ARKANSAS POWER & LIGHT COMPANY
POST OFFICE BOX 551 LITTLE ROCK, ARKANSAS 72203 (501) 371-4000

June 7, 1983

1CANØ683Ø6

Director of Nuclear Reactor Regulation
ATTN: Mr. J. F. Stolz, Chief
Operating Reactors Branch #4
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51
Addition of Shunt Trip to Reactor
Protection System Trip Breakers

Gentlemen:

During a conversation with Region IV personnel on March 25, 1983, we indicated our intentions to install the capability to trip the ANO-1 Reactor Trip Breakers (RTBs) by use of a shunt attachment. This modification was proposed as a backup to the existing safety grade undervoltage (UV) trip capability to provide enhanced overall reliability of the Reactor Trip System on either automatic or manual SCRAM demand.

Following this conversation, a Confirmatory Action Letter (CAL) was issued to AP&L later that same date. On March 29, 1983, we received a call from you and others of the NRC staff indicating that a review of AP&L's actions in the CAL would be conducted by NRR and a Safety Evaluation Report (SER) issued prior to allowing restart of the ANO-1 unit (ANO-1 was in Mode 5 at that time). You further requested a meeting with AP&L on March 31, 1983, wherein we were to discuss the actions taken or to be taken prior to restart. It was indicated to us that the SER would then be issued and that the SER would supercede the CAL. We did meet with you, as requested, on March 31, 1983, and a SER was issued on April 5, 1983, (1CNAØ483Ø1).

During that meeting and subsequent meetings on April 1 and 2, 1983, significant discussion was held on the design details of the proposed shunt trip modification. During these discussions, and as identified in your SER, NRC developed concerns with regard to the adequacy of the proposed solid state undervoltage relay to qualify as an isolation device. Based on this concern, AP&L proposed, and NRC agreed, to postpone installation of the shunt trip until this concern had been resolved.

A001
1/20

Since that time, AP&L has conducted a complete re-review of the entire modification including reviews by QA and the Plant Safety Committee. In addition, we contracted B&W to conduct an independent review of the proposed design. Both our re-review and B&W's independent review have concluded that the design as previously proposed acceptably and completely meets the design basis requirements for ANO-1.

As communicated to Mr. D. G. Eisenhut by Mr. E. G. Wallace (Chairman, B&W Owners Group Steering Committee) by his correspondence dated May 27, 1983, the B&W Owners Group has conducted a review of the AP&L shunt trip design and has endorsed the AP&L proposed design as a generic design approach for the B&W facilities.

All parties involved in the reviews of the design provided to you on March 31, 1983, have concluded that no Unreviewed Safety Question (as defined by 10CFR50.59) would be created by the addition of shunt trip capability. Indeed, as the overall reliability of the Reactor Trip System will be increased by the modification, the margin of safety as provided to the public will be increased.

Although we are convinced that installation of the shunt trip capability does not constitute an Unreviewed Safety Question, we agreed in our letter dated April 4, 1983, (1CAN048303) to submit the design to you for your review and pursuant to your verbal request under the provisions of 10CFR50.54f. The attached information is provided for your review and approval.

Upon your approval, we will install the shunt trip capability on the ANO-1 RTBs during the first available cold shutdown of sufficient duration but no later than the next refueling outage. The approved design will also be provided to the B&W Owners Group for use by individual utilities.

Very truly yours,

John R. Marshall

John R. Marshall
Manager, Licensing

JRM:JTE:sl

Attachments

STATE OF ARKANSAS)
)
COUNTY OF PULASKI)

SS

I, John R. Marshall, being duly sworn, subscribe to and say that I am Manager, Licensing for Arkansas Power & Light Company; that I have full authority to execute this oath; that I have read the document numbered 1CANØ68306 and know the contents thereof; and that to the best of my knowledge, information and belief the statements in it are true.

John R. Marshall

John R. Marshall

SUBSCRIBED AND SWORN TO before me, a Notary Public in and for the County and State above named, this 9th day of June, 1983.

Carol A. Schultz

Notary Public

My Commission Expires:

4-1-85

ATTACHMENT 1

ADDITION OF SHUNT TRIP
TO ANO-1 REACTOR TRIP BREAKERS

Description of Change

A backup shunt trip from the Reactor Protection System (RPS) and the manual SCRAM is to be added to each of the two AC Reactor Trip Breakers (RTBs) and each of the four DC RTBs (see SAR Figure 7-9) using the currently existing shunt trip devices. For the RTBs in each channel, an undervoltage relay will be installed with its operating coil in a parallel with the operating coil of the undervoltage (UV) trip devices across the RPS trip command line (120 VAC vital power). The output contact of the undervoltage relay controls 125 VDC power to the operating coil of the shunt trip device. A test switch is to be installed for each AC trip breaker, and two test switches are installed for each pair of DC trip breakers to permit surveillance testing of the undervoltage trip device and the shunt trip device separately and as currently required by Technical Specifications. Status lights will indicate when shunt trip power is available and when a trip command has been received. Loss of shunt trip power will be annunciated.

One line drawings of the modification for the AC and DC RTBs are provided as Attachments A and B.

This modification conforms to the design basis requirements of ANO-1 as provided in the ANO-1 SAR Chapters 7 and 8. In particular, the following requirements were addressed where applicable:

GDC-21	Protection Systems Reliability and Testing
GDC-22	Protection System Independence
GDC-23	Protection System Failure Modes
GDC-24	Separation of Protection and Control Systems
IEEE 279-1971	Criteria for Protection Systems
IEEE 308-1971	Standard Criteria for Class 1E Power Systems
IEEE 344-1971	Recommended Practices for Seismic Qualification of Class 1E Equipment

The features of this design which are responsive to the requirements of the criteria documents include the following:

1. Each of the six existing undervoltage trip devices are to be backed by shunt trip devices providing additional diversity of trip action.

2. The shunt trip devices will be redundant and maintain the channel separation inherent in the original reactor trip system design.

3. No single failure in shunt trip components will result in loss of protection function.

4. Removal from service of any shunt trip component for repair or testing will not result in loss of the required minimum redundancy.

5. The shunt trip function is designed to permit periodic surveillance testing of its functioning when the reactor is in operation. Each trip channel can be tested independently, and within each trip channel the undervoltage trip device and the shunt trip device(s) can be tested independently.

6. The effects of normal operating, maintenance and testing conditions on redundant shunt trip channels will not result in loss of protection functions.

7. Failures of the shunt trip devices, their power sources and their connections are benign; that is, their failure cannot prevent the undervoltage trip devices or the SCR trip relays from tripping the reactor when called upon to do so.

Undervoltage Relay

To initiate the shunt trip actions, the design incorporates the use of BBC Model ITE-27H-211R high speed undervoltage relay. Although it is called a solid state relay, it is closer to a standard relay driven by solid state circuitry. Over 400 of these relays have been chosen for use in over 30 nuclear plants in the USA. In selecting the 211R revision of this relay, the design has addressed the concerns of IE Information Notice 82-50 about relay response to loss of DC control power.

The QA data package, provided with the relays, demonstrates that this relay is qualified and certified to IEEE 323 and IEEE 344. In addition, this relay has more recently been qualified to the requirements of IEEE 501 (ANSI C37.98) Standard Seismic Testing of Relays.

Each relay is tested line-to-line and line-to-ground before shipment to satisfy the dielectric test requirements of IEEE 313 (ANSI C37.90) and the surge withstand capability (SWC) requirements of IEEE 472 (ANSI C37.90a). As required by these standards, the dielectric tests are performed at 1500 volts and the SWC tests are performed at 2500 volts with the relay operating at normal voltages and temperatures.

Attachment C is a schematic of the relay. Attachment D is a specimen of the conformance test conducted on these relays before shipment from the vendor. Attachment E is the results of the vendors SWC testing on the mode relay used by AP&L. Attachment F is a package of qualification data provided by the vendor.

AP&L has concluded that this testing and documentation more than adequately establishes the undervoltage relay as appropriate and qualified for its application in this design.

