA Output Shift During Test, %
Vertical	<0.2
Side-to-Side	<0.2
Front-to-Back	<0.2

4.6.2 Random Tests

Plane	12 mA Output Shift During Test, %
Five 1/2 SSE's Vertical/ Horizontal (Back-to-Front)	<0.2
Five 1/2 SSE's Vertical/Horizontal (Front-to-Back)	<0.2
Five 1/2 SSE's Vertical/Horizontal (Right-to-Left)	<0.2
Five 1/2 SSE's Vertical/Horizontal (Left-to-Right)	<0.2

4.0 Summary of Test Results (Cont.)

4.6 M/610AT-OI Power Supply (Cont.)

4.6.2 Random Tests (Cont.)

	12 mA Output Shift During Test, %
One SSE Vertical/ Horizontal (Back-to-Front)	<0.2
One SSE Vertical/ Horizontal (Front-to-Back)	<0.2
One SSE Vertical/ Horizontal (Right-to-Left)	<0.2
One SSE Vertical/ Horizontal (Left-to-Right)	<0.2

4.7 M/6403H-F-OJ Recorder

Rated Accuracy: 0.5%

4.7.1 Resonance Search

4.7.1.1 Green Pen

Plane	Calibration Shifts After Test, % 0%	50%	100%
Vertical	+0.3	+0.1	-0.9
Side-to-Side	-0.2	-0.5	+0.7
Front-to-Back	<0.1	<0.1	<0.1

4.7.1.2 Red Pen

Plane	0%	50%	100%
Vertical	-1.0	-0.4	-1.0
Side-to-Side	+0.7	-0.2	+0.7
Front-to-Back	+0.1	<0.1	-0.5

4.0 Summary of Test Results (Cont.)

4.7 M/6403H-F-OJ Recorder (Cont.)

4.7.1 Resonance Search (Cont.)

4.7.1.3 Blue Pen

	Calibration Shift After Test, %		
	0%	50%	100%
Vertical	-0.2	-0.3	-0.9
Side-to-Side	+0.1	<0.1	+0.4
Front-to-Back	-0.2	<0.1	-0.3

4.7.2 Random Tests

4.7.2.1 Green Pen

Plane	Calibration Shifts After Test, % 0%	50%	100%
Five 1/2 SSE's Vertical/Horizontal (Back-to-Front)	+2.7	+1.4	+2.0
Five 1/2 SSE's Vertical/Horizontal (Front-to-Back)	-2.8	-1.3	-1.2
Five 1/2 SSE's Vertical/Horizontal (Right-to-Left)	<0.1	+0.3	+0.2
Five 1/2 SSE's Vertical/Horizontal (Left-to-Right)	<0.1	-0.1	+0.4
One SSE Vertical/ Horizontal (Back-to-Front)	-0.1	+0.2	-0.2
One SSE Vertical/ Horizontal (Front-to-Back)	+0.2	+0.2	-0.1
One SSE Vertical/ Horizontal Right-to-Left)	-0.2	+0.1	+0.1
One SSE Vertical/ Horizontal (Left-to-Right)	-0.3	-0.4	-0.2

4.0 Summary of Test Results (Cont.)

4.7 M/6403H-F-OJ Recorder (Cont.)

4.7.2 Random Tests (Cont.)

4.7.2.2 Red Pen

Plane	Calibration Shifts After Test, % 0%	50%	100%
Five 1/2 SSE's Vertical/Horizontal (Back-to-Front)	-0.1	+0.2	+1.0
Five 1/2 SSE's Vertical/Horizontal (Front-to-Back)	+1.6	+1.2	0.1
Five 1/2 SSE's Vertical/Horizontal (Right-to-Left)	+1.9	+2.1	+2.1
Five 1/2 SSE's Vertical/Horizontal (Left-to-Right)	+0.4	+1.0	+0.5
One SSE Vertical/Horizontal (Back-to-Front)	+0.1	+0.6	+0.3
One SSE Vertical/Horizontal (Front-to-Back)	+0.5	+0.2	+0.1
One SSE Vertical/Horizontal (Right-to-Left)	+2.2	+2.5	+2.5
One SSE Vertical/Horizontal (Left-to-Right)	+0.2	+0.4	-0.1

4.0 Summary of Test Results (Cont.)

4.7 M/6403H-F-OJ Recorder (Cont.)

4.7.2 Random Tests (Cont.)

4.7.2.3 Blue Pen

Plane	Calibration Shifts After Test, %		
	0%	50%	100%
Five 1/2 SSE's Vertical/Horizontal (Back-to-Front)	+1.5	+1.3	+1.8
Five 1/2 SSE's Vertical/Horizontal (Front-to-Back)	+0.1	<0.1	<0.1
Five 1/2 SSE's Vertical/Horizontal (Right-to-Left)	-0.3	-0.2	<0.1
Five 1/2 SSE's Vertical/Horizontal (Left-to-Right)	+0.2	+0.2	+0.1
One SSE Vertical/ Horizontal (Back-to-Front)	-0.2	-0.3	-0.1
One SSE Vertical/ Horizontal (Front-to-Back)	+0.5	+0.3	+0.3
One SSE Vertical/ Horizontal (Right-to-Left)	-0.3	+0.1	+0.2
One SSE Vertical/ Horizontal (Left-to-Right)	-0.1	-0.2	-0.1

4.0 Summary of Test Results (Cont.)

4.7 M/6403H-F-OJ Recorder (Cont.)

4.7.3 Comments

1. After each random test it was necessary to readjust the pen tension on all three pens.

2. After Test No. 4 (five 1/2 SSE's in the horizontal back-to-front plane) two screws (P/N X0116CM) which hold the chart drive motor assembly to the motor mounting plate were found loose and rattling near the front door and caused the chart drive to become inoperative.

5.0 Test Procedure

5.1.1 Rack-Mounted Units

The units were mounted in a test fixture which simulates normal rack installation (see Photograph No. 1). The front terminal plates of the units were secured to the test fixture by screws through the holes provided. At a point approximately three quarters of the distance from the front terminal plate to the rear of each instrument, supports above and below the units were installed to limit vertical movement. This rear retention simulates the use of Unistrut in present rack installation.

5.1.2 Shelf-Mounted Units

The four-unit shelf was mounted in a test fixture secured front and rear by normal installation means. Three additional seismic modifications were made to the standard EH shelf for this test.

The first modification was the addition of a retention bar with spring loaded clips mounted towards the rear of the shelf to minimize vertical movement of the installed units (see Photograph Nos. 1 & 2). The second modification was the addition of spring loaded clips to the primary top horizontal member of the shelf, again to limit the vertical motion of the instruments. The third modification was the addition of pawl mechanisms (see Photograph No. 2) which are actuated by screws below the front plate of each instrument. Each screw rotates a pawl which engages a slot in the bottom of each instrument housing to assure that the instruments will remain in the shelf during a seismic event.

5.2 Test Monitoring

The instruments were operational during all tests. Calibrations were made before and after each test and each output was monitored during all tests. The test setups were as in Drawing Nos. 1 through 7.

5.3 Resonance Survey

A resonance search at one octave per minute using a sinusoidal input of 0.3g at frequencies of 1 through 40 Hz was run in each of the three major perpendicular axes.

5.4 Random Test

The random input was simultaneous biaxial, performed in the horizontal A and vertical directions and in the horizontal B and vertical directions. The test fixture was then rotated 180° from the original direction and both horizontal/vertical components were equal and resulted in a TRS which enveloped the curves of Figure No. 1.

5.4 Random Test (Cont.)

The test duration was 30 seconds for each biaxial test. The frequency range was from 1 to 40 Hz. Five 1/2 SSE tests in each of the four planes preceeded one SSE in each of the four planes.

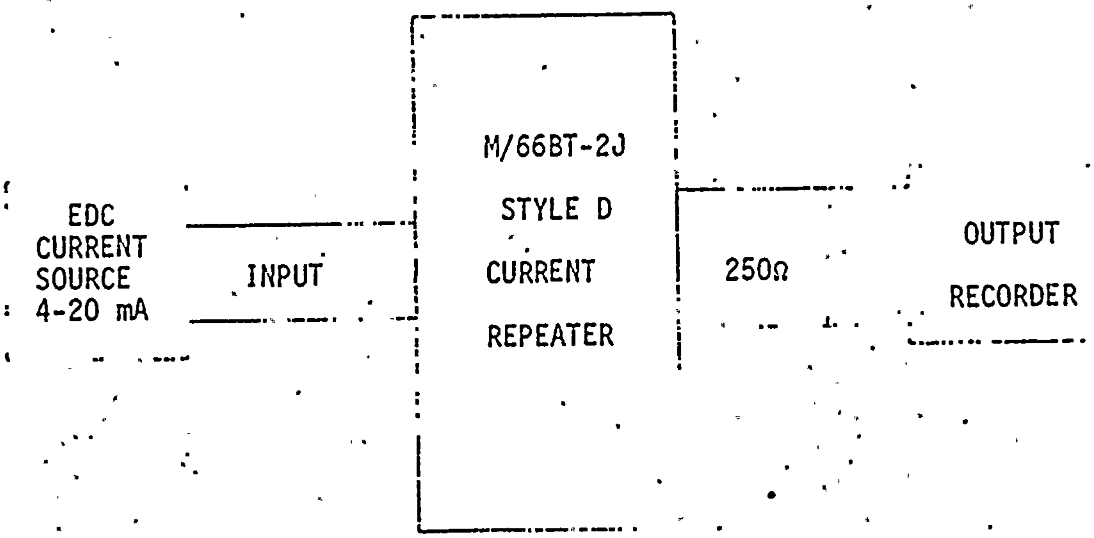
6.0 Test Equipment

Description	Model	Serial No.	Date Calibrated	Next Calibration Date
EDC Current Source	CR-100	4717	2/21/75	8/21/75
Brush Recorder Mark 280	15-6327-10	779	7/26/74	7/26/75
Brush Recorder Mark II	RD-2521-00	110	6/15/75	3/76
Hewlett Packard 4 Channel Recorder	7754A	1135A00104	2/17/75	8/17/75
Fairchild Digital Multimeter	7000A	1122	2/75	8/75
EDC Voltage Source	MV-105	5118	6/23/75	12/23/75
EDC Voltage Source	MV-105	4785	4/7/75	4/7/76

7.0 Test Sequence

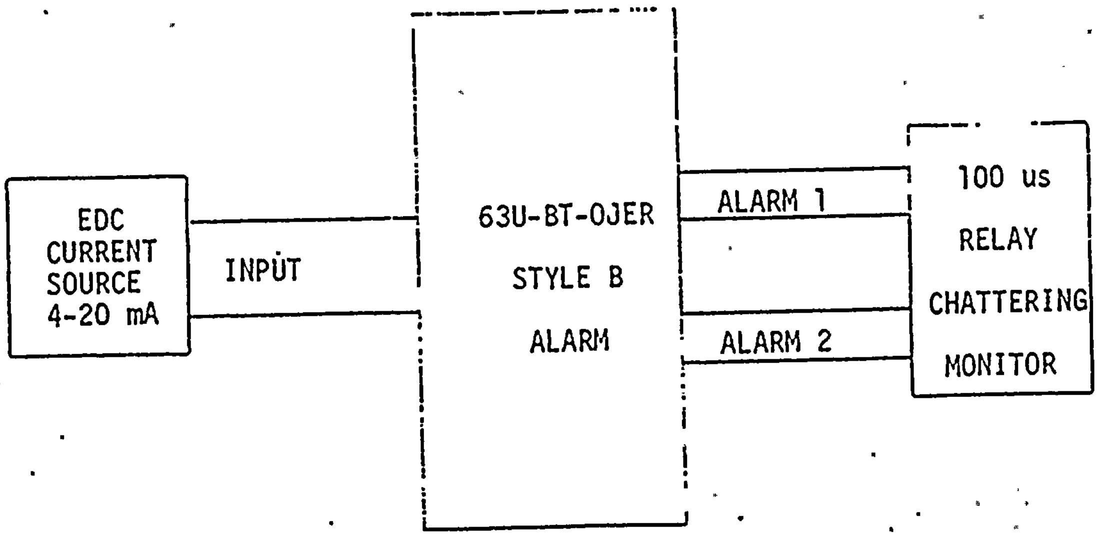
Test No	Type	Plane
1	Resonance Search	Vertical
2	Resonance Search	Side-to-Side
3	Resonance Search	Front-to-Back
4	Random Test (Five 1/2 SSE's)	Horizontal, Back-to-Front
5	Random Test (Five 1/2 SSE's)	Horizontal, Front-to-Back
6	Random Test (Five 1/2 SSE's)	Horizontal, Right-to-Left
7	Random Test (Five 1/2 SSE's)	Horizontal, Left-to-Right
8	Random Test (One Full SSE)	Horizontal, Back-to-Front
9	Random Test (One Full SSE)	Horizontal, Front-to-Back
10	Random Test (One Full SSE)	Horizontal, Right-to-Left
11	Random Test (One Full SSE)	Horizontal, Left-to-Right

Drawing No. 1

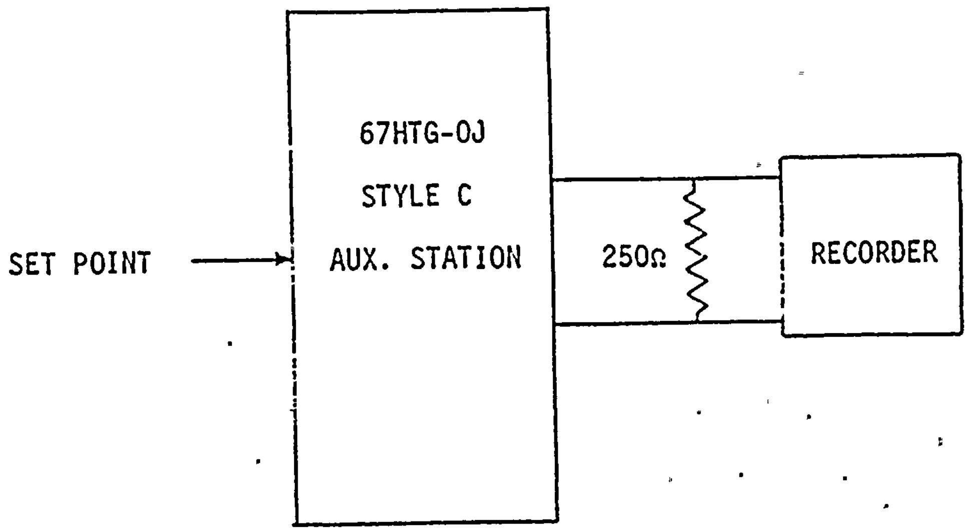


EDC
CURRENT
SOURCE
4-20 mA
INPUT
M/66BT-2J
STYLE D
CURRENT
REPEATER
250Ω
OUTPUT
RECORDER

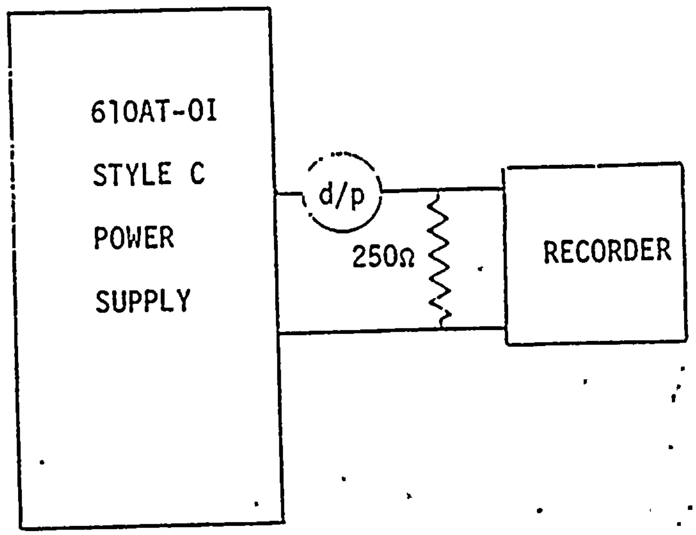
Drawing No. 2


EDC
CURRENT
SOURCE
4-20 mA
INPUT
63U-BT-OJER
STYLE B
ALARM
ALARM 1
ALARM 2
100 us
RELAY
CHATTERING
MONITOR

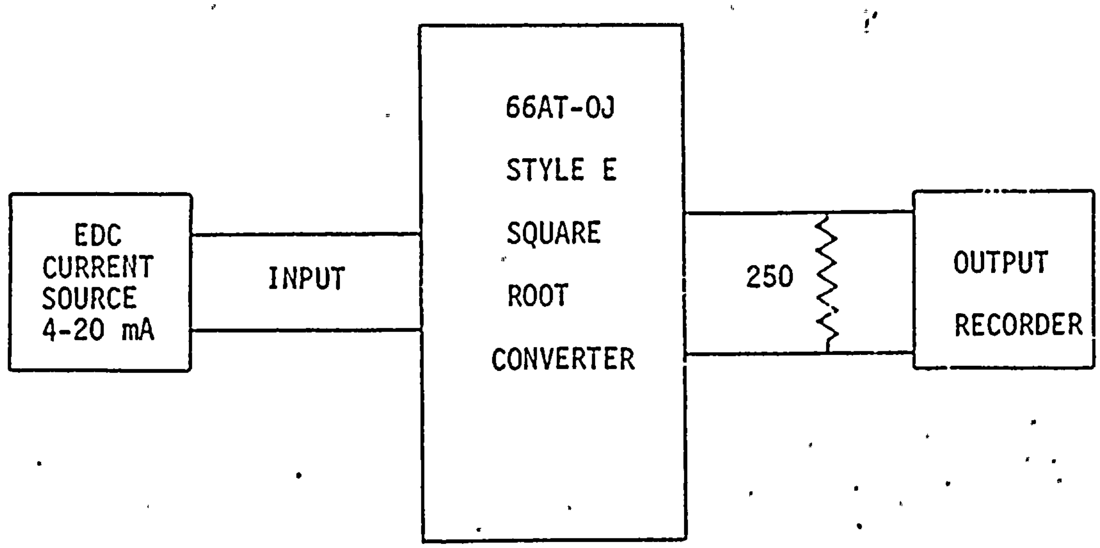
Drawing No. 3



Drawing No. 4

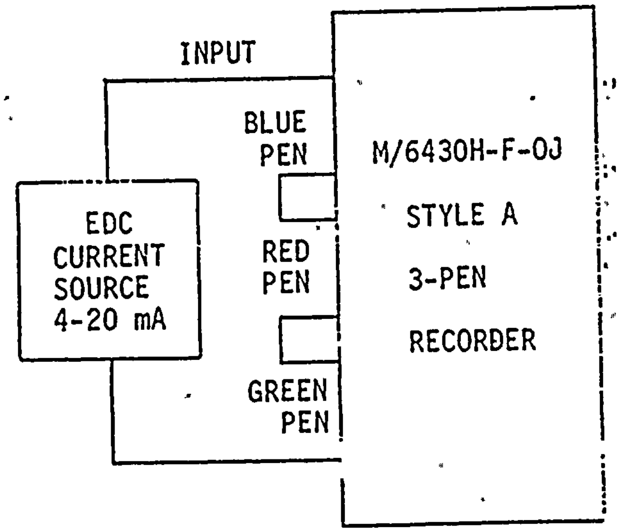


Drawing No. 5

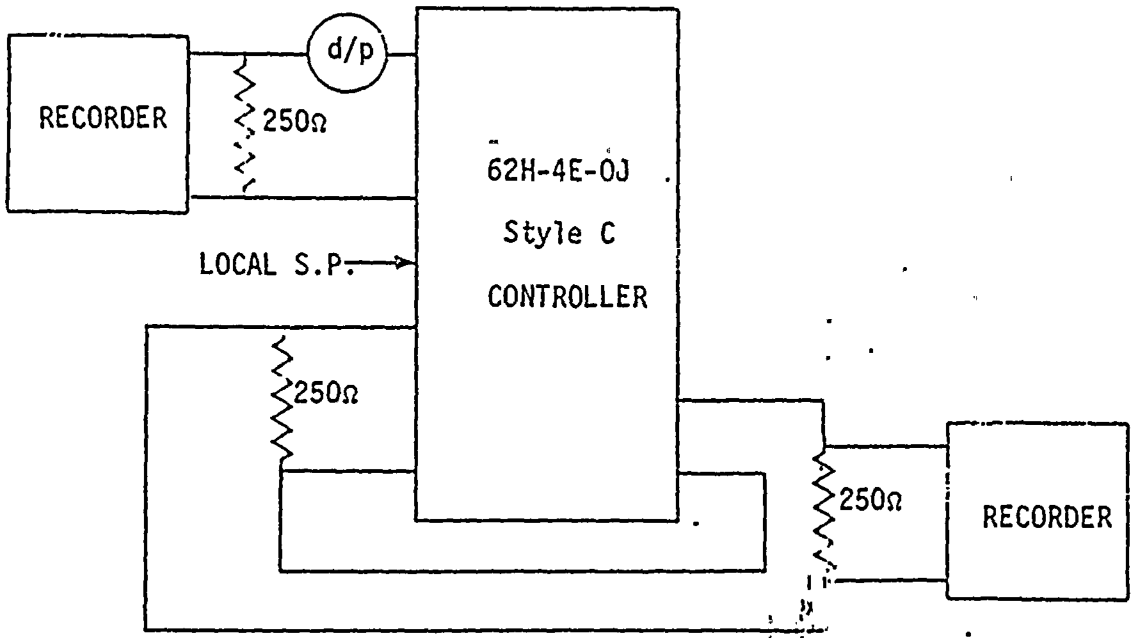


EDC
CURRENT
SOURCE
4-20 mA
INPUT
66AT-0J
STYLE E
SQUARE
ROOT
CONVERTER
250
OUTPUT
RECORDER

Drawing No. 6


INPUT
BLUE PEN
RED PEN
GREEN PEN
EDC CURRENT SOURCE 4-20 mA
M/6430H-F-OJ
STYLE A
3-PEN
RECORDER

Drawing No. 7



RECORDER
d/p
250Ω
62H-4E-OJ
Style C
CONTROLLER
LOCAL S.P.
250Ω
250Ω
RECORDER

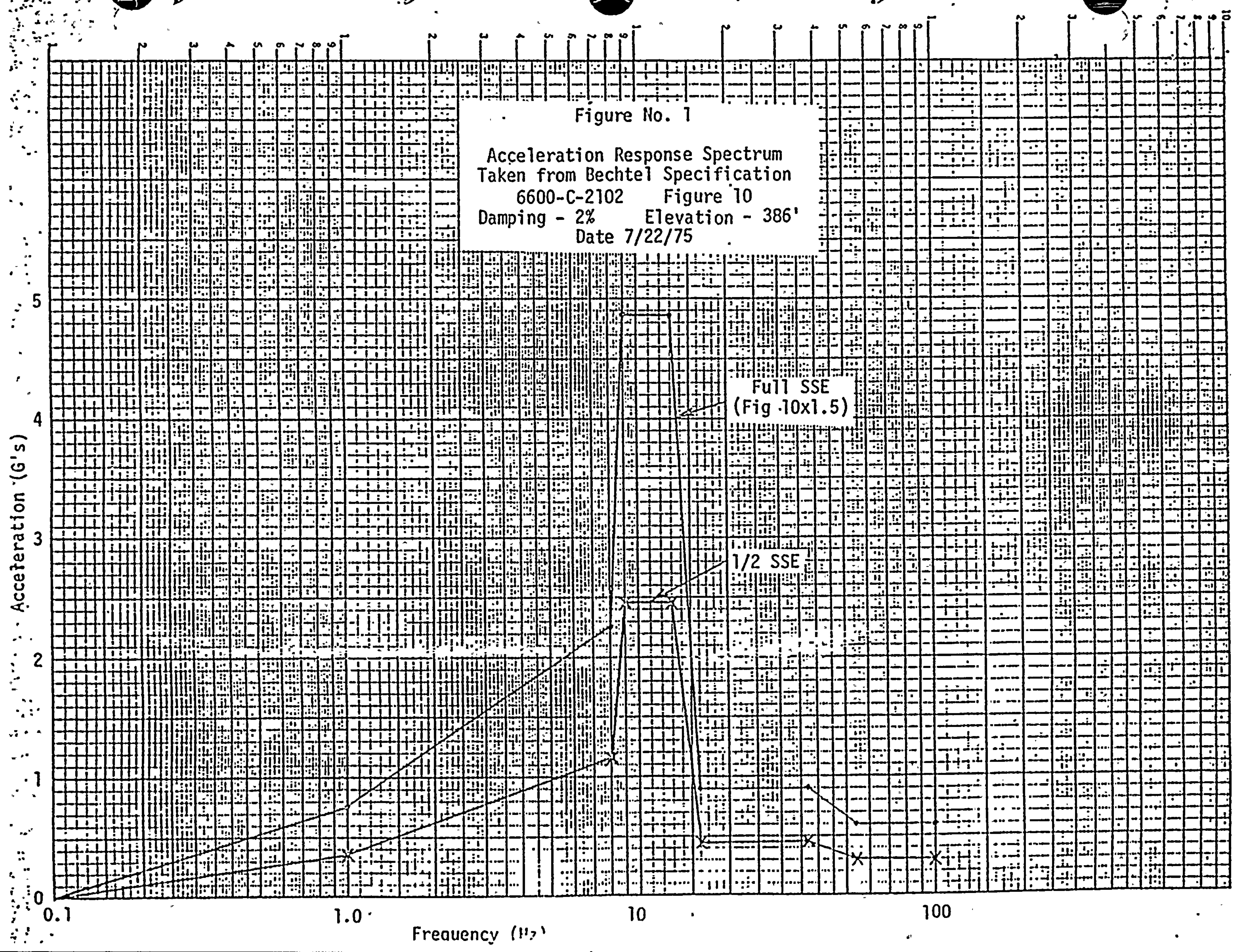
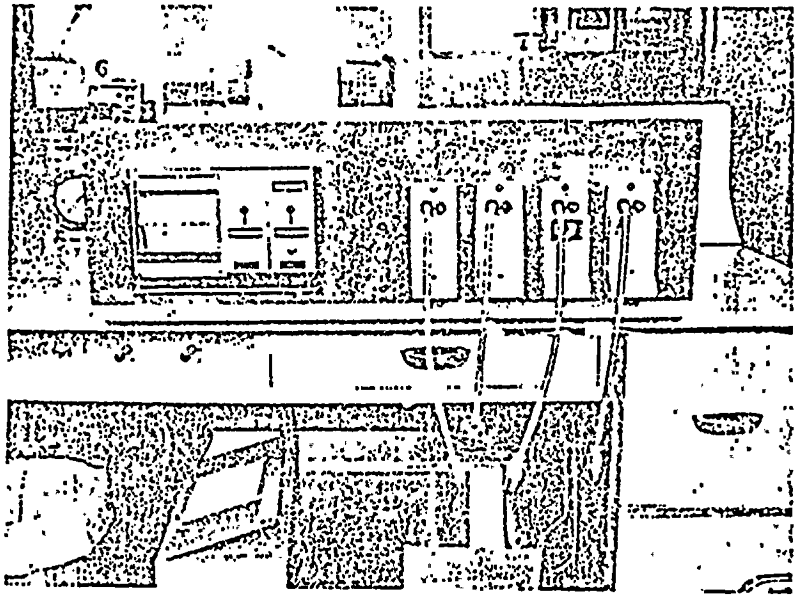


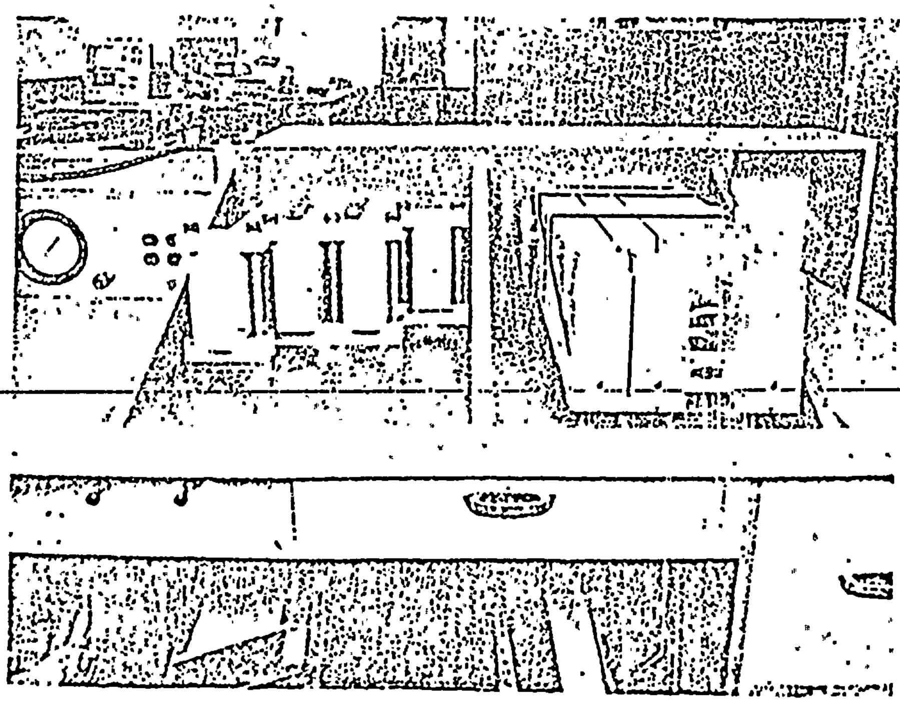
Figure No. 1
Acceleration Response Spectrum
Taken from Bechtel Specification
6600-C-2102 Figure 10
Damping - 2% Elevation - 386'
Date 7/22/75
Full SSE
(Fig 10x1.5)
1/2 SSE
Acceleration (G's)
0
1
2
3
4
5
0.1
1.0
10
100

Photograph No. 1

Front View of Test
Fixture and Instruments Tested

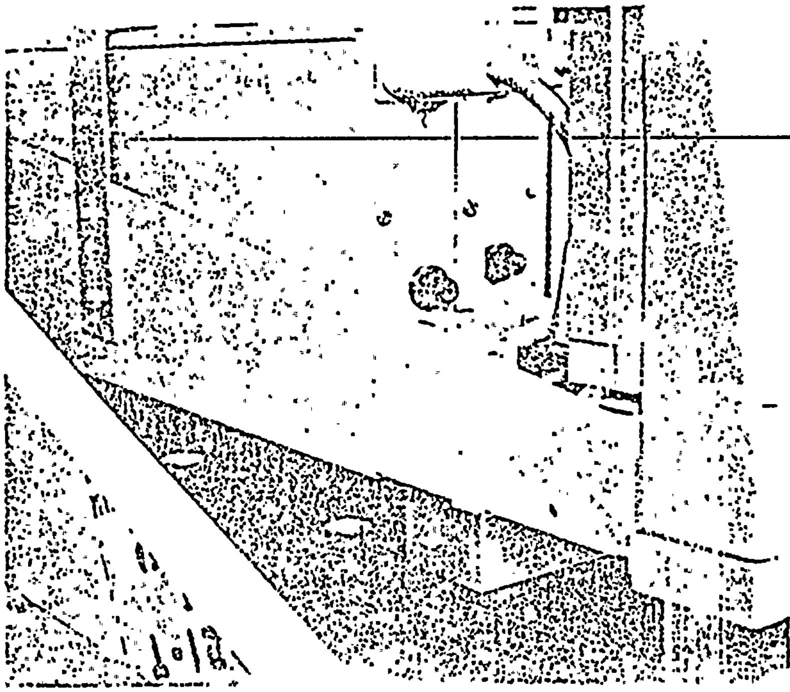


Rear View of Test Fixture
and Instruments Tested

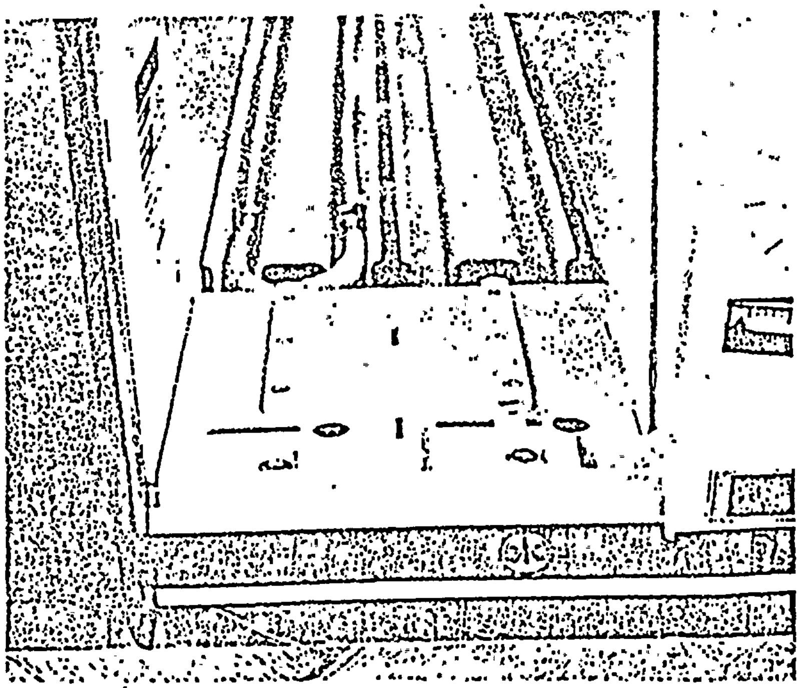


Photograph No. 2

Corner View of "H" Line
Shelf Vertical Restraint Bracket



Front View Showing Latch
Locking Mechanism for "H" Line
Display Instruments



The Foxboro Company
Addendum to
Test Report No. T4-1030
9 SEPT 75

Seismic Vibration Test
of
M/64H Recorder
and M/63U Alarm
< BT

- Tested at -
Acton Environmental Testing
Corporation, Acton, Mass.

J C Childs
Reviewed by:
J. C. Childs
Staff Engineer
Nuclear Power Products

K G McC
Approved by:
K. G. McCasland, Supervisor
Test & Evaluation Laboratory

Test Conducted by:
LWH
L. W. Hewey
Senior Test & Evaluation Engineer
Test & Evaluation Laboratory

OCT 1 1975

Addendum to → 6600 M2204 AC-027-8

INDEX

1.0 Test Items

Instrument	Style	Type	Serial No.
M/6430HF-OJ	Style A	Recorder	3091846
M/6420HF-OJ	Style B	Recorder	2943033
M/63U-BT-OJER	Style B	Recorder	3103851

2.0 Objective

Determine if the modified M/64 Recorder chart drive functions properly and remains attached to the motor mounting plate during four full SSE's as noted on Figure No. 1. Initial tests T4-1030, dated 26 AUG 75, indicated that the chart drive assembly became inoperative because two screws holding the motor assembly to the motor mounting plate became loose. Modifications to the chart drive assemblies of the two M/64H Recorders were as follows:

1. Unit Serial Numbered 3091846 had Loctite® 242 applied to the two screws attaching the chart drive assembly to the motor mounting plate.

2. Unit Serial Numbered 2943033 had lockwashers added to the two screws attaching the chart drive assembly to the motor mounting plate.

Also, step the input of the M/63U Alarm and monitor the outputs to assure proper operation during seismic tests.

3.0 Test Results and Conclusions

The chart drives of both M/64H Recorders remained operational during all tests.

The M/63U Alarm operated properly when stepped during all tests. Both the N.O. and N.C. contacts of each alarm output were monitored and operated properly during each test.

4.0 Test Procedures

4.1 M/64H Recorders

The two recorders were mounted in a four-unit shelf which, in turn, was mounted in a test fixture secured front and rear by normal installation means. Three additional seismic modifications were made to the standard EH shelf for this test.

The first modification was the addition of a retention bar with spring-loaded clips mounted towards the rear of the shelf to minimize vertical movement of the installed units. The second modification was the addition of spring-loaded clips to the primary top horizontal member of the shelf, again to limit the vertical motion of the instruments. The third modification was the addition of pawl mechanisms which are actuated by screws below the front plate of each instrument. Each screw rotates a pawl which engages a slot in the bottom of each instrument housing to assure that the instruments will remain in the shelf during a seismic event.

4.2 M/63U Alarm

This unit was mounted in a test fixture which simulates normal rack installation. The front terminal plate of the unit was secured to the test fixture by screws through the holes provided. At a point approximately three quarters of the distance from the front terminal plate to the rear of each instrument, supports above and below the units were installed to limit vertical movement. This rear retention simulates the use of Unistrut® in present rack installation.

4.3 Test Monitoring

The M/64H Recorder chart drive was operational during all tests. Checks were made to determine if the chart drive was operational before, during and after each test.

The M/63U Alarm was stepped during all tests. The output was monitored with equipment capable of detecting 100 us openings or closings.

4.4 Random Test

The random input was simultaneous biaxial, performed in the horizontal A and vertical directions and in the horizontal B and vertical directions. The test fixture was then rotated 180° from the original direction and both horizontal/vertical directions run again. The magnitude of the horizontal and vertical components were equal and resulted in a TRS which enveloped the full SSE curve of Figure No. 1. The test duration was 30 seconds for each biaxial test. The frequency range was from 1 to 40 Hz. One SSE in each of the four planes was tested.

5.0 Test Equipment

Description	Model	Serial Number	Date Calibrated	Nex. Calibration Date
EDC Current	CR100	4717	8/19/75	3/76
Hewlett Packard 4-Channel Recorder	7754A	1135A00104	8/75	2/7-
Matrix, False Contact Monitor	202D	310	Cal. Interval	6 mos.

[illegible]

DATE ......

SUBJECT: SEISMIC VIBRATION [illegible] 5 KV METAL-CLAD SWITCHGEAR

WESTINGHOUSE GENERAL ORDER NO. ....

APPARATUS: Type W-2 Control Switch S#505A714 G04

SHOP ORDER NO. ....

RATING

TEST DATE AND PLACE:

Tests were performed at the Westinghouse Astronuclear Laboratories from February 9, 1970 to February 20, 1970.

SCOPE OF TESTS:

In order to assure the adequacy of metal clad switchgear equipment for seismic applications, the Switchgear Division conducted an extensive series of test o[illegible] a 5 KV metal-clad cell and breaker with representative control equipment. Included on the control panel (front door of the cell) were a type W-2 circuit breaker control switch, a type W-2 ammeter switch, and a type W-2 voltmeter switch.

This equipment was subjected to simulated seismic beat vibrations individually in each of three directions (side-to-side, front-to-back, and vertical). The cell was mounted on hydraulic supported tables for the two horizontal test conditions and on a spring supported system for the vertical condition. Two 10,000 pound electro-dynamic thrusters were used for the simulated seismic input to the tables for the horizontal test and one thruster for the vertical test.

Strain gage type accelerometers were located at various points on the equipment to record the magnitude of the acceleration response at these locations. Two accelerometers were mounted on the control panel approximately equidistant from the location of the control switches. One was in the center of the panel at the top and the other in the center of the panel below the switch location.

TEST RESULTS:

Interpolation of the readings of the two panel mounted accelerometers indicate that the W-2 switches were subjected to the following maximum seismic forces:

Front-to-Back	-	3.3g at 13 Hz
Side-to-Side	-	2.8g at 7 Hz
Vertical	-	1.25g at 5 Hz

Contacts on the W-2 Circuit Breaker control switch were electrically monitored during the tests and no evidence of circuit disturbance was detected. In addition, the contacts were in the energized circuit breaker control circuit and no unplanned operations of the breaker resulted from the tests giving further evidence of circuit continuity.

It is concluded, therefore, that the Type W-2 circuit breaker control switch is satisfactory for seismic applications up to the values indicated in the above data.

THE ABOVE IS A TRUE AND CORRECT RECORD OF DATA OBTAINED FROM TESTS AT THE East Pittsburgh WORKS
WESTINGHOUSE ELECTRIC CORPORATION.

PAGE 1 OF 1 PAGES

W. S. Albert

REPORT OF TESTS
FORM [illegible]

Westinghouse

DATE 9-1-62

PURCHASER ______ WESTINGHOUSE GENERAL ORDER NO. ______

APPARATUS W-2 Switch Model SHOP ORDER NO. Development

RATING ______

Testing of W-2 Switch was done on Development models and final results were satisfactory. Summary of these tests follows.

Contact Resistance - Many readings of MV drop were taken across constant terminals. The average reading was 46 MV at 16.3 amperes flowing. This results in approximately .003 ohms contact resistance.

Dielectric - The switch satisfactorily withstood 2200 V 60 Cy. between open contacts, between adjacent contacts, and contact terminals and ground.