Conclusion

It is AP&L's conclusion, supported by B&W, that the design as proposed:

1. Does not constitute an Unreviewed Safety Question;

2. Increases the margin of safety provided to the public; and

3. Conforms to all applicable design basis requirements and regulations applicable to ANO-1.

ATTACHMENT A

ONE LINE SCHEMATIC DIAGRAM
OF THE AC CONTROL ROD DRIVE
REACTOR TRIP BREAKER

DOCUMENT/ PAGE PULLED

ANO. 8306160324

NO. OF PAGES 1

REASON

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OTHER _____

☐ BETTER COPY REQUESTED ON ___/___/___

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ATTACHMENT B

ONE LINE SCHEMATIC DIAGRAM
OF THE DC CONTROL ROD DRIVE
REACTOR TRIP BREAKER

DOCUMENT/ PAGE PULLED

ANO. 8306160324

NO. OF PAGES 1

REASON

☐ PAGE ILLEGIBLE

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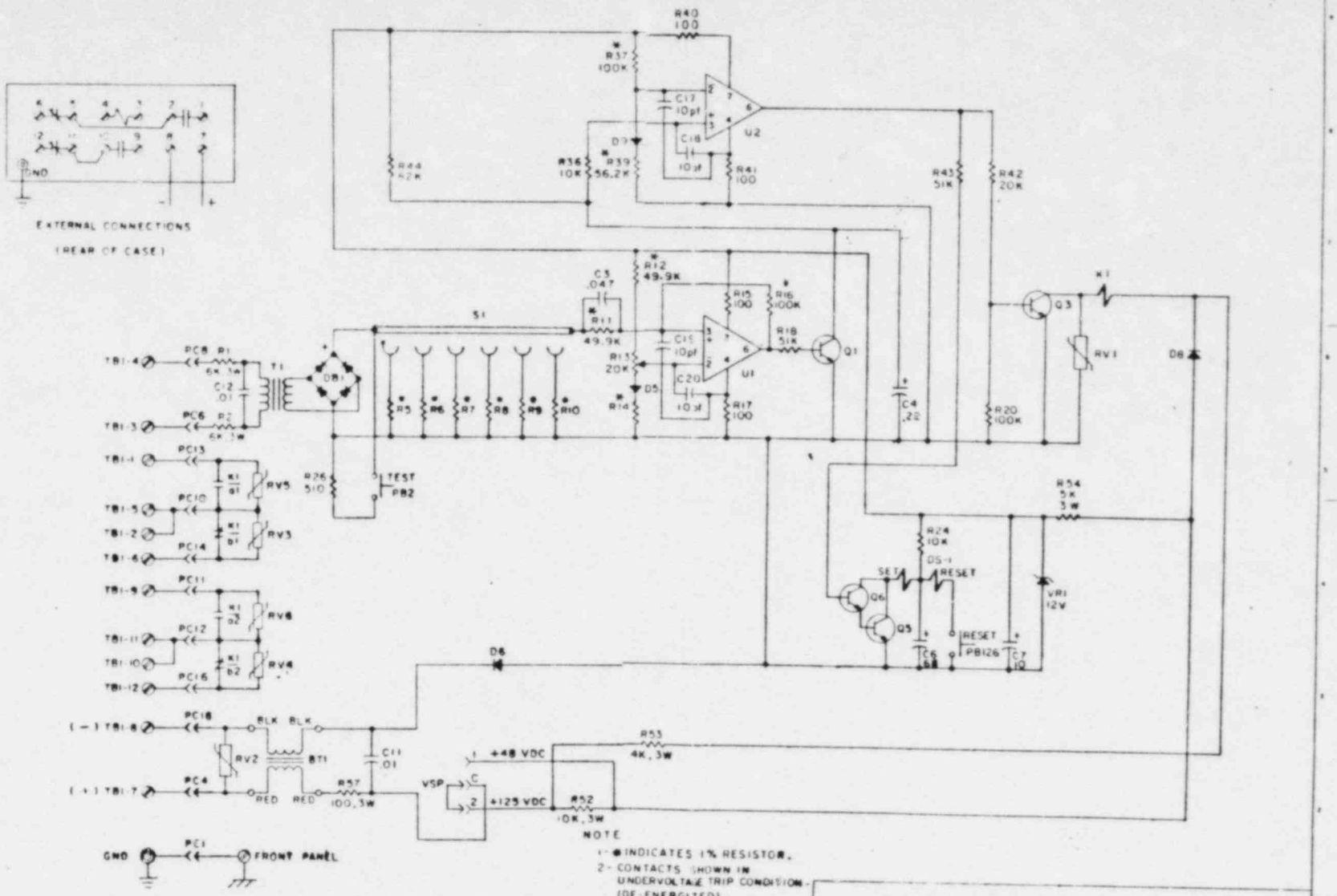
☒ FILMED ON APERTURE CARD NO 8306160324-02

ATTACHMENT C

SCHEMATIC DIAGRAM
OF THE BBC MODEL
ITE-27H-211R UNDERVOLTAGE RELAY



EXTERNAL CONNECTIONS
(REAR OF CASE)

TAP RANGE DROPOUT	S1 BURDENS						
	R5	R6	R7	R8	R9	R10	R14
30 TO 55V	30V	35V	40V	45V	50V	55V	50.9K
	3.16K	2.37K	1.96K	1.65K	1.47K	1.27K	
80 TO 140 V	80V	70V	80V	90V	100V	110V	56.2K
	1.1K	909	788	665	590	523	

NOTE
1 - ✱ INDICATES 1% RESISTOR.
2 - CONTACTS SHOWN IN UNDERVOLTAGE TRIP CONDITION. (DE-ENERGIZED)
3 - CONTROL POWER IS APPLIED.

UNDERVOLTAGE RELAY SCHEMATIC

ITE 27H — REVERSE LOGIC

SHEET NO.	611139	BY	CHKD	DATE	DATE	DATE
		J. Russell	6 24 80	7-1-80	7-F-80	

ITE Imperial Corporation

611167 — SHEET NO. 3

ATTACHMENT D

SPECIMEN OF THE BBC MODEL
ITE-27H-211R UNDERVOLTAGE RELAY
CONFORMANCE TEST

BROWN BOVERI ELECTRIC, INC. Protective Relay Operation 207 Witmer Road, Horsham, PA 19044 MANUFACTURER OF I-T-E EQUIPMENT	QUALITY ASSURANCE PROCEDURE	Number: RC-3046-A
		DATE:
Title: CONFORMANCE TEST - UNDERVOLTAGE RELAY TYPE 27-H		S.O.#
		SERIAL #

Cat. # 211R0175

SET-UP: Check all instruments for current certification. _____

1) PRE-TEST INSPECTION

A) All manufacturing processes completed. _____

B) All Q.C. Inspection stamps affixed. _____

2) OPERATION

A) Test Operation of Target, Set/Reset. _____

B) Test Operation of "Test" Button. _____

C) Test Operation of Relay Contacts. _____

3) PICK-UP TESTS

Tap Set	Limits	Pass/Fail
60	57 - 63	_____
90	85.5 - 94.5	_____
110	104.5 - 115.5	_____

4) TIME DELAY CHECK

A) Test with pick-up set on 60V tap.

Setting	Limits	Pass/Fail
Fixed Inst.	<14 ms	_____

5) DIELECTRIC TEST (ANSI C37.90-1978), 1500 VAC, 1 minute between all circuits _____ all circuits to ground _____

It is hereby certified that this device conforms to all applicable standards and specifications per BBE IB-18.4.7-2.

Prepared by:	
Approved by:	Revision No.

SPECIMAN

ATTACHMENT E

RESULTS OF SURGE WITHSTAND
CAPABILITY TESTING
OF A BBC MODEL ITE-27H-211R
UNDERVOLTAGE RELAY BY VENDOR

BBC Brown Boveri Electric, Inc.
Manufacturer of I-T-E Electrical Power Equipment

TEST NO. SO / DO 957-3008

TABULATION OF DATA - TABLE NO. 211A0175

DATE 4-6-83
TECH Bunn

IEEE SURGE WITHSTAND TEST OF ITE 27H RELAY

CONTROL VOLTAGE 125 DC

TEST SET UP SK. NO.

TEST GROUP VII

P.C. BOARD 610644 002

SK DRAWING 610703 A3

CIRCUIT UNDER TEST	GENERATOR APPLICATION	TB's TERMINAL FROM	TO	INDUCTORS	CAPACITORS	FALSE INDICATION FALSE TRIP	FALSE TARGET	INPUT (pickup) AC SIGNAL %	DC PS % VOLT	REMARKS
INPUT SIGNAL	COMMON MODE	3,4	Hard	Yes	Yes	None	None	120	100	
POWER SUPPLY		7,8	Hard	Yes	Yes	None	None	120	100	Relay set at 100V
OUTPUT CKT 1	1,2,	5,6	Hard	Yes	Yes	None	None	120	100	
OUTPUT CKT 2	9,10,	11,12	Hard	Yes	Yes	None	None	120	100	Input signal 120V
								120	100	
INPUT SIGNAL	TRANSVERSE	9	4	Yes	Yes	None	None	120	100	SURGE
POWER SUPPLY		7	8	Yes	Yes	None	None	120	100	Generator used
OUTPUT CKT 1	1,2,	5,6	7,8	Yes	Yes	None	None	120	100	
OUTPUT CKT 1	1,2,	5,6	3,4	Yes	Yes	None	None	120	100	Manufactured
								120	100	
										HFD-Relay Tester
OUTPUT 2	9,10,	11,12	7,8	Yes	Yes	None	None	120	100	Type P3
OUTPUT 2	1,2,	5,6	3,4	Yes	Yes	None	None	120	100	Tester set at 2.5 KV

TEST SUMMARY Passed all test's

Calibration and operation OK CLD 4/6/83

Form G2450-2M

ATTACHMENT F

QUALIFICATION DATA CONCERNING
BBC MODEL ITE-27H-211R UNDERVOLTAGE RELAY

GOULD

Gould Inc., Industrial Controls Divison
2002 Bethel Road
Westminster, MD 21157

STATEMENT OF CONFORMANCE

We certify that the listed equipment and required documentation for same meet the requirements of the purchase order and applicable specifications:

CUSTOMER Arkansas Power & Light

P.O. NUMBER 35277 REV. 0

SPECIFICATION 102F6 REV. 12/7/82

DESCRIPTION OF EQUIPMENT Class 1E Undervoltage Relays Type ITE-27H

REFERENCE Gould S.O. 84-30925

IDENTIFICATION OF SUBJECT EQUIPMENT

A. P.O. ITEM NUMBERS - 1 -

B. EQUIPMENT NUMBERS 211R0175

C. TAG NUMBERS N/A

APPROVED EXCEPTIONS NONE

Signature (Supplier Representative)

J. David Hudgins, QA Engineer
Name/Title

March 25, 1983
Date

FORM QA-37

GOULD

Finksburg, Md.

INSPECTION REPORT

5600 Startor Modules

NUCLEAR
Class: 1E / Non 1E
QA Review By / Date
MAR 25 1983

S.O. NO. 84 – 30925 METHOD: III ____ II ____ SPARE PARTS ____

MCC NO. ____ L/O DWG. ____ REV. ____

CUSTOMER ARKANSAS PWR. & LIGHT CUSTOMER P.O. NO. 85277

Module ID.			Inspection/Test														
Vert. Section	Cubicle No.	Spare Part Item No.	Correct Assembly	Correct Mechanical Operation	Correct Power Wiring	Correct Control Wiring	Correct Components Identification	Electrical Operations	Correct UL Label	Correct Unit Label	Safety/Warning Label	Other:	Quantity:	Test set #	Remarks (Description)	Date	Final Inspection By
		1	✓	N/A	N/A	N/A	✓	N/A	N/A	✓	N/A	–	8	2		25/3/83	

Legend: S – Satisfactory NR – Not Required
X – Unsatisfactory NA – Not Applicable

CC 25
(Rev. 8/81)

Gould, Inc., Industrial Controls Division
2032 Bethel Rd., Finksburg, MD 21048
Telephone (301) 876-2214

GOULD
An Electrical/Electronics Company

IEEE 323 CERTIFICATION
FOR CLASS 1E EQUIPMENT

It is hereby certified that equipment being furnished in accordance with the requirements of Arkansas Power & Light Company's Purchase Order No. 85277 have been qualified to the requirements presented in Bechtel Specification No. 6600-E-2011 and IEEE 323-1974 for Arkansas Power & Light Company's Arkansas Nuclear One.

The equipment tested is representative of the equipment being supplied for this order.

In order for this certification to be valid, the equipment must be properly installed and maintained in an environment equal to or less severe than that indicated in specifications 6600-E-2011 and Attachment A. Required maintenance is detailed in Attachment A.

The environment simulated as part of the 323 qualification program performed on representative samples of the subject equipment demonstrates a qualified life of 40 years for the service conditions indicated in Attachment. If these levels are exceeded, the relay must be replaced.

Prepared by:

Paul W. Higgins

Paul W. Higgins
Project Engineer

Approved by:

G. P. Kennedy

Gerry P. Kennedy
Operations Manager

March 25, 1983, Rev. 0

jm

CC-74-207
SO #84-30925
Ref: SO #84-87656

ATTACHMENT A

Qualification Provided by Subvendor
for 27H Undervoltage Relay

Brown Boveri Electric, Inc.

Manufacturer of I-T-E Electrical Power Equipment

CERTIFICATE OF CONFORMANCE

The material supplied in the accompanying shipment is hereby certified to conform to the applicable requirements and specifications as called for by the customer's purchase order.

Brown Boveri Electric Protective Relays are designed and tested for conformance to ANSI C37.90 and C37.90a.

The quality assurance program in effect at this location complies with the applicable requirements of 10 CFR 50, Appendix B, (NRC), MIL-I-45208, ANSI N45.2-1977 and/or 1971.

DATE: MAR. 24, 1983 S.O. 34-44546

CUSTOMER: GOULD, INC, WESTMINSTER, MD.

CUSTOMER P.O.: S 02184 / 84-30925

SITE/JOB: ARKANSAS POWER & LIGHT

SUPPLEMENTARY SPECIFICATIONS: IEEE-323-1974 CERTIFICATION

BBE ITEM	CUST. ITEM	QUAN.	TYPE	CATALOG NO.	SERIAL NO.
A	-	8	27H	211R0175	6955, 6957-6963

GOULD
Controls Division

R. Conrad
Quality Assurance Manager
Protective Relays

Q.A. Review
By/Date 3/25/83

BROWN BOVERI ELECTRIC, INC. Protective Relay Operation 207 Wilmer Road, Horsham, PA 19044 MANUFACTURER OF I.T.E EQUIPMENT	CERTIFICATION	Number: RC-5005-A Page: 1 of 4
Title: CLASS 1E EQUIPMENT ITE 27D/H UNDERVOLTAGE RELAY		Issue Date: 3/24/83

CLASS 1E ELECTRICAL EQUIPMENT CERTIFICATION

IDENTIFICATION:

B.B.E. S.O. 34-44546 File 15-2

CUSTOMER Gould, Inc., Westminster, MD

STATION Arkansas Power & Light

ORDER NO. S 02184 / 84-30925

SPECIFICATION --

AGENT/A&E --

MATERIAL:

BBE ITEM	CUST. ITEM	QUAN.	DEVICE	CATALOG NO.	QUALIFIED LIFE
A	-	8	27H	211R0175	40 yrs.

Q.A. Review
7/26/83
By/Date

The above material is hereby certified to be qualified in accordance with the principles of IEEE Standard 323-1974 for application as Class 1E Equipment for Nuclear Generating Stations. This certification is limited to the devices identified above when used within the limits of the ratings and conditions detailed by the attached equipment performance specifications, including seismic levels and recommended surveillance and maintenance. Substantiating documentation is on file at the Horsham Operation in the form of Qualification Summary Report RC-5105-A , and Seismic Test Report RC-5514.

R. Conrad 3/28/83 C. Downs 3/24/83

R. Conrad Q. A. Mgr. Date C. Downs Eng. Mgr. Date

1.0 RATING DATA is detailed in the attached Bulletin 7.4.1-1B.

2.0 INSTALLATION requirements are detailed in Instruction Book 18.4.7-2 which is provided with the device.

3.0 SERVICE CONDITIONS, including ANSI C37.90 Standards:

3.1 Usual conditions of operation for which there will be no loss of functional capability:
Temperature Range: $-20^{\circ}C$ to $+55^{\circ}C$
Long Term Avg. Ambient: $+35^{\circ}C$
Relative Humidity: 0 to 90%, no condensation
Pressure: Atmospheric, up to 1500 meters (5000 feet)
Vibration: Minimal
Contamination: Minimal
Radiation: Gamma, 1×10^5 RADS, integrated 40 year dosage
Operations: 2000 tripping operations (limited by output relay)

3.2 Unusual conditions of operation for which there will be no effect on functional capability.
Temperature: Equipment is operable from $-30^{\circ}C$ to $+70^{\circ}C$
Fire Suppression: CO_2 or Halon gases
Seismic: (Refer to Seismic Withstandability Report)
IEEE-501, 1978 Test Response Spectrum with a ZPA Level of 6g is applicable for usual and unusual service conditions throughout the qualified life.