Contact Interruption - These tests were conducted on standard voltage contacts not having the wheels on each end of roller contact. A summary of the results are as follows:

	Voltage.	Inductive Current*	Non-Inductive Current
A-C	125V	30A	50A
	250V	15A	25A
	600V	2A	9A
D-C	125V	1.5A	12A
	250V	.7A	2A
	600V	Not Tested	Not Tested
	Using 2 contacts in series		
D-C	125V	1A	
	250V	1.3	*Coil Approx. .2 henry

These tests were made with oscillograph to determine length of arc and whether arc was extinguished before adjacent contact was made. Higher ratings could be used if adjacent contacts were not used.

Interruption life varies with the current and voltage; the greater the current and voltage, the shorter the life. At 1A 115 volt A-C the life tested 2 million. Yet at 2A 115 V A-C the life can be expected to be less than a million.

Mechanical Operation: The starwheel mechanism was satisfactorily tested for 4 million operations. Wear on texin wheel reduced snap action but still retained position action.

Glass polyester molded parts showed no great wear after millions of operations and appear good for long life.

THE ABOVE IS A TRUE AND CORRECT RECORD OF DATA OBTAINED FROM TESTS AT THE East Pittsburgh WORKS OF WESTINGHOUSE ELECTRIC CORPORATION.

PAGE 1 OF 1 PAGES

SIGNED M. P. Silvius ENGINEER

REPORT OF TESTS
FORM 0401 F.

Westinghouse

DATE 12-1-63

PURCHASER
WESTINGHOUSE GENERAL ORDER NO.

APPARATUS W-2 Switch Production Parts
SHOP ORDER NO. Development

Further tests on W-2 Switch using production parts were made and all results were satisfactory. Summary of these tests follows:

Standard Contact Life: Life test of 5 million operations at high speed was made operating at 160 RPM using load of 1 ampere 250 V. D-C with 4.84 henries in coil load. The switch was directly coupled to motor and had a reversing action every 15 secs. After 5 million operations on contacts, they were still in good condition. Contact wheels had wear but were in good condition.

Return Spring Life: Earlier tests showed spring breakage but with addition of teflon tubing under spring, mechanical life was greatly expanded. Life of 10 million operations was completed on a heavy load spring that is much stronger than used in present production.

Contact Resistance: Contact resistance of standard contact averaged approximately .00215 ohms and two in parallel was .00150 ohms.

Normally Closed Contact Life: Operating a 5 ampere milli-volt current circuit. It was found that contacts functioned properly with no interruption of current for 6 million operations. This includes the operation of medium sized roller contacts without contact wheels.

Slip Contact Life: These contacts functioned satisfactory for better than 3 million operations.

Standard contact interruption tests were not made on final production parts. It is believed that switch will test better than values recorded in DB37-150.

General conclusion of W-2 Switch is that it has a good mechanical life with millions of operations possible, low contact resistance, and good electrical life.

A TRUE AND CORRECT RECORD OF DATA OBTAINED FROM TESTS AT THE East Pittsburgh WORKS OF WESTINGHOUSE ELECTRIC CORPORATION.

1 OF 1 PAGES

SIGNED W. P. Silvius ENGINEER

Seismic Test Reports

Westinghouse Relay Instrument Division

Relay

WESTINGHOUSE RELAY-INSTRUMENT DIVISION

PROTECTIVE RELAY SEISMIC EVALUATION TEST PROGRAM

The Westinghouse Relay-Instrument Division Protective Relay Seismic Evaluation Test Program, follows for the most part, the guidelines set forth in the IEEE STD-344, "Guide for Seismic Qualification of Class I Electrical Equipment for Nuclear Power Generating Stations." Each test is basically conducted in two parts. Part A of the test consists of a resonance search of the test relay and Part B, the determination of its maximum seismic operating fragility level under seismic vibration.

The resonance search of a relay under test is accomplished by a one octave per minute sinusoidal wave sweep of not less than 0.2g input level over a frequency span of 1.5 to 35 hertz. Any observed resonance of the test relay is noted by off frequency stroboscopic inspection.

The maximum seismic operating acceleration level test consists of applying sine beat inputs at discrete frequencies in three mutually perpendicular axes simultaneously (east-west, north-south, and vertical). These discrete frequencies are determined by computer analysis such that any relay test sample resonance is excited to at least 1/2 peak amplitude. For a sine beat excitation of 10 cycles/beat the discrete frequencies of 1.25, 1.7, 2.25, 3.2, 4.25, 5.9, 8.0, 11.1, 15.4, 21.25, 29.4, and 35 are applied for assurance that any natural resonance of the test specimen which would affect its functional capability would be detected. At each frequency the sine beat input level in acceleration (g) is increased until there is a change in state of any of the monitored relay contacts. The test consists of a minimum of 5 sine beats each of 10 cycles/beat with at least a 2-second interval between beats as shown in Exhibit I. The input acceleration is applied at a 45-degree angle to the relay major horizontal axis and at a 56.3 degree angle to the vertical axis. This provides a vertical force which is 2/3 of the horizontal forces. A vector diagram of the resultant forces is shown on the seismic capability curve for each type relay.

After the testing of the specimen has been completed with the above orientation, the relay is rotated 180° in the horizontal plane and the fragility tests are repeated. This additional parameter is based on the IEEE STD. 344-1973 which recommends that if the test inputs in the two axes are identical and in phase that the test be repeated with the inputs 180° out of phase. The purpose of this new test is to insure that all modes of coupling will be excited since relays are assymetrical due to their structural characteristics. The resultant vectors will thus excite any test relay resonance in the 1.0 to 35 Hz. range in any of the 3 test planes.

A minimum of 3 relays of each particular type mechanism selected at random from calibrated production relays is used to establish the seismic withstand capability curve of the protective relay. The capability curve for each type relay is established by the lowest ((g) level points of any of the relays tested. A final test report capability curve is made at a slightly lower level than the above established curve to allow for the normal manufacturing contingencies.

The state of the protective relay under test is in accordance with its normal application. For a normally energized relay, the current circuits are energized at 75% of their rating and potential circuits are energized at 100%. As an example, a type CO-8 overcurrent relay with a tap setting of 8 amps will be energized with 6 amps AC in its current circuit. All critical contacts including auxiliary elements normally furnished in the test relay (ICS, IIT) are monitored by a timing circuit to detect and measure changes in status of such contacts.

The loss of function criterion for the relay test program is a change of status of any critical relay contact for a duration of two milliseconds or greater and 10 milliseconds or greater. In order to establish positive documentation as to the capability of each relay type under seismic vibration testing, it is necessary to test the relay under at least two of the following three modes of operation: (1) its normal non-operating mode energized at a current and or voltage level which does not cause its operation (quiescent) (2) the relay functional change to an operate mode during the sine beat test where the current, voltage or differential change is applied, dependent on the relay under test, for ascerthinment of the proper functional operation of the relay in a seismic environment and (3) the operate mode, if applicable, such as a latching auxiliary relay.

Exhibit II is a comprehensive list of the test equipment used in the protective relay seismic test program. Figure 1 is a closeup view of the relay mounting test fixture attached to the Unholtz-Dickie Model 6 Shaker. The horizontal and vertical accelerometers are shown rigidly mounted to the test fixture adjacent to the test relay so as to accurately determine and record the type and amplitude of the vibration applied to the relay mounting surface. Figure 2 shows the test control and monitoring equipment.

A special lightweight, yet rugged relay mounting fixture was designed to obtain the minimum distortion of any vibration sequence applied by the shaker shaft and to accommodate testing of the many sizes and types of relay cases. The relay mounting fixture will permit, with the use of adapter plates, the application of vibration in at least (7) directions with respect to the test relay.

The sine beat method lends itself to the seismic fragility testing of protective relays. The protective relay is a relatively small complex mechanical assembly where there are no apparent marked peak resonances so that the loss of function is a more critical design problem than an obvious strength failure.

It should be apparent from the above test procedure that each type of relay mechanism is subjected to a great many tests in order to document its capability under all modes of operation over the critical frequency range. The sine beat method limits the quasi-resonance build-up and avoids excessive fatigue in the equipment. This test program, therefore, should be accurate and adequate for the satisfaction of the requirement for seismic capability documentation. This program is particularly significant because the tested relays simulate the actual electrical conditions for its normal environment including all complementary devices such as indicating contactor switch and indicating instantaneous trip units over the complete frequency span of 1 to 35 Hz. The testing of individual relay basic mechanisms without their normal complements would present inconclusive evidence of the seismic capability of a protective relay.

Exhibit IV is a copy of Dr. E. G. Fisher's treatise on the Sine Beat Method for seismic qualification of electrical test equipment. This report should clarify any questions which may arise regarding our sine beat method of testing.

This test program description Part I, covers that portion of the test program which is common to all relay seismic testing. Separate capability curves, Part II attached, are issued for each type of relay.

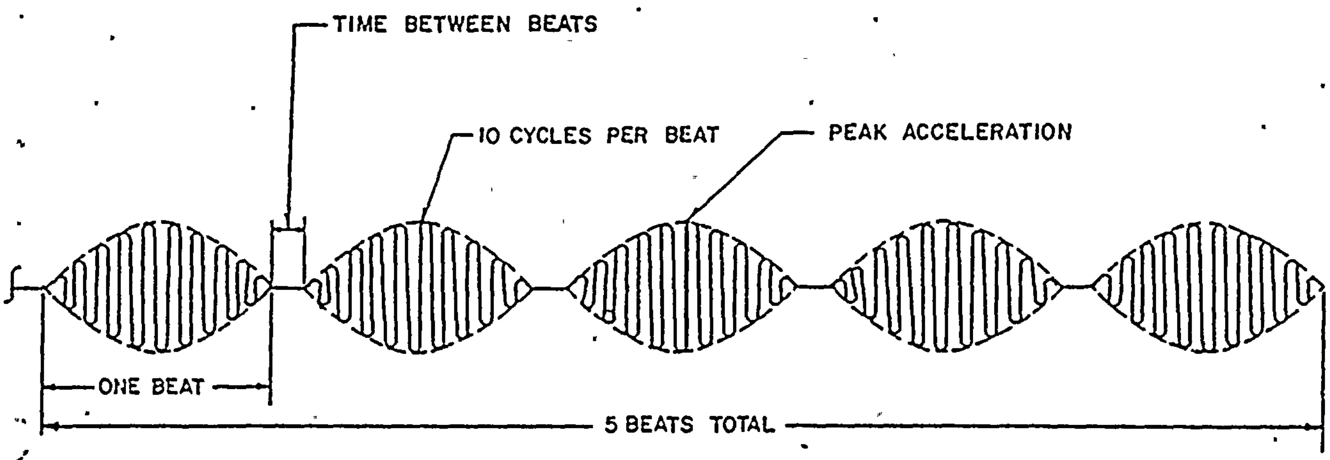


EXHIBIT I — SINE BEAT INPUT FOR TESTING

EXHIBIT II

TEST EQUIPMENT

A. Shaker: Unholtz-Dickie Model 6 capable of generating 1000 pounds of force from D.C. to 1000 Hz. With a 6-inch, peak-to-peak stroke.

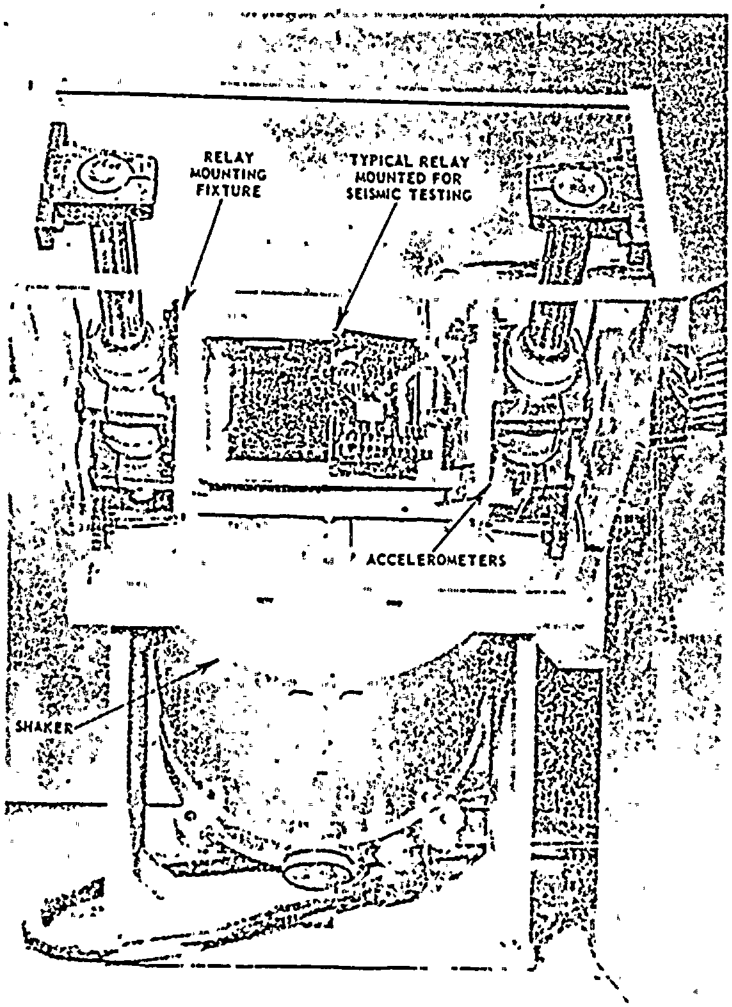
B. Function Generator: Wavetek Model 114 and Model 136 which generate all standard waveshapes as well as sine beat.

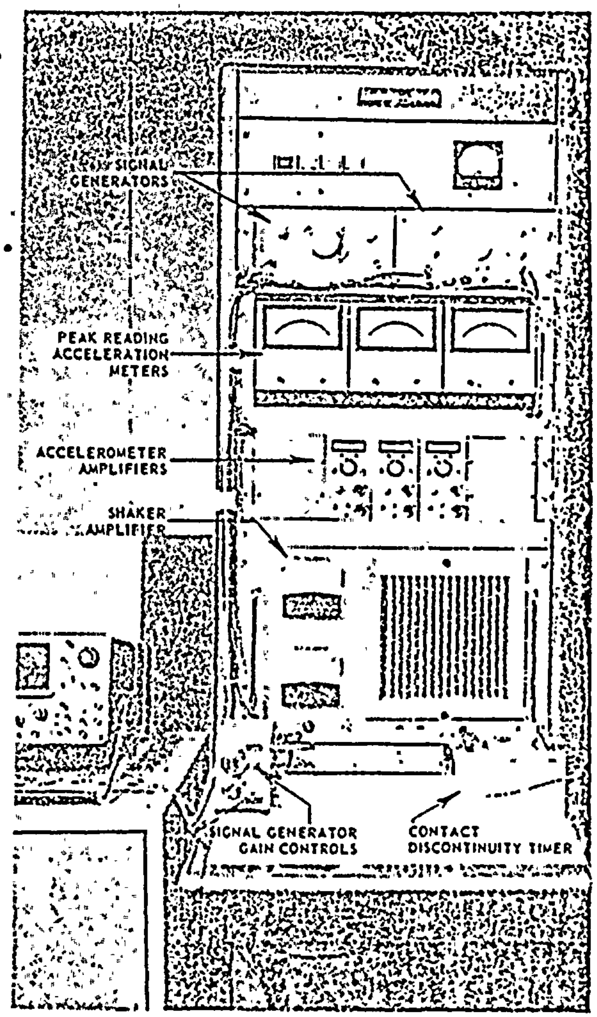
C. Motion Sensing: Three Unholtz-Dickie accelerometers and amplifiers.

D. Motion Recording: Three Endevco Model 2954A Peak Reading Meters.

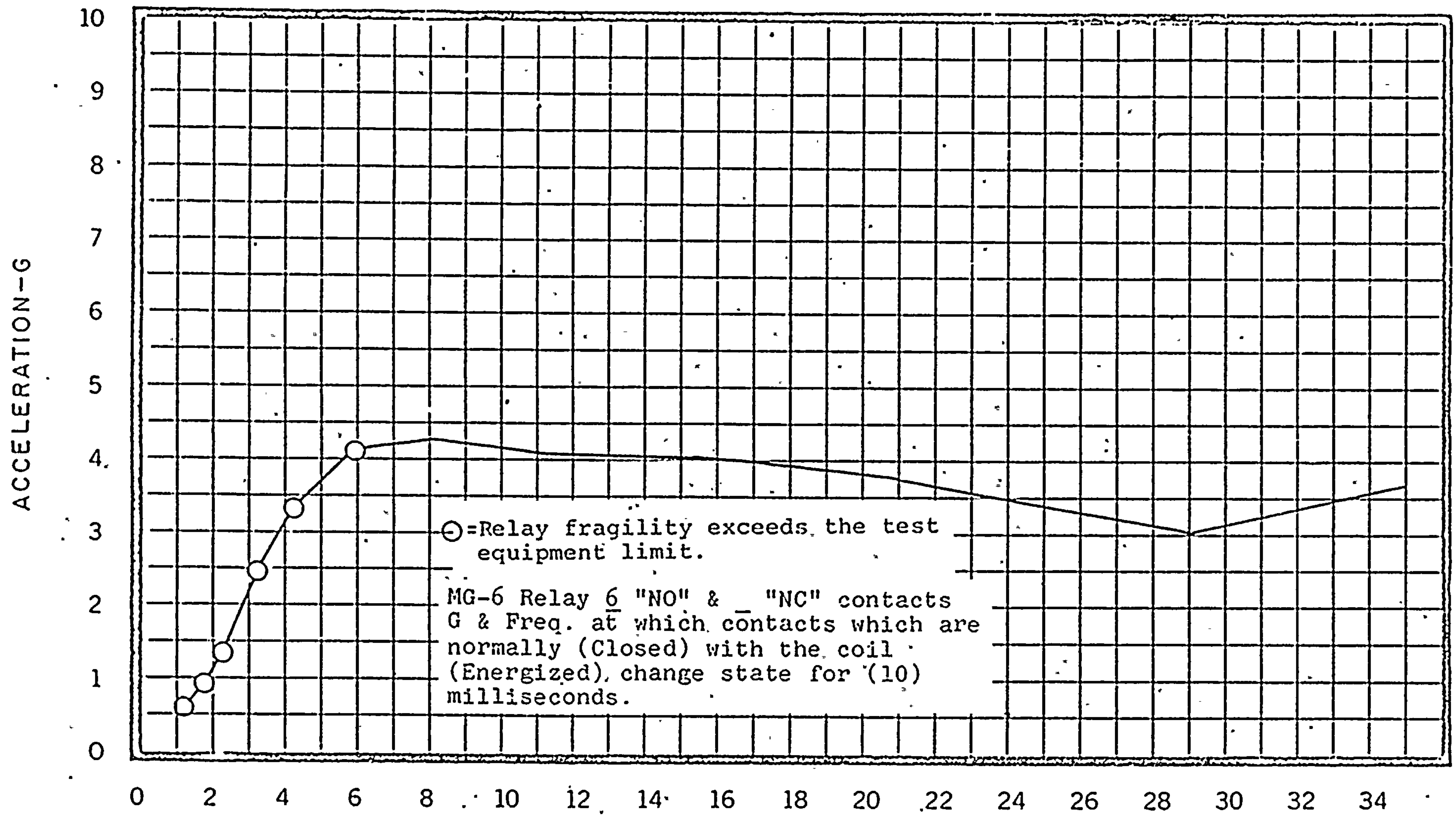
E. Mounting Fixture: Westinghouse-designed fixture to permit testing of relays in one, two or three directions simultaneously and in phase.

F. Time Monitoring: Westinghouse time monitoring fixture for detection of contact or circuit status change.

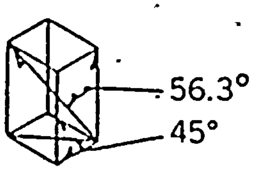




MAXIMUM SEISMIC OPERATING ACCELERATION



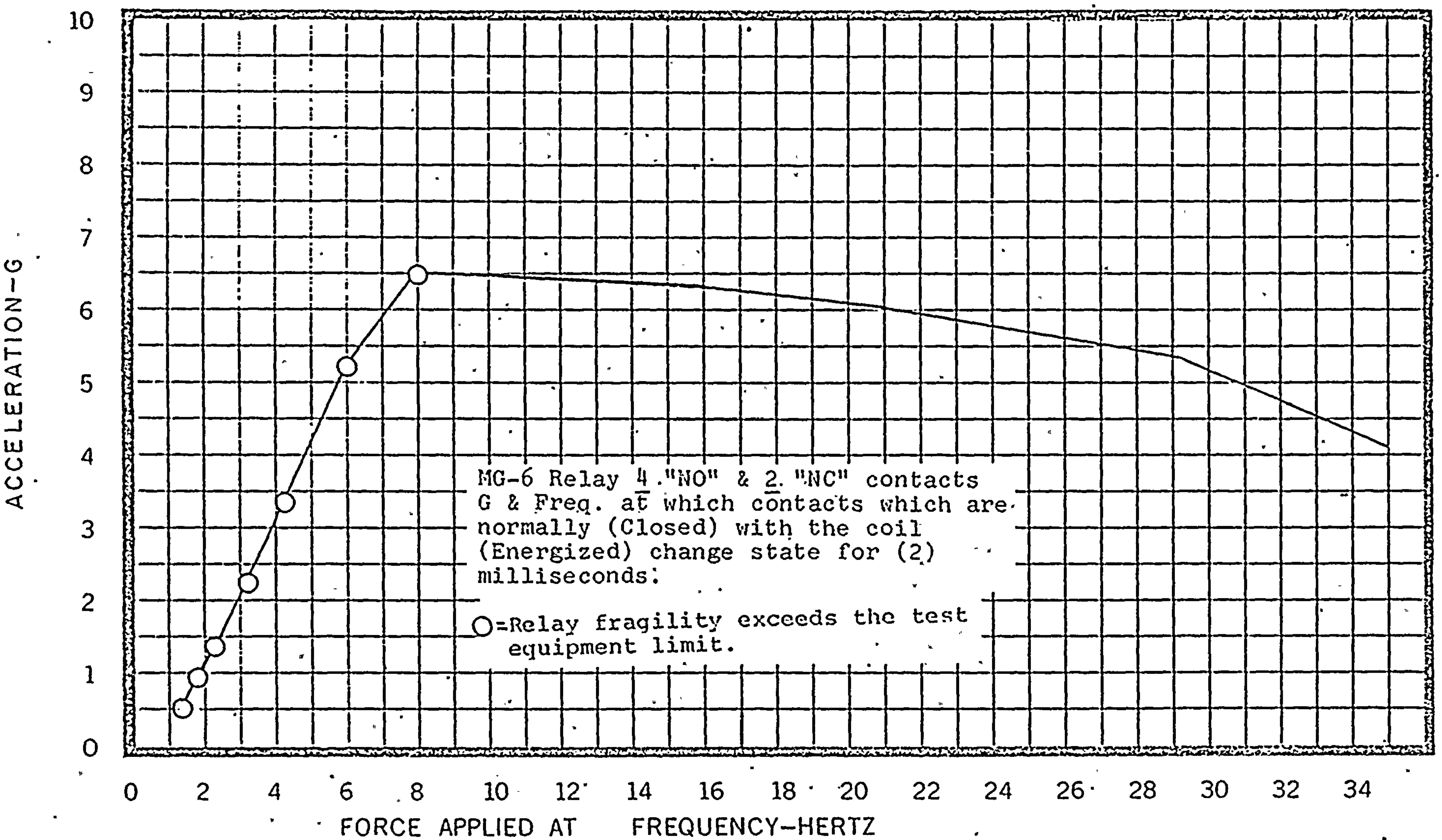
FREQUENCY-HERTZ

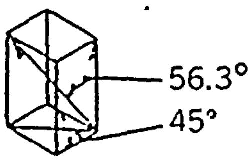


FORCE APPLIED AT 45° TO RELAY MAJOR HORIZ. AXES AND AT 56.3° TO THE MAJOR VERTICAL AXIS.

WESTINGHOUSE RELAY INSTRUMENT DIVISION ENG. ______ DATE: ______

MAXIMUM SEISMIC OPERATING ACCELERATION





FORCE APPLIED AT 45° TO RELAY MAJOR HORIZ. AXES AND AT 56.3° TO THE MAJOR VERTICAL AXIS.

WESTINGHOUSE RELAY INSTRUMENT DIVISION ENG. DATE :

motor control Center, 1L & 1M

FULL SEISMIC CERTIFICATION FOR THE GINNA STATION
MOTOR CONTROL CENTERS DESIGNATED 1L and 1M

INTRODUCTION AND SUMMARY

A computer-aided analysis has been made of a Type "W" motor control center which was originally tested at Wyle Laboratories, Huntsville AL, in October-1972 to meet the seismic requirements recommended by IEEE Std 344-1971. These calculations determined the acceleration g-levels and type of motion response that was excited in the equipment by a simultaneous horizontal and vertical sine beat type of motion input (5 cyc/beat, 4% damping).

Subsequently, a similar dynamic analysis was made of the equipment as modified for the Ginna Station, with attention focused on the new panelboard and distribution transformers. Hence, a comparison can be made of the original test response spectrum and the required response spectrum (4% damping) for this new equipment application.

The well-known "normal mode" method was used to evaluate both multi-direction and multi-frequency effects as recommended by the latest (1975) revision of IEEE Std 344. The comparison of input response spectra, as well as corresponding g-levels sustained in the equipment, shows that the original fragility-level tests performed at Wyle Laboratories were quite severe (1.49g rms) and can now be used to fully qualify the Ginna Station equipment for the specified seismic environment.

COMPUTER MODEL OF MOTOR CONTROL CENTER

Figure 1 shows a cutaway photograph of the type of motor control center that was tested with a variety of typical control devices according to the 1971 seismic standard. The computer model was based upon simple static load and "snap-back" vibration tests of a single cabinet

unit, which was built up out of actual structural members (channel and angle beams, flat plates) using the finite element method. The final four-cabinet model, as tested, was assembled using 4 single-cabinet substructures (so called "super elements"). The base spring attachment was subsequently adjusted so that the computer model had natural frequencies in agreement with the 1972 prototype test values.

Figure 2 shows a schematic diagram of the original Type W equipment as modified for the Ginna Station. Special attention was paid to the modeling of the panelboard and the three (75 lb each) distribution transformers. In general, the new assembly was made up of a combination of different substructures based upon the original single cabinet as follows:

I. Original cabinet, except increased to 20 in. deep.
II. Original cabinet, except reduced to 14.5 in. wide. (Use twice)
III. Original cabinet, except added weight for top panelboard and for transformers in the bottom three drawers.

The base spring attachments for both the original and the new assemblies remained the same, and were not part of the substructuring.

The natural frequencies and modal effective weights determined from the normal mode analysis are shown in Table I. The original equipment assembly as modified for the Ginna Station had similar modal frequencies and modal effective weights so that the seismic test results on the original Type W motor control center can safely be applied to the modified equipment by means of the computer-aided dynamic analysis.

In general, only the first three normal modes were in the seismic frequency range (1 to 33 Hz) and in addition could be effectively excited by the base motion input. The vertical (14th) normal mode of vibration was introduced by the base spring attachment in the computer model, but is well-above the seismic frequency range and has little influence on the final seismic response of the equipment.

Table I - Results of Normal Mode Analysis

Mode No.	Frequency (Hz)	Modal Effective Weight, lb		
		X (Front to Rear)	Y (Side to Side)	Z (Vertical)
Original Type "W" Motor Control Center				
1	8.5	28	503	-
2	9.9	960	15	-
3	24.0	-	439	-
4	30.5	-	4	-
5	33.8	-	24	-
14	67.1	1	-	1071
Ginna Station (as modified)				
1	8.4	63	589	1
2	10.3	971	39	1
3	22.7	-	395	-
4	30.1	-	5	-
5	31.5	1	46	-
14	64.8	-	1	1118

In the Wyle Lab tests of October-1972, the 4-cabinet assembly was positioned on the shaking machine at 45° to the horizontal motion input. The major response motion occurred at 8.5 Hz and consisted of a combined (side to side) lateral and (front to rear) torsional vibration buildup. The analysis shows this test motion to be a combination of the first and second normal modes of vibration.

SEISMIC INPUT RESPONSE SPECTRA (4% Critical Damping)

Figure 3 shows the seismic response spectrum as specified for the SSE (safe shutdown earthquake) at the Ginna Station and it is to be used for both horizontal and vertical directions. In the normal mode analysis the equipment is assumed at 45° to the horizontal direction (similar to the Wyle Lab test) so that the total horizontal and vertical ZPA (zero period acceleration) vector input is as follows:

$$\text{X-dir (front to rear)} = .707\ (.56) = 0.40g$$
$$\text{Y-dir (side to side)} = .707\ (.56) = 0.40g$$
$$\text{Z-dir (vertical)} = 1.000\ (.56) = 0.56g$$

$$\text{ZPA (rms)} = .56\sqrt{(.707)^2 + (.707)^2 + (1.0)^2} = 0.79g$$

In the 3-dimensional computer-aided analysis, the SSE spectrum is applied in each coordinate direction, except that the ordinate values are proportioned as shown above.

Figure 3 also shows the response spectrum for the 5 cyc/beat horizontal direction input at Wyle Lab during the quasi-resonance sine beat test at the 8.5 Hz measured natural frequency in the equipment assembly. In addition, the simultaneous vertical direction input was equal to two-thirds of the single horizontal component giving a total vector input as follows:

$$\text{X-dir (front to rear)} = .707\ (1.35) = 0.95g$$
$$\text{Y-dir (side to side)} = .707\ (1.35) = 0.95g$$
$$\text{Z-dir (vertical)} = .667\ (0.95) = 0.64g$$

$$\text{ZPA (rms)} = 0.95\sqrt{(1)^2 + (1)^2 + (2/3)^2} = 1.49g$$

The resonance search specified by IEEE Std 344-1971 indicated a major resonance at 8.5 Hz and as much as 5-10% damping measured in the equipment at the maximum 1.49g sine beat acceleration input. However, the subsequent comparison of equipment response values has been made at only 4% damping, the largest value appearing in the required response spectra supplied for the Ginna Station.

In addition to the test at 8.5 Hz, similar quasi-resonance dwell tests (5 beats at 5 cyc/beat) were performed at the six most significant resonant frequencies in the seismic range from 1 to 33 Hz. Corresponding g-level input and SDF (single degree of freedom) response are shown in Table II.

Table II - RMS Input and SDF Response

Frequency	g-Level Input			g-Level Response	
	Horizontal	Vertical	RMS	1%	4%
2	0.72	0.34	0.80	6.9	4.9
5	1.35	0.64	1.49	12.9	9.1
8.5	1.35	0.64	1.49	12.9	9.1
17	0.82	0.40	0.91	7.9	5.6
20	0.68	0.37	0.77	6.7	4.7
33	0.45	0.21	0.50	4.3	3.1

In general, the calculated SDF g-level test response values are well-above 1.5 times the required SSE response spectrum values for the Ginna Station (see Figure 3). The latter factor accounts for possible multi-frequency effects of a typical, broadband seismic motion input compared to the original, single-frequency tests at Wyle Lab in October-1972.

COMPARISON OF EQUIPMENT RESPONSE g-LEVELS

The normal mode analysis provides a summation of the g-level response at any location in the equipment corresponding to the 3-direction seismic input spectra illustrated by Figure 3. A comparison of the overall severity of the Wyle Lab test versus the Ginna Station design specification has been made in terms of the g-level response calculated at the top-left-front corner of the cabinet assemblies shown by Figures 1 and 2. Table III shows that for X-dir response only the first two modes are important, while for Y-dir response only the first mode is important. (Note: The Z-dir summation has been arbitrarily increased to the ZPA value as a maximum representing the contributions of the many modes above 33 Hz which were not tabulated.)

In general, as also shown by Tables IV and V, the g-levels throughout the equipment were at least 2 times greater when calculated for 5 cyc/beat test at 8.5 Hz compared to the Ginna Station spectrum,

Table III - Equipment Response at Top-Left-Front-Corner

Mode No.	Frequency (Hz)	Equipment Response g-level X (Front to Rear)	Y (Side to Side)	Z (Vertical)
Wyle Lab Test Input				
1	8.5	1.66	5.19	.02
2	9.9	4.98	.11	.01
3	24.0	.02	.29	-
4	30.5	-	.02	-
5	33.8	.01	.20	-
Summation:	1-dir (rms)	5.25	5.20	ZPA .64
	3-dir (rms)	7.42*		
Ginna Station Design Input				
1	8.4	.98	2.26	.01
2	10.3	2.07	.14	.01
3	22.7	.01	.17	-
4	30.1	-	-	-
5	31.5	.01	.07	.01
Summation:	1-dir (rms)	2.29	2.27	ZPA .56
	3-dir (rms)	3.27*		

*The calculated equipment response for the seismic test of the original Type W motor control center was 2.3 (=7.42/3.27) times greater than specified for the modified Ginna Station equipment at the top-left-front-corner of the cabinet assembly.

Table IV - Equipment Response at Panelboard Location

Mode No.	Frequency (Hz)	Equipment Response g-level X (Front to Rear)	Y (Side to Side)	Z (Vertical)
Wyle Lab Test Input				
1	8.5	.71	4.87	.01
2	9.9	4.21	.11	.01
3	24.0	.01	.63	-
4	30.5	-	.08	-
5	33.8	-	.05	-
Summation:	1-dir (rms)	4.27	4.91	ZPA .64
	3-dir (rms)	6.54*		
Ginna Station Design Input				
1	8.4	.42	2.12	.01
2	10.3	1.86	.13	.01
3	22.7	-	.11	-
4	30.1	-	.03	-
5	31.5	-	-	-
Summation:	1-dir (rms)	1.90	2.13	ZPA .56
	3-dir (rms)	2.91*		

*The calculated equipment response for the seismic test of the original Type W motor control center was 2.2 (6.54/2.91) times greater than specified for the modified Ginna Station equipment at the panelboard location.

Table V - Equipment Response at Top Transformer Location

Mode No.	Frequency (Hz)	Equipment Response g-level		
		X (Front to Rear)	Y (Side to Side)	Z (Vertical)
Wyle Lab Test Input				
1	8.5	.22	1.23	.01
2	9.9	1.28	.01	.01
3	24.0	-	.96	-
4	30.5	-	.10	-
5	33.8	-	.18	-
Summation:	1-dir (rms)	1.30	1.57	ZPA .64
	3-dir (rms)	2.14*		
Ginna Station Design Input				
1	8.4	.13	.57	.01
2	10.3	.57	.02	.01
3	22.7	-	.30	-
4	30.1	-	.03	-
5	31.5	-	.08	-
Summation:	1-dir (rms)	.61	.65	ZPA .56
	3-dir (rms)	1.05*		

*The calculated equipment response for the seismic test of the original Type W motor control center was 2.1 (≈2.14/1.05) times greater than specified for the modified Ginna Station equipment at the top transformer location.

both at 4% damping. In addition, the original sine beat tests were performed at other significant frequencies as shown in Table II.

CONCLUSIONS

The foregoing dynamic analyses have been used to show that the Ginna station equipment as modified according to Figure 2 would be able to perform satisfactorily in a seismic environment like the Type W equipment tested at Wyle Lab according to IEEE Std 344-1971. In other words, the more drastic g-levels and fatigue effects applied to similar structures and devices on the seismic shaking table means that strength failures or malfunctions will not occur in the Ginna Station seismic environment as specified. In particular, the HFB breaker units, the panelboard NQP breakers and the 5 KVA distribution transformers can withstand 2 times the g-levels anticipated for the Ginna Station on the basis of the original successful Wyle Lab tests in October-1972.

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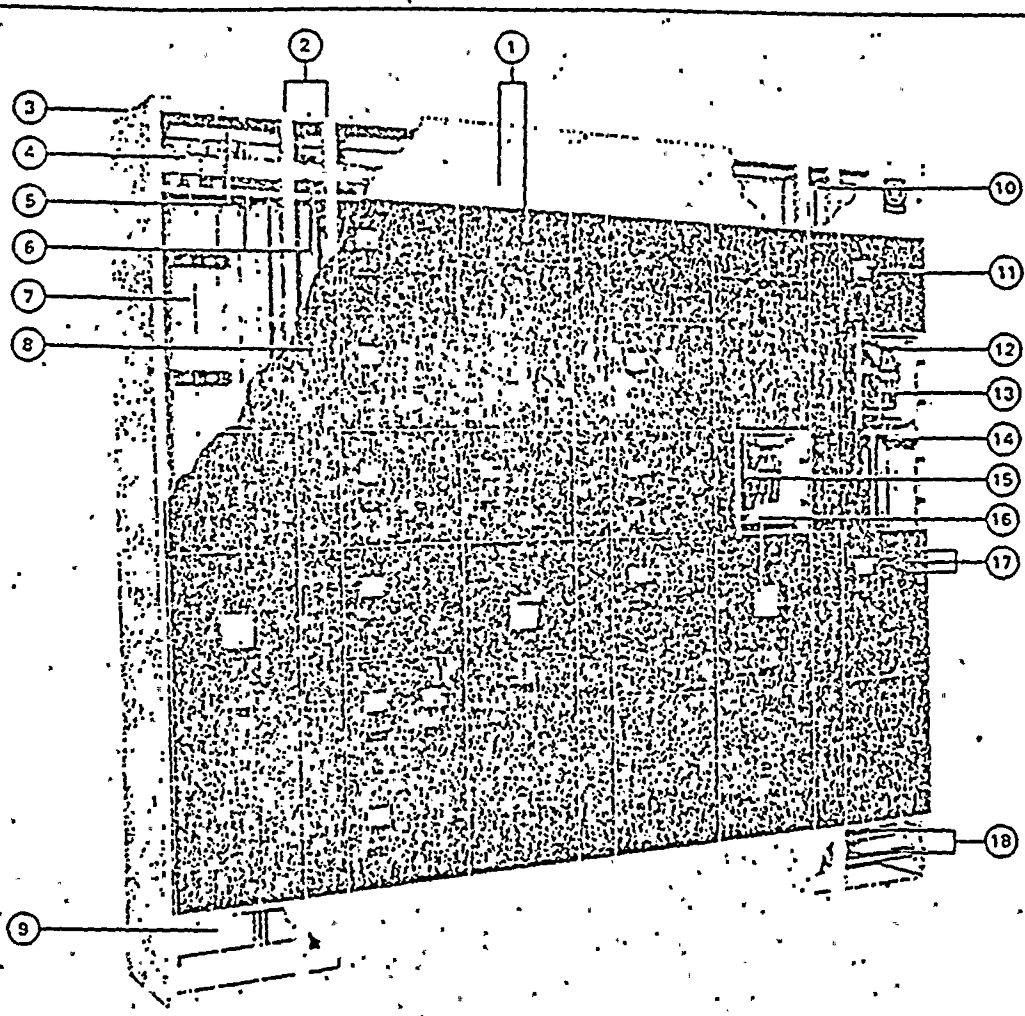


1. Cover Plates
2. Structural Upright Members (Front)
3. End Coverplate
4. Horizontal Bus
5. Incoming Line Lugs (350 MCM Max)
6. Horizontal Bus Barriers, Upper Divider Pans, and Shelf of Horizontal Wiring Trough
7. Vertical Bus
8. Vertical Wireway Covered by Hinged Doors
9. Bottom Conduit and Wiring Space
10. Horizontal Bus Barrier and Rear of Horizontal Wiring Trough
11. Unit Door
12. Draw Out Unit
13. Starter Components
14. Guide Rail,
15. Unit Latch
16. Disconnect Operating Mechanism
17. Control Devices
18. Master Terminal Blocks (Bottom)

Figure 1 — Cutaway of motor control center.