3.3 Abnormal conditions for which equipment is not qualified include:
In-Containment applications
Damaging fumes or vapors
Excessive moisture or dripping water
Excessive dust, abrassive dust or magnetic dust
Steam
Explosive mixtures of dust or gases
Salt air
Abnormal shock and vibration (seismic covered separately)
Unusual transportation or storage conditions
Extreme temperature or sudden change in temperature
Oil vapors
Extreme variations of supply voltage
Application of equipment beyond ratings

3.4 Evaluation of realistic, long-term environmental conditions expected in a nuclear power generating station, leads to the conclusion that nuclear station applications impose comparatively mild operating conditions on this class of equipment.

Requirements of Class 1E equipment, therefore, fall easily within the actual performance requirements for the identified devices including the specific area of seismic withstandability.

The essential requirement is to retain operating capability over a long period of time and during a seismic design basis event at any time during the qualified life of the equipment.

4.0 SURVEILLANCE AND MAINTENANCE at regular intervals is recommended to preserve the performance capability of the equipment for the rated qualified life.

Solid state relays, with minimal numbers of moving parts, will normally require no adjustments or other maintenance in the usual sense, as for example, checking contact wipe or clutch pressure.

4.1 Periodic Tests of appropriate relay parameters are recommended as surveillance for possible incipient failure. A basic set of minimum tests is listed in the Instruction booklet. The total test program should be carefully planned.

In the performance of these tests it is expected that good practice will be followed, exercising moving parts (switches, targets, etc.) and checking and tightening connections.

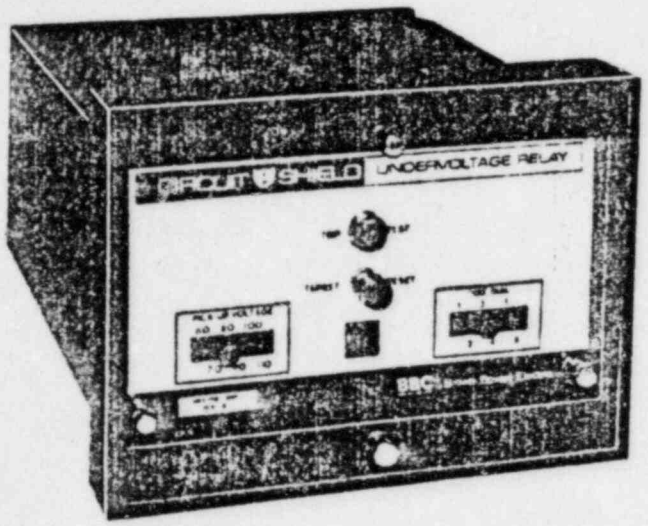
It is recommended that each relay be tested at least once during each two year period.

4.2 Records of surveillance and maintenance should be carefully prepared and stored.

I-T-E Type Protective Relays Drawout

[illegible]-I-T-E-27D [illegible]-I-T-E-59D.

[illegible] and Overvoltage Relays



Circuit-Shield Voltage Relays provide a wide range of protective functions, including undervoltage protection of motors, overvoltage protection, and automatic bus transfer. Inherently high seismic and transient immunity allow the use of these relays in generating stations or substations where the performance of electromechanical or other types of static relays is marginal.

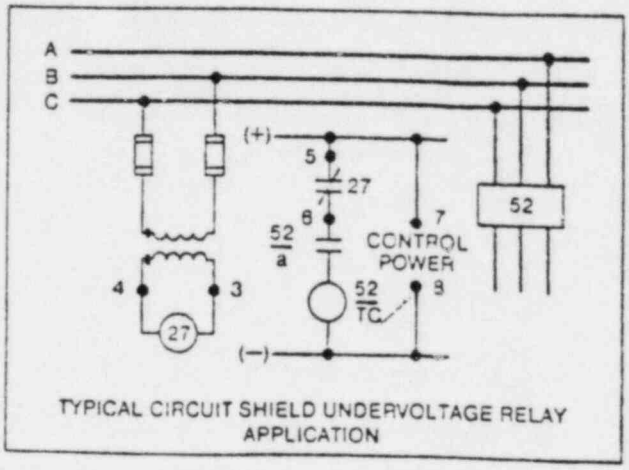
All types are frequency compensated for reliable operation from 15 to 400 Hz, and have a dual nominal frequency rating of 50 or 60 Hz.

The unique design of the output circuit does not require seal-in contacts, allowing simplification of bus-transfer schemes. Operation indicators, however, are provided as standard features on all types.

The operating characteristic of each relay in this series is indicated as follows: H suffix for high speed; D suffix for definite time; no suffix for inverse time.

Features

- **Frequency compensation to 15 Hz**
- **Inverse, definite time, or high speed**
- **Accurate, repeatable characteristics**
- **Low burden**
- **Seismic capability to 6g ZPA**
- **Transient immunity**
- **Drawout construction**



TYPICAL CIRCUIT SHIELD UNDERVOLTAGE RELAY APPLICATION

Undervoltage and Ov[illegible]
I-T-E-27, I-T-E-27D, I-[illegible]

Specifications

	Type 27 Type 27D Type 27H	Type 27H	Type 59 Type 59D Type 59H
PICKUP TAPS (volts)			100 110 120 130 140 150
DROPOUT TAPS (volts)	60 70 80 90 100 110	30 35 40 45 50 55	

Input Circuit Rating: 160V, 50/60 Hz continuous

Burden: 1.2 VA, 1.0 p.f. at 120V

Control Power: 48/125 Vdc, dual rated. .08A max; 24 Vdc, 0.08A max

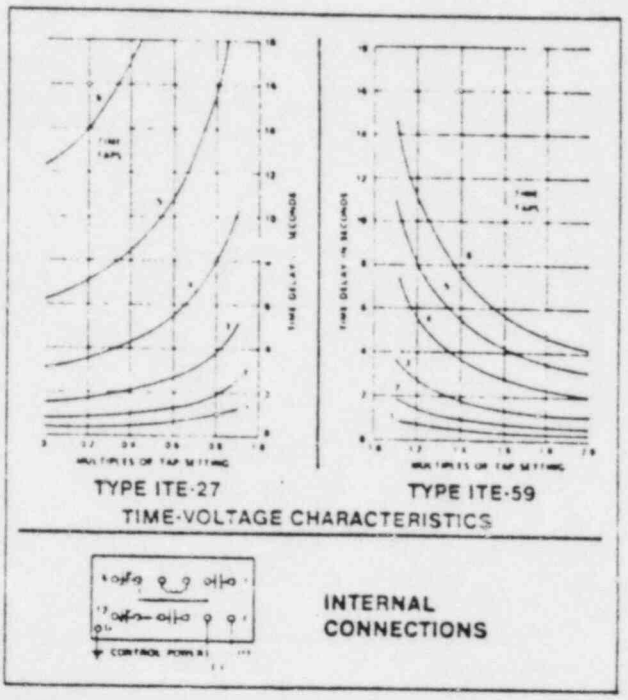
Output Circuit Rating @ 125 Vdc:
30 Amps Tripping Duty
5 Amps Continuous
1 Amp, Opening Resistive
0.3 Amp, Opening Inductive

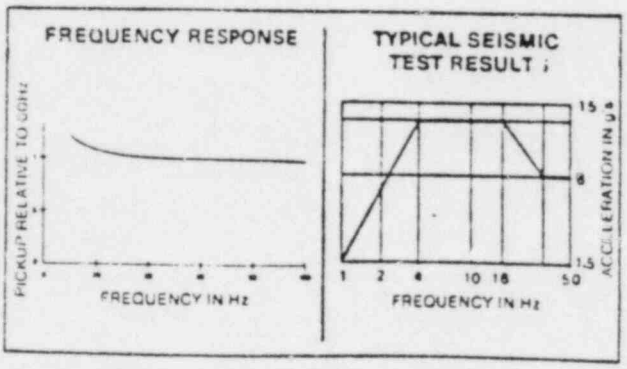
Temperature: Minus 20° to Plus 75° C

Seismic Capability: More than 6g ZPA biaxial multifrequency vibration without damage or malfunction.

Transient Immunity: More than 3000V, 1 MHz bursts at 60 Hz repetition rate, continuous.