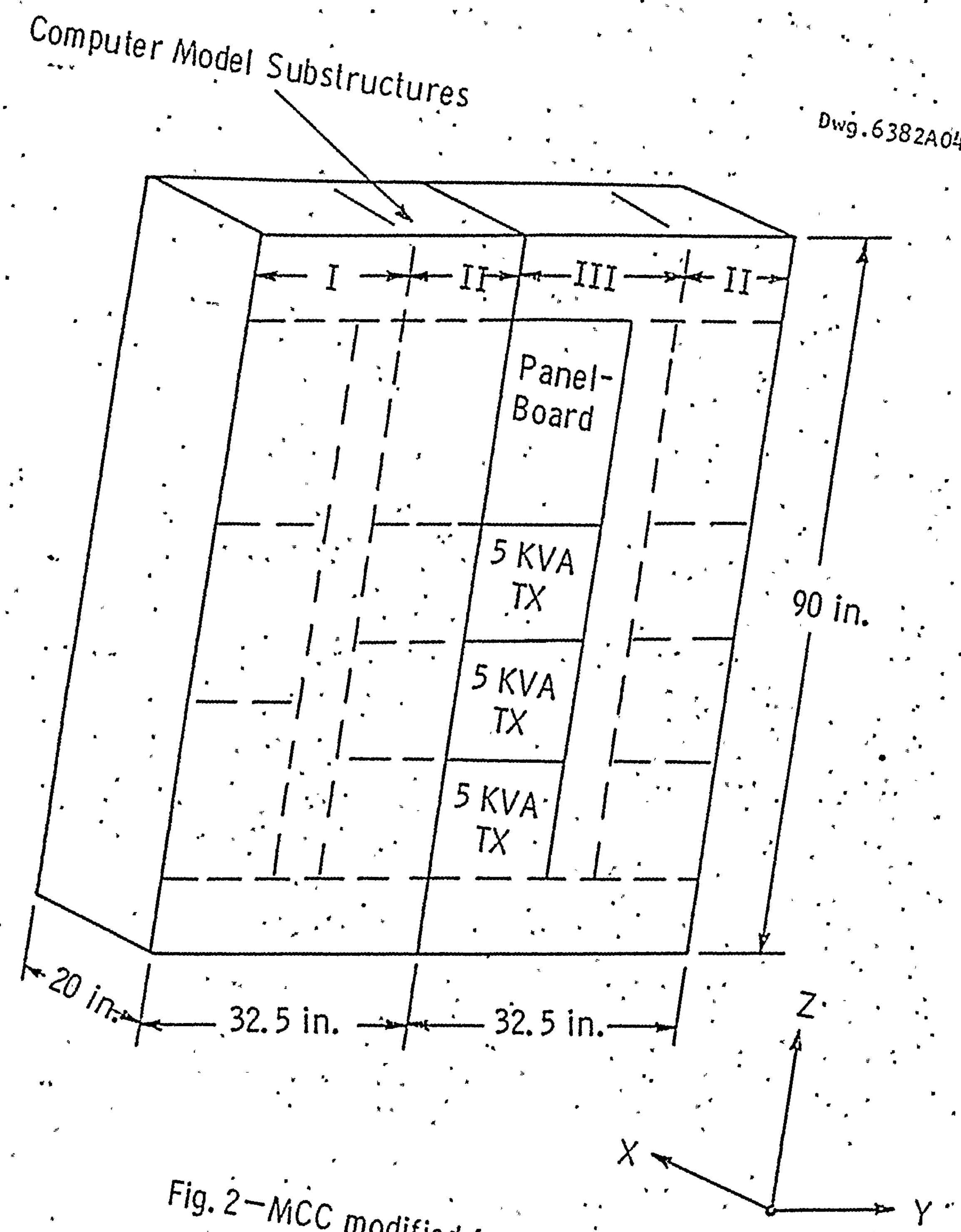


Fig. 2—MCC modified for Ginna Station

Curve 685458-A

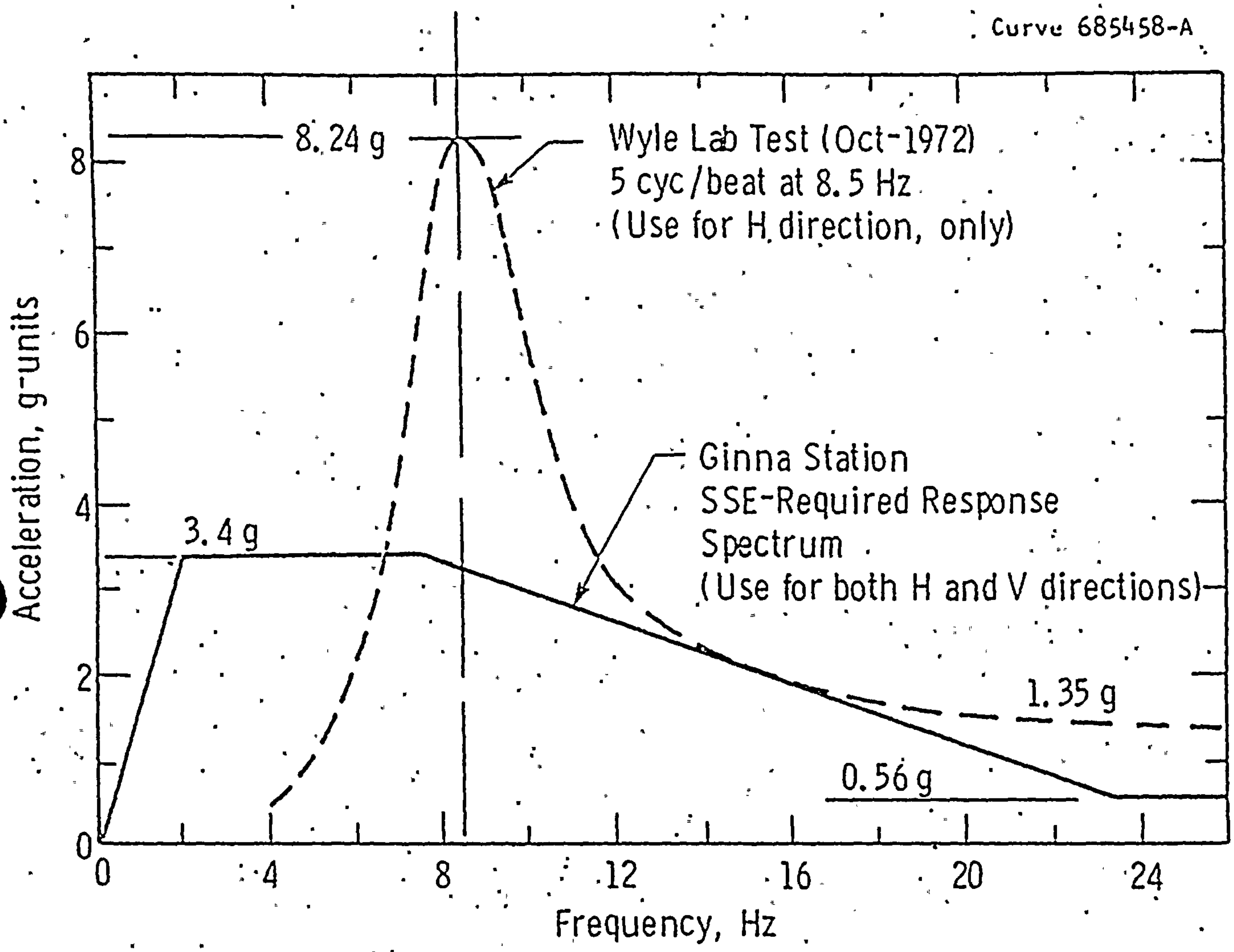
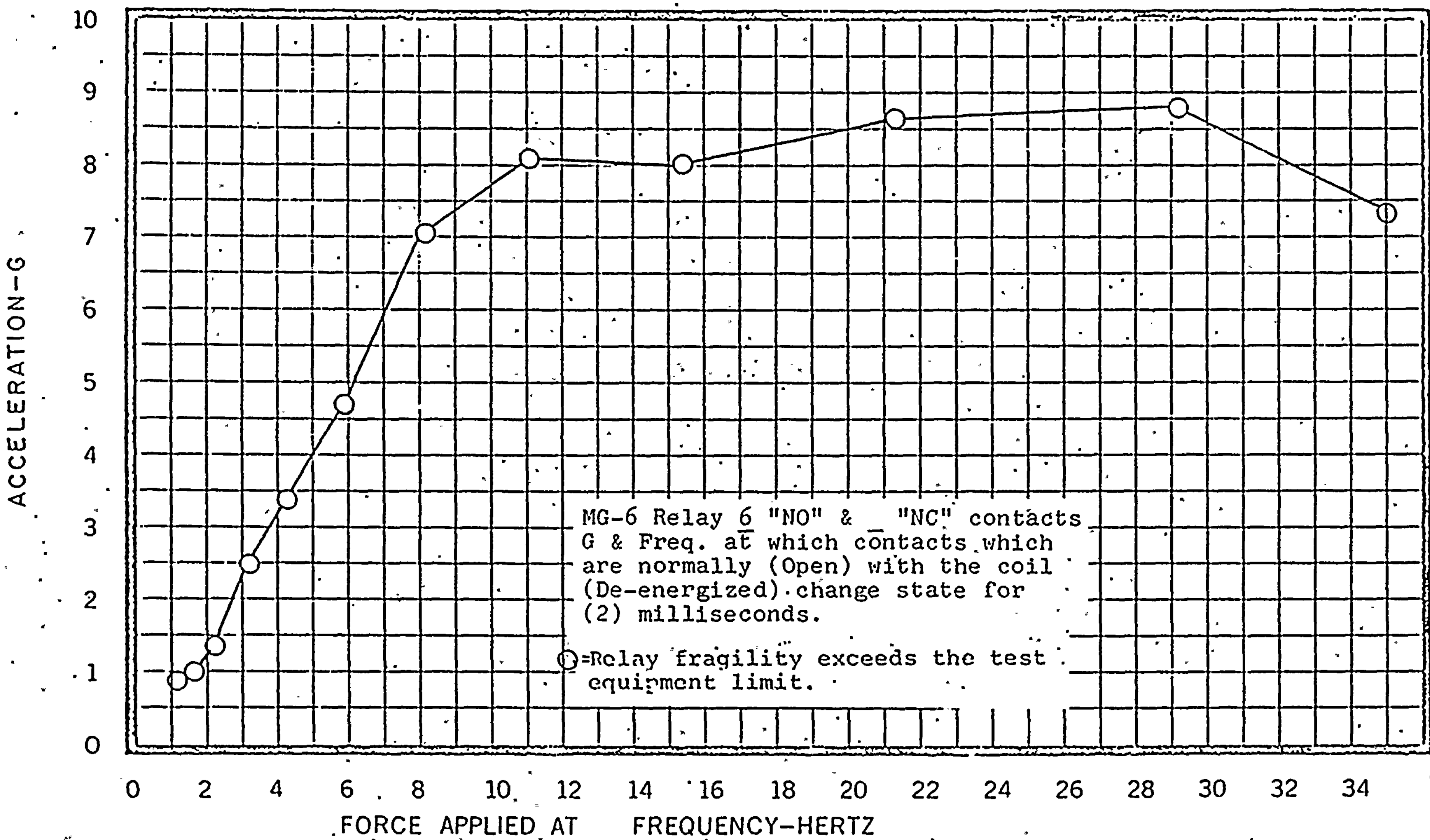
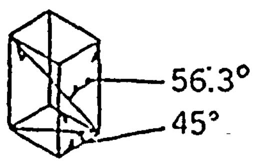


Fig. 3—Seismic response spectra at 4% critical damping

MAXIMUM SEISMIC OPERATING ACCELERATION





FORCE APPLIED AT 45° TO RELAY MAJOR HORIZ. AXES AND AT 56.3° TO THE MAJOR VERTICAL AXIS.

WESTINGHOUSE RELAY INSTRUMENT DIVISION ENG. H.J.C. DATE: 2/24/75

X

IV (Air Circuit Breakers)

CERTIFICATION OF

SHOCK TEST FOR

WS-107-A-2

EQUIPMENT

CONTRACT NO. DA04-167-ENG.2140

WESTINGHOUSE GENERAL ORDER

NA-44100-ZY

TEST CONDUCTED ON:

THE LOW VOLTAGE

METAL ENCLOSED POWER CENTER SWITCHGEAR

FOR BEALE AFB

REPORT WRITTEN BY:

S. Kovacs

S. Kovacs November 1, 1960

Assembled Switchgear and Devices Department

Westinghouse Electric Corporation

East Pittsburgh, Pennsylvania

State of Pennsylvania,)
County of Allegheny,) ss:

MARLIN I. FOWLER NOTARY PUBLIC

Sworn to and subscribed before me this 3 day of November, 1960.

Marlin I. Fowler

Notary Public
My Commission expires
February 1, 1961

CERTIFICATION OF SHOCK TEST FOR WS-107-A-2 EQUIPMENT

1. Manufacturer's or Testing Laboratory's Test Serial No.

   Lab Serial No. 16-86494-5

2. Equipment Tested

   a. Manufacturer - Westinghouse Electric Corporation
   East Pittsburgh, Pennsylvania

   b. Type of Equipment - Three-unit Low Voltage Metal Enclosed Switchgear* Assembly consisting chiefly of - (See Drawings 116D808 to 811)

      (1) Three steel housings.

      (2) Drawout and fixed type DB-50 air circuit breakers.

      (3) Ten molded-case thermal magnetic air breakers (two type JKL, four type JK, four type MARK 75HF).

      (4) Three Navy-approved round ground indicating lamp assemblies with built-in potential transformers.

      (5) One type MSP three-phase reactor, 480 V, 1000 A, 0.011 ohm.

      (6) Necessary silver-plated aluminum main bus and connections.

   (1) [illegible]
   (2) [illegible]

   c. Size - 70-1/8 wide x 90-3/8 high x 54 deep.

   d. Weight - 3825 pounds.

   e. Model No. - None.

   f. Type No. - Universal frame construction.

   g. Serial No. --Shop Order 23Y5799.

   h. Remarks - The equipment tested is the switchgear portion of the equipment terminal 1000 kva power center that will be installed in a Zone "C" shock area.

3. Method of Test Performed

   a. Description of Test Apparatus

   The tests were conducted on a trapeze tester. The complete explanation of the testing facilities is given in the document of September 12, 1960 entitled "Westinghouse Shock Testing Facilities and Procedures".

   Not Attached!

* This assembly was tested as a typical low voltage switchgear assembly supplied on this contract.

b. Test Procedure

6.06 (1)

The switchgear assembly was bolted to the platform in six different positions to apply a shock test equal to a 3 G, 0.165 sec., half sine wave input pulse (+ 10%) in both directions parallel to each of three principal axes. For each of six positions an accelerometer of the unbonded strain gage type was used to determine if the test was equivalent with the above shock requirement. The pulse obtained from the accelerometer-visicorder combination was analyzed by the digital computer. The data obtained was plotted on a shock spectra curve. (Refer to Appendix #1 for data and shock spectra.)

(1) The breakers were tested in open position to check contact closing and in closed position with single phase current to check contact opening. An oscillograph record was used in order to determine contact closing or contact opening.

(2) The molded case breaker test was made with 80% rated current and the DB-50 breaker test with 100% rated current.

(3) The reactor was energized with 480 volt, 60 cycle voltage.

c. Test Data:

Refer to Appendix #1. A total of 16 tests were conducted.

4. Location where Test was Conducted

Westinghouse Electric Corporation
East Pittsburgh Works
East Pittsburgh, Pa.

5. Individual Laboratory or Agency Witnessing Test

a. Individual's Name

b. Registration No. and State

c. Agency or Laboratory - Westinghouse High Power Laboratory

d. Date of Tests - October 19, 20, 21, 24, 25, 26

e. Were Shock Mounts used in this Test? - No

f. Apparent Results of Test

(1) Results of Tests

(a) The steel housings passed all tests.

(b) The molded-case breakers passed all tests.

(c) The DB-50 breakers passed all tests. With switchgear standing in vertical position with rear facing the springs, there was a one-cycle contact bounce on open DB-50 breakers. This was the only position when contact bounce was detected on open breakers.

(d) The ground indicating lamp assemblies, the main bus and connections, and the reactor passed all tests.

(2) Recommendations

None. Data merely submitted.

g. Post Shock Examination Results

(1) There was no cracking of welds.

(2) All breaker mechanism operated normally on closing and tripping.

(3) The ground indicating lamp assemblies and the reactor were intact.

(4) There was no movement or deflection of busses and connections.

(5) All nut and bolt assemblies remained tight.

h. Post Shock Test Results

The switchgear was tested, and satisfactorily operated in accordance with the manufacturer's specifications for electrical performance.

The small wiring and the busses, breakers and reactors passed the standard high potential tests.

i. Is Item of Equipment Acceptable?

This three-unit switchgear assembly is acceptable for Shock Zone "C". It passed all tests without malfunction or disabling distortion.

APPENDIX I

APPENDIX

The attached pulse, from which spectrum was obtained, is typical of horizontal, vertical and transverse horizontal tests performed on the three-unit low voltage switchgear, and the test spectrum is above the required spectrum for the "C" shock zone. The following list includes dates, test numbers, and the conditions necessary to produce the required response spectrum.

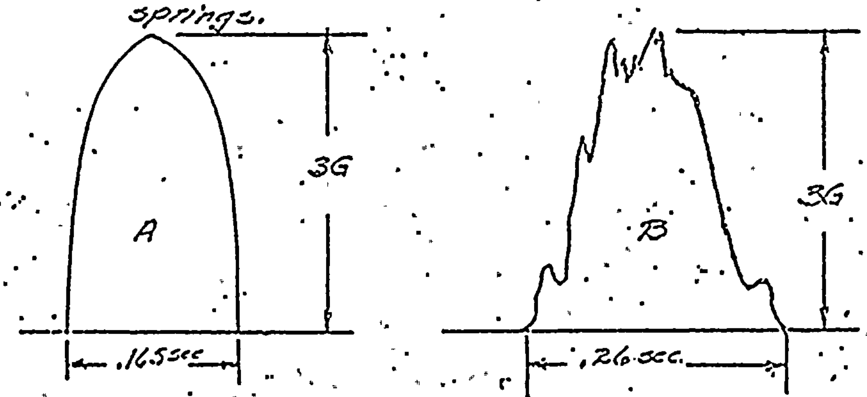
Test No.	Date	Conditions
	Plus Direction Horizontal	
1	10-19-60	6-5/8" Drop. 30 Springs
2	10-20-60	5" Drop 25 Springs
3	10-20-60	5" Drop 28 Springs
4	10-20-60	5-1/4" Drop 30 Springs
	Minus Direction Horizontal	
5	10-21-60	5-1/2" Drop 30 Springs
6	10-21-60	5-1/2" Drop 30 Springs
15	10-26-60	5-1/2" Drop 30 Springs
16	10-26-60	6-1/2" Drop 30 Springs
	Plus Direction Transverse Horizontal	
7	10-24-60	5" Drop 30 Springs
8	10-24-60	5-1/4" Drop. 30 Springs
	Minus Direction Transverse Horizontal	
9	10-24-60	5-1/2" Drop 30 Springs
10	10-24-60	5-1/2" Drop 30 Springs
	Plus Direction Vertical	
11	10-25-60	5-1/2" Drop 30 Springs
12	10-25-60	5-1/2" Drop 30 Springs

Minus Direction
Vertical

Test No.	Date	Conditions
13	10-26-60	5-1/2" Drop 30 Springs
14	10-26-60	5-1/2" Drop 30 Springs

COMPARISON BETWEEN REQUIRED
SINE PULSE & TEST PULSE PRODUCED
BY E. PGH. TRAPEZE TESTER.

Tester Pulse B was recorded by an accelerometer calibrated at 1.9 G's/in. and a Viscorder with a film speed of 5"/sec. The Test was conducted on a 3,500# weight on 10-21-60. The height of Drop was 5½" and the arresting medium was 30 springs.



Curve A = Test pulse required by spec.

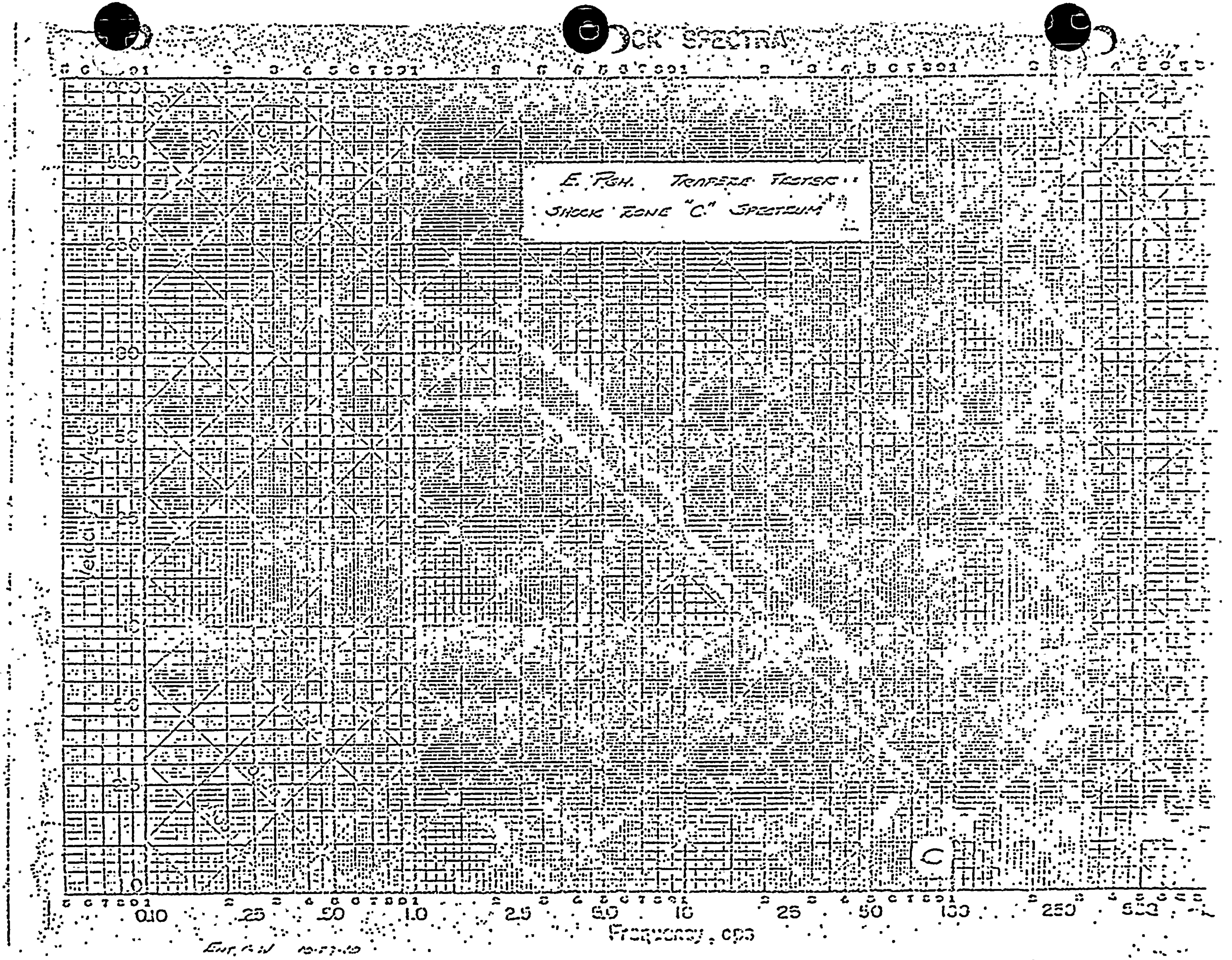
Curve B = Test pulse recorded on E. Pgh. Trapeze Tester.

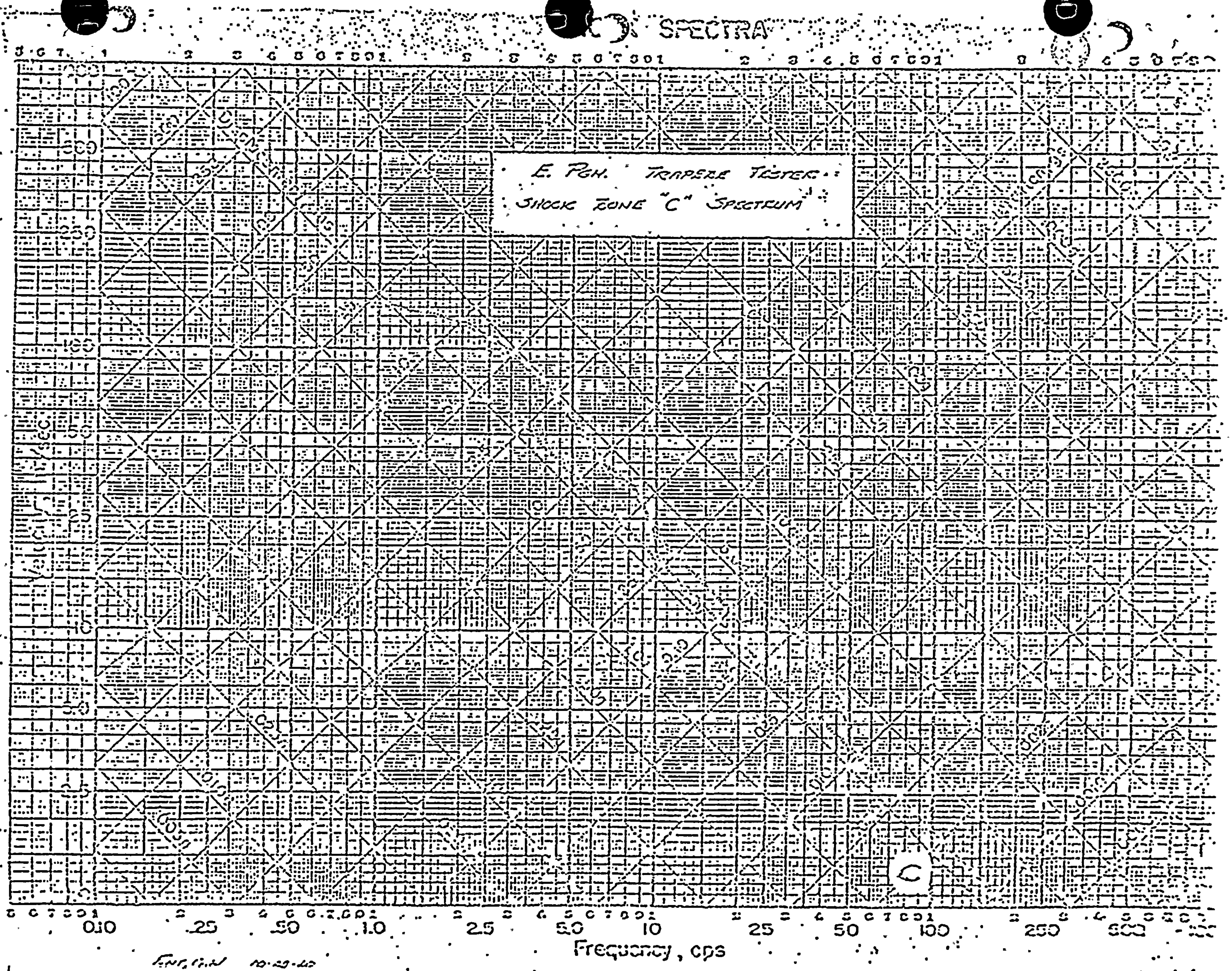
The area of pulse A = .3878 G-sec
The area of pulse B = .399 G-sec.

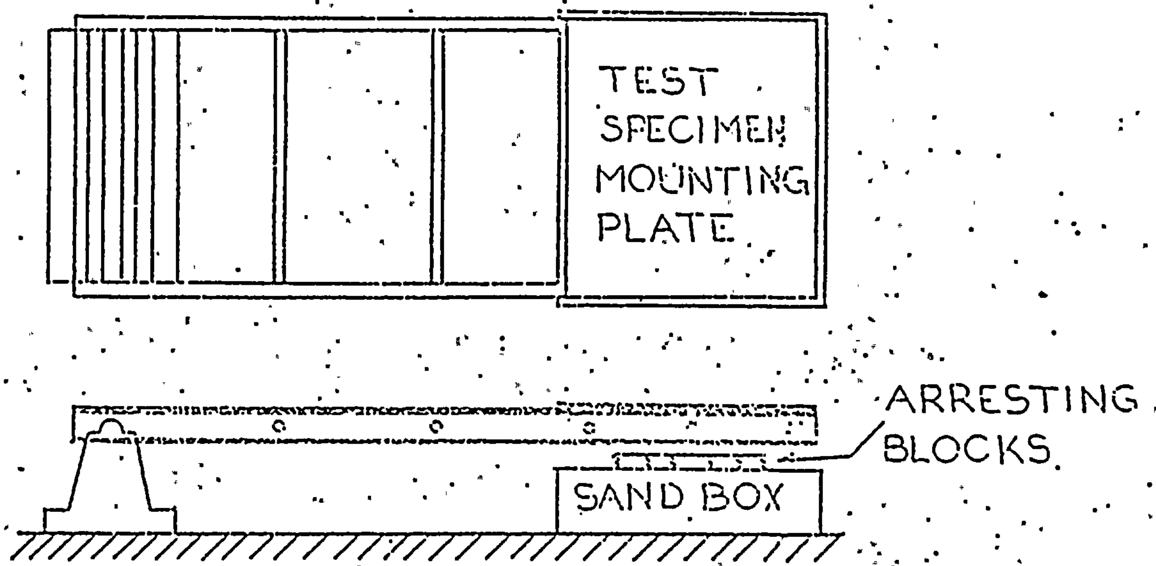
This information along with the information on the enclosed spectrum shows that pulse B is the equivalent of pulse A.

FIGURE #1

10-28-60
G.W.E.


CK SPECTRA
E. PGH. TRAPEZE TESTS
SHOCK ZONE "C" SPECTRUM
C
0.10 .25 .50 1.0 2.5 5.0 10 25 50 100 250 500
Frequency, cps


SPECTRA
E. PGH. TRAPEZE TESTER
SHOCK ZONE "C" SPECTRUM
Velocity, in/sec
0.10
.25
.50
1.0
2.5
5.0
10
25
50
100
250
500
Frequency, cps
C



EAST PGH. DIVISION
TESTER SET UP FOR
SHOCK TESTING.

FULL SEISMIC CERTIFICATION FOR THE GINNA STATION
MOTOR CONTROL CENTERS DESIGNATED 1L and 1M

INTRODUCTION AND SUMMARY

A computer-aided analysis has been made of a Type "W" motor control center which was originally tested at Wyle Laboratories, Huntsville AL, in October-1972 to meet the seismic requirements recommended by IEEE Std 344-1971. These calculations determined the acceleration g-levels and type of motion response that was excited in the equipment by a simultaneous horizontal and vertical sine beat type of motion input (5 cyc/beat, 4% damping).

Subsequently, a similar dynamic analysis was made of the equipment as modified for the Ginna Station, with attention focused on the new panelboard and distribution transformers. Hence, a comparison can be made of the original test response spectrum and the required response spectrum (4% damping) for this new equipment application.

The well-known "normal mode" method was used to evaluate both multi-direction and multi-frequency effects as recommended by the latest (1975) revision of IEEE Std 344. The comparison of input response spectra, as well as corresponding g-levels sustained in the equipment, shows that the original fragility-level tests performed at Wyle Laboratories were quite severe (1.49g rms) and can now be used to fully qualify the Ginna Station equipment for the specified seismic environment.

COMPUTER MODEL OF MOTOR CONTROL CENTER

Figure 1 shows a cutaway photograph of the type of motor control center that was tested with a variety of typical control devices according to the 1971 seismic standard. The computer model was based upon simple static load and "snap-back" vibration tests of a single cabinet

unit, which was built up out of actual structural members (channel and angle beams, flat plates) using the finite element method. The final four-cabinet model, as tested, was assembled using 4 single-cabinet substructures (so called "super elements"). The base spring attachment was subsequently adjusted so that the computer model had natural frequencies in agreement with the 1972 prototype test values.

Figure 2 shows a schematic diagram of the original Type W equipment as modified for the Ginna Station. Special attention was paid to the modeling of the panelboard and the three (75 lb each) distribution transformers. In general, the new assembly was made up of a combination of different substructures based upon the original single cabinet as follows:

I. Original cabinet, except increased to 20 in. deep.
II. Original cabinet, except reduced to 14.5 in. wide. (Use twice)
III. Original cabinet, except added weight for top panelboard and for transformers in the bottom three drawers.

The base spring attachments for both the original and the new assemblies remained the same, and were not part of the substructuring.

The natural frequencies and modal effective weights determined from the normal mode analysis are shown in Table I.. The original equipment assembly as modified for the Ginna Station had similar modal frequencies and modal effective weights so that the seismic test results on the original Type W motor control center can safely be applied to the modified equipment by means of the computer-aided dynamic analysis.

In general, only the first three normal modes were in the seismic frequency range (1 to 33 Hz) and in addition could be effectively excited by the base motion input. The vertical (14th) normal mode of vibration was introduced by the base spring attachment in the computer model, but is well-above the seismic frequency range and has little influence on the final seismic response of the equipment.

Table I - Results of Normal Mode Analysis

Mode No.	Frequency (Hz)	Modal Effective Weight, lb		
		X (Front to Rear)	Y (Side to Side)	Z (Vertical)
Original Type "W" Motor Control Center				
1	8.5	28	503	-
2	9.9	960	15	-
3	24.0	-	439	-
4	30.5	-	4	-
5	33.8	-	24	-
14	67.1	1	-	1071
Ginna Station (as modified)				
1	8.4	63	589	1
2	10.3	971	39	1
3	22.7	-	395	-
4	30.1	-	5	-
5	31.5	1	46	-
14	64.8	-	1	1118

In the Wyle Lab tests of October-1972, the 4-cabinet assembly was positioned on the shaking machine at 45° to the horizontal motion input. The major response motion occurred at 8.5 Hz and consisted of a combined (side to side) lateral and (front to rear) torsional vibration buildup. The analysis shows this test motion to be a combination of the first and second normal modes of vibration.

SEISMIC INPUT RESPONSE SPECTRA (4% Critical Damping)

Figure 3 shows the seismic response spectrum as specified for the SSE (safe shutdown earthquake) at the Ginna Station and it is to be used for both horizontal and vertical directions. In the normal mode analysis the equipment is assumed at 45° to the horizontal direction (similar to the Wyle Lab test) so that the total horizontal and vertical ZPA (zero period acceleration) vector input is as follows:

$$X\text{-dir (front to rear)} = .707\ (.56) = 0.40g$$
$$Y\text{-dir (side to side)} = .707\ (.56) = 0.40g$$
$$Z\text{-dir (vertical)} = 1.000\ (.56) = 0.56g$$

$$ZPA\ (rms) = .56 \sqrt{(.707)^2 + (.707)^2 + (1.0)^2} = 0.79g$$

In the 3-dimensional computer-aided analysis, the SSE spectrum is applied in each coordinate direction, except that the ordinate values are proportioned as shown above.

Figure 3 also shows the response spectrum for the 5 cyc/beat horizontal direction input at Wyle Lab during the quasi-resonance sine beat test at the 8.5 Hz measured natural frequency in the equipment assembly. In addition, the simultaneous vertical direction input was equal to two-thirds of the single horizontal component giving a total vector input as follows:

$$X\text{-dir (front to rear)} = .707\ (1.35) = 0.95g$$
$$Y\text{-dir (side to side)} = .707\ (1.35) = 0.95g$$
$$Z\text{-dir (vertical)} = .667\ (0.95) = 0.64g$$

$$ZPA\ (rms) = 0.95 \sqrt{(1)^2 + (1)^2 + (2/3)^2} = 1.49g$$

The resonance search specified by IEEE Std 344-1971 indicated a major resonance at 8.5 Hz and as much as 5-10% damping measured in the equipment at the maximum 1.49g sine beat acceleration input. However, the subsequent comparison of equipment response values has been made at only 4% damping, the largest value appearing in the required response spectra supplied for the Ginna Station.

In addition to the test at 8.5 Hz, similar quasi-resonance dwell tests (5 beats at 5 cyc/beat) were performed at the six most significant resonant frequencies in the seismic range from 1 to 33 Hz. Corresponding g-level input and SDF (single degree of freedom) response are shown in Table II.

Table II - RMS Input and SDF Response

Frequency	g-Level Input			g-Level Response	
	Horizontal	Vertical	RMS	1%	4%
2	0.72	0.34	0.80	6.9	4.9
5	1.35	0.64	1.49	12.9	9.1
8.5	1.35	0.64	1.49	12.9	9.1
17	0.82	0.40	0.91	7.9	5.6
20	0.68	0.37	0.77	6.7	4.7
33	0.45	0.21	0.50	4.3	3.1

In general, the calculated SDF g-level test response values are well-above 1.5 times the required SSE response spectrum values for the Ginna Station (see Figure 3). The latter factor accounts for possible multi-frequency effects of a typical, broadband seismic motion input compared to the original, single-frequency tests at Wyle Lab in October-1972.

COMPARISON OF EQUIPMENT RESPONSE g-LEVELS

The normal mode analysis provides a summation of the g-level response at any location in the equipment corresponding to the 3-direction seismic input spectra illustrated by Figure 3. A comparison of the overall severity of the Wyle Lab test versus the Ginna Station design specification has been made in terms of the g-level response calculated at the top-left-front corner of the cabinet assemblies shown by Figures 1 and 2. Table III shows that for X-dir response only the first two modes are important, while for Y-dir response only the first mode is important. (Note: The Z-dir summation has been arbitrarily increased to the ZPA value as a maximum representing the contributions of the many modes above 33 Hz which were not tabulated.)

In general, as also shown by Tables IV and V, the g-levels throughout the equipment were at least 2 times greater when calculated for 5 cyc/beat test at 8.5 Hz compared to the Ginna Station spectrum,

Table III - Equipment Response at Top-Left-Front-Corner

Mode No.	Frequency (Hz)	Equipment Response g-level X (Front to Rear)	Y (Side to Side)	Z (Vertical)
Wyle Lab Test Input				
1	8.5	1.66	5.19	.02
2	9.9	4.98	.11	.01
3	24.0	.02	.29	-
4	30.5	-	.02	-
5	33.8	.01	.20	-
Summation:	1-dir (rms)	5.25	5.20	ZPA .64
	3-dir (rms)	7.42*		
Ginna Station Design Input				
1	8.4	.98	2.26	.01
2	10.3	2.07	.14	.01
3	22.7	.01	.17	-
4	30.1	-	-	-
5	31.5	.01	.07	.01
Summation:	1-dir (rms)	2.29	2.27	ZPA .56
	3-dir (rms)	3.27*		

*The calculated equipment response for the seismic test of the original Type W motor control center was 2.3 (=7.42/3.27) times greater than specified for the modified Ginna Station equipment at the top-left-front-corner of the cabinet assembly.

Table IV - Equipment Response at Panelboard Location

Mode No.	Frequency (Hz)	Equipment Response g-level		
		X (Front to Rear)	Y (Side to Side)	Z (Vertical).
Wyle Lab Test Input				
1	8.5	.71	4.87	.01
2	9.9	4.21	.11	.01
3	24.0	.01	.63	-
4	30.5	-	.08	-
5	33.8	-	.05	-
Summation:	1-dir (rms)	4.27	4.91	ZPA .64
	3-dir (rms)	6.54*		
Ginna Station Design Input				
1	8.4	.42	2.12	.01
2	10.3	1.86	.13	.01
3	22.7	-	.11	-
4	30.1	-	.03	-
5	31.5	-	-	-
Summation:	1-dir (rms)	1.90	2.13	ZPA .56
	3-dir (rms)	2.91*		

*The calculated equipment response for the seismic test of the original Type W motor control center was 2.2 (6.54/2.91) times greater than specified for the modified Ginna Station equipment at the panelboard location.

Table V - Equipment Response at Top Transformer Location

Mode No.	Frequency (Hz)	Equipment Response g-level X (Front to Rear)	Y (Side to Side)	Z (Vertical)
Wyle Lab Test Input				
1	8.5	.22	1.23	.01
2	9.9	1.28	.01	.01
3	24.0	-	.96	-
4	30.5	-	.10	-
5	33.8	-	.18	-
Summation:	1-dir (rms)	1.30	1.57	ZPA .64
	3-dir (rms)	2.14*		
Ginna Station Design Input				
1	8.4	.13	.57	.01
2	10.3	.57	.02	.01
3	22.7	-	.30	-
4	30.1	-	.03	-
5	31.5	-	.08	-
Summation:	1-dir (rms)	.61	.65	ZPA .56
	3-dir (rms)	1.05*		

*The calculated equipment response for the seismic test of the original Type W motor control center was 2.1 (=2.14/1.05) times greater than specified for the modified Ginna Station equipment at the top transformer location.

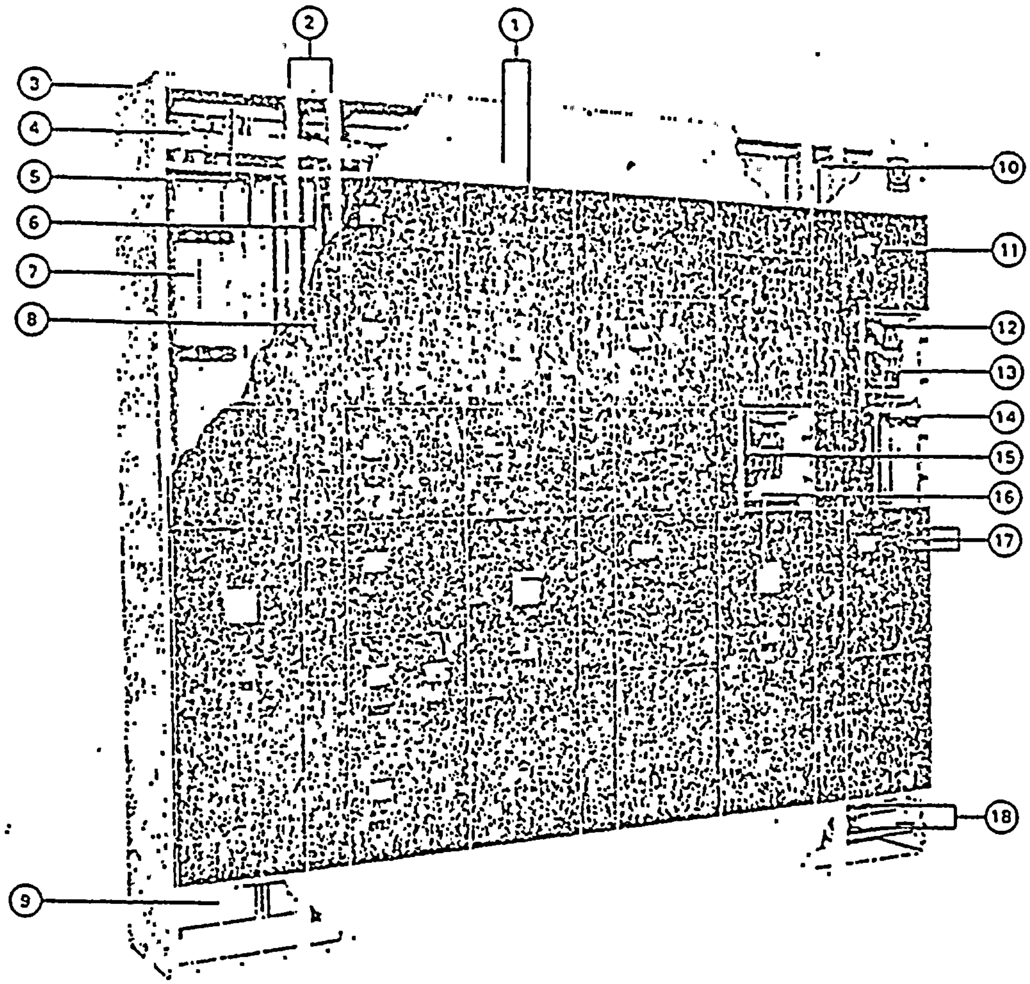
both at 4% damping. In addition, the original sine beat tests were performed at other significant frequencies as shown in Table II.

CONCLUSIONS

The foregoing dynamic analyses have been used to show that the Ginna station equipment as modified according to Figure 2 would be able to perform satisfactorily in a seismic environment like the Type W equipment tested at Wyle Lab according to IEEE Std 344-1971. In other words, the more drastic g-levels and fatigue effects applied to similar structures and devices on the seismic shaking table means that strength failures or malfunctions will not occur in the Ginna Station seismic environment as specified. In particular, the HFB breaker units, the panelboard NQP breakers and the 5 KVA distribution transformers can withstand 2 times the g-levels anticipated for the Ginna Station on the basis of the original successful Wyle Lab tests in October-1972.

Edw. G. Fischer

Edward G. Fischer
Consulting Engineer
Mechanics Department - 401-2A2
Research Laboratories



1. Cover Plates
2. Structural Upright Members (Front)
3. End Coverplate
4. Horizontal Bus
5. Incoming Line Lugs (350 MCM Max) -
6. Horizontal Bus Barriers, Upper Divider Pans, and Shelf of Horizontal Wiring Trough
7. Vertical Bus
8. Vertical Wireway Covered by Hinged Doors
9. Bottom Conduit and Wiring Space
10. Horizontal Bus Barrier and Rear of Horizontal Wiring Trough
11. Unit Door
12. Draw Out Unit
13. Starter Components
14. Guide Rail
15. Unit Latch
16. Disconnect Operating Mechanism
17. Control Devices
18. Master Terminal Blocks (Bottom)

Figure 1 — Cutaway of motor control center.

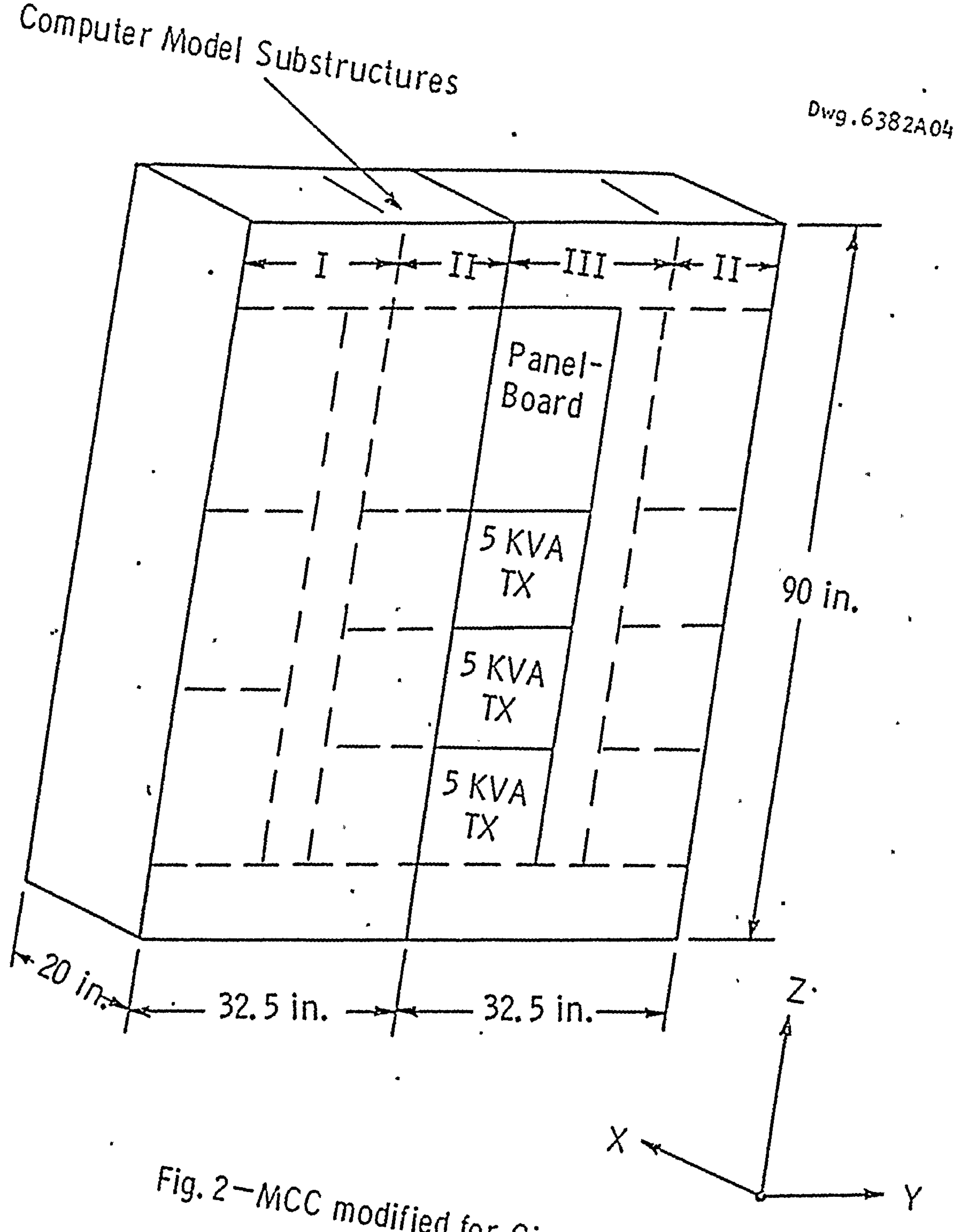


Fig. 2—MCC modified for Ginna Station

Curve 685458-A

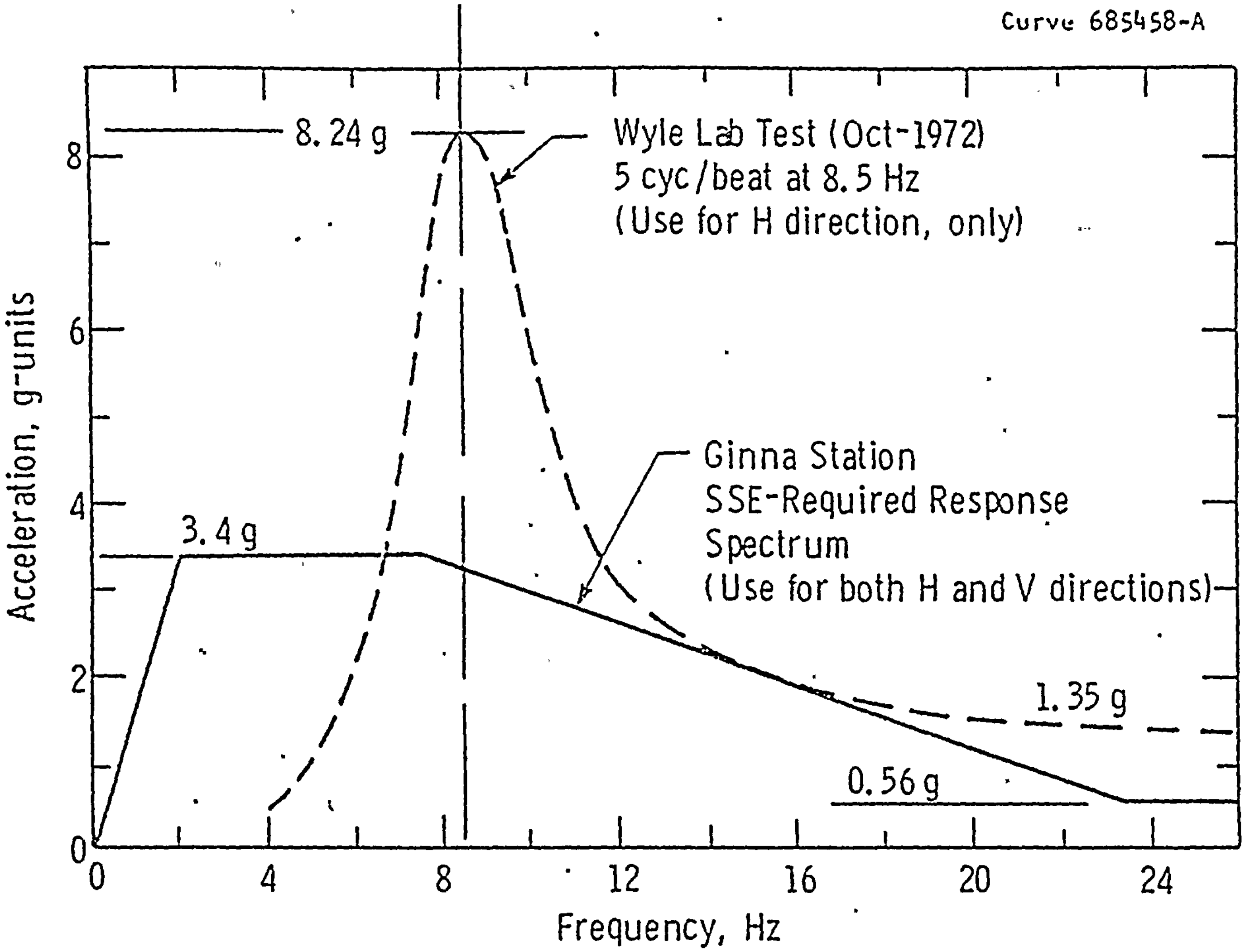


Fig. 3—Seismic response spectra at 4% critical damping

TAS

TECHNICAL SPECIFICATIONS

DISTRIBUTION PANELBOARDS

120 VOLT INSTRUMENT POWER SUPPLY

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

UNIT NO. 1

ROCHESTER GAS AND ELECTRIC CORPORATION
ROCHESTER, NEW YORK

PRIME CONTRACTOR

WESTINGHOUSE ELECTRIC CORPORATION

ATOMIC POWER DIVISION

PITTSBURGH, PENNSYLVANIA

SP-5466

GILBERT ASSOCIATES, INC.
525 Lancaster Avenue
Reading, Pennsylvania 19603

1:00 SCOPE

1:01 General

1:01.1 This Specification covers ////////////// power distribution panelboards for the distribution 120 volt single phase a-c as required for vital instrumentation and other miscellaneous circuits requiring a reliable source of 120 volt single phase power.

1:01.2 The //// panelboards are to be installed as part of the No. 1 Unit at the Robert Emmett Ginna Nuclear Power Plant, Rochester Gas and Electric Corporation, located in Wayne County approximately 18 miles east of Rochester, New York.

1:01.3 The distribution panelboards as described in the Panelboard Details shall be as manufactured by Westinghouse Electric Corporation, Type NEB and shall be furnished and installed by the CONSTRUCTOR.

2:00 DELIVERY

Delivery to job site of complete panelboards, including box enclosures and breaker section shall be scheduled as required by the CONSTRUCTOR.

3:00 REQUIREMENTS

3:01 Codes and Standards

The panelboards shall be of modern design in all respects and shall be manufactured with materials and workmanship of first quality and in accordance with accepted electric utility standards. All panelboards shall be assembled and tested with the latest applicable ASA, AIEE and NEMA standards, and shall meet Federal Specification W-P-115a, for Panelboards and Federal Specification W-C-375a for Circuit Breakers.

3:02 Vendor Warranties

The material supplied under this specification shall be fully warranted by the vendor against faulty material and factory workmanship. The warranty period shall be for a period of one (1) year after plant acceptance; and the warranty on any repaired or replaced item shall be extended for one (1) year from date of repair or replacement.

4:00 DRAWINGS

Fifteen copies of complete panelboard drawings, showing size and arrangement of breakers and main bus sections, and front elevations of typical panelboard shall be submitted to the ENGINEER for approval before release for manufacture.

5:00 NAMEPLATES

Each panelboard shall be provided with nameplates of laminated construction with 1/4" high white letter engraved on a black background.

6:00 PANELBOARDS

6:01 General

6:02 The panelboards shall be for surface mounting.

6:03 All ~~////~~ panelboards shall consist of one main and a neutral bus for 120 volt single phase source and branch circuits.

Section 9:00

6:04 All panelboards/shall have two mechanically interlocked main breakers.

6:05 Panelboards shall be dead-front safety type.

7:00 CIRCUIT BREAKERS

7:01 All branch circuit breakers shall be the molded case, thermal-magnetic type, quick-make, quick-break, trip free, common trip and factory sealed to operate at the rating specified.

7:02 All breakers shall be type EA single pole, in ratings as shown on the panelboard detailed description. They shall be ambient compensated.

7:03 All breakers shall be the bolted connection type, and they shall indicate clearly whether they are in the "ON" or "OFF" position. Terminals shall be solderless, pressure type.

8:00 PANELBOX ENCLOSURES AND ASSEMBLY

8:01 Panel box enclosures shall be constructed of galvanized code guage sheet steel, with trim mounting flanges bent to inside all around, and of sufficient size to provide a minimum gutter space of four inches on all sides. Panel boxes shall be for surface mounting. Knockouts in top and bottom of box enclosures will not be required.

8:02 Panel box enclosures and front trim assembly shall be of NEMA-1 construction.

8:03 All panelboard interior breaker sections shall be factory assembled complete with circuit breakers. Interiors shall be designed and assembled so that any individual breaker can be replaced without disturbing adjacent breakers or without removing main bus or branch circuit connectors.

8:04 The panelboards shall have hinged doors, and shall be provided with combination cylinder lock and catch, with all locks keyed alike. Directory card and card holder shall be provided on the inside of each door. All cards shall have branch circuit information typed thereon. Cards shall be no less than 4 inches wide by 8 inches long.

8:05 All front trim shall be made of code gaugé galvanized sheet steel with a rust-inhibiting coating and finished with ASA-61 grey enamel paint.

9:00 PANELBOARD DETAILS (Main Instrument Supply Panels)

9:01 Four panelboards shall be furnished each with two main breakers for perferred and alternate sources. These two breakers shall be type EA, 100 ampere 1 pole. They shall be mechanically interlocked so that only one breaker can be closed.

9:02 Each panel shall have one main and neutral bus and will be supplied from a single phase 115 volt transformer or from a single phase 115 volt inverter source.

9:03 Branch circuit breakers shall be type EA, single pole in number and rating as follows:

Number of Branch Circuits	Ampere Rating	Wire
20	15	#14 - #12
4	50	#8

9:04 Each panelboard shall be furnished with a nameplate in accordance with section 5:00. The designations shall be as follows:

Panel #1 - INSTRUMENT BUS - 1A
Panel #2 - INSTRUMENT BUS - 1B
Panel #3 - INSTRUMENT BUS - 1C
Panel #4 - INSTRUMENT BUS - 1D

10:00 PANELBOARD DETAILS (Regulated Instrument Supply Panels)

10:01 Six panelboards shall be furnished, each with one single pole main breaker type EA rated 20 ampere.

10:02 Each panel shall have one main and neutral bus and will be supplied from a single phase 115 volt regulating transformer source.

10:03 Branch circuit breakers shall be type EA, single pole rated 15 ampere with terminals for #14-#12 AWG wire. Each panelboard shall have ten (10) branch circuit breakers.

10:04 The panelboards shall be circuit breaker column type, type NALB-LX with the neutral bar at the bottom of the panel.

10:05 Each panelboard shall be furnished with a nameplate in accordance with Section 5:00. The designations shall be as follows:

Panel #1 - TWINCO DISTRIBUTION PANEL - 1A1
Panel #2 - TWINCO DISTRIBUTION PANEL - 1A2
Panel #3 - TWINCO DISTRIBUTION PANEL - 1B1
Panel #4 - TWINCO DISTRIBUTION PANEL - 1B2
Panel #5 - TWINCO DISTRIBUTION PANEL - 1C
Panel #6 - TWINCO DISTRIBUTION PANEL - 1D

6:00 PANELBOARDS

6:01 General

6:02 The panelboards shall be for surface mounting.

6:03 All four panelboards shall consist of one main and a neutral bus for 120 volt single phase source and branch circuits.

6:04 All panelboards shall have two mechanically interlocked main breakers.

6:05 Panelboards shall be dead-front safety type.

7:00 CIRCUIT BREAKERS

7:01 All branch circuit breakers shall be the molded case, thermal-magnetic type, quick-make, quick-break, trip free, common trip and factory sealed to operate at the rating specified.

7:02 All breakers shall be type EA single pole, in ratings as shown on the panelboard detailed description. They shall be ambient compensated.

7:03 All breakers shall be the bolted connection type, and they shall indicate clearly whether they are in the "ON" or "OFF" position. Terminals shall be solderless, pressure type.

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8:04 The panelboards shall have hinged doors, and shall be provided with combination cylinder lock and catch, with all locks keyed alike. Directory card and card holder shall be provided on the inside of each door. All cards shall have branch circuit information typed thereon. Cards shall be no less than 4 inches wide by 8 inches long.

8:05 All front trim shall be made of code gauge galvanized sheet steel with a rust-inhibiting coating and finished with ASA-61 grey enamel paint.

9:00 PANELBOARD DETAILS

9:01 Each panelboard shall be furnished with two main breakers for perferred and alternate sources. These two breakers shall be type EA, 100 ampere 1 pole. They shall be mechanically interlocked so that only one breaker can be closed.

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Panel #4 - INSTRUMENT BUS - 1D

BATTERY & BATT RACK

SPEC

REQUIREMENT OUTLINE

FOR

D.C. POWER & CONTROL BATTERIES

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

UNIT NO. 1

ROCHESTER GAS AND ELECTRIC CORPORATION
ROCHESTER, NEW YORK

PRIME CONTRACTOR

WESTINGHOUSE ELECTRIC CORPORATION

ATOMIC POWER DIVISION

PITTSBURGH, PENNSYLVANIA

RO-2400

GILBERT ASSOCIATES, INC.
525 Lancaster Avenue
Reading, Pennsylvania 19603

5-24-67
TAS

REQUIREMENT OUTLINE

FOR

D.C. POWER & CONTROL BATTERIES

ROBERT EMMETT GINNA NUCLEAR POWER PLANT

UNIT NO. 1

ROCHESTER GAS AND ELECTRIC CORPORATION
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GILBERT ASSOCIATES, INC.
525 Lancaster Avenue
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5-24-67
TAS

TABLE OF CONTENTS

1:00 SCOPE OF WORK

1:01 General

1:01.1 This Requirement Outline covers two (2) 125 Volt, 60 cell station batteries with necessary racks and accessories.

1:01.2 These batteries are to be installed as part of the No. 1 Unit at the GINNA Station, Rochester Gas and Electric Corporation, located in Wayne County, approximately 18 miles east of Rochester, New York.

1:01.3 This electric generating unit is scheduled for commercial operation on June 1, 1969.

1:01.4 The batteries specified herein shall be furnished in strict accordance with these specifications. No substitutions will be allowed.

2:00 REQUIREMENTS

2:01 Codes and Standards

All material furnished shall be of modern design in all respects and shall be manufactured with materials and workmanship of first quality and in accordance with accepted electric utility standards and the standards of IPCEA, ASA, IEEE (AIEE) and NEMA.

2:02 Inspection and Testing

2:02.1 The material covered by this Requirement Outline shall be completely assembled in the factory and thoroughly tested in accordance with the latest applicable standards of IPCEA, IEEE (AIEE) and NEMA.

2:02.2 Certified test reports shall be submitted to the ENGINEER prior to shipment.

2:02.3 The ENGINEER reserves the right to inspect this equipment at point of manufacture and to witness routine factory tests and such other tests as may be required to prove the correctness of operation. Any inspection by the ENGINEER shall not be considered as a waiver of any warranty or other rights.

2:03 Warranty

The material supplied under this Requirement Outline shall be fully warranted against faulty material and factory workmanship. The warranty period shall be for a period of (1) year after Plant Acceptance; and the warranty on any repaired or replaced item shall be extended for (1) year from date of repair or replacement.

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2:04 Drawings

Fifteen copies of batteries and racks shall be submitted to the ENGINEER for approval.

2:05 Instruction Books and Spare Parts List

2:05.1 Quoted price shall include the cost of fifteen (15) copies of instruction books covering equipment being furnished.

2:05.2 Fifteen copies of recommended spare parts list shall be furnished.

2:06 Proposals

2:06.1 Proposals shall be drawn in the name of Gilbert Associates, Inc. as Consulting Engineers and Agent for the Westinghouse Electric Corporation, Atomic Power Division, the Prime Contractor.

2:06.2 Proposals shall be submitted as follows:

Original and (5) copies to:

Gilbert Associates, Inc.
525 Lancaster Avenue
Reading, Pennsylvania 19603

Attention: Mr. H. F. Ulmer
Chief Purchasing Agent

3:00 DATA REQUIRED WITH PROPOSAL

3:01 Bidder shall submit with his proposal complete data for the equipment offered. This data shall include, but not necessarily be limited to, the following:

3:01.1 Descriptive data including dimensions and net weights, construction of positive and negative plates, etc.

3:01.2 Discharge curves, in amperes per positive plate, for batteries quoted.

3:01.3 Ambient temperature limitations on battery life and capacity and discharge characteristics of batteries quoted upon.

3:01.4 Actual discharge rates, to 1.75 volts for one minute, one hour, three hours, and eight hours.

3:01.5 Clear statement of guarantees applying to equipment covered in this Requirement Outline.

3:01.6 List and price of recommended spare parts.

3:01.7 The proposal must be in accordance with this Requirement Outline and the quotation must be made against this Requirement Outline number. Any exception which the CONTRACTOR wishes or intends to take to this Requirement Outline shall be clearly stated, and the reasons therefore, in the proposal.

4:00 DESIGN AND OPERATING CONDITIONS

4:01 General

4:01.1 Batteries shall be stationary, sealed type, assembled in heat-resistant, shock-absorbing clear plastic containers with covers cemented in place to form a permanent, leak-proof seal. Covers shall be fitted with spray-proof vent plugs and shall be of tough, impervious plastic.

4:01.2 All cell terminals shall be of lead alloy, reinforced with copper core inserts. Cell terminal posts shall be equipped with connector bolts having acid resisting nuts.

4:01.3 All necessary connector bolts and lead-plated copper inter-cell, inter-step and inter-rack connectors shall be furnished with the batteries.

4:01.4 Cell posts shall be sealed against creepage of electrolyte either by burned ring (or equivalent) seals or by compression fittings, which shall be described in the proposal.

4:01.5 Cells shall have a nominal specific gravity of 1.200 to 1.220 at 77F when fully charged and shall have sufficient electrolyte to provide full capacity at all ratings.

4:01.6 Sufficient sediment space shall be provided so the battery will not have to be cleaned out during its normal life.

4:01.7 Electrolyte level lines shall be marked on all four sides of each container.

4:01.8 Batteries shall be shipped fully charged and filled with electrolyte.

4:01.9 All necessary battery racks shall be furnished with the batteries, complete with all required bolts and fasteners. They shall all be of two step design.

Battery racks shall be steel with an acid resisting finish.

4:01.10 Batteries shall be of standard design in all respects in that any part may be readily replaced with manufacturer's stock parts.

4:01.11 Supplier shall guarantee 100% of quoted capacity of battery when delivered.

4:01.12 The installed batteries and supporting racks must be capable of resisting earthquake forces resulting from an acceleration ocurring simultaneously in the vertical and horizontal directions, with both components equal to 0.21g applied at the center of gravity. In addition the batteries and racks shall not dislodge, cause relative movement or result in any loss or change of function of the batteries when subjected to seismic accelerations of 0.52g acting in the vertical and horizontal planes simultaneously.

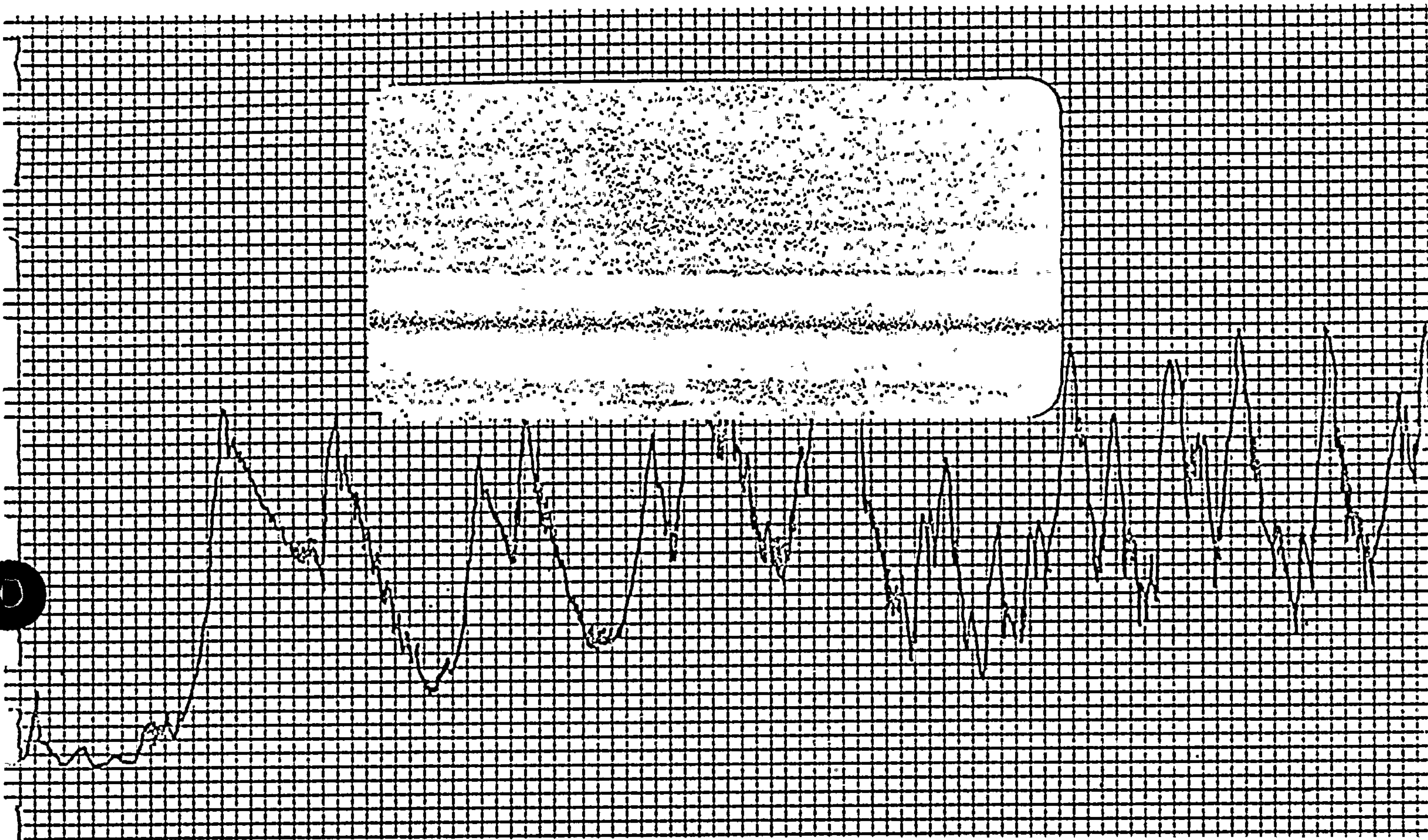
4:02 Detail Requirements

The bus batteries covered by this Requirement Outline shall be Lead Calcium Faure type for full float operation.

Each battery shall consist of 60 cells and shall equal or exceed the following discharge rates to 1.75 volts per cell:

8 hours -	131 amperes - 1050 Amp. Hrs.
3 hours -	270 amperes
1 hour -	525 amperes
1 minute -	1169 amperes

WYLE LABORATORIES
SCIENTIFIC SERVICES AND SYSTEMS GROUP



Seismic Qualification test REPORT

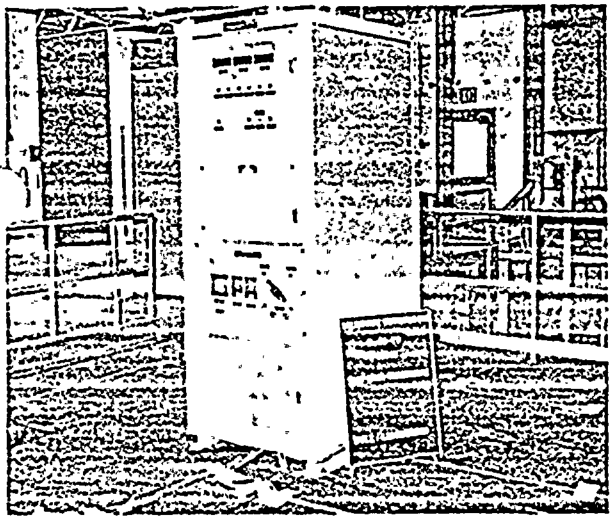
SEISMIC SIMULATION TEST PROGRAM

ON A

7.5 kVA STATIC INVERTER

FOR

SOLIDSTATE CONTROLS, INC.
600 OAKLAND PARK AVENUE
COLUMBUS, OHIO 43214



SEISMIC SIMULATION
Test Report

REPORT NO. 43943-1

WYLE JOB NO. 43943

CUSTOMER P. O. NO. 13919

PAGE 1 OF 62 PAGE REPORT

DATE March 23, 1978

SPECIFICATION (S) See References in Section 7.0

1.0 CUSTOMER Solidstate Controls, Inc.

ADDRESS 600 Oakland Park Avenue, Columbus, Ohio 43214

2.0 TEST SPECIMEN 7.5 kVA Static Inverter

3.0 MANUFACTURER Solidstate Controls, Inc.

4.0 SUMMARY

A 7.5 kVA Static Inverter, hereinafter called the specimen, was subjected to a Seismic Simulation Test Program as required by the Solidstate Controls, Inc., Purchase Order Number 13919, and Wyle Laboratories' Seismic Test Plan 541/0075/GH, dated February 28, 1978, Revision A.

The test program consisted of biaxial random multifrequency testing and resonant search testing in each of two test orientations. The specimen was instrumented with accelerometers and monitored for functional operation during the test program.

It was demonstrated that the specimen possessed sufficient integrity to withstand, without compromise of structure or electrical function, the prescribed simulated seismic environment.

Ala. Professional Eng.
License No. 7112

STATE OF ALABAMA
COUNTY OF MADISON } ss.

William W. Holbrook, being duly sworn, deposes and says: The information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

SEAL William W. Holbrook

SUBSCRIBED and sworn to before me this 30th day of March, 1978

Virginia R. Dink

Notary Public in and for the County of Madison, State of Alabama.

My Commission expires June 13, 1979

PREPARED BY Rod R. Thornberry
R. Thornberry

APPROVED BY H. Jordan / Larry E. Frazier

WYLE Q. A. L. M. Davies
L. M. Davies

WYLE LABORATORIES
SCIENTIFIC SERVICES AND SYSTEMS GROUP
HUNTSVILLE, ALABAMA

4.0 SUMMARY (Continued)

Table I contains a description of the tests.

Figures 1 and 2 show the horizontal and vertical Safe Shutdown Earthquake Required Response Spectra.

Photograph 1 shows the specimen installed in the side-to-side/vertical orientation for testing on the Wyle Multiaxis Seismic Simulator.

Photographs 2 through 6 show the specimen response accelerometer locations.

Appendix I contains the transmissibility plots of the specimen response accelerometers divided by the control accelerometers from the resonant search tests.

Appendix II contains Test Response Spectra plots of the control and specimen response accelerometers from the Safe Shutdown Earthquake test in each orientation.

Appendix III contains the Instrumentation Log Sheets and the Instrumentation Equipment Sheets.

Appendix IV contains the Wyle Seismic Test Plan 541/0075/GH, dated February 28, 1978, Revision A.

5.0 TEST REQUIREMENTS

5.1 Specimen Mounting and Orientation

The specimen shall be placed on the Wyle Multiaxis Seismic Simulator Table such that the base of the specimen is flush with the top of the table. The mounting base of the specimen shall be bolted to the test table in each test orientation. The mounting of the specimen shall simulate the in-service mounting configuration as closely as practical. The specimen shall be installed such that its lateral axis shall be co-linear with the longitudinal axis of the test table. For the second axis of tests, the specimen shall be rotated 90 degrees in the horizontal plane.

5.2 Resonance Search

A low-level (approximately 0.2 g horizontally and vertically) biaxial sine sweep shall be performed to determine major resonances in both the side-to-side/vertical and the front-to-back/vertical orientations. The sweep rate shall be one octave per minute over the frequency range of 1 Hz to 35 Hz.

5.3 Random Multifrequency Tests

The specimen shall be subjected to 30-second duration simultaneous horizontal and vertical inputs of phase-incoherent random waveform motion consisting of frequency bandwidths spaced one-third octave apart over the frequency range of 1 Hz to 40 Hz. The amplitude of each one-third octave bandwidth shall be independently adjusted in each axis until the Test Response Spectra (TRS) envelop the Required Response Spectra (RRS). The horizontal and vertical control accelerometers shall be recorded on oscillograph and FM tape recorders. The resulting table motion shall be analyzed at five percent (5%) damping, and plotted at one-third octave frequency intervals over the frequency range of interest.

The specimen shall be subjected to five (5) Operating Basis Earthquake (OBE) tests, followed by one (1) Safe Shutdown Earthquake (SSE) test, in each test orientation. The SSE RRS are shown in Figures 1 and 2. The OBE level Required Response Spectrum is 80 percent of the SSE level Required Response Spectrum.

5.0 TEST REQUIREMENTS (Continued)

5.4 Specimen Response

A total of six (6) uniaxial piezo-electric accelerometers shall be located on the specimen to monitor the response of the specimen to the seismic excitaton. The placement of these accelerometers shall be at the discretion of the Solidstate Controls Technical Representative and the Wyle Test Engineer. FM tape and oscillograph recorders shall provide a record of each accelerometer response during the test program. Transmissibility plots of the specimen response accelerometers divided by the control accelerometers from the resonance search tests shall be provided. TRS plots of the specimen response accelerometers from the SSE test in each test orientation analyzed at five percent (5%) damping shall be included in the test report.

5.5 Electrical Power

Electrical power of 480 VAC, single-phase, 60 Hz at approximately 80 amperes or less, and 105-140 VDC at 80 amperes or less, shall be provided for operation of the specimen during the test program..

5.6 Electrical Monitoring

Three (3) electrical monitoring channels shall be furnished to monitor operation of the specimen. The electrical monitoring channels can be used to ascertain electrical continuity, current/voltage levels, spurious operation, contact chatter, etc. before, during and after the seismic excitation.

5.7 Electrical Loading

A Solidstate-furnished electrical load shall be connected to the Inverter 120 VAC output during the seismic tests.

6.0 TEST PROCEDURES AND RESULTS

6.1 Specimen Mounting and Orientation Procedures

The specimen was placed on the Wyle Multiaxis Seismic Simulator Table such that the base of the specimen was flush with the top of the table. The mounting base of the specimen was bolted to the test table, using four (4) 1/2"-13 Grade 5 bolts, in each test orientation. The mounting of the specimen simulated the in-service mounting configuration as closely as practical. The specimen was initially installed in the side-to-side/vertical orientation as shown in Photograph 1. For the second axis of tests, the specimen was rotated 90 degrees in the horizontal plane to the front-to-back/vertical orientation.

6.2 Resonance Search Procedures

A low-level (approximately 0.2 g horizontally and vertically) biaxial sine sweep was performed to determine major resonances in both the side-to-side/vertical and the front-to-back/vertical orientations. The sweep rate was one octave per minute over the frequency range of 1 Hz to 35 Hz.

6.2.1 Resonance Search Results

A description of the resonance search tests, including test numbers, axes, and input accelerations is contained in Table I.

Transmissibility plots of the specimen response accelerometers divided by the control accelerometers from the resonance search tests are presented in Appendix I.

6.3 Random Multifrequency Test Procedures

The specimen was subjected to 30-second duration simultaneous horizontal and vertical inputs of phase-incoherent random waveform motion consisting of frequency bandwidths spaced one-third octave apart over the frequency range of 1 Hz to 40 Hz. The amplitude of each one-third octave bandwidth was independently adjusted in each axis until the TRS enveloped the RRS. The horizontal and vertical control accelerometers were recorded on oscillograph and FM tape recorders. The resulting table motion was analyzed at five percent (5%) damping, and plotted at one-third octave frequency intervals over the frequency range of interest.

Five (5) OBE tests, followed by one (1) SSE test, were performed in each test orientation. The SSE RRS are shown in Figures 1 and 2. The OBE level Required Response Spectrum was 80 percent of the SSE level Required Response Spectrum.

6.0 TEST PROCEDURES AND RESULTS (Continued)

6.3.1 Random Multifrequency Test Results

It was demonstrated that the specimen possessed sufficient integrity to withstand, without compromise of structure, the prescribed simulated seismic environment.

Table I contains a description of the tests.

The TRS plots of the control accelerometers from the SSE test in each test orientation analyzed at 5% damping are presented in Appendix II.

6.4 Specimen Response Procedures

A total of six (6) uniaxial piezo-electric accelerometers were located on the specimen to monitor the response of the specimen to the seismic excitation. The placement of these accelerometers was at the discretion of the Solidstate Controls Technical Representative and the Wyle Test Engineer, and is shown in Photographs 2 through 6. The horizontal accelerometers were oriented in the side-to-side direction during the side-to-side/vertical testing and were re-oriented to the front-to-back direction during the front-to-back/vertical testing.

6.4.1 Specimen Response Results

Transmissibility plots of the specimen response accelerometers divided by the control accelerometers from the resonance search tests are presented in Appendix I.

TRS plots of the specimen response accelerometers from the SSE test in each test orientation (Test Nos. 7 and 14), analyzed at 5% damping, are presented in Appendix II.