Operating Time: models available:
- high speed
- inverse time delay (see curves)
- definite time delay, ranges 0.1 - 1.0 seconds, and 1.0 - 10 seconds





How To Specify

Undervoltage relay shall be type I-T-E-27 or approved equal, drawout case, capable of withstanding up to 6g ZPA seismic stress without damage or malfunction, at minimum voltage and time settings. A magnetic operation indicator shall be provided which retains position on loss of control power. Built-in means shall be provided to allow operational tests without additional equipment.

Additional Information

Instruction Book	IB 18.4.7-2
Relay Selection Sheet	7403
IEEE Southeastcon Paper	April 1975

For a complete listing of available versions of single and three phase voltage relays see selection sheet 7403.

All types operate from 48 or 125 Vdc control power, and 120 Vac potential transformers. For other control voltages contact the nearest District Office.

To place an order, or for further information, contact the nearest District Office, or the Sales Manager, Protective Relays.

Distribution Apparatus Division
207 Witmer Road, Horsham, PA 19044
Telephone (215) 674-5990

Supersedes Issue A and Bulletin 18.4-1C

Brown Boveri Electric

Gould, Inc., Industrial Controls Division
2032 Bethel Rd., Finksburg, MD 21048
Telephone (301) 876-2214

GOULD
An Electrical/Electronics Company

SEISMIC CERTIFICATION
FOR CLASS 1E EQUIPMENT

It is hereby certified that equipment being furnished in accordance with the requirements of Arkansas Power & Light Company's Purchase Order No. 85277 have been qualified by seismic test and meet the seismic requirements presented in Bechtel's Specification No. 6600-E-2011 and 6600-C-2102, Rev. 1 and IEEE Standard 344-1971, for Arkansas Power & Light Company's Arkansas Nuclear One. Acceleration levels in excess of those indicated by the Required Response Spectra curves attached to the specifications were achieved without loss of function during these tests, Reference RRS of Attachment A and TRS of Attachment B. The 27H undervoltage relay has been seismically qualified up to a ZPA level of 6 g's resulting in the standardized Response Spectra curve shown in Attachment C. This curve has been superimposed on the TRS curves of Attachment D which are derived from MCC specimen mounted accelerometers. The relay qualified curve envelopes the curve of Attachment D, therefore the relay is seismically qualified for this application.

The equipment tested is seismically representative of the equipment being supplied for this order.

In order for this certification to be valid, the equipment must be installed properly insuring a secure mount utilizing standard grade fasteners.

It is further certified that the addition of the equipment covered by this document will not compromise the Seismic Certification issued for the original order, SC-25.

Prepared by:

Paul W. Higgins

Paul W. Higgins
Project Engineer

Approved by:

G. Erich Heberlein

G. Erich Heberlein, Jr.
Engineering Manager, Systems

March 24, 1983, Rev. 0

jm

SC-501
SO #84-30925
R-STS-16
Ref: SO #84-87656
SC-25

ATTACHMENT A

Worse Case RRS Curves from
Specification C-2102, Rev. 1

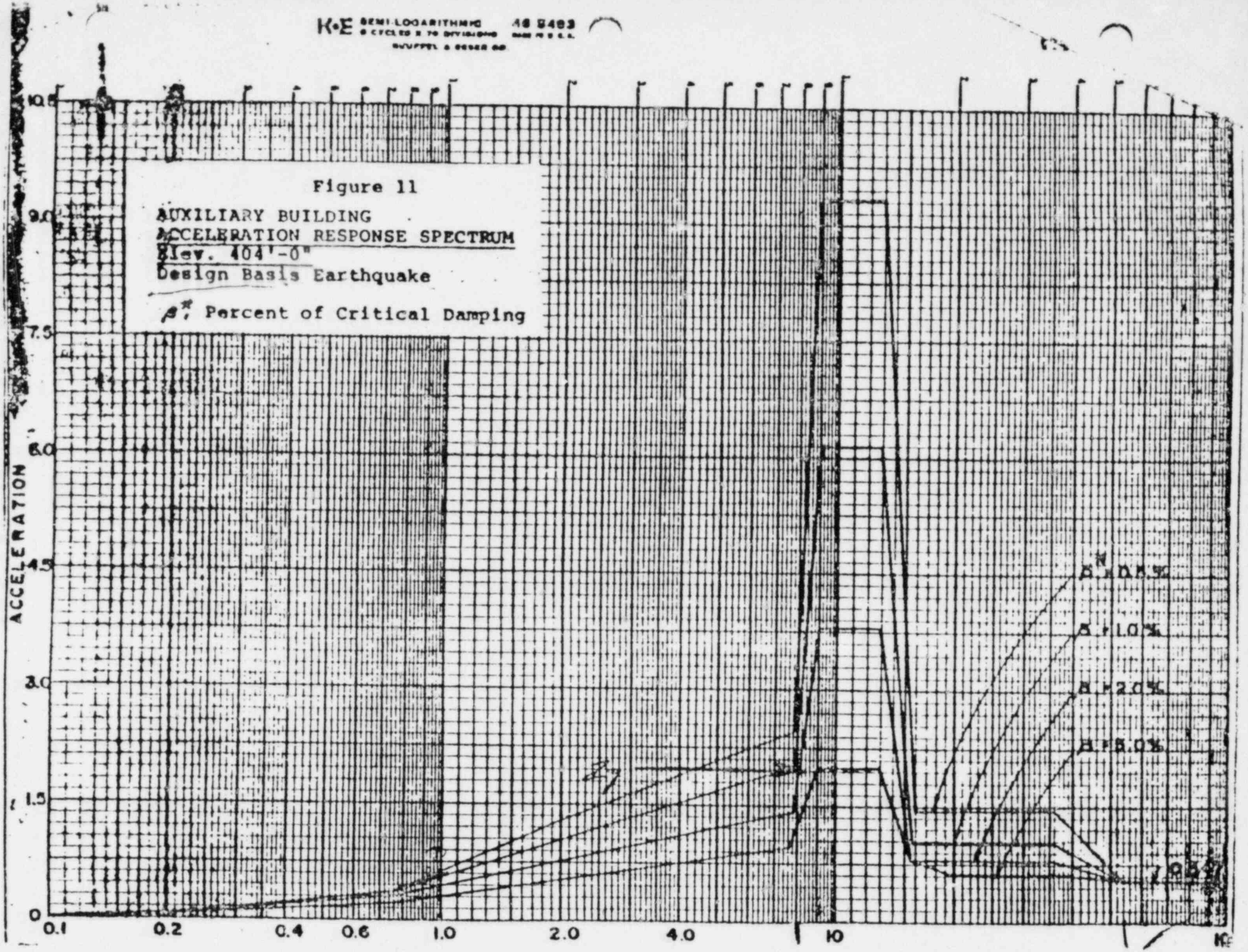


Figure 11
AUXILIARY BUILDING
ACCELERATION RESPONSE SPECTRUM
Elev. 404'-0"
Design Basis Earthquake
β%, Percent of Critical Damping
ACCELERATION
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0
0.1
0.2
0.4
0.6
1.0
2.0
4.0
10
β = 0.5%
β = 1.0%
β = 2.0%
β = 5.0%