6.5 Electrical Powering Procedures

Electrical power of 106 VDC at approximately 80 amperes or less was connected to the input terminals, and 480 VAC, 60 Hz, single-phase at approximately 80 amperes or less, was connected to the alternate input terminals, for operation of the specimen.

6.0 TEST PROCEDURES AND RESULTS (Continued)

6.6 Electrical Monitoring Procedures

Three (3) electrical monitoring channels, as described below, were furnished to monitor operation of the specimen. The electrical monitoring channels were used to ascertain electrical continuity, voltage levels, spurious operation, contact chatter, etc. before, during and after the seismic excitation.

At approximately 20 seconds into each test run, the DC input voltage was removed.

Channel	Function Monitored
1	DC Voltage Input
2	AC Voltage Output
3	Normally Closed (NC) Alarm Contact

6.6.1 Electrical Monitoring Results

It was demonstrated that the specimen possessed sufficient integrity to withstand, without compromise of electrical function, the simulated seismic environment

No spurious operation, contact chatter, etc. was noted during the test program.

6.7 Electrical Loading Procedures

A Solidstate-furnished electrical load (approximately 33 amperes) was connected to the Inverter 120 VAC output during the seismic tests.

7.0 REFERENCES

7.1 The Solidstate Controls, Inc., Purchase Order Number 13919.

7.2 Wyle Laboratories' Seismic Test Plan 541/0075/GH, dated February 28, 1978, Revision A.

7.3 IEEE Standard 344-1975 entitled "Recommended Practices for Seismic Qualification of Class 1 Electrical Equipment for Nuclear Power Generating Stations".

TABLE I

TEST RUN DESCRIPTIONS

TEST RUN NO.	TYPE TEST	ORIENTATION	LEVEL	INPUT ACCELERATION (g)	
				HZPA	VZPA
1	Sine Sweep	SS/V	---	0.2	0.2
2*	RMF	SS/V	OBE	1.4	0.69
3	RMF	SS/V	OBE	1.35	0.61
4	RMF	SS/V	OBE	1.4	0.58
5	RMF	SS/V	OBE	1.4	0.54
6	RMF	SS/V	OBE	1.4	0.55
7	RMF	SS/V	SSE	2.1	0.68
8	Sine Sweep	FB/V	---	0.2	0.2
9	RMF	FB/V	OBE	1.45	0.55
10	RMF	FB/V	OBE	1.45	0.58
11	RMF	FB/V	OBE	1.5	0.57
12	RMF	FB/V	OBE	1.45	0.57
13	RMF	FB/V	OBE	1.45	0.57
14	RMF	FB/V	SSE	2.2	0.66

LEGEND:
HZPA = Horizontal Zero Period Acceleration
VZPA = Vertical Zero Period Acceleration
SS/V = Side-to-Side and Vertical
FB/V = Front-to-Back and Vertical
RMF = Random Multifrequency
OBE = Operating Basis Earthquake
SSE = Safe Shutdown Earthquake

*120 VAC output load was inadvertently left off during run.

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %

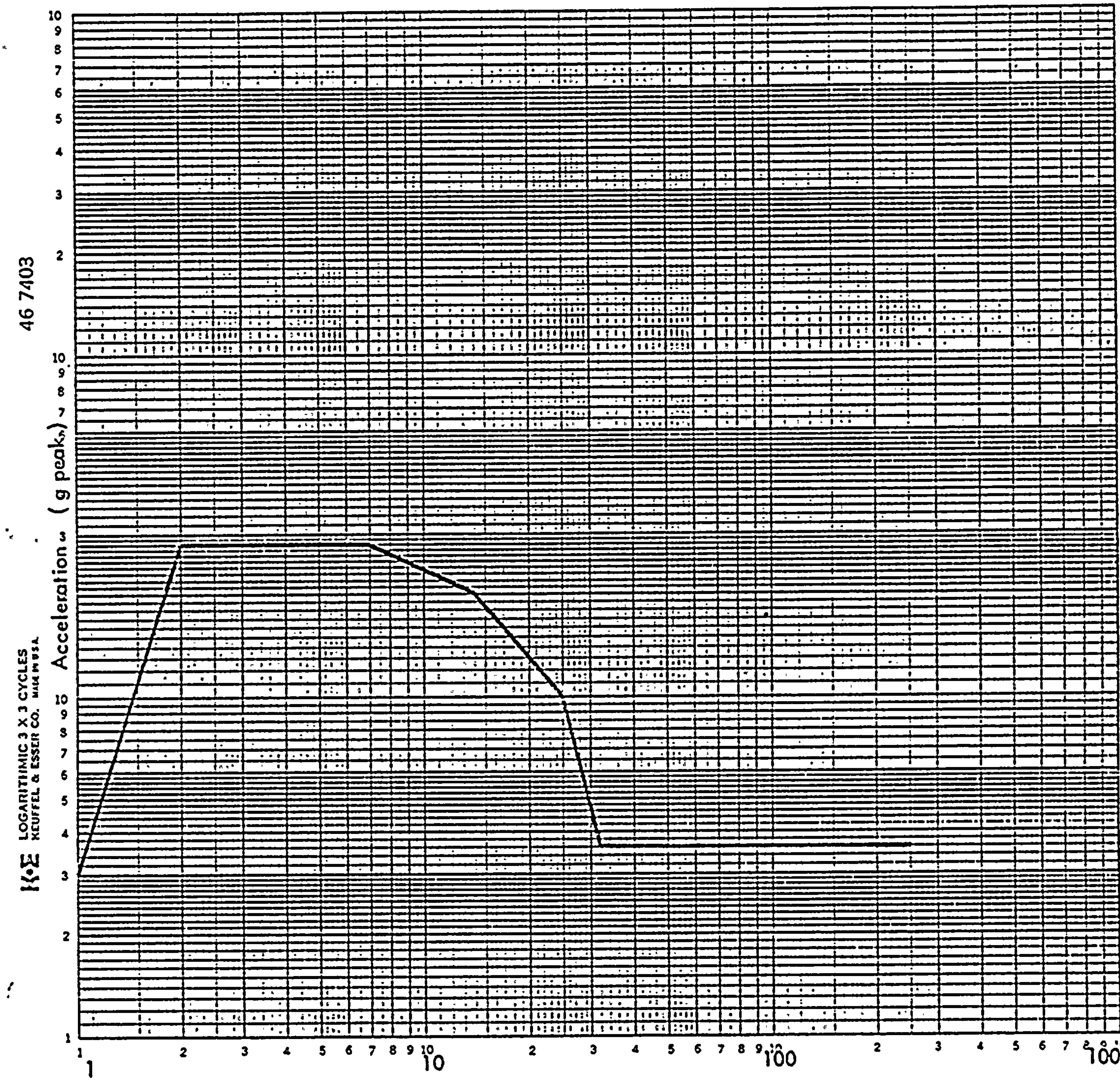


FIGURE 1. HORIZONTAL SAFE SHUTDOWN EARTHQUAKE REQUIRED RESPONSE SPECTRUM

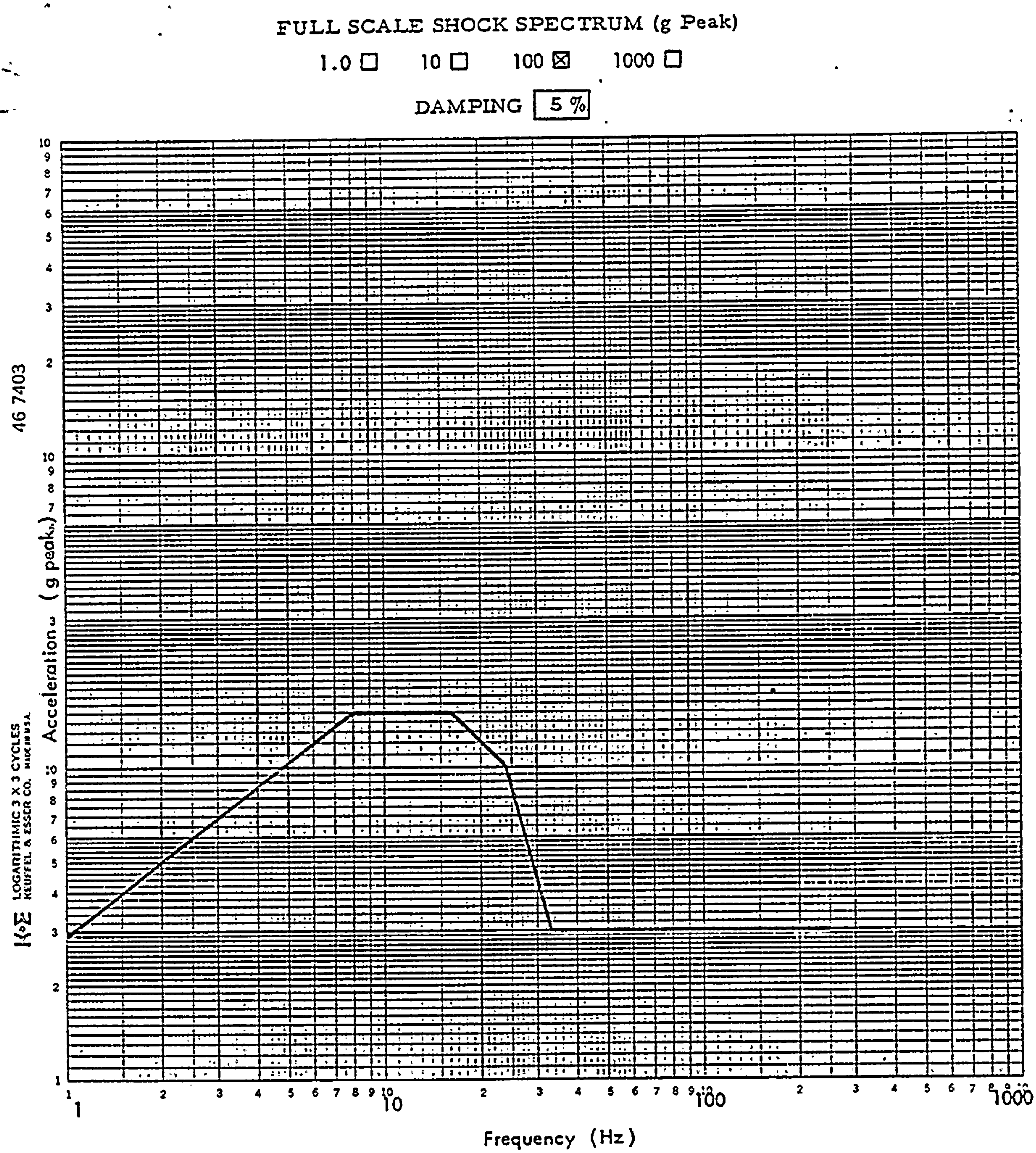
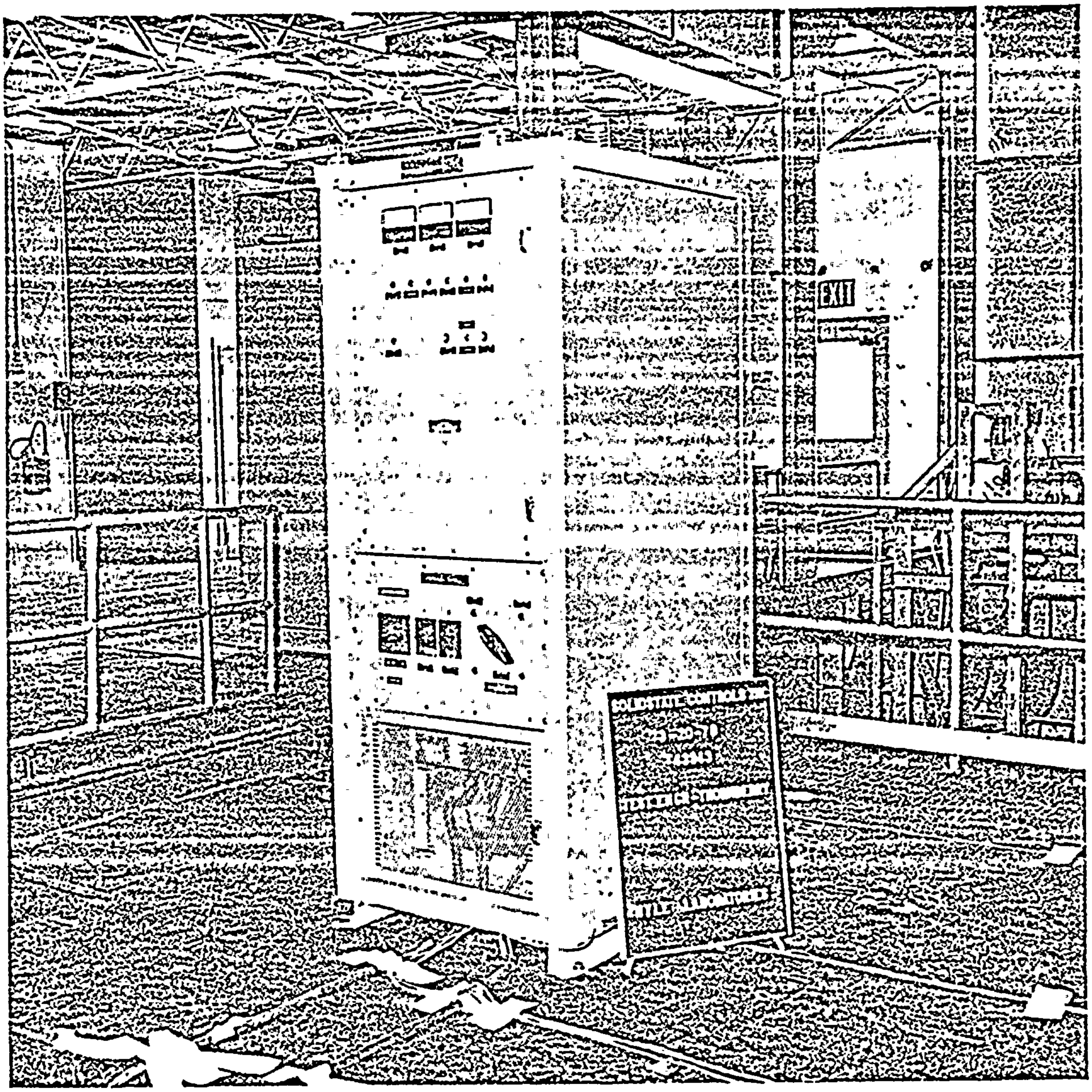
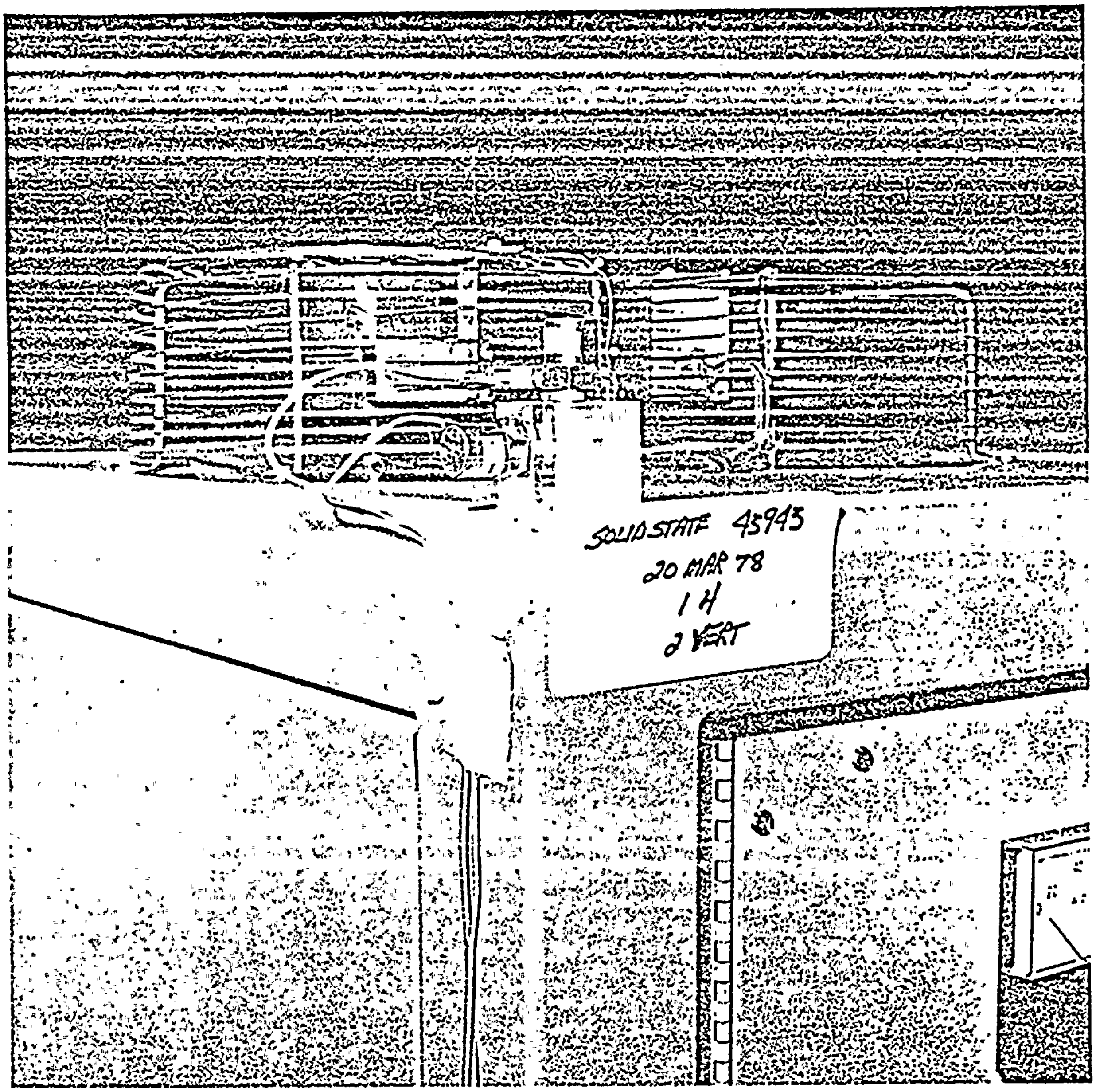