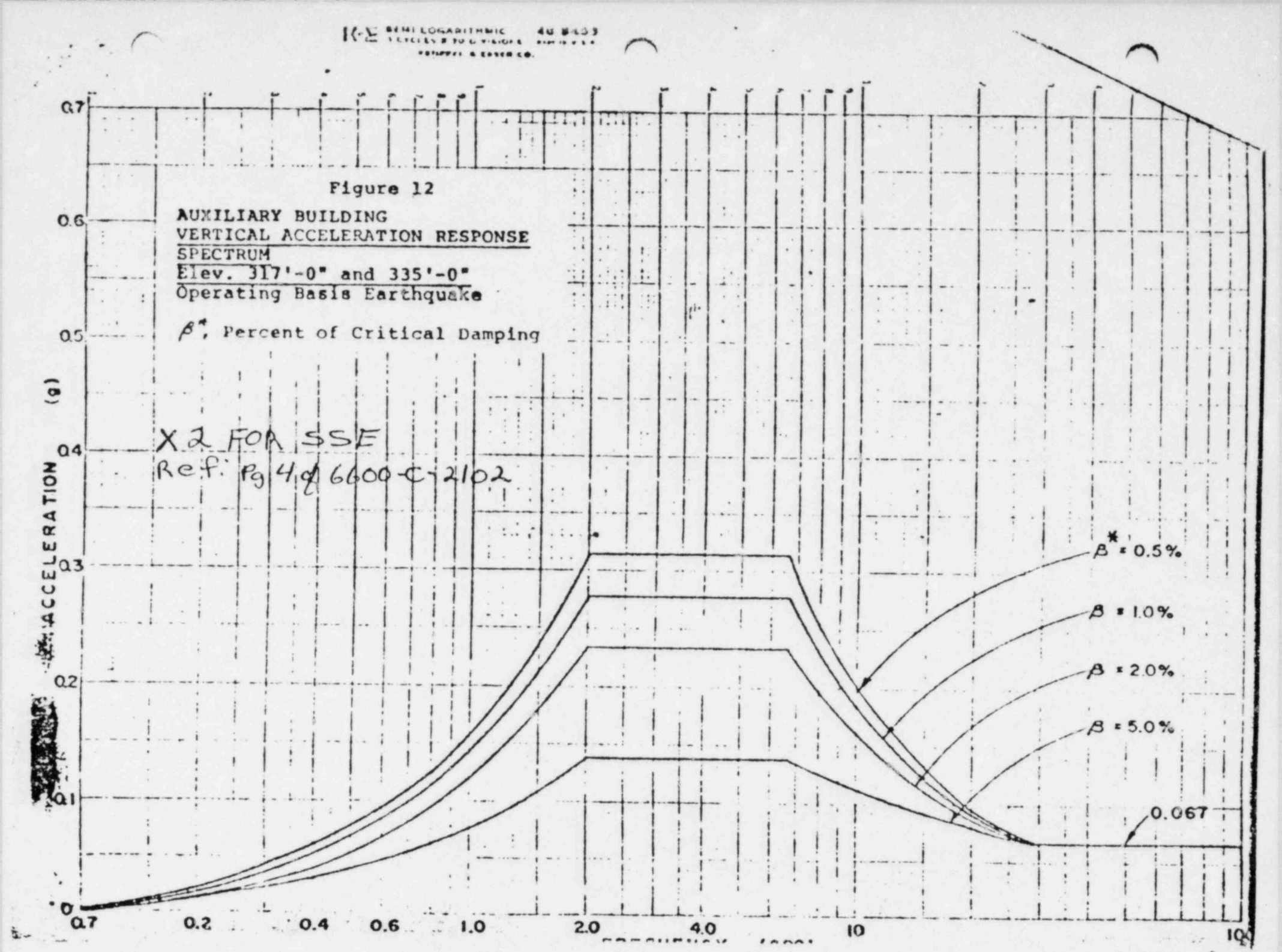


Figure 12
AUXILIARY BUILDING
VERTICAL ACCELERATION RESPONSE
SPECTRUM
Elev. 317'-0" and 335'-0"
Operating Basis Earthquake
β*, Percent of Critical Damping
X 2 FOR SSE
Ref. Pg 4 of 6600-C-2102
ACCELERATION (g)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.2
0.4
0.6
1.0
2.0
4.0
10
β* = 0.5%
β = 1.0%
β = 2.0%
β = 5.0%
0.067

ATTACHMENT B

See TRS Curves from MCC Seismic Test
R-STS-16, Wyle Report No. 43472-1

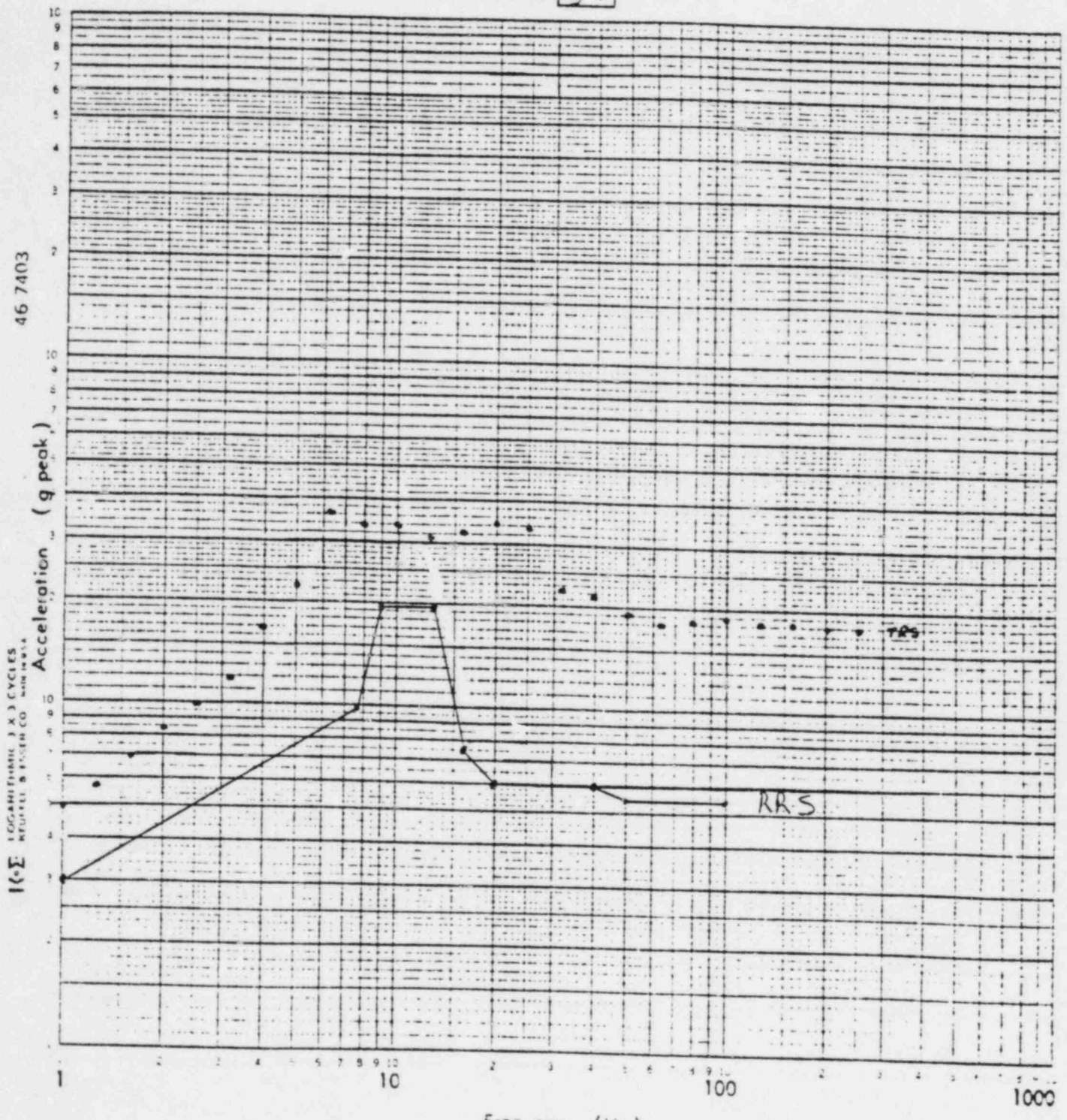
These curves were derived from the table
mounted control accelerometers.

FULL SCALE SHOCK SPECTRUM (g Peak)

-6-

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5%



AXIS F-B/VERT

LOCATION NO. HCA

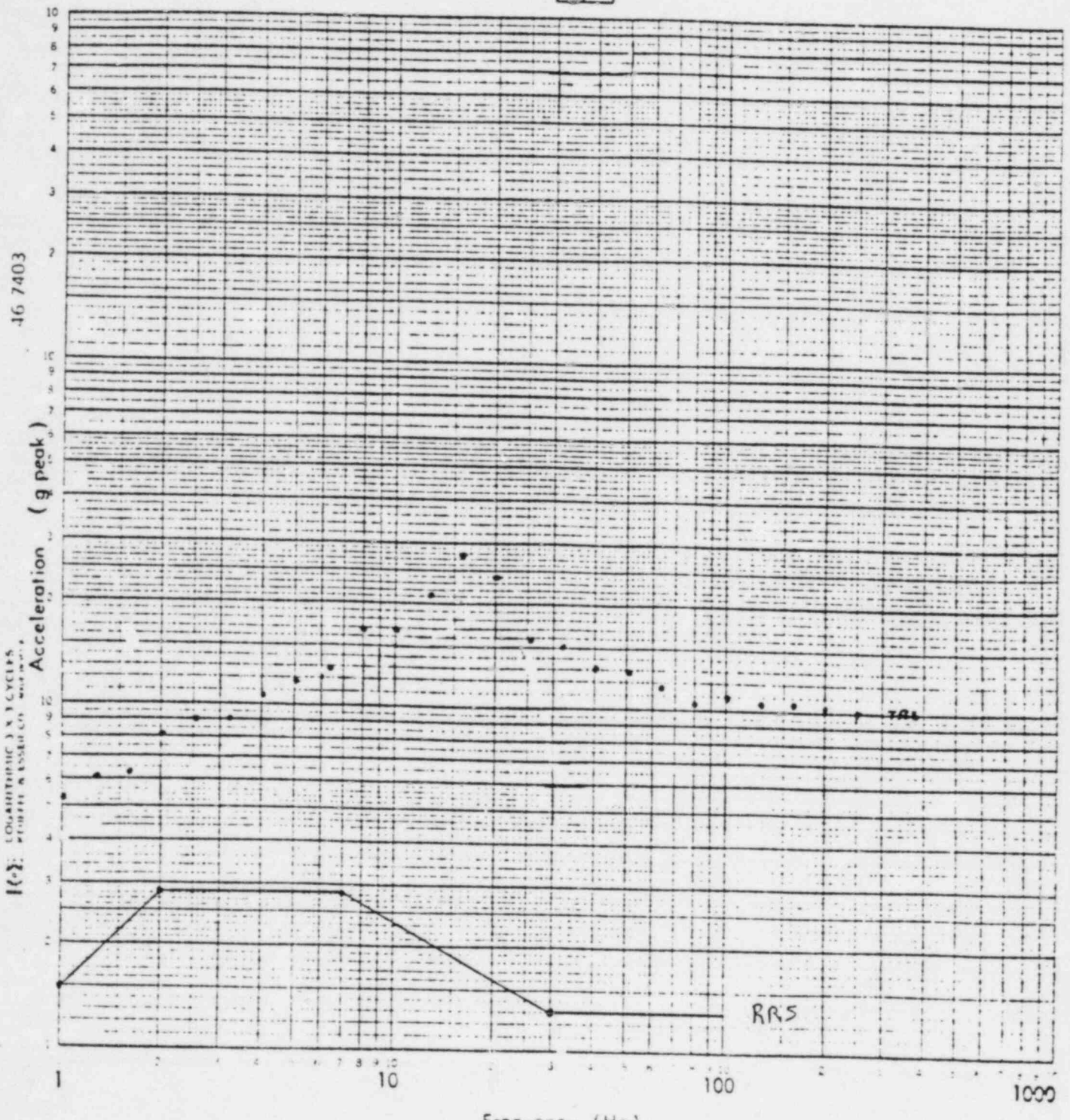
TEST RUN NO. 17

FULL SCALE SHOCK SPECTRUM (g Peak)

-7-

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5%



AXIS F-8/Vert

LOCATION NO. VUA

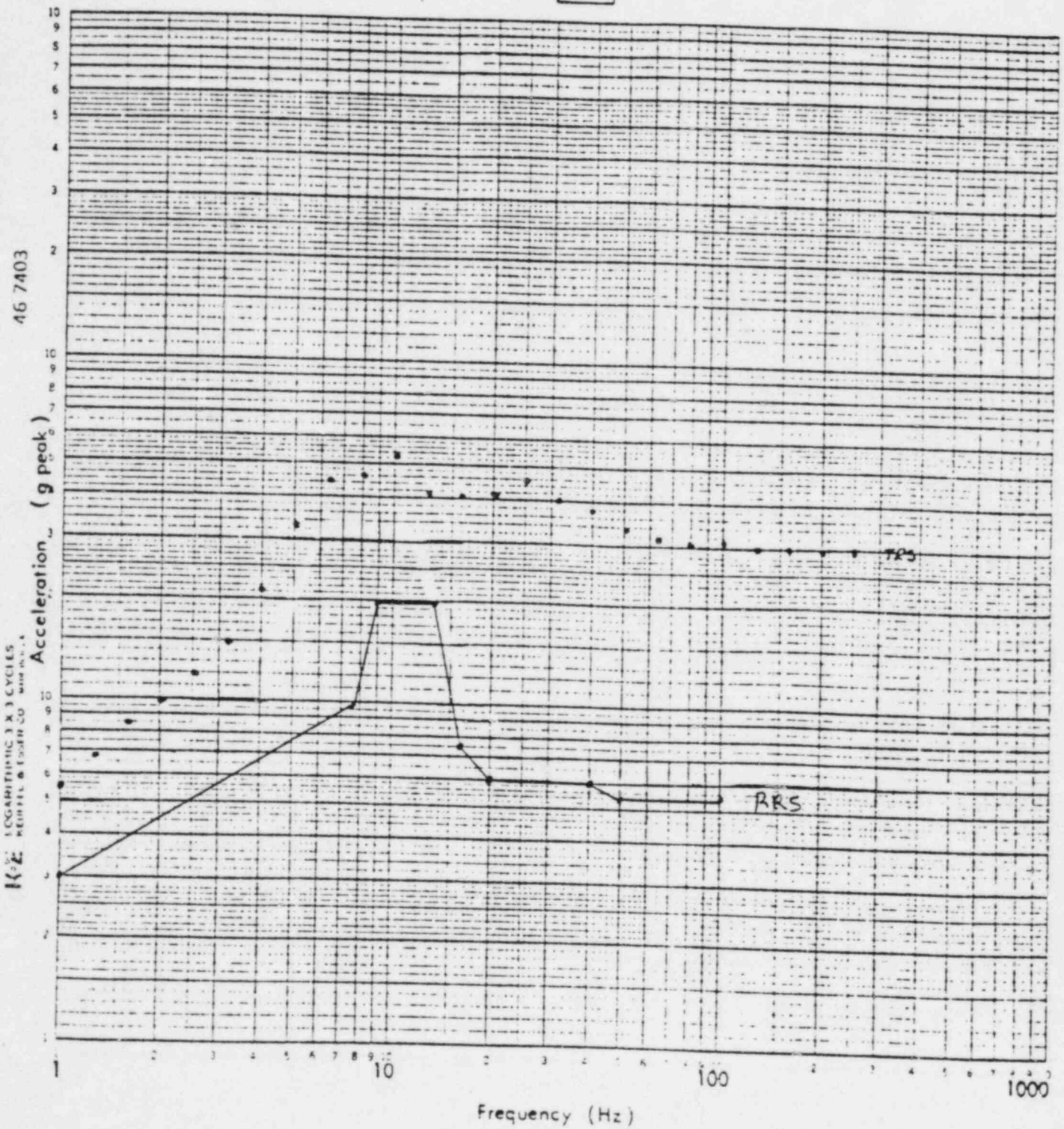
TEST RUN NO. 17

FULL SCALE SHOCK SPECTRUM (g Peak)