FIGURE 2. VERTICAL SAFE SHUTDOWN EARTHQUAKE REQUIRED RESPONSE SPECTRUM



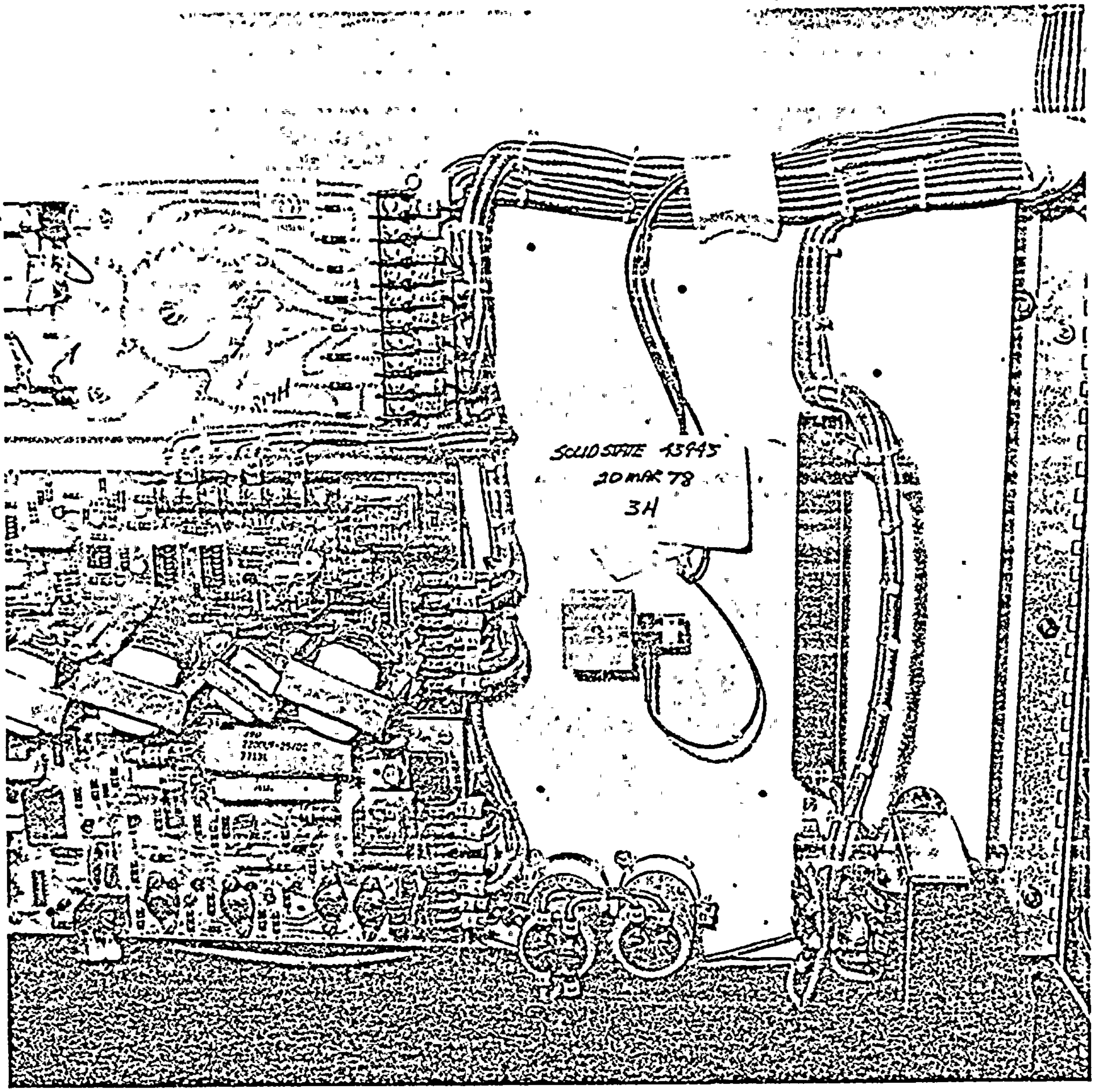
PHOTOGRAPH 1

TEST SETUP
SIDE-TO-SIDE/VERTICAL ORIENTATION



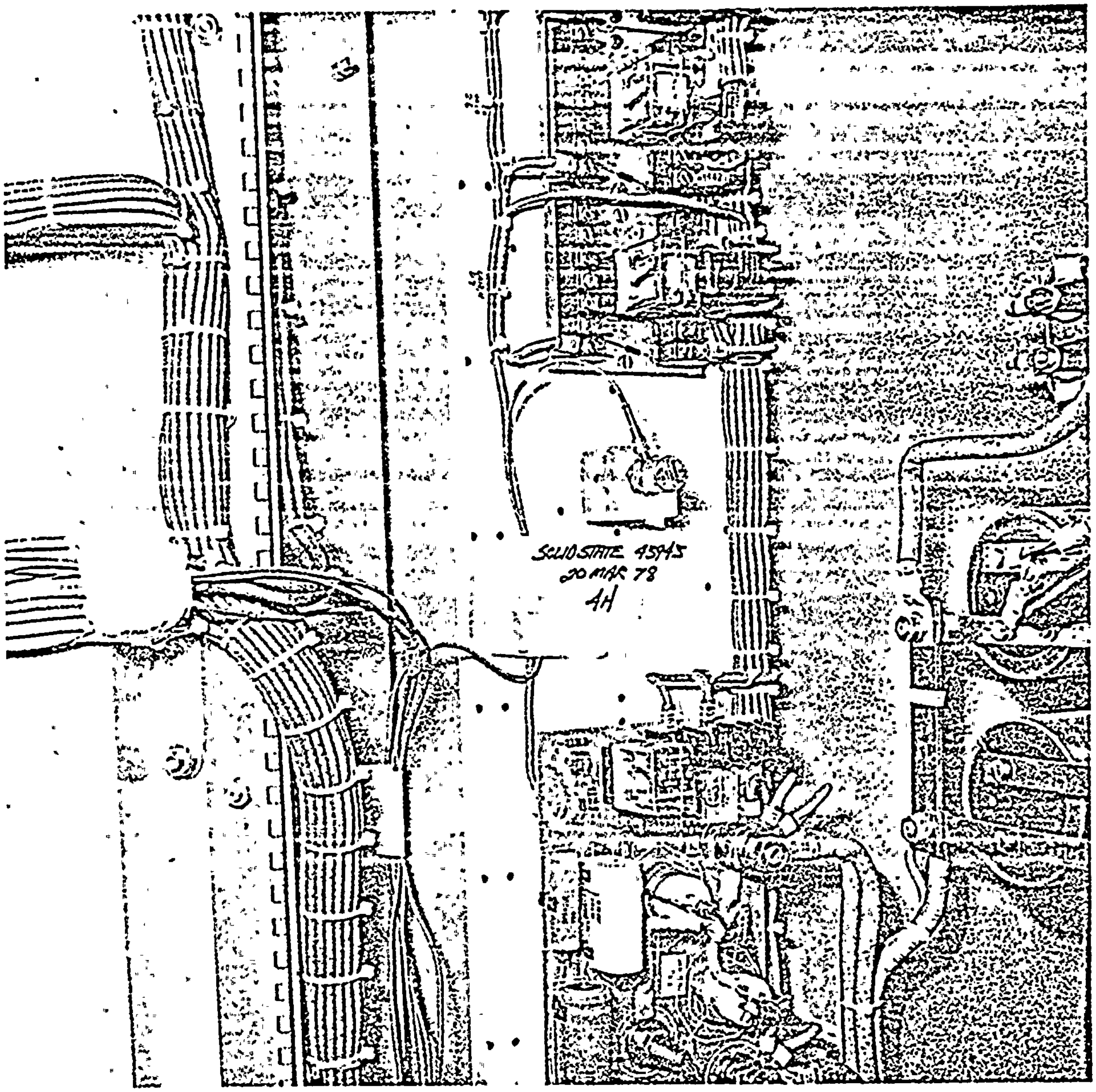
PHOTOGRAPH 2

ACCELEROMETER LOCATION 1H, 2V



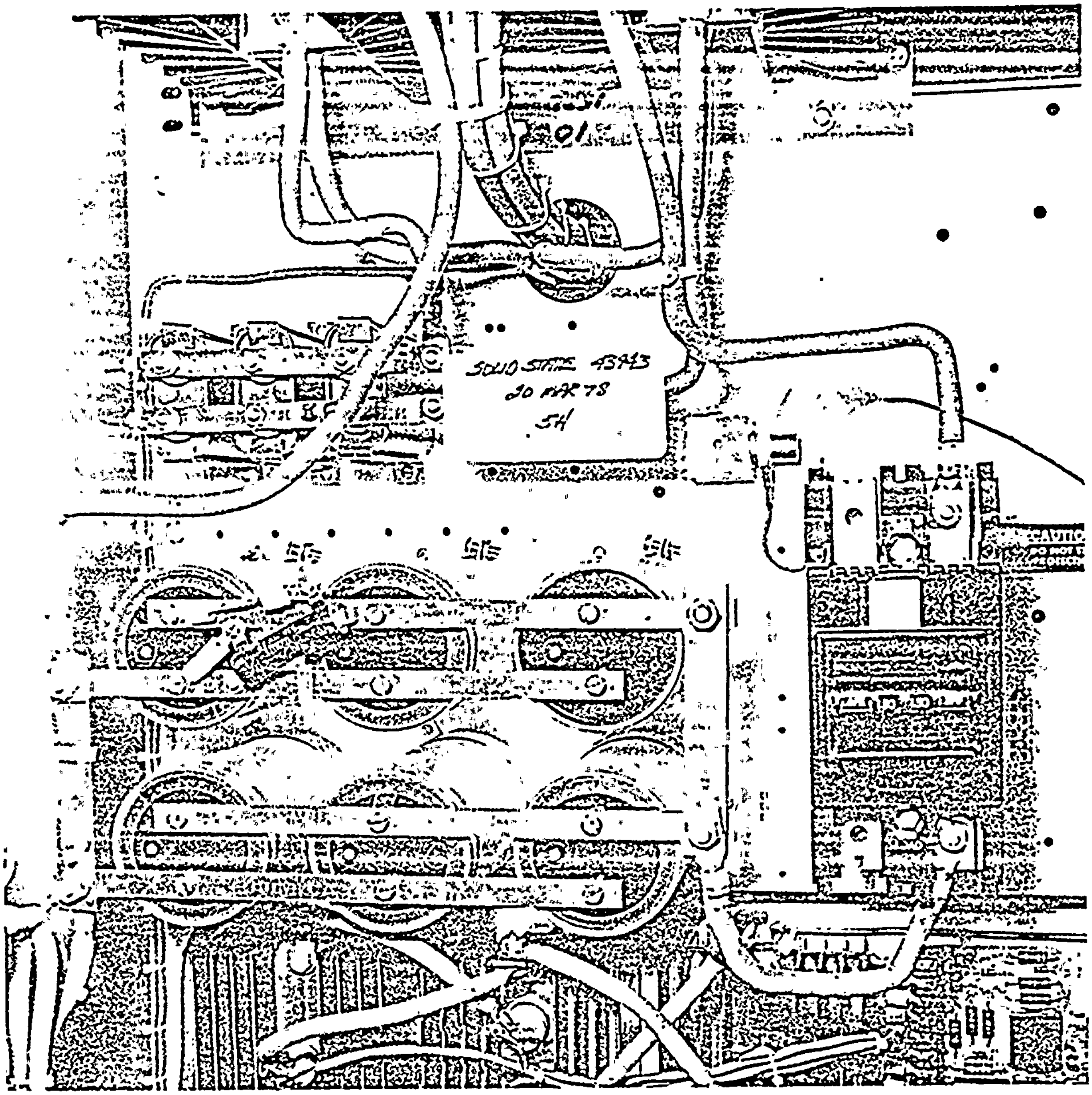
PHOTOGRAPH 3

ACCELEROMETER LOCATION 3H



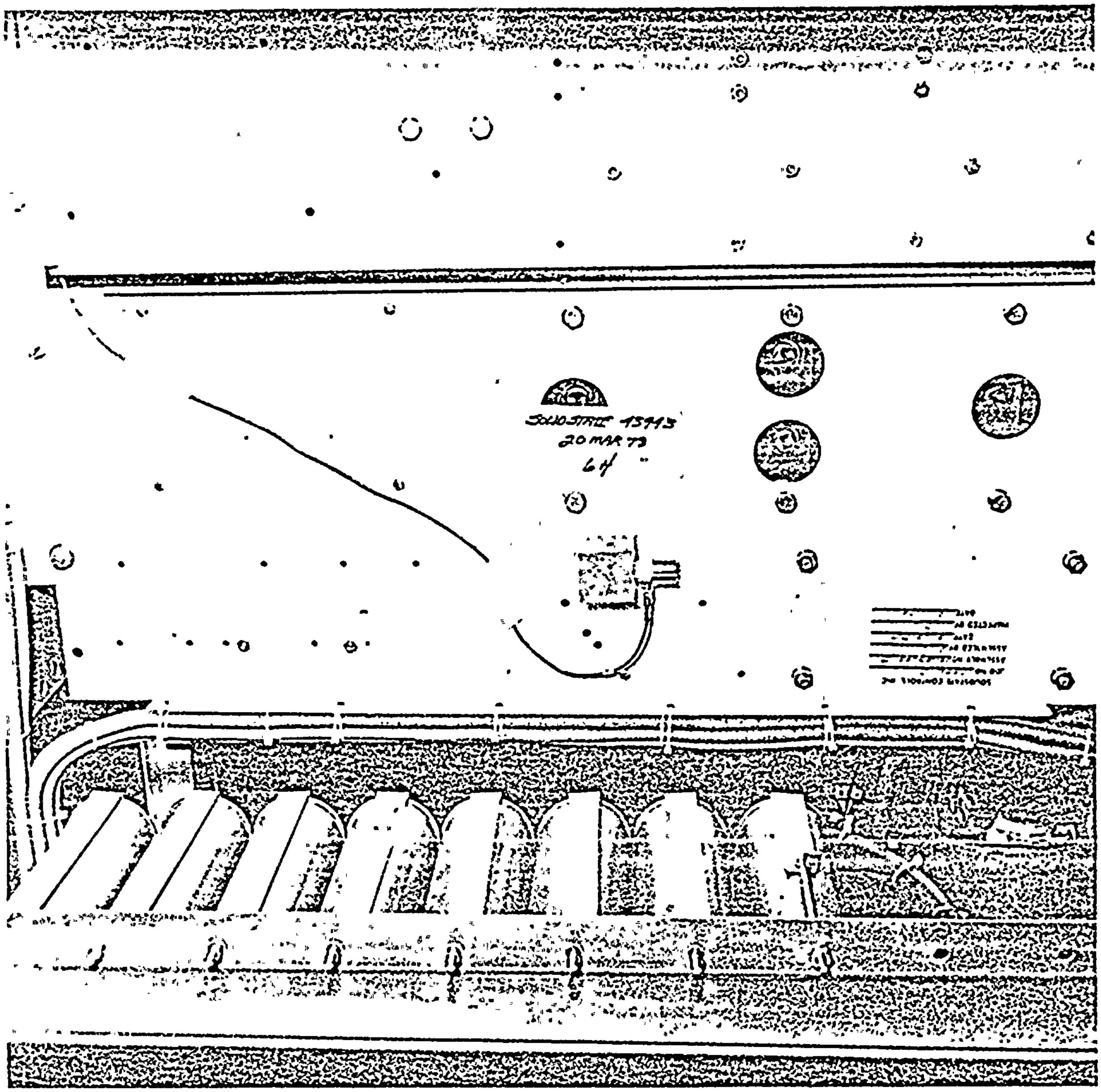
PHOTOGRAPH 4

ACCELEROMETER LOCATION 4H



PHOTOGRAPH 5

ACCELEROMETER LOCATION 5H



PHOTOGRAPH 6

ACCELEROMETER LOCATION 6H

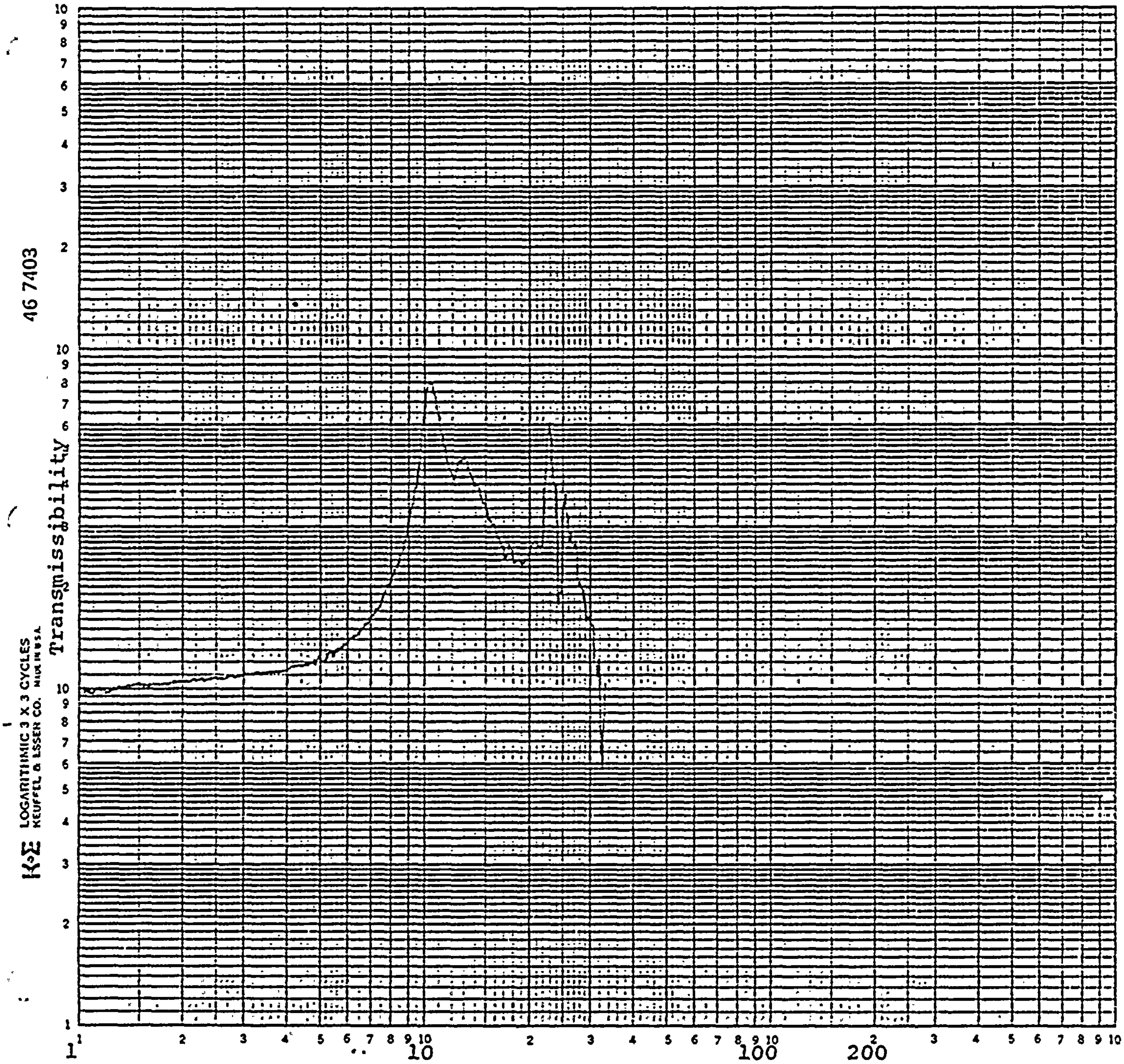
APPENDIX I

TRANSMISSIBILITY PLOTS

TEST NO.	AXES
1	Side-to-Side/Vertical
8	Front-to-Back/Vertical

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



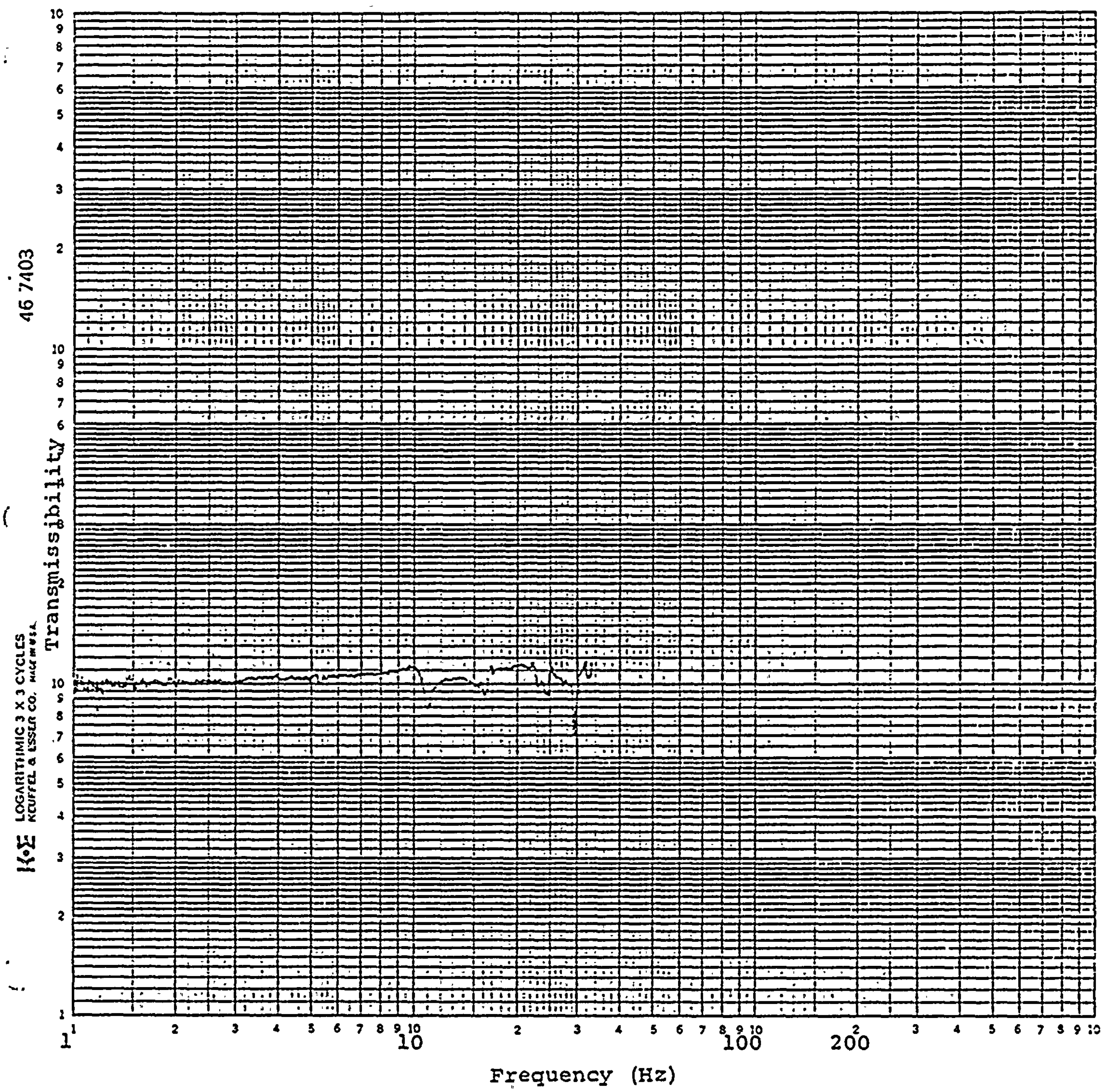
AXIS SS/VERT

ACCEL. NO. 155 ÷ NO. HCA

TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



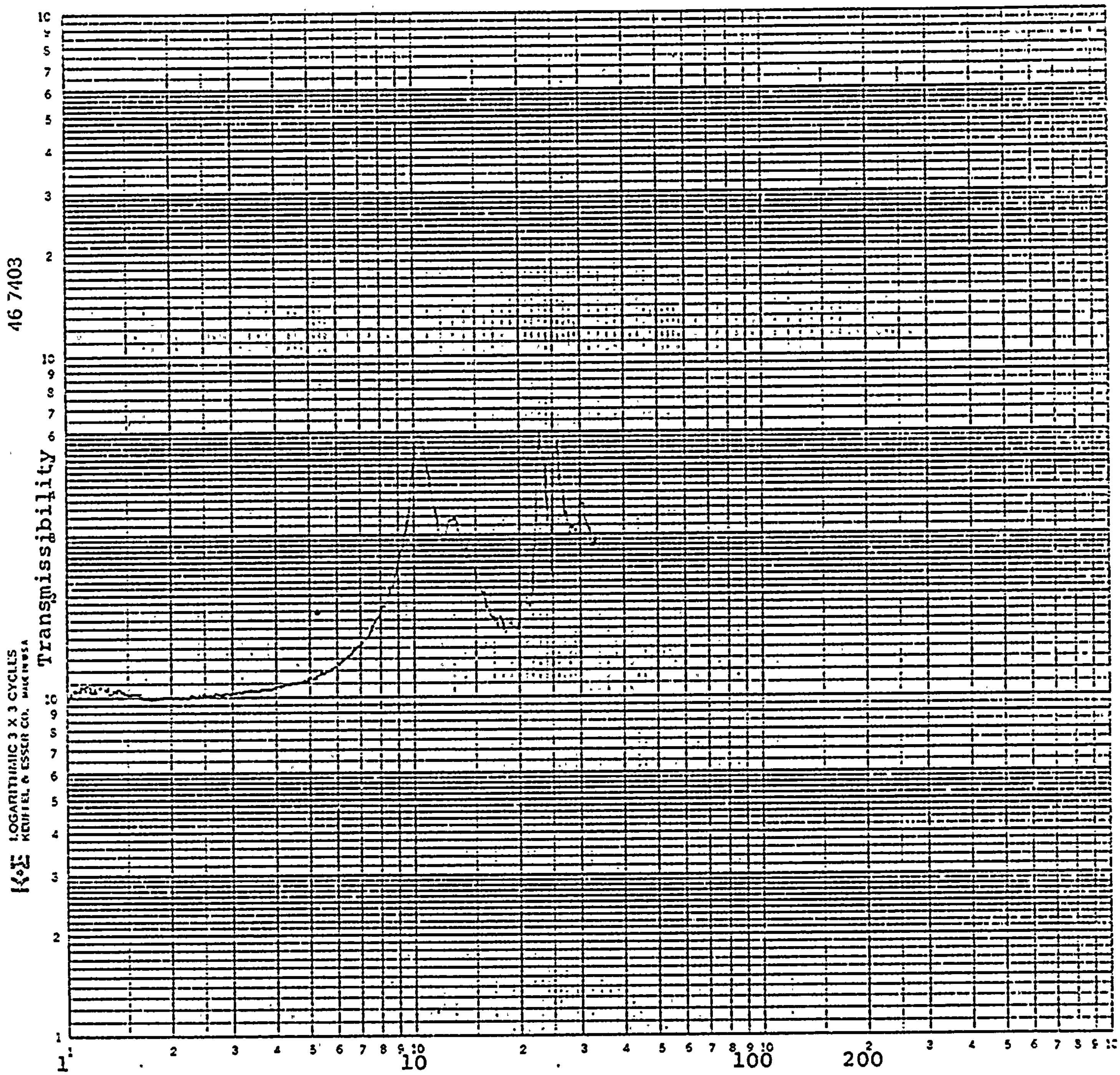
AXIS 55/VERT

ACCEL. NO. 2V ÷ NO. VCA

TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



AXIS 55/VERT

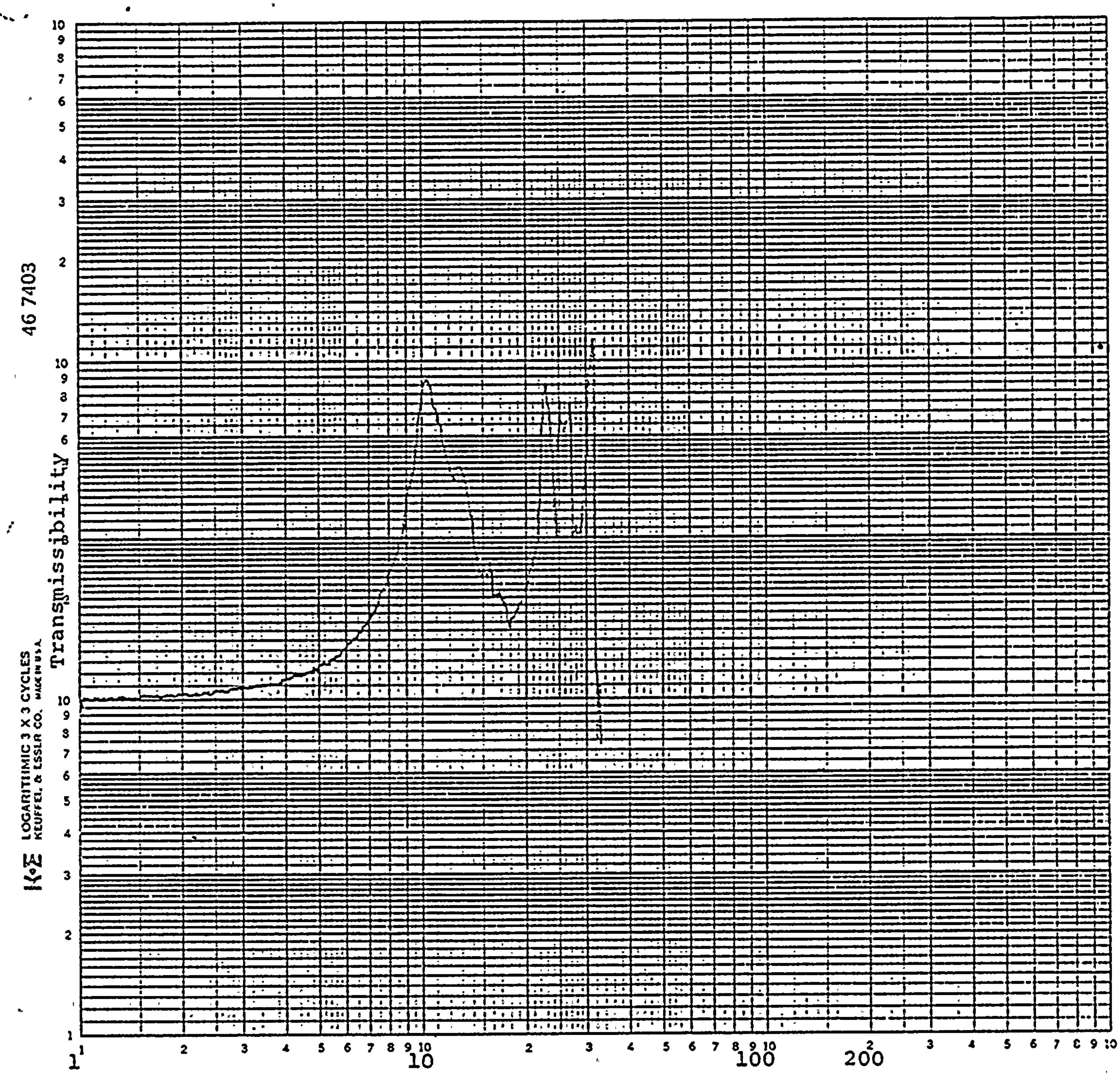
ACCEL. NO. 355 ÷ NO. HCA

TEST RUN NO. 1

[illegible]

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



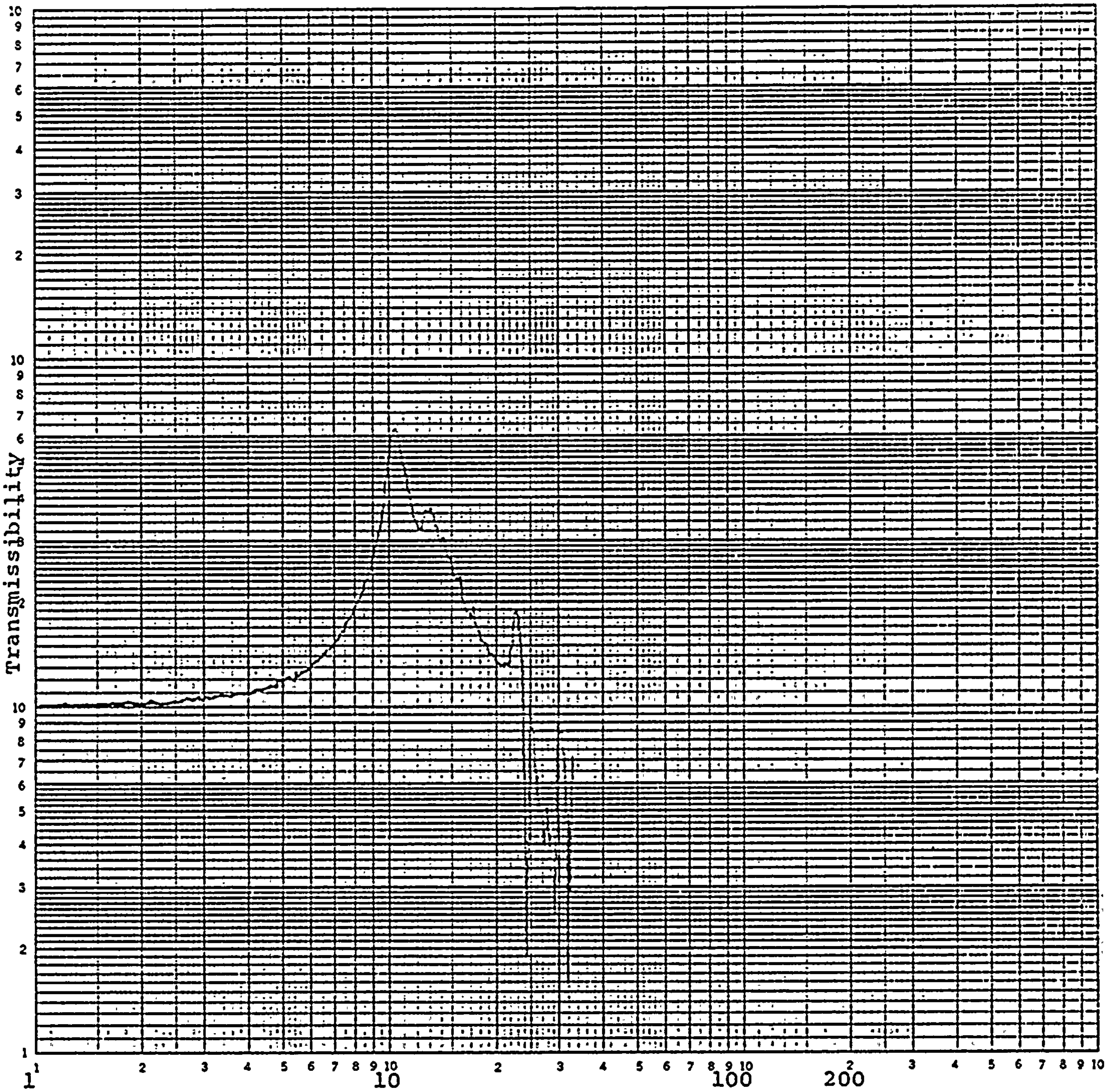
AXIS SS/VERT

ACCEL. NO. 455 ÷ NO. HCA

TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



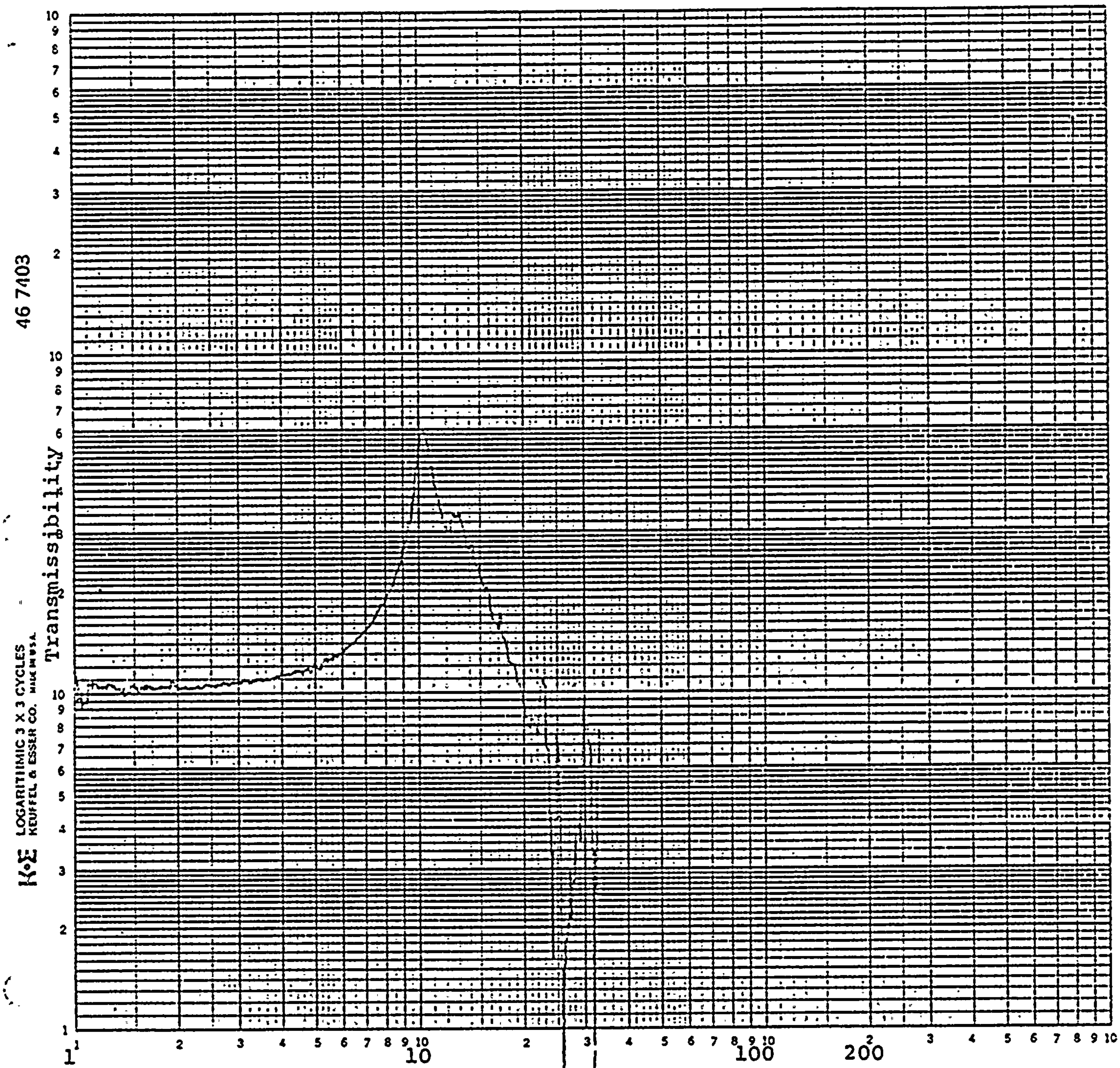
AXIS 55/VERT

ACCEL. NO. 555 ÷ NO. HCA

TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



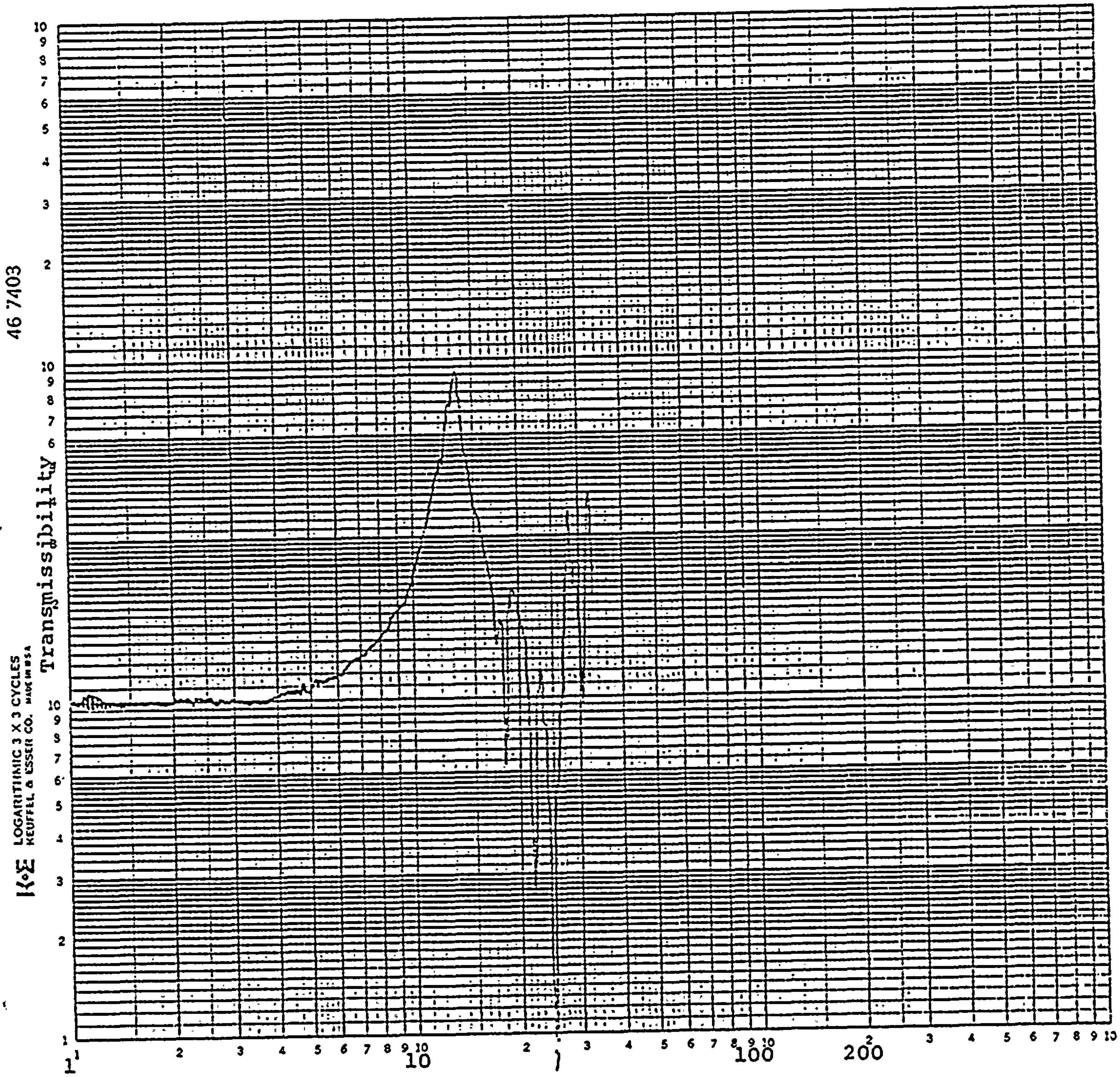
AXIS SS/VERT

ACCEL. NO. LSS ÷ NO. HCA

TEST RUN NO. 1

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



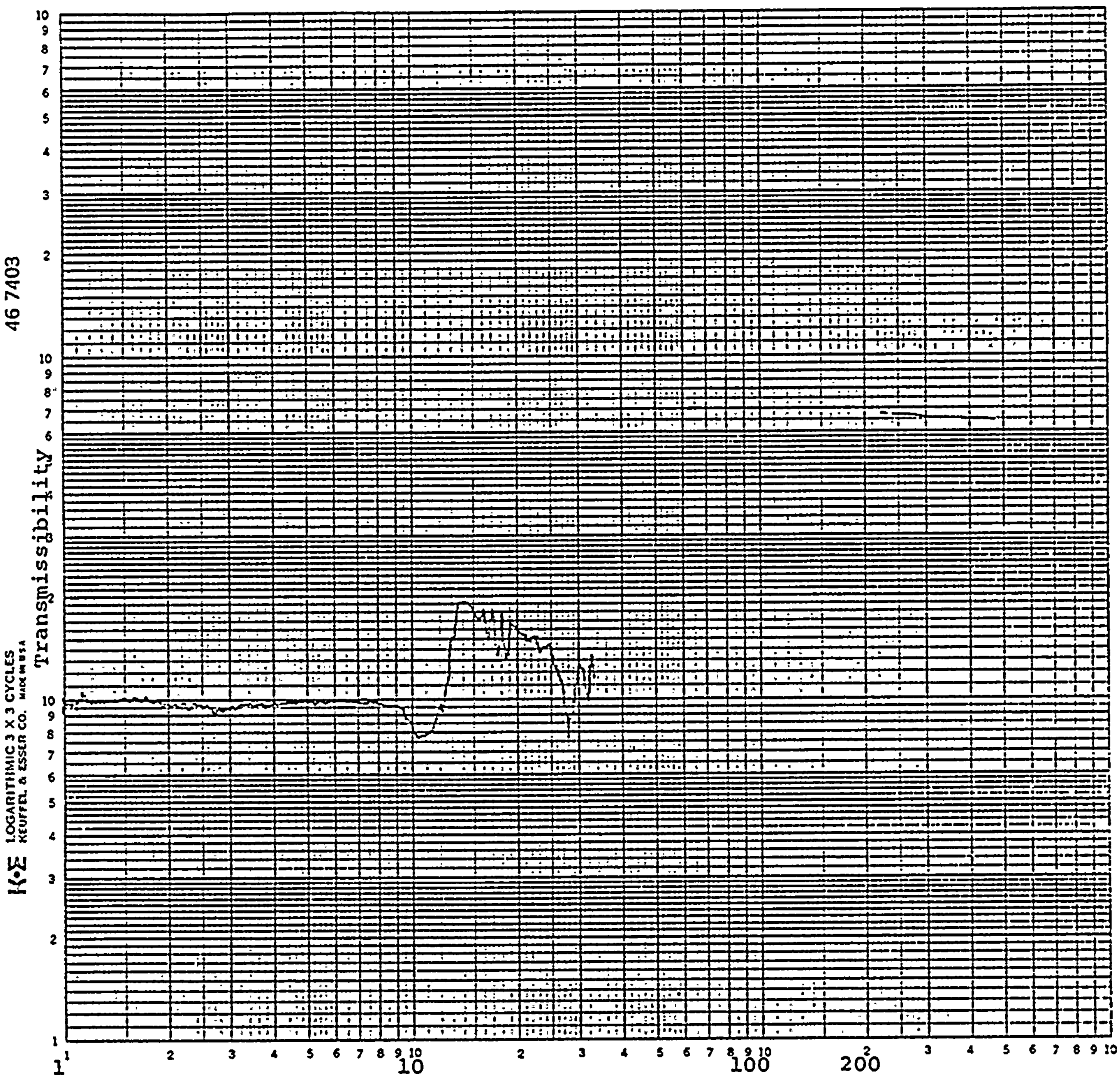
AXIS F-B/V

ACCEL. NO. F-B ÷ NO. HLA

TEST RUN NO. 8

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



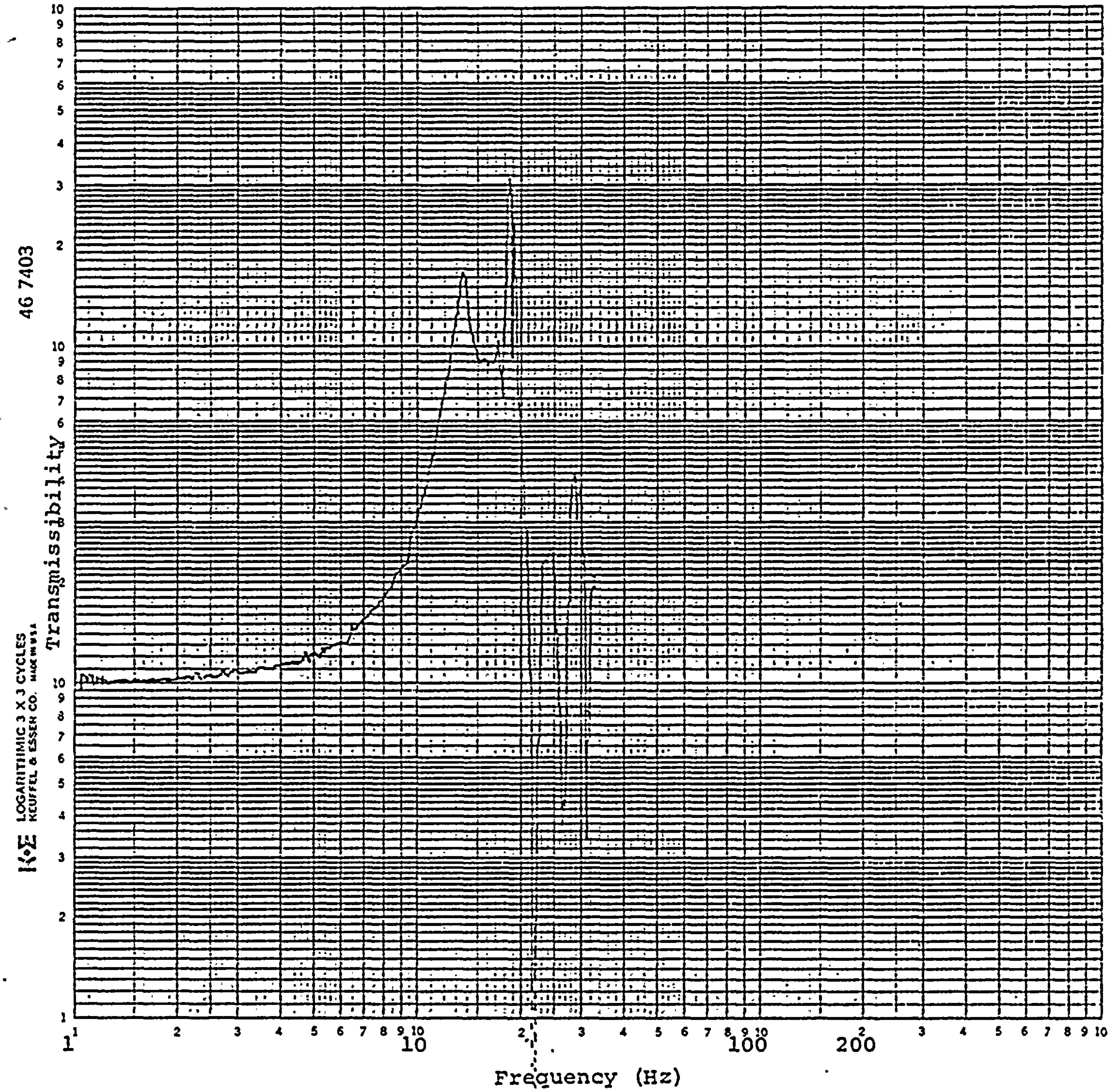
AXIS E-B/Y

ACCEL. NO. 2V ÷ NO. VCA

TEST RUN NO. 8

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



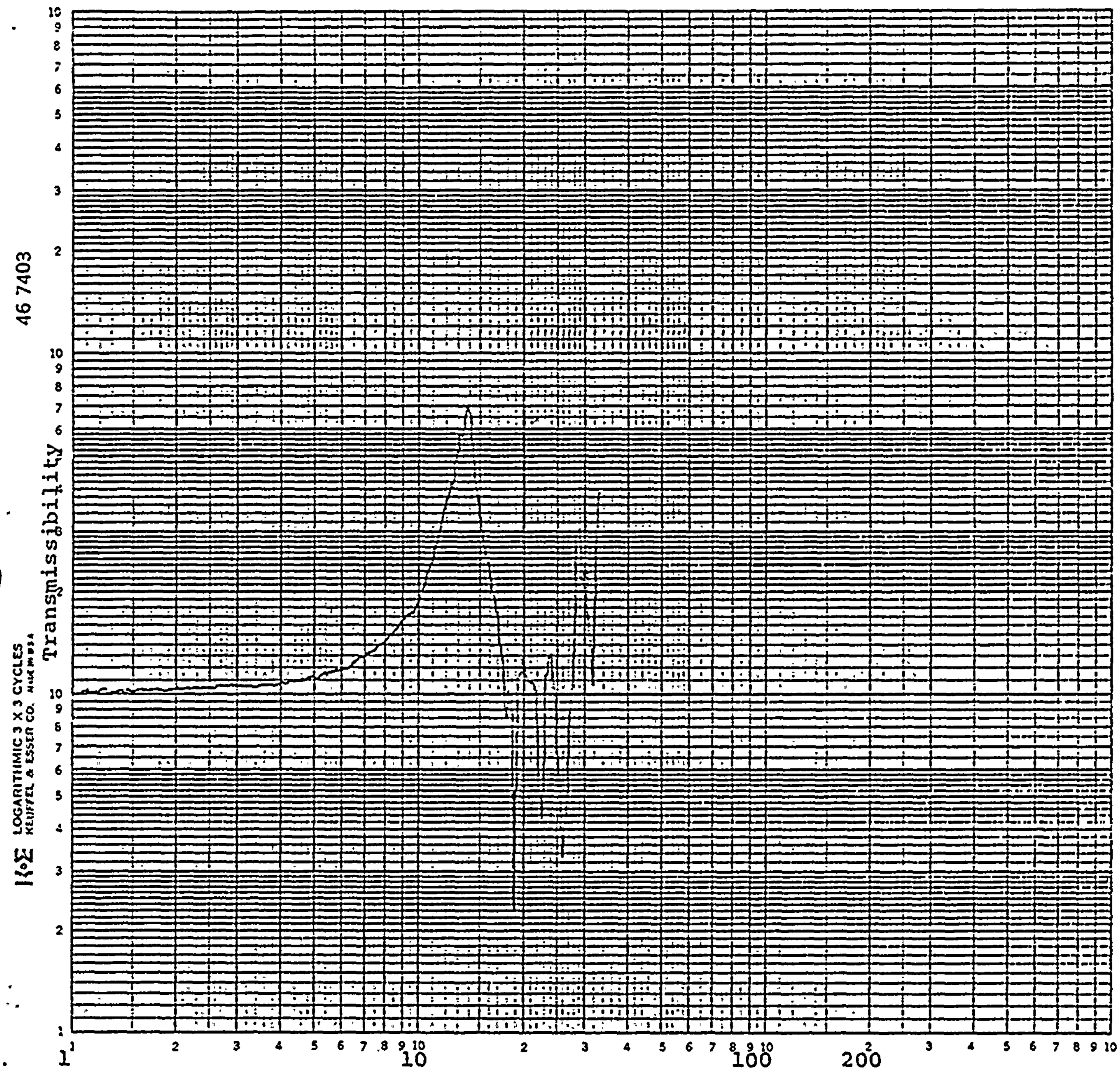
AXIS FB/VERT

ACCEL. NO. JFB ÷ NO. HA

TEST RUN NO. 8

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



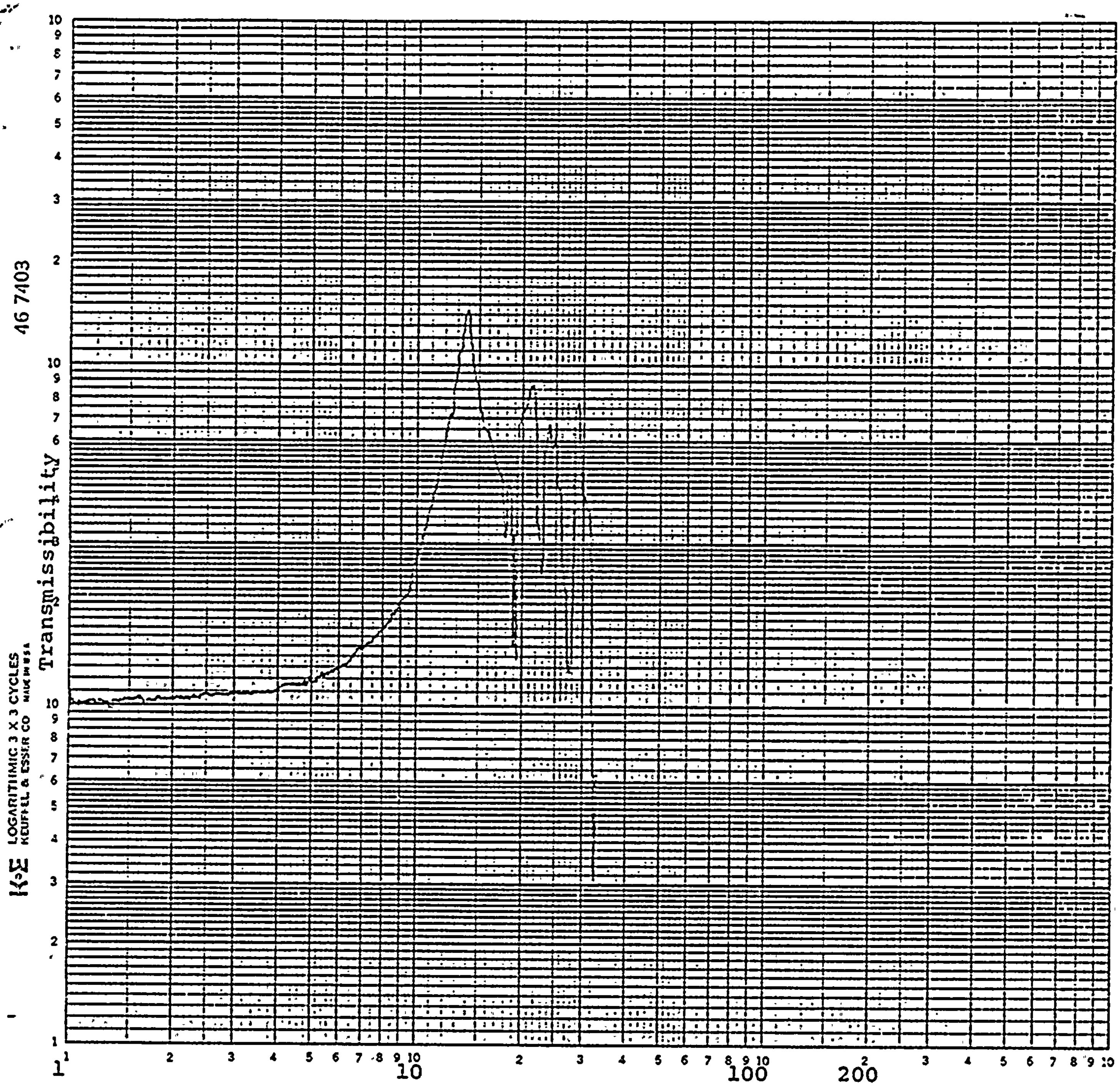
AXIS: FB/VERT

ACCEL. NO. 4FB ÷ NO. 1KA

TEST RUN NO. 8

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



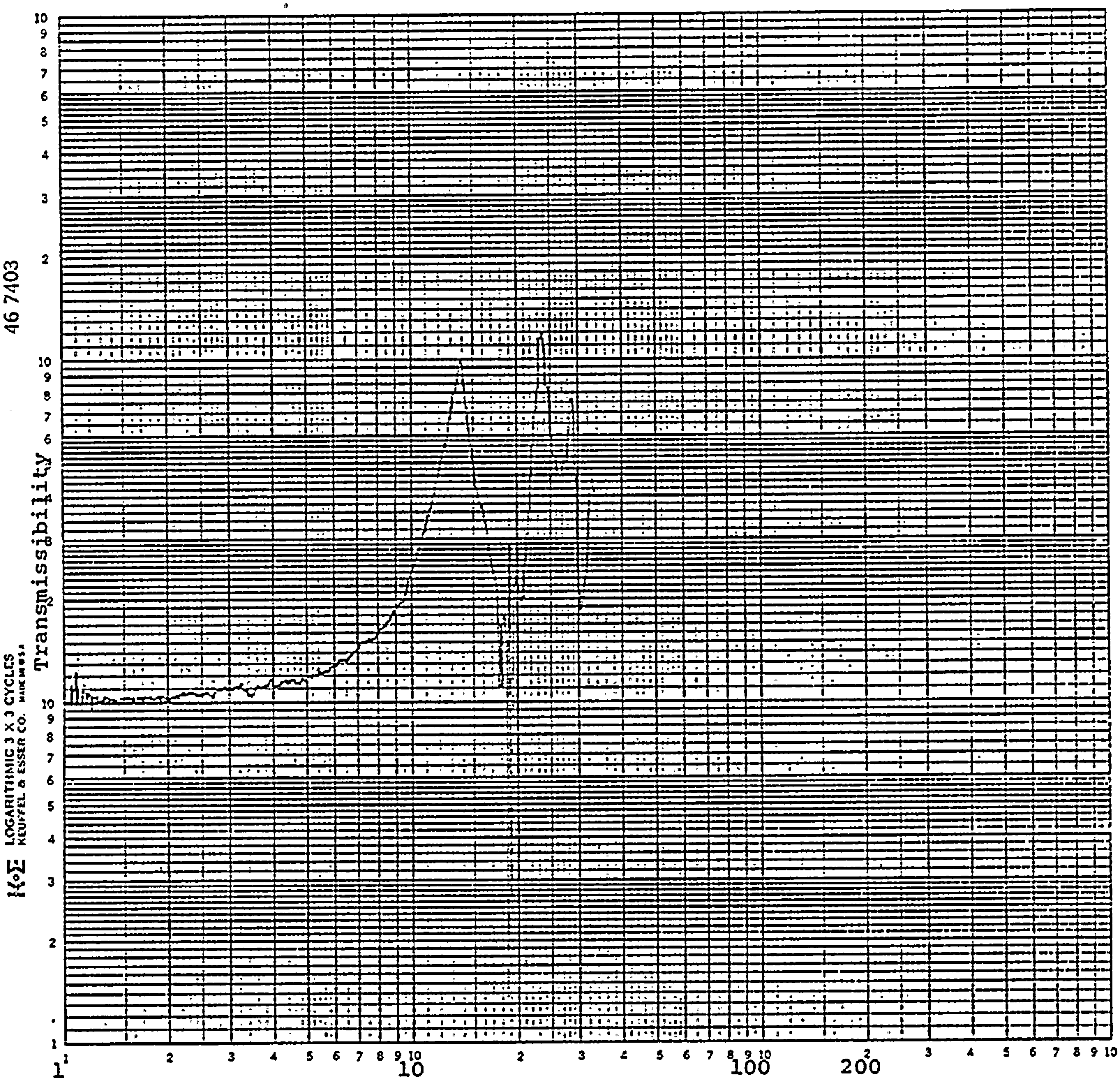
AXIS: FB/VERT

ACCEL. NO. 5FB ÷ NO. HCA

TEST RUN NO. 8

FULL SCALE TRANSMISSIBILITY

0.1 ☐ 1.0 ☐ 10 ☐ 100 ☒ 1000 ☐



Frequency (Hz)

AXIS FB/VERT

ACCEL. NO. 6FB ÷ NO. HCA

TEST RUN NO. 8

APPENDIX II

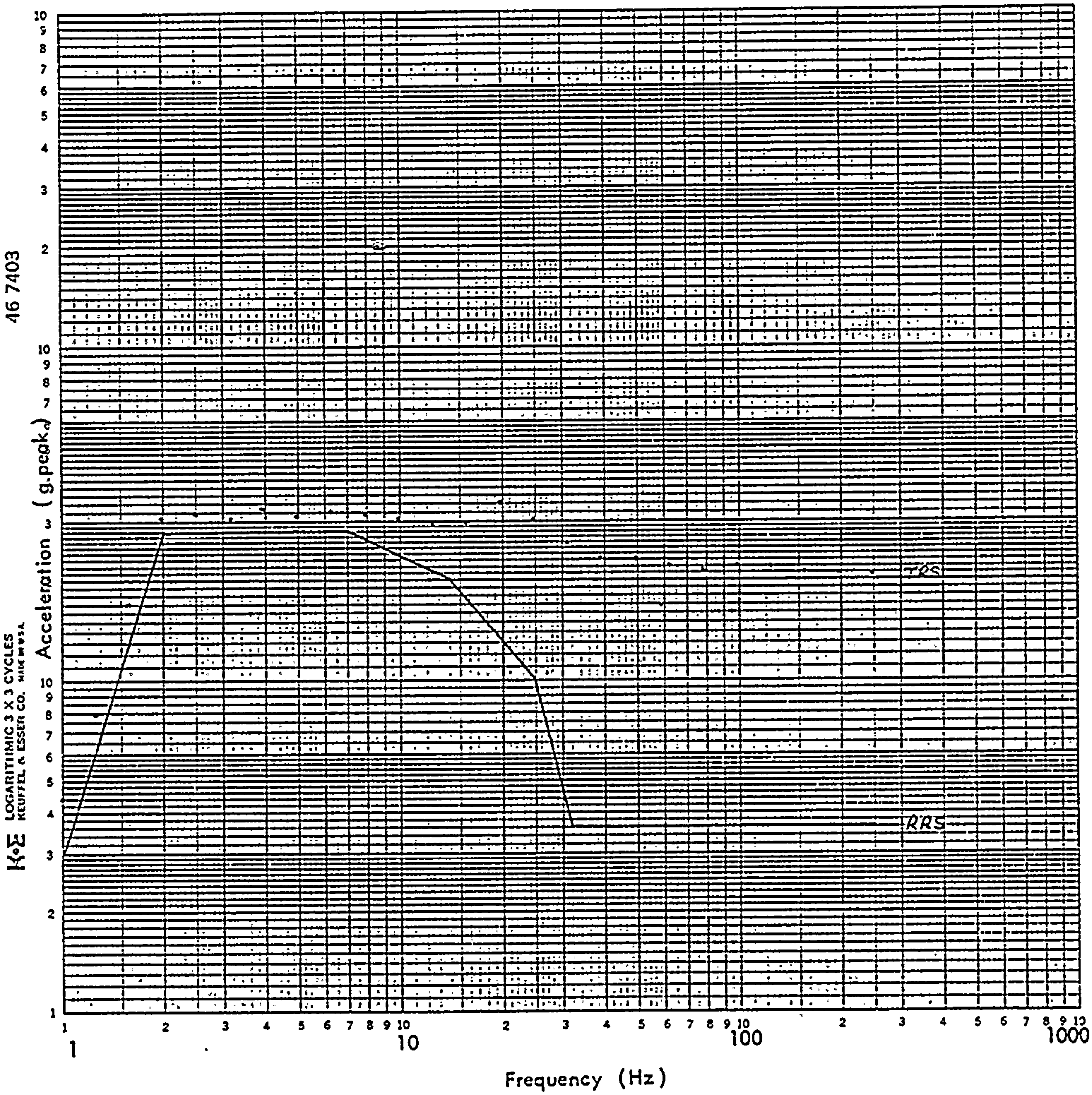
TEST RESPONSE SPECTRA PLOTS

TEST NO.	AXES
7	Side-to-Side/Vertical
14	Front-to-Back/Vertical

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



AXIS S-S/V

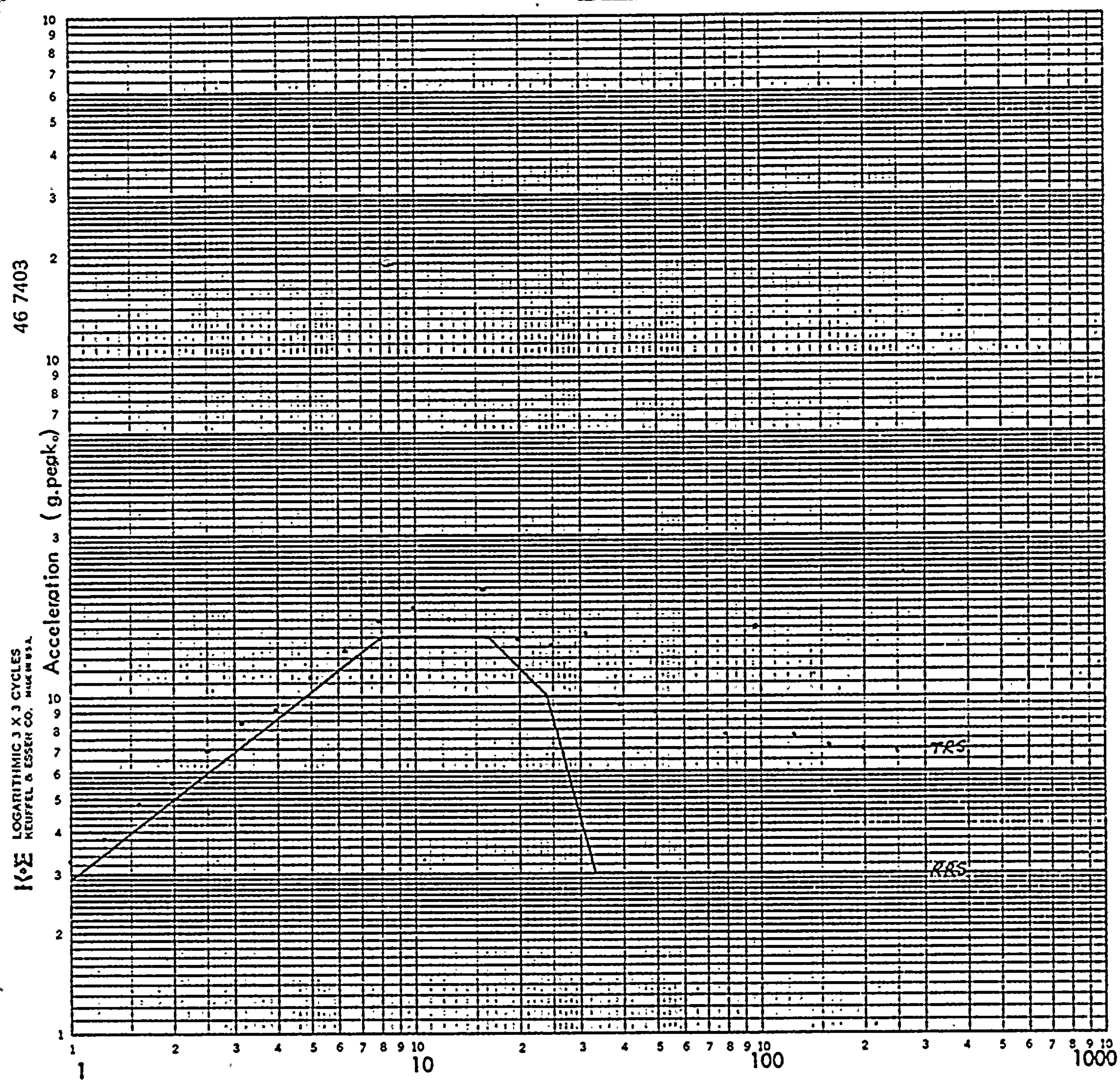
LOCATION NO. HCD

TEST RUN NO. 7

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



AXIS 5-5/V

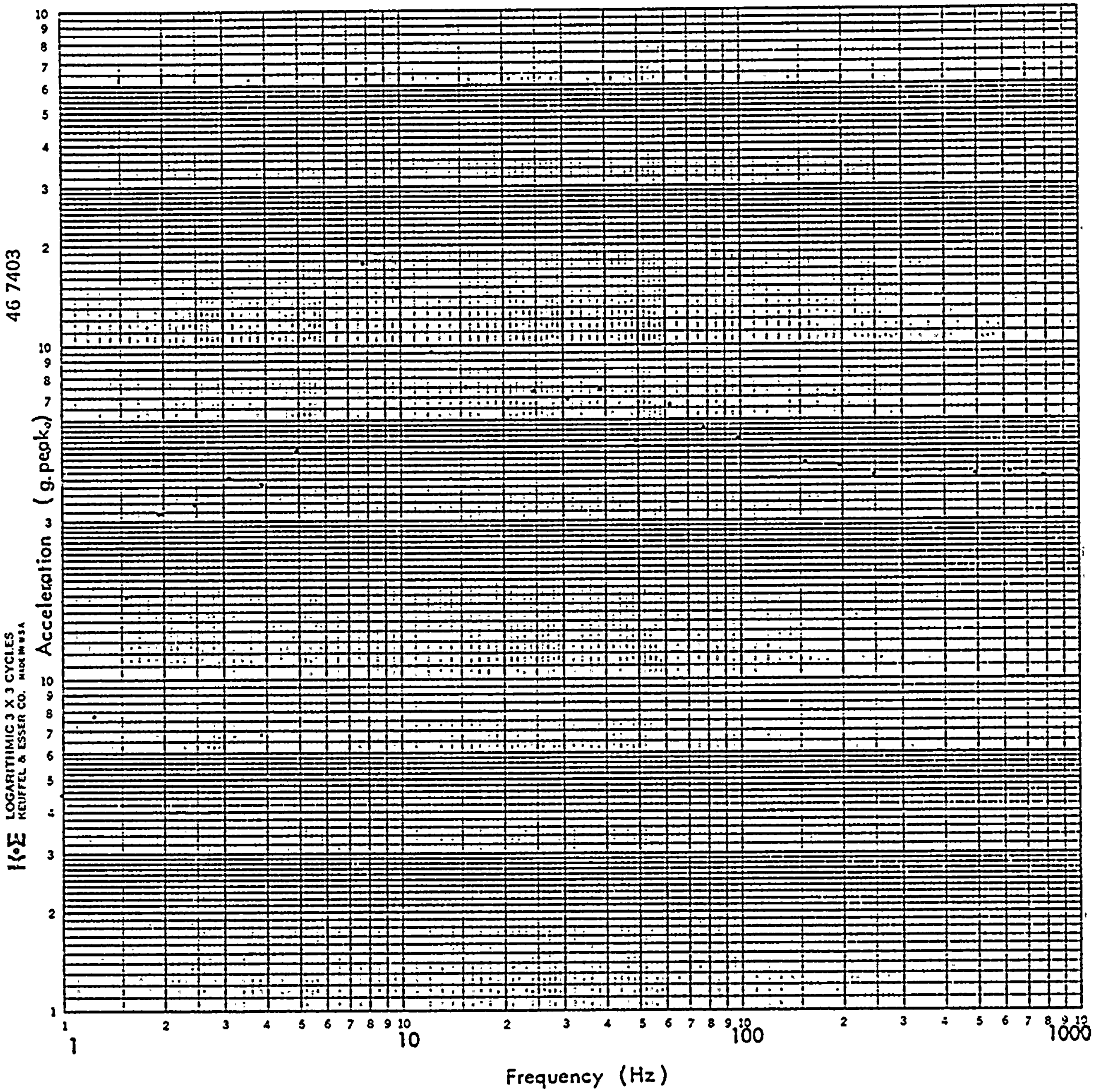
LOCATION NO. VCB

TEST RUN NO. 7

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



AXIS S-S/U

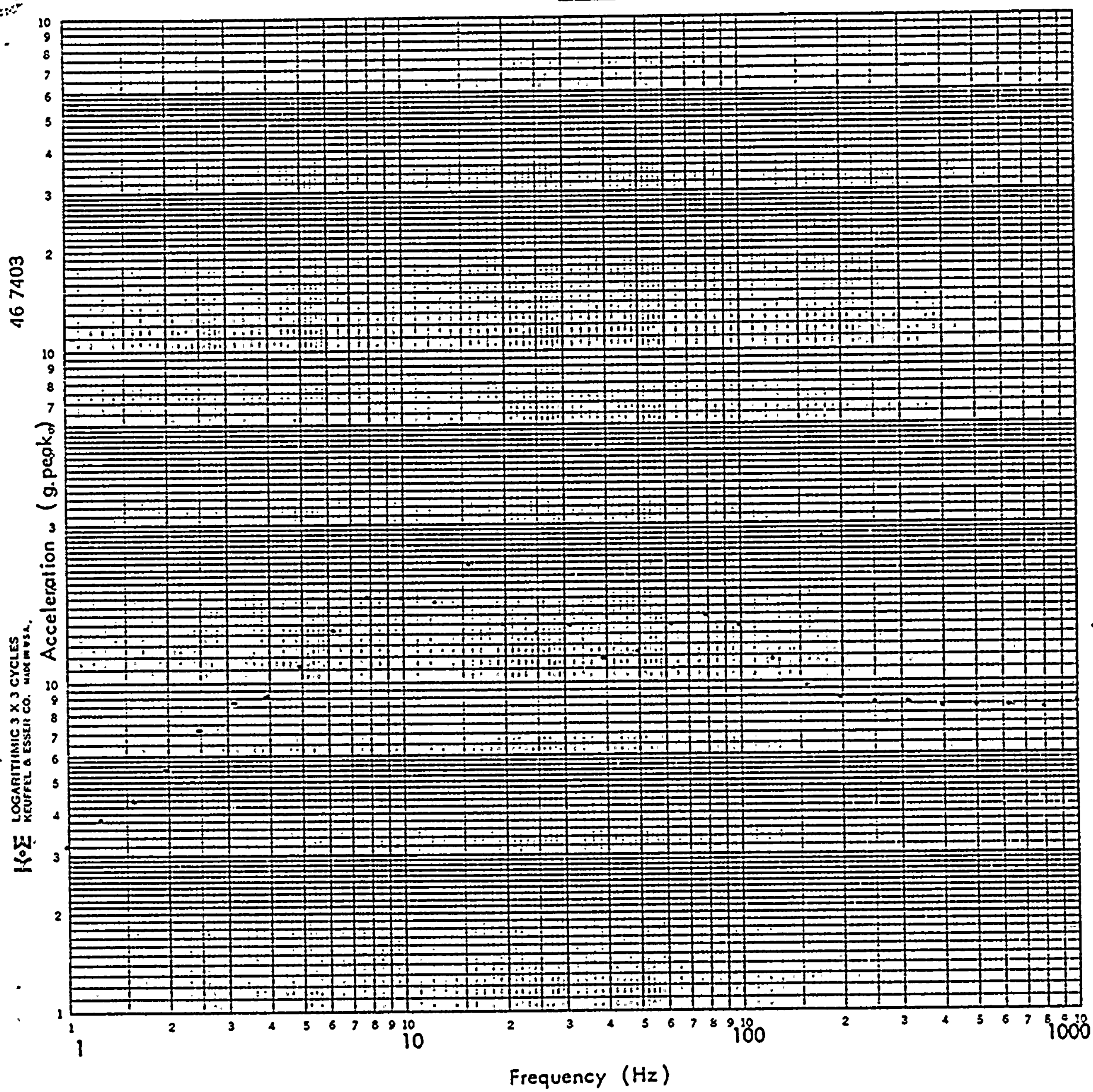
LOCATION NO. 15.5

TEST RUN NO. 7

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING $\boxed{5\ \%}$



AXIS S-S/V

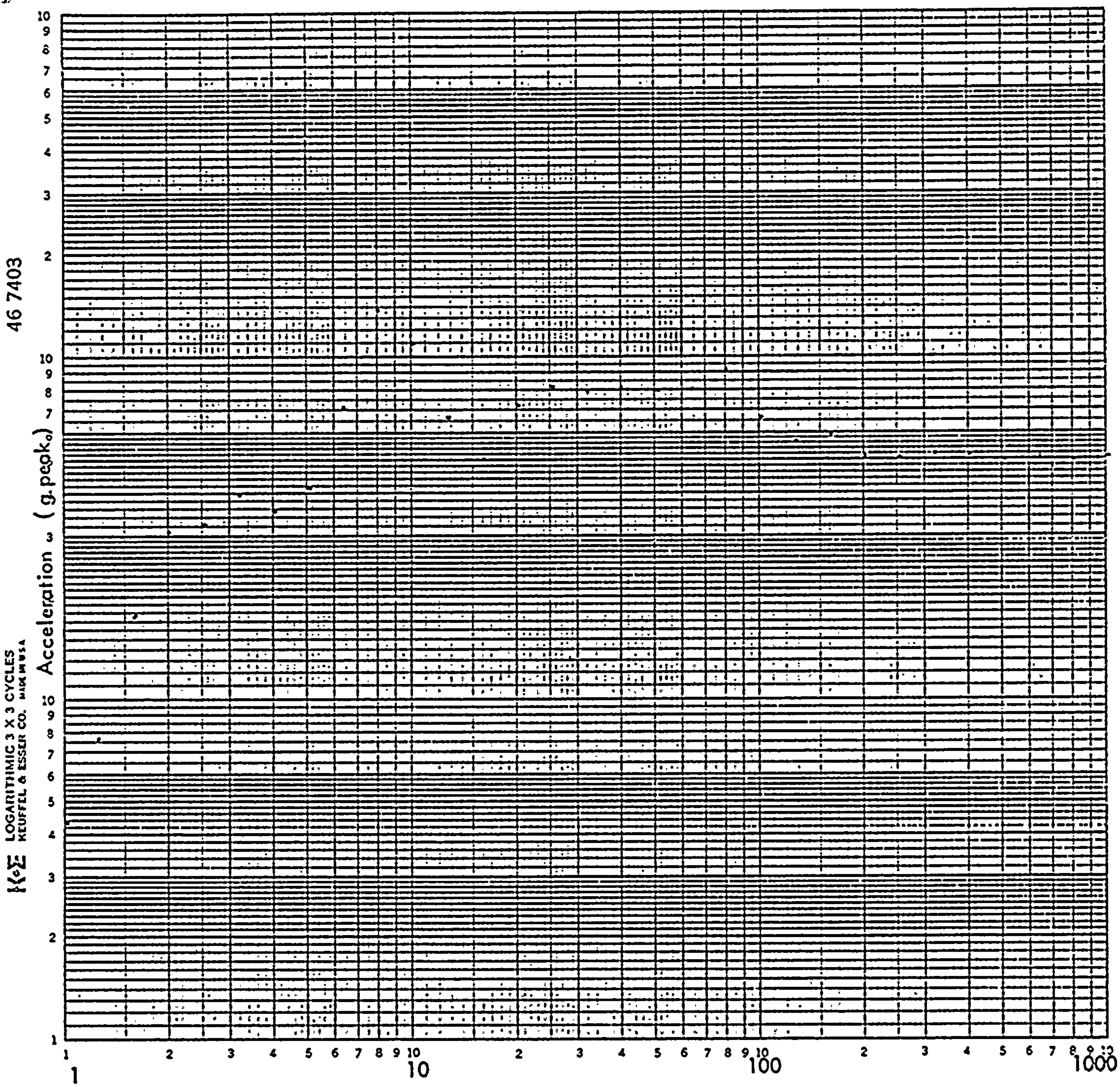
LOCATION NO. 2V

TEST RUN NO. 7

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



AXIS 5-5/V

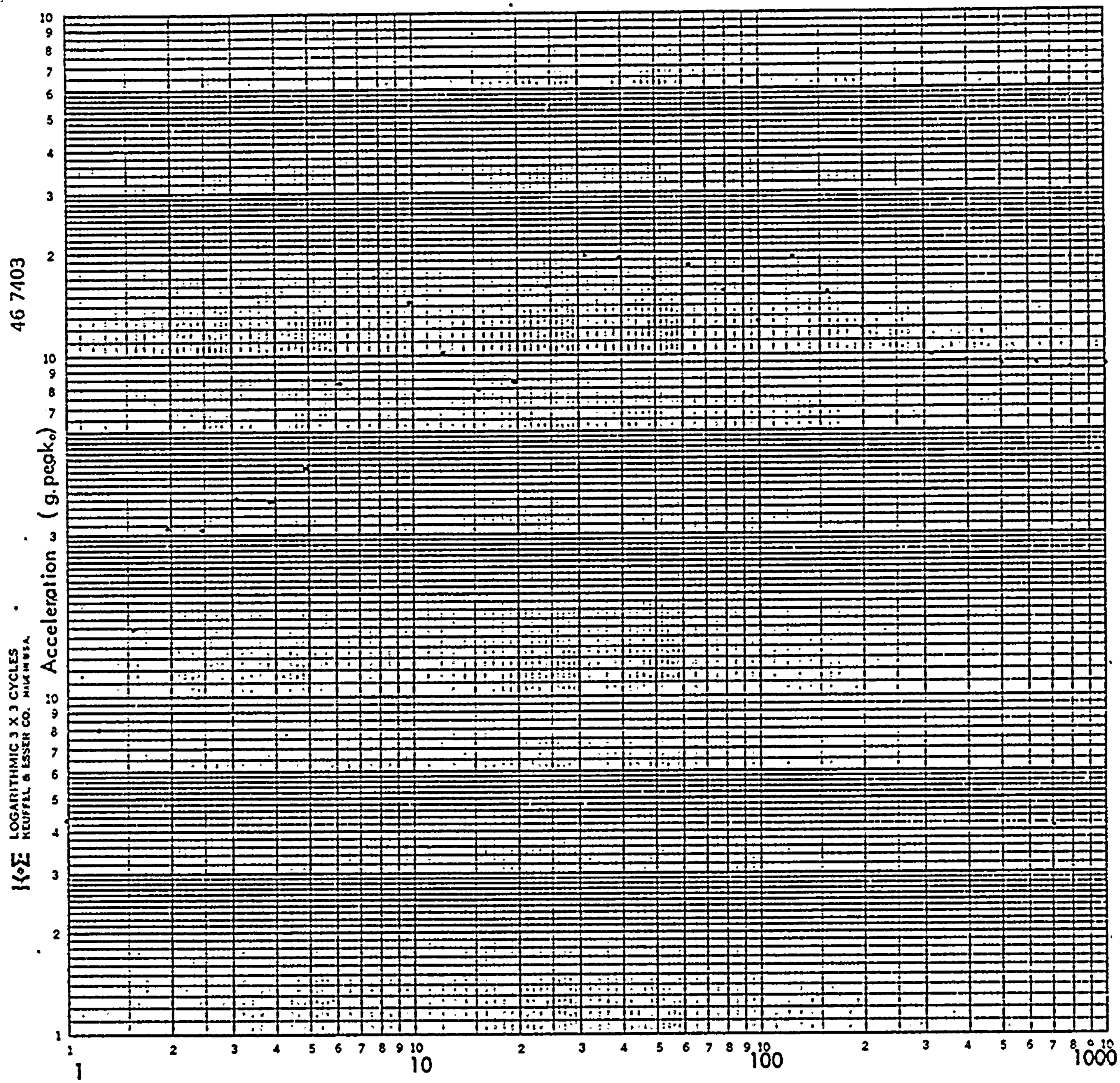
LOCATION NO. 35-5

TEST RUN NO. 7

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING | 5 % |



Frequency (Hz)

AXIS S-S/V

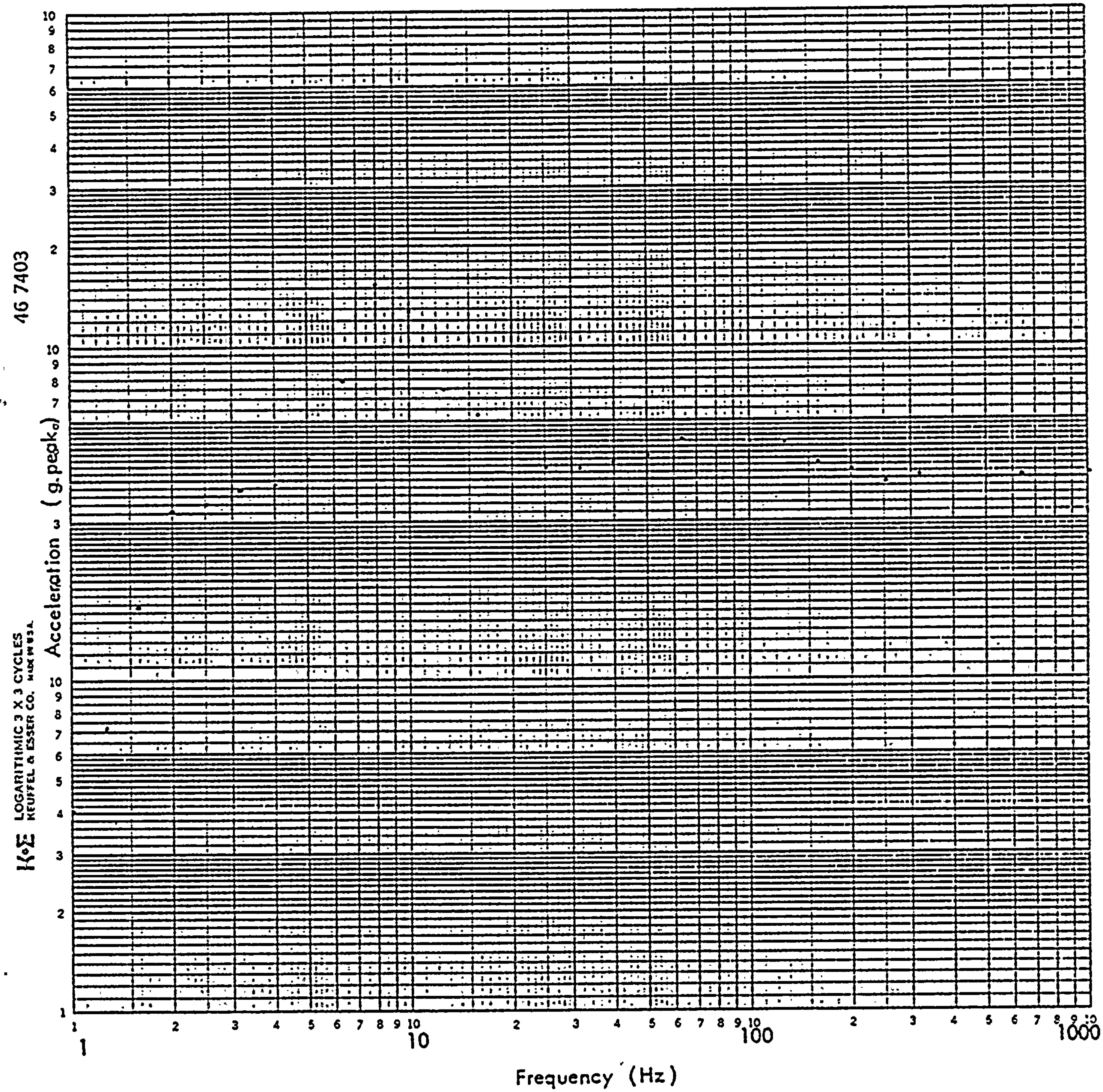
LOCATION NO. 4 S-S

TEST RUN NO. 7

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



AXIS S-S/V

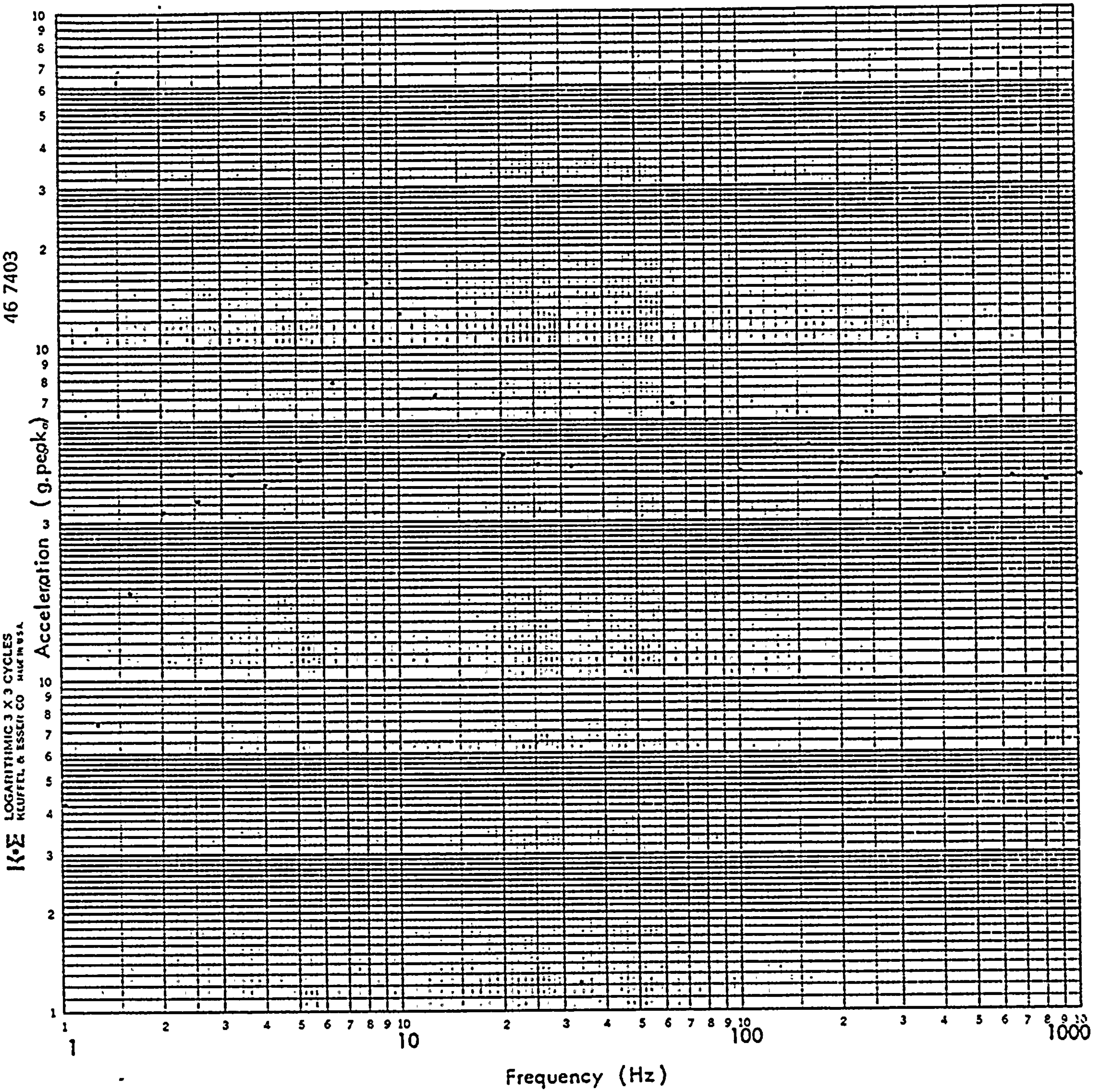
LOCATION NO. 5S-S

TEST RUN NO. 7

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING $\boxed{5\ \%}$



AXIS S-S/V

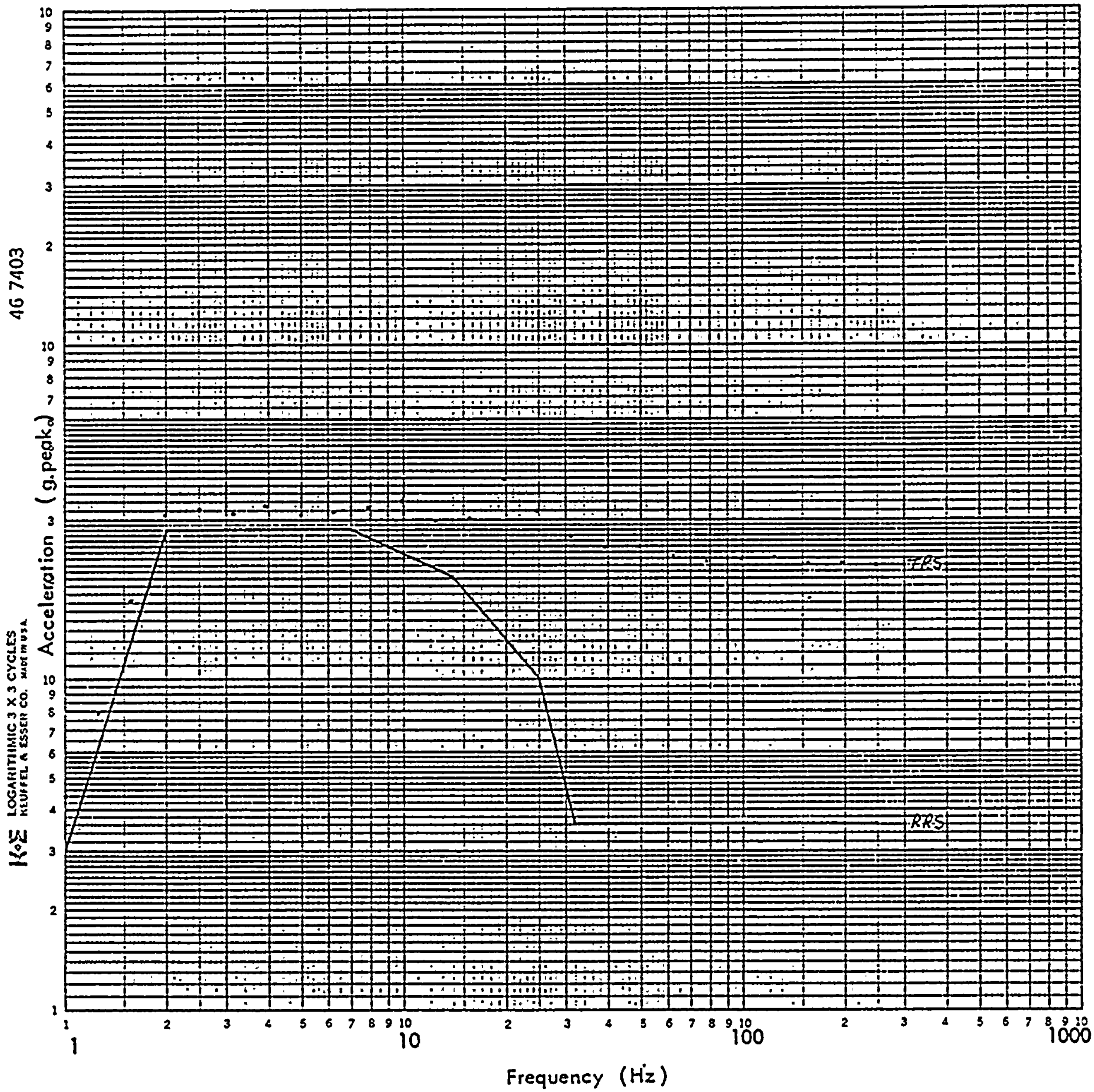
LOCATION NO. 6S-S

TEST RUN NO. 7

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5%



AXIS E-B/V

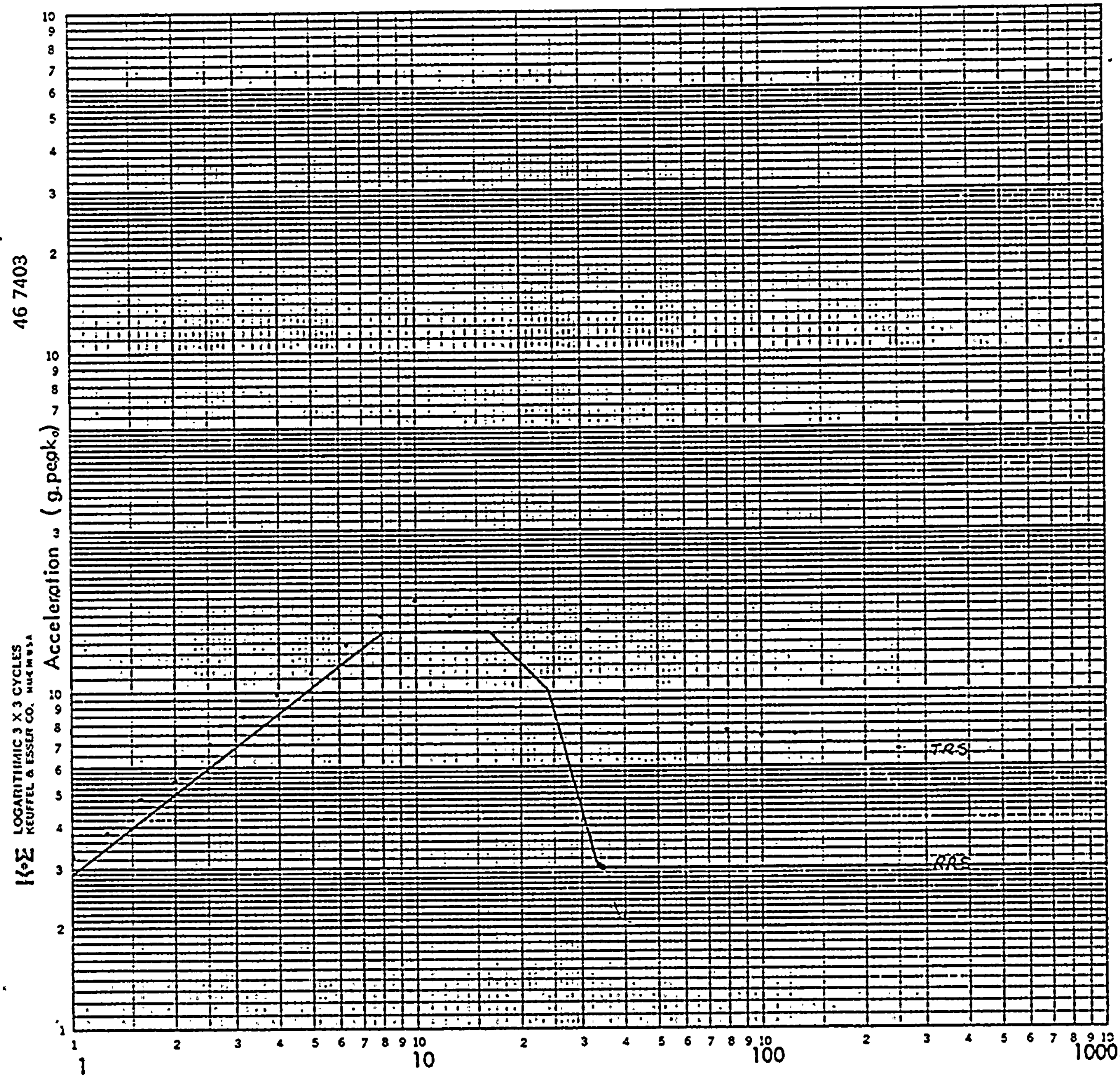
LOCATION NO. Hce

TEST RUN NO. 1b

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING $\boxed{5\%}$



AXIS E-B/V

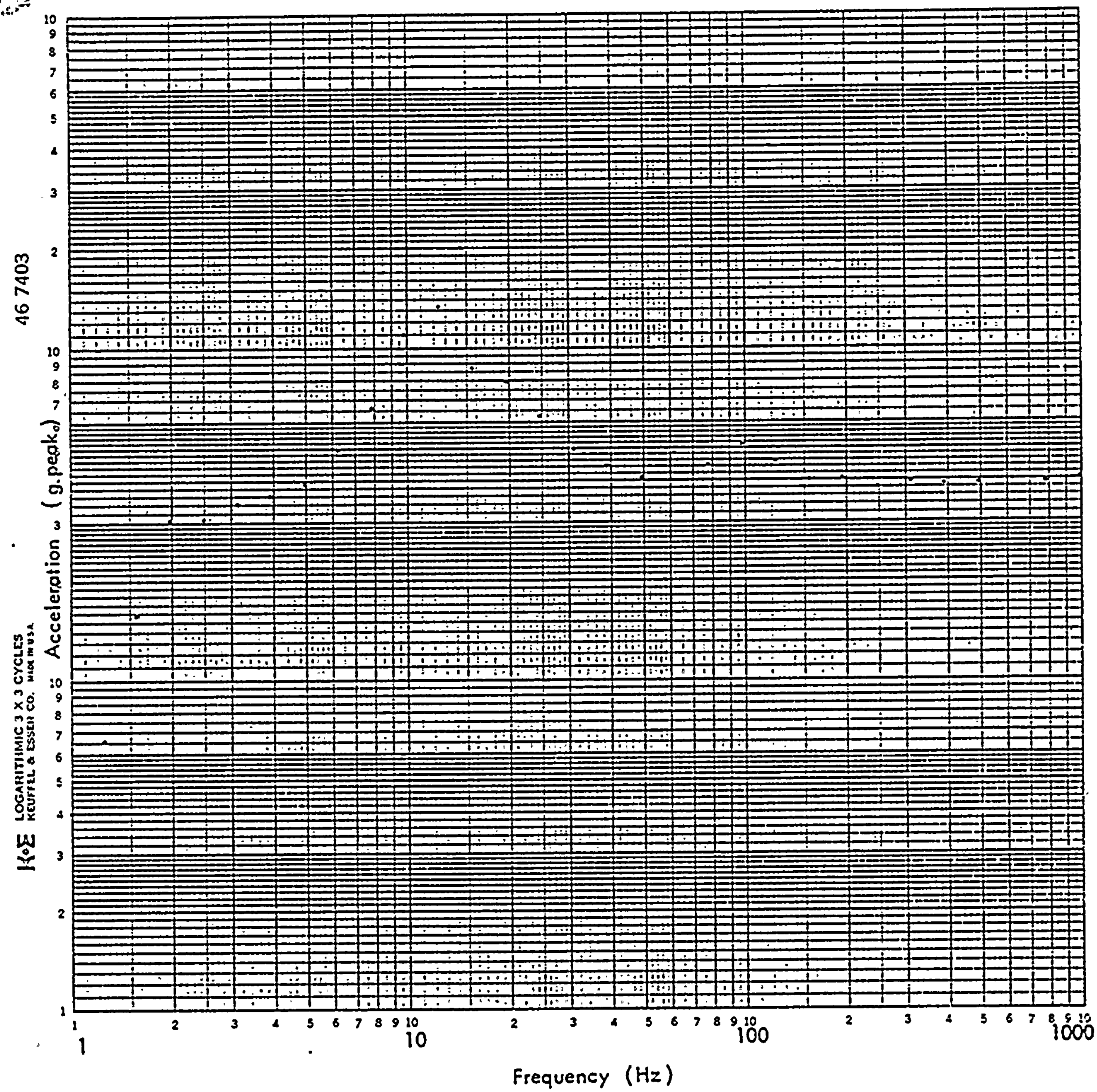
LOCATION NO. V4a

TEST RUN NO. 1a

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING $\boxed{5\ \%}$



AXIS E-B/V

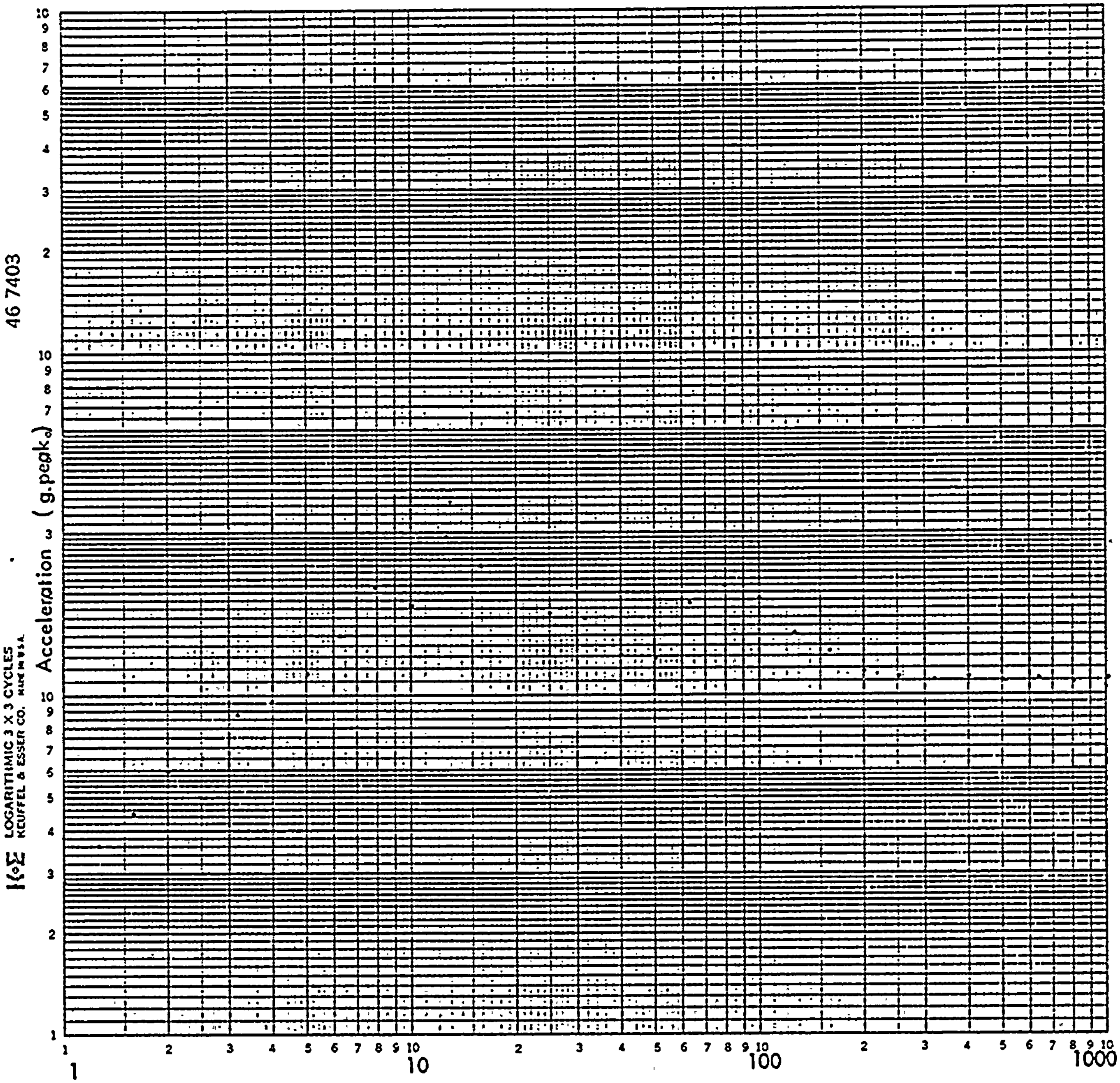
LOCATION NO. 1E-B

TEST RUN NO. 14

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING $\boxed{5\ \%}$



AXIS E-B/V

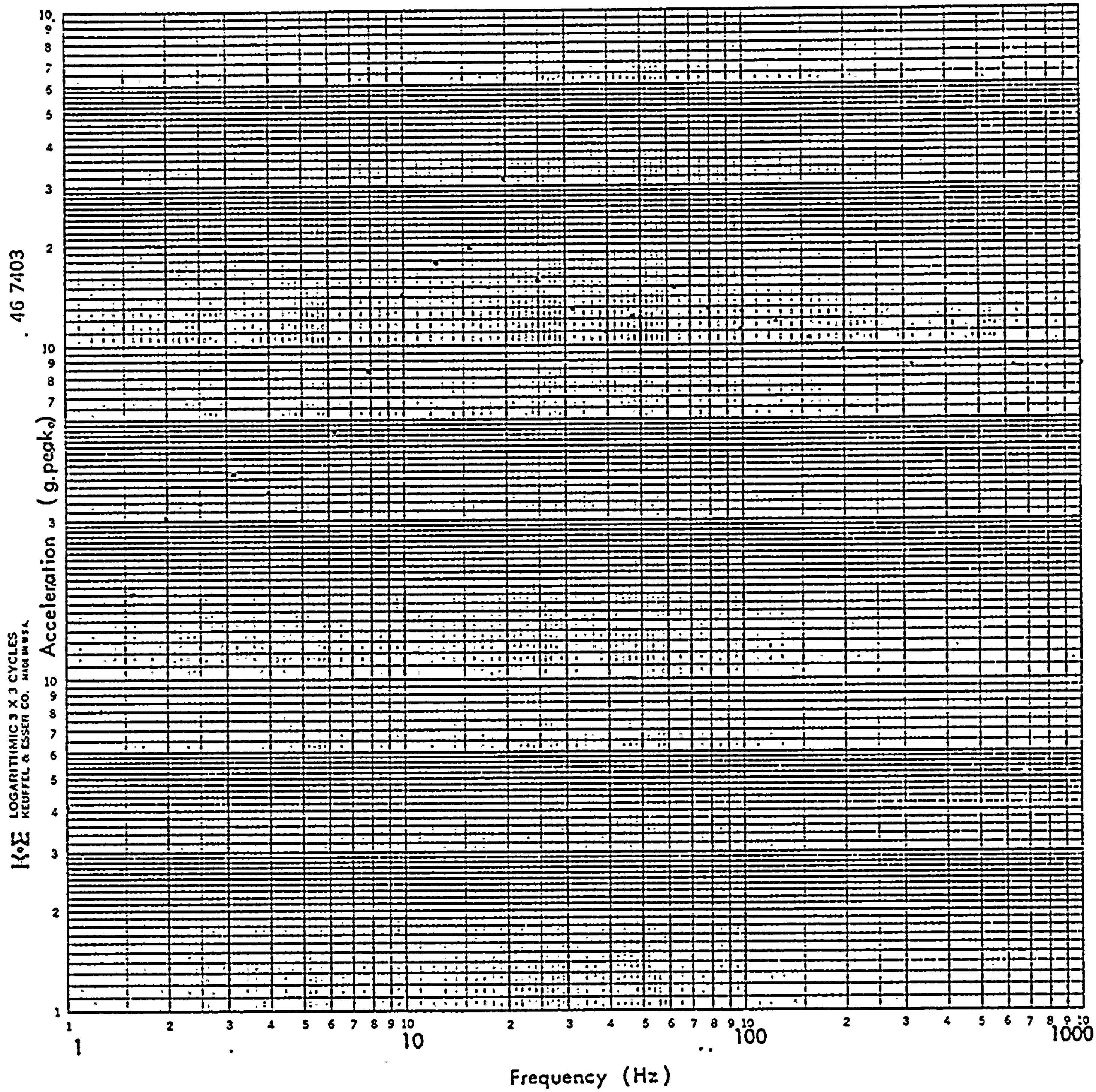
LOCATION NO. 2V

TEST RUN NO. 14

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING $\boxed{5\ \%}$



AXIS E-B/V

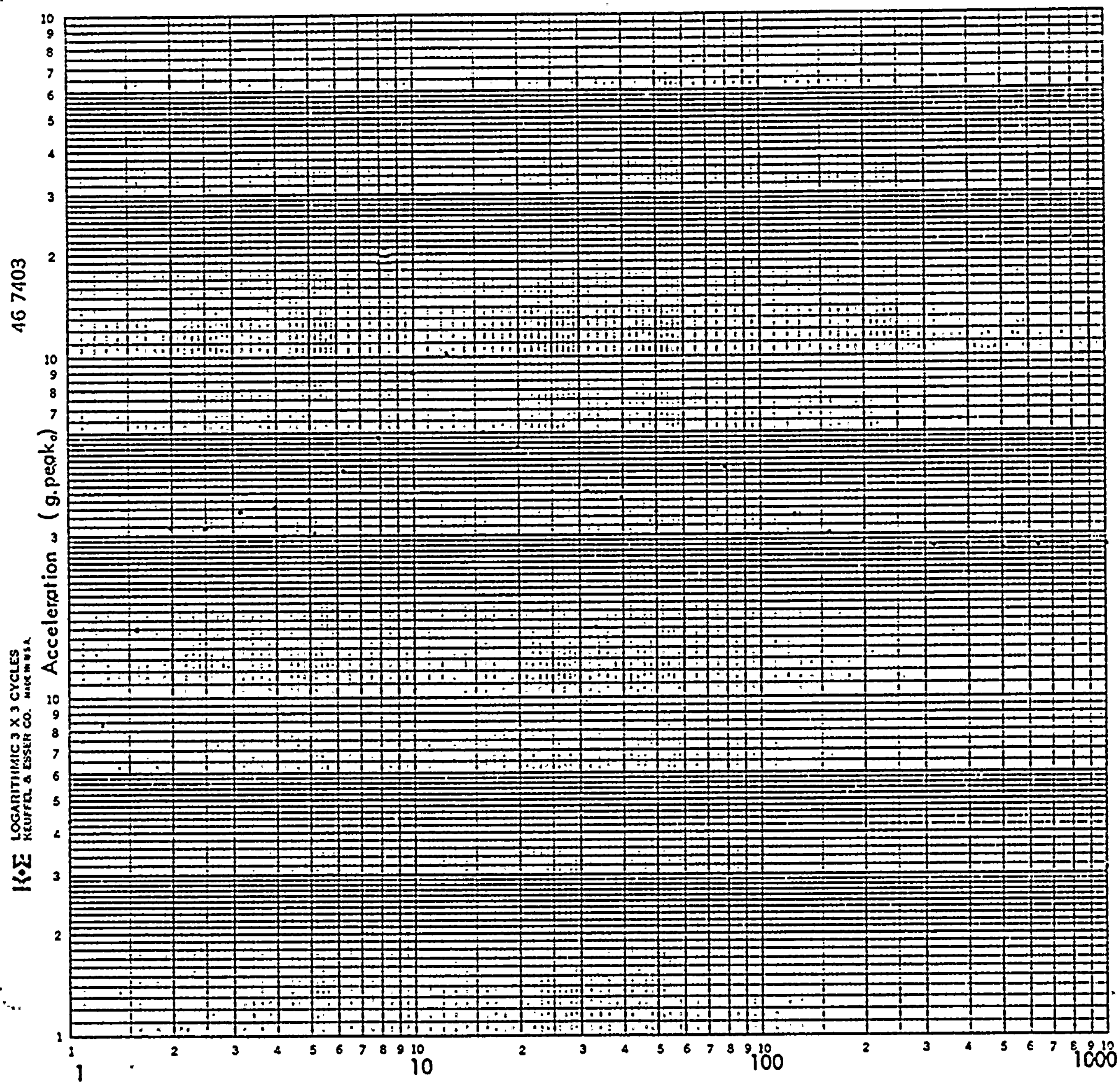
LOCATION NO. 3E-B

TEST RUN NO. 14

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING $\boxed{5\%}$



AXIS E-B/V

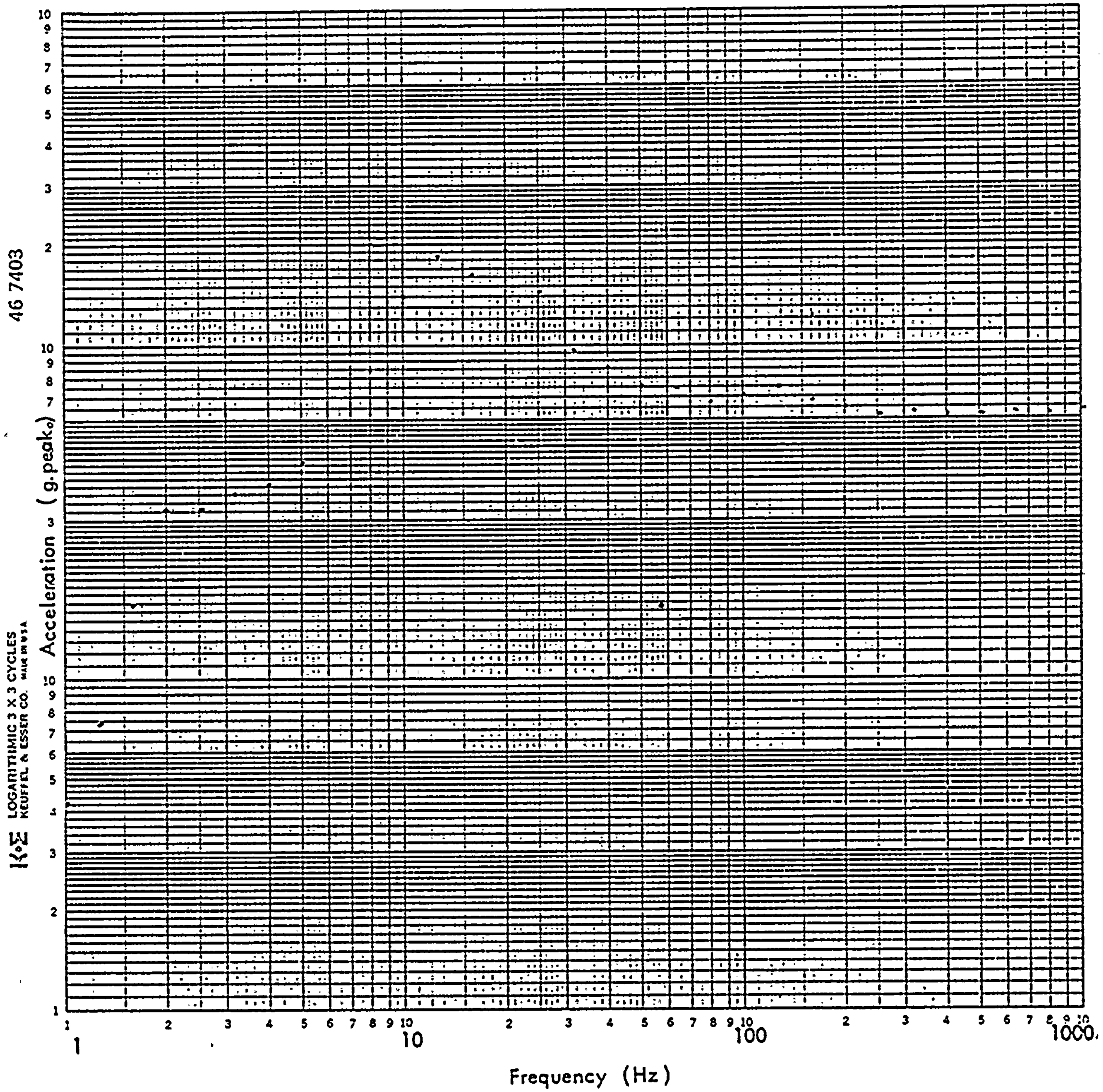
LOCATION NO. 4E-B

TEST RUN NO. 14

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐   10 ☐   100 ☒   1000 ☐

DAMPING 5%



AXIS E-B/V

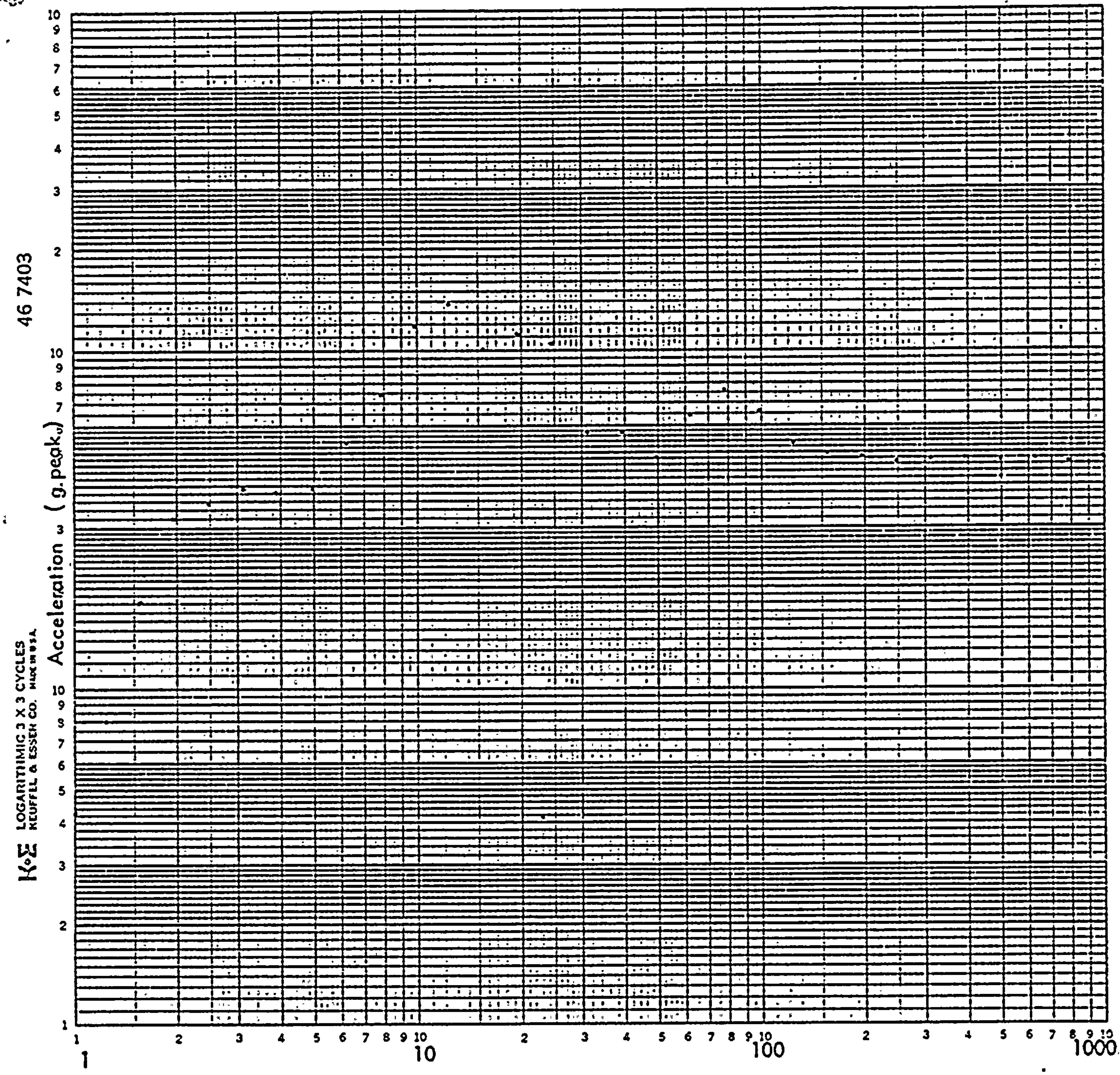
LOCATION NO. 5F-B

TEST RUN NO. 1F

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



AXIS F-B/V

LOCATION NO. 6F-B

TEST RUN NO. 1L

APPENDIX III

INSTRUMENTATION LOG SHEETS
AND
INSTRUMENTATION EQUIPMENT SHEETS

W 322

WYLE LABORATORIES
INSTRUMENTATION LOG SHEET

JOB NO. 43943

LOG PAGE NO. 1 OF 3

CUSTOMER SOLID STATE CONTROL

TEST ENGINEER

DATE	TIME	REMARKS (Include Run Number, Part Changes, Shift Changes and all other pertinent data)
20 MARCH 78		SET-UP TO RECORD 2 CONTROL AND 6 RESPONSE ACCELEROMETERS
		ON TAPE AND OSCILLOGRAPH
		SET-UP TO RECORD 3 ELECTRICAL MONITORS ON OSCILLOGRAPH
		RECORDED CALIBRATION SIGNAL 1VPK 100 HZ ON TAPE
		TAPE START 0000' END 0100'
		MOUNTED SPECIMEN IN THE S-S/VERT. AXIS
	1055	RUN #1, SINE SWEEP 1-33 HZ 0.2G HORIZ 0.2G VERT S-S/VERT. AXIS
		TAPE START 0100' END 0320
	1105	RUN #2, MULTI. FREQUENCY RANDOM OBE S-S/VERT. AXIS
		TAPE START 0320' END 0355' OUTPUT LOAD OFF
	1110	RUN #3, MULTI- FREQUENCY RANDOM OBE S-S/VERT. AXIS
		TAPE START 0355' END 0395'

W 322

WYLE LABORATORIES
INSTRUMENTATION LOG SHEET

JOB NO. 43943 LOG PAGE NO. 2 OF 3

CUSTOMER SOLIDSTATE CONTROL TEST ENGINEER

DATE	TIME	REMARKS (Include Run Number, Part Changes, Shift Changes and all other pertinent data)	
20 MARCH 78	1130	RUN# 4, MULTI-FREQUENCY RANDOM OBE	S-S/VERT AXIS
		TAPE START 0395' END 0430'	
	1135	RUN# 5, MULTI-FREQUENCY RANDOM OBE	S-S/VERT AXIS
		TAPE START 0430' END 0465'	
	1138	RUN# 6, MULTI-FREQUENCY RANDOM OBE	S-S/VERT AXIS
		TAPE START 0465' END 0500'	
	1143	RUN# 7, MULTI-FREQUENCY RANDOM SSE	S-S/VERT AXIS
		TAPE START 0500' END 0505'	
		ROTATED SPECIMEN 90° TO THE F-B/VERT AXIS	
	1210	RUN# 8, SINE SWEEP 1-33HZ, 0.2GHORIZ 0.2GVERT	F-B/VERT AXIS
		TAPE START 0595' END 0770'	

W 322

WYLE LABORATORIES
INSTRUMENTATION LOG SHEET

JOB NO. 43943

LOG PAGE NO. 3 OF 3

CUSTOMER Solid State Control

TEST ENGINEER

DATE	TIME	REMARKS (Include Run Number, Part Changes, Shift Changes and all other pertinent data)
20 March 78	1220	Run # 9, multi-frequency random OBE — F-B/Vert. Axis
		Tape start 0770' End 0805'
	1223	Run # 10, multi-frequency random OBE — F-B/Vert. Axis
		Tape start 0805' End 0845'
	1227	Run # 11, multi-frequency random OBE — F-B/Vert. Axis
		Tape start 0845' End 0880'
	1232	Run # 12, multi-frequency random OBE — F-B/Vert. Axis
		Tape start 0880' End 0915'
	1236	Run # 13, multi-frequency random OBE — F-B/Vert. Axis
		Tape start 0915' End 0950'
	1240	Run # 14, multi-frequency random SSE — F-B/Vert. Axis
		Tape start 0950' End 0990'

Page No. 51
Report No. 43943-1

INSTRUMENTATION EQUIPMENT SHEET

Date 20 MAR 78 Job No. 43943 Test Area PIT #1

Technician C R FROST Customer SOLID STATE CONTROLS Type Test SEISMIC

No.	Instrument	Manufacturer	Model No.	Serial No.	Wyle or Gov't No.	Range	Accuracy	Calibration On	Calibration Due
1	ACCELEROMETER	ENDEVCO	2272	EQ34	96149	1000 G	±5%	3.17.78	6.17.78
2	ACCELEROMETER	ENDEVCO	2272	EQ38	96151	1000 G	±5%	3.17.78	6.17.78
3	ACCELEROMETER	ENDEVCO	2272	EQ36	96150	1000G	±5%	3.17.78	6.17.78
4	ACCELEROMETER	ENDEVCO	2272	EQ58	96155	1000G	±5%	3.17.78	6.17.78
5	ACCELEROMETER	ENDEVCO	2272	AQ93	F1442	1000G	±5%	3.17.78	6.17.78
6	ACCELEROMETER	ENDEVCO	2272	EP53	96147	1000 G	±5%	3.17.78	6.17.78
7	ACCELEROMETER	ENDEVCO	2219	AC02	96280	1000 G	±5%	3.17.78	4.17.78
8	ACCELEROMETER	ENDEVCO	7701-100	AA09	11149	1000 G	±5%	3.17.78	6.17.78
9	CHARGE AMP	DYNAMICS	7302	—	1592	500G	±2%	12.30.77	6.30.78
10	CHARGE AMP	DYNAMICS	7302	—	1632	500G	±2%	12.30.77	6.30.78
11	CHARGE AMP	DYNAMICS	7302	—	1691	500G	±2%	12.30.77	6.30.78
12	CHARGE AMP	DYNAMICS	7302	—	1628	500G	±2%	1.3.78	7.3.78
13	CHARGE AMP	DYNAMICS	7302	—	1673	500G	±2%	1.3.78	7.3.78
14	CHARGE AMP	DYNAMICS.	7302	—	1516	500G	±2%	12.30.77	6.30.78
15	CHARGE AMP	ENDEVCO	2740B	—	11212	150KG	1.5%	12.15.77	6.15.78
16	CHARGE AMP	ENDEVCO	2740B	—	11213	150KG	1.5%	12.15.77	6.15.78
17	GALVO AMP	HONEYWELL	766A-500	—	77702	1:1	±2%	1.6.78	7.6.78
18	GALVO AMP	HONEYWELL	766A-500	—	96260	1:1	±2%	3.1.78	9.1.78

Instrument Test Engineer [signature] Checked & Received By [signature]

WH-1029

INSTRUMENTATION EQUIPMENT SHEET

Date 20 MAR 78 Job No. 43943 Test Area Pit #1

Technician C R FROST Customer SOLID STATE CONTROLS Type Test SIESMIC

No.	Instrument	Manufacturer	Model No.	Serial No.	Wyle or Gov't No.	Range	Accuracy	Calibration On	Calibration Due
19	GALVO AMP	HONEYWELL	T6GA-500	—	96279	1:1	±2%	1.13.78	7.13.78
20	GALVO AMP	HONEYWELL	T6GA-500	—	96161	1:1	±2%	12.6.77	6.6.78
21	VISICORDER	HONEYWELL	1508	—	96056	2.5KHz	±2%	3.7.78	9.7.78
22	VISICORDER	HONEYWELL	1508	—	96274	2.5KHz	±2%	11.14.77	5.14.78
23	VISICORDER	HONEYWELL	1508	—	96338	2.5KHz	±4%	2.15.78	8.15.78
24	TAPE RECORDER	BELL & HOWELL	CPR4010	—	77701	DC 2.5KHz	±1.5%	1.27.78	4.27.78
25	TAPE RECORDER	TANDBERG	100	—	95457	DC 1.0KHz	±2%	2.2.78	8.2.78
26	OSCILLOSCOPE	TEKTRONIX	321A	—	605F41	0.01V–20V/DIV	±3%	1.26.78	7.26.78
27	VOLTMETER	B&K	2426	—	95492	300 V	±2%	1.12.78	4.12.78
28	X-Y RECORDER	HEWLETT PACKARD	7004B	—	95202	0.5mV–10V/IN	±0.2%	1.31.78	4.31.78
29	X-Y RECORDER	HEWLETT PACKARD	7044A	—	95377	0.5mV–10V/IN	±0.2%	2.28.78	5.28.78
30	LOG FREQ CONVERTER	SPEC DYNAMICS	50116	—	95123	20KHz	±2%	1.31.78	4.31.78
31	TRACKING FILTER	SPEC DYNAMICS	50131	—	11242	40db	±0.5db	1.3.78	7.3.78
32	TRACKING FILTER	SPEC DYNAMICS	50131	—	11243	40db	±0.5db	1.3.78	7.3.78
33	SWEEP OSCILLATOR	SPEC. DYNAMICS	50104	—	95360	0.05KHz–50KHz	±2%	1.18.78	4.18.78
34	SERVO MONITOR	SPEC DYNAMICS	50105	—	95359	1000g	±4%	1.19.78	4.19.78
35	SERVO MONITOR	SPEC DYNAMICS	50105	—	95358	1000g	±4%	1.19.78	4.19.78
36	SPECTRUM SYNTHESIZER	TIME/DATA	1975	—	95363	0.5–100Hz	±4%	11.28.77	5.28.78

Instrument Test Engineer [signature] Checked & Received By R. P. Lounbury

WH-1029

INSTRUMENTATION EQUIPMENT SHEET

Date 20 MAR 78 Job No. 43943 Test Area P.I.#1

Technician C R FROST Customer SOLID STATE CONTROLS Type Test SIESMIC

No.	Instrument	Manufacturer	Model No.	Serial No.	Wyle or Gov't No.	Range	Accuracy	Calibration On	Calibration Due
37	SPECTRUM ANALYZER	NIRAD	2825	—	95354	0.3Hz – 20KHz	±2%	2.1.78	5.1.78
38	BAND PASS FILTER	KROHN – HITE	330m	—	80203	0.02Hz – 20KHz	±1db	1.25.78	4.25.78
39	POWER SUPPLY	DRESSEN	27144	—	95174	0-15vdc	±10mv	2.14.78	8.14.78
40	POWER SUPPLY	KEPCO	SM160-2	—	97872	0-160vdc	±0.1%	2.14.78	8.14.78

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Report No. 43943-1

Instrument Test Engineer [signature] Checked & Received By R. P. [signature]

WH-1029

APPENDIX IV

SEISMIC TEST PLAN

TEST PROCEDURE

WYLE LABORATORIES
SCIENTIFIC SERVICES AND SYSTEMS GROUP
P. O. BOX 1008 • HUNTSVILLE, ALABAMA 35807
TWX (810) 726-2225 • TELEPHONE (205) 837-4411

TEST PROCEDURE NO. 541/0075/GH

DATE: February 28, 1978
Revision A

SEISMIC TEST PLAN

FOR A

7.5 kVA STATIC INVERTER
#10506

FOR

SOLIDSTATE CONTROLS, INC.
COLUMBUS, OHIO

APPROVED BY: Herschel D. Jordan
FOR:

APPROVED BY PROJECT MANAGER: Larry E. Frazier

APPROVED BY:
FOR:

APPROVED BY QUALITY ENGINEER:

APPROVED BY:
FOR:

PREPARED BY PROJECT ENGINEER: Rod [illegible]

REVISIONS

FORM 1054-1 Rev. 4/74

REV. NO.	DATE	PAGES AFFECTED	BY	APP'L.	DESCRIPTION OF CHANGES
A	3-20-78	3 and Figures 1 and 2	RT	HL	Para. 2.3 - Revised RRS
"	"	3 and Figure 3	RT	HL	Para. 2.4 - Deleted higher level
					multifrequency test option
"	"	3	RT	HL	Para. 3.3 - Revised power requirement
					from 120 VAC, single-phase to 480
					VAC, single-phase

1.0 MOUNTING

1.1 Specimen Orientation

A 7.5 kVA Static Inverter, 36 inches deep by 29 inches wide by 83 inches high, weighing approximately 1500 pounds, hereinafter called the specimen, will be installed on the Wyle Multiaxis Seismic Simulator Table such that its front-to-back direction will be colinear with the longitudinal axis of the table. For the second axis of tests, the specimen will be rotated 90 degrees in the horizontal plane.

1.2 Specimen Tie-Down

The mounting hole pattern of the specimen's mounting base will be transferred to the test table. The mounting holes will then be drilled in the table, and the specimen attached using available bolts, nuts and washers. The specimen will be attached in a manner that simulates the actual in-service mounting condition as closely as practical. Lifting angles for handling the specimen with an overhead crane will be provided by Solidstate.

2.0 EXCITATION

2.1 Simultaneous Biaxial Excitation

Each horizontal axis will be excited separately, but each one will be excited simultaneously with the vertical axis (longitudinal simultaneously with vertical, then lateral simultaneously with vertical). The horizontal and vertical input acceleration levels will be phase incoherent during the multifrequency tests.

2.2 Resonant Search

A low-level (approximately 0.2 g) biaxial sine sweep will be performed in both the front-to-back/vertical and the side-to-side/vertical orientations. The frequency range of the sine sweep will be from 1 Hz to 33 Hz at a sweep rate of one octave per minute.

2.3 Multifrequency Tests

The specimen will be subjected to 30-second duration simultaneous horizontal and vertical inputs of phase-incoherent random waveform motion consisting of frequency bandwidths spaced one-third octave apart over the frequency range of 1.0 Hz to 40 Hz as necessary to envelop the Required Response Spectra (RRS). The amplitude of each one-third octave frequency will be independently adjusted in each axis until the Test Response Spectra (TRS) envelop the RRS within the limitations of the test machine. The resulting table motion will be analyzed by a spectrum analyzer at five percent (5%) damping, unless otherwise specified by Solidstate, and plotted at one-third octave frequency intervals over the frequency range of interest.

Five (5) Operating Basis Earthquake (OBE) tests will be applied to the specimen prior to the application of a Safe Shutdown Earthquake (SSE) test in each test axis. The Zero Period Acceleration (ZPA) as well as other areas of the RRS could be exceeded in order to meet the peak responses of the curves. The SSE Required Response Spectrum is shown in Figures 1 and 2. The OBE level Required Response Spectrum will be 80 percent (80%) of the SSE level Required Response Spectrum. The approximate test machine capabilities are shown in Figure 3. A

3.0 INSTRUMENTATION

3.1 Excitation Control

The horizontal and vertical control accelerometers will be located on the test table as near the base of the specimen as practical.

3.2 Specimen Response

Six (6) uniaxial piezo-electric accelerometers will be located on the specimen under test. The placement of the accelerometers will be at the discretion of the Solidstate Controls Technical Representative. FM tape and oscillograph recorders will provide a record of each accelerometer response. TRS plots of the specimen response accelerometers analyzed at five percent (5%) damping for an SSE test in each test orientation will be provided in the test report. Transmissibility plots of the specimen-mounted accelerometers will be provided from the resonant search tests.

3.3 Electrical Power

Electrical power of 480 VAC, single-phase, 60 Hz at approximately 80 amperes or less, and 125 VDC at 80 amperes or less, will be provided for operation of the specimen during the test program. A

3.4 Electrical Monitoring

Three (3) channels of electrical monitoring will be furnished for determining operational conditions of the specimen during the seismic testing. These channels will be monitored by an oscillograph recorder to ascertain electrical continuity, current/voltage levels, spurious operation, contact chatter, etc. before, during and after the seismic excitation. Additional channels can be provided and are quoted as an option.

3.5 Electrical Load

A Solidstate-furnished electrical load will be connected to the Inverter 120 VAC output during the seismic tests.

4.0 IN-PROCESS INSPECTION

The records will be checked for equality of performance after each test.

The specimens will be examined for possible damage following all violent tests such as at a severe structural resonance.

All important vibration effects will be logged.

Photographs will be taken of any noticeable physical damage that may occur.

5.0 REPORT

Ten (10) copies of a certification-type report will be issued subsequent to completion of testing. This report will be signed by a Registered Professional Engineer and will summarize the response spectrum plots of the table motion, results and conclusions, details and recommendations concerning deficiencies and repairs, photographs of test setups, failures, etc. The report will also contain a list of test equipment used, calibrations, and Instrumentation Log Sheets.

SEISMIC QUALIFICATION

Limitorque Valve Actuators

Tests per IEEE 344-75

Tests performed starting April 1, 1975

Prepared by Limitorque Corporation

G. LINK

ROCHESTER GAS AND ELECTRIC CORPORATION • 89 EAST AVENUE, ROCHESTER, N.Y. 14649

HARRY G. SADDOCK
VICE PRESIDENT

TELEPHONE
AREA CODE 716 546-2700

April 12, 1979

Director of Nuclear Reactor Regulation
ATTN: Mr. Dennis L. Ziemann, Chief
Operating Reactors Branch No. 2
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Systematic Evaluation Program
Topic VIII-4, "Electrical Penetrations of Reactor Containment"
R. E. Ginna Nuclear Power Plant, Unit No. 1
Docket No. 50-244

Dear Mr. Ziemann:

Enclosed is the information regarding electrical penetrations of the reactor containment at the R. E. Ginna Station, as requested in your December 8, 1978 letter.

Very truly yours,

Harry G. Saddock

Harry G. Saddock

Enclosure

ROCHESTER GAS AND ELECTRIC CORPORATION • 89 EAST AVENUE, ROCHESTER, N.Y. 14649

NEW YORK STATE

LEON D. WHITE, JR.
VICE PRESIDENT

TELEPHONE
AREA CODE 716 546-2700

July 3, 1979

Director of Nuclear Reactor Regulation
Attention: Mr. Dennis L. Ziemann, Chief
Operating Reactors Branch No. 2
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Systematic Evaluation Program - Seismic Review
R. E. Ginna Nuclear Power Plant
Docket No. 50-244

Dear Mr. Ziemann:

During the April 10-11, 1979 site visit by the NRC Seismic Review Team, members of the team requested that we supply additional information relating to the seismic qualification of mechanical and electrical equipment; and fluid and electric distribution systems.

A subsequent meeting was held in Pittsburgh, Pennsylvania on June 12, 1979 between the NRC, RG&E and their respective consultants. It was agreed at the June 12 meeting that RG&E would submit additional information and expected submittal dates for mechanical and electrical equipment and systems by about June 29, 1979.

Accordingly, Enclosure I lists attached material and submittal dates for the mechanical equipment and systems and Enclosure II lists attached material and submittal dates for electrical equipment and systems.

As requested by your Staff, eight copies of this letter and enclosures are being supplied for your use. If there are any questions regarding this material, please contact us.

Very truly yours,

L D White, Jr.

L. D. White, Jr.

Enclosures