-8-

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



AXIS S-S/VERT

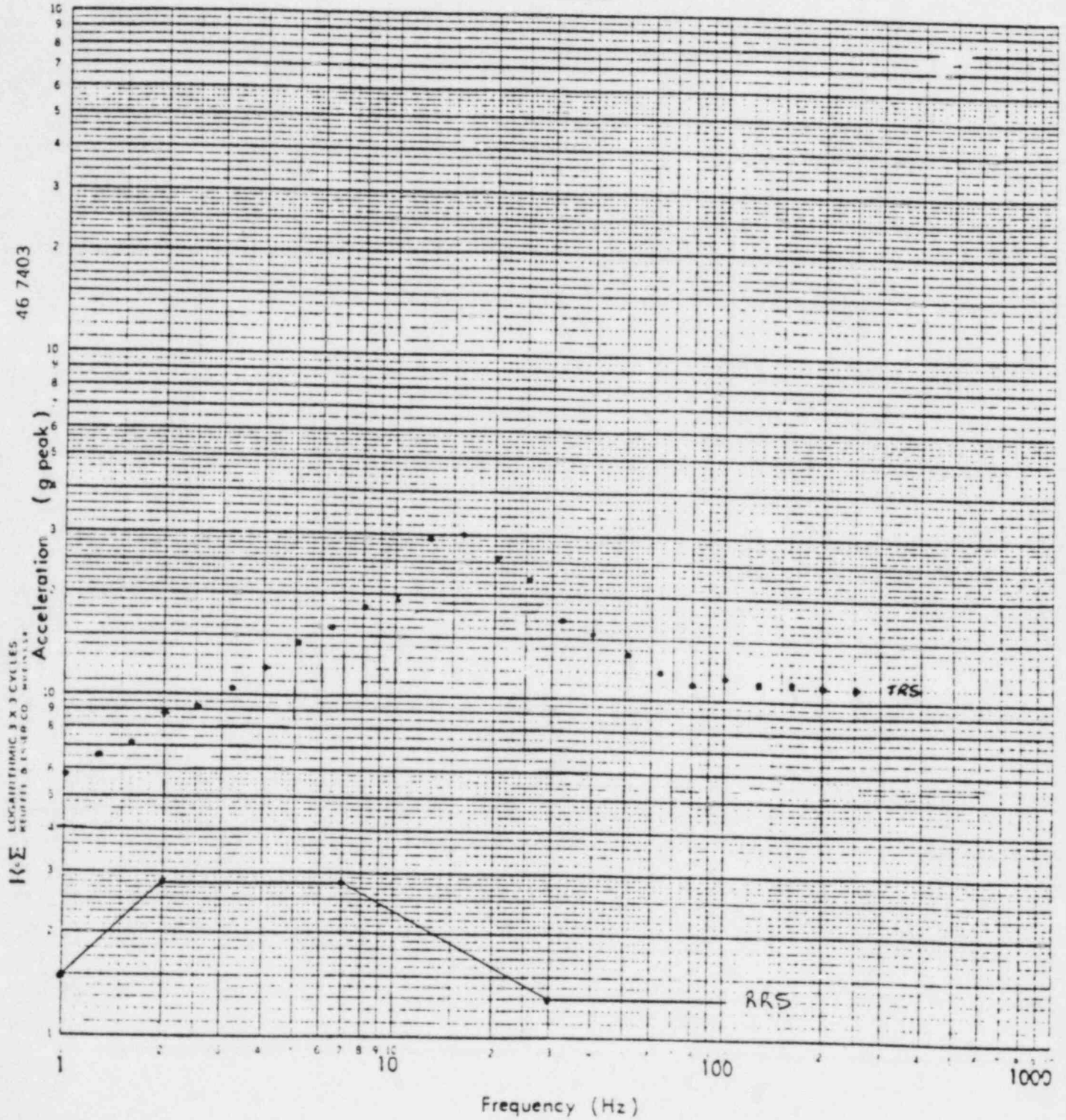
LOCATION NO. HCA

TEST RUN NO. 25

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



AXIS S-S/VERT

LOCATION NO. VCA

TEST RUN NO. 25

ATTACHMENT C

Qualification Provided by Subvendor for 27H Undervoltage Relay including standardize TRS curve for a ZPA rating of 6 g's.

BBC BROWN BOVERI

Brown Boveri Electric, Inc.

Manufacturer of I-T-E Electrical Power Equipment

CERTIFICATE OF CONFORMANCE

The material supplied in the accompanying shipment is hereby certified to conform to the applicable requirements and specifications as called for by the customer's purchase order.

Brown Boveri Electric Protective Relays are designed and tested for conformance to ANSI C37.90 and C37.90a.

The quality assurance program in effect at this location complies with the applicable requirements of 10 CFR 50, Appendix B, (NRC), MIL-I-45208, ANSI N45.2-1977 and/or 1971.

DATE: MAR. 24, 1983 S.O. 34-44546

CUSTOMER: GOULD, INC, WESTMINISTER, MD.

CUSTOMER P.O.: S 02184 / 84-30925

SITE/JOB: ARKANSAS POWER & LIGHT

SUPPLEMENTARY SPECIFICATIONS: IEEE-323-1974 CERTIFICATION

BBE ITEM	CUST. ITEM	QUAN.	TYPE	CATALOG NO.	SERIAL NO.
A	-	8	27H	211R0175	6855, 6857-6863

GOULD
Controls Division

R. Conrad
R. Conrad
Quality Assurance Manager
Protective Relays

Q.A. Review
By / Date 3/25/83

BROWN BOVERI ELECTRIC, INC. Protective Relay Operation 207 Wilmer Road, Horsham, PA 19044 MANUFACTURER OF I.T.E EQUIPMENT	CERTIFICATION	Number: RC-5005-A Page: 1 of 4
Title: CLASS 1E EQUIPMENT ITE 27D/H UNDERVOLTAGE RELAY		Issue Date: 3/24/83

CLASS 1E ELECTRICAL EQUIPMENT CERTIFICATION

IDENTIFICATION:

B.B.E. S.O. 34-44546 File 15-2

CUSTOMER Gould, Inc., Westminster, MD

STATION Arkansas Power & Light

ORDER NO. S 02184 / 84-30925

SPECIFICATION --

AGENT/A&E --

MATERIAL:

BBE ITEM	CUST. ITEM	QUAN.	DEVICE	CATALOG NO.	QUALIFIED LIFE
A	-	8	27H	211R0175	40 yrs.

Q.A. Review
By/Date 3/25/83

5

The above material is hereby certified to be qualified in accordance with the principles of IEEE Standard 323-1974 for application as Class 1E Equipment for Nuclear Generating Stations. This certification is limited to the devices identified above when used within the limits of the ratings and conditions detailed by the attached equipment performance specifications, including seismic levels and recommended surveillance and maintenance. Substantiating documentation is on file at the Horsham Operation in the form of Qualification Summary Report RC-5105-A , and Seismic Test Report RC-5514.

R. Conrad — Q. A. Mgr. — 3/28/83 Date

C. Downs — Eng. Mgr. — 3/24/83 Date

BROWN BOVERI ELECTRIC, INC. Protective Relay Operation 207 Wilmer Road, Horsham, PA 19044 MANUFACTURER OF I·T·E EQUIPMENT	CERTIFICATION	Number: RC-5005-A Page: 2 of 4
Title: EQUIPMENT PERFORMANCE SPECIFICATIONS FOR I.T.E.- 27D/H UNDERVOLTAGE RELAY		Issue Date: 3/24/83 Revised:

1.0 RATING DATA is detailed in the attached Bulletin 7.4.1-1B.

2.0 INSTALLATION requirements are detailed in Instruction Book 18.4.7-2 which is provided with the device.

3.0 SERVICE CONDITIONS, including ANSI C37.90 Standards:

3.1 Usual conditions of operation for which there will be no loss of functional capability:

Temperature Range: $-20^{\circ}C$ to $+55^{\circ}C$
Long Term Avg. Ambient: $+35^{\circ}C$
Relative Humidity: 0 to 90%, no condensation
Pressure: Atmospheric, up to 1500 meters (5000 feet)
Vibration: Minimal
Contamination: Minimal
Radiation: Gamma, 1×10^{5} RADS, integrated 40 year dosage
Operations: 2000 tripping operations (limited by output relay)

3.2 Unusual conditions of operation for which there will be no effect on functional capability.

Temperature: Equipment is operable from $-30^{\circ}C$ to $+70^{\circ}C$
Fire Suppression: CO_2 or Halon gases
Seismic: (Refer to Seismic Withstandability Report)
IEEE-501, 1978 Test Response Spectrum with a ZPA Level of 6g is applicable for usual and unusual service conditions throughout the qualified life.

3.3 Abnormal conditions for which equipment is not qualified include:

In-Containment applications
Damaging fumes or vapors
Excessive moisture or dripping water
Excessive dust, abrassive dust or magnetic dust
Steam
Explosive mixtures of dust or gases
Salt air
Abnormal shock and vibration (seismic covered separately)
Unusual transportation or storage conditions
Extreme temperature or sudden change in temperature
Oil vapors
Extreme variations of supply voltage
Application of equipment beyond ratings

3.4 Evaluation of realistic, long-term environmental conditions expected in a nuclear power generating station, leads to the conclusion that nuclear station applications impose comparatively mild operating conditions on this class of equipment.

Requirements of Class 1E equipment, therefore, fall easily within the actual performance requirements for the identified devices including the specific area of seismic withstandability.

The essential requirement is to retain operating capability over a long period of time and during a seismic design basis event at any time during the qualified life of the equipment.

4.0 SURVEILLANCE AND MAINTENANCE at regular intervals is recommended to preserve the performance capability of the equipment for the rated qualified life.

Solid state relays, with minimal numbers of moving parts, will normally require no adjustments or other maintenance in the usual sense, as for example, checking contact wipe or clutch pressure.

4.1 Periodic Tests of appropriate relay parameters are recommended as surveillance for possible incipient failure. A basic set of minimum tests is listed in the Instruction booklet. The total test program should be carefully planned.

In the performance of these tests it is expected that good practice will be followed, exercising moving parts (switches, targets, etc.) and checking and tightening connections.

It is recommended that each relay be tested at least once during each two year period.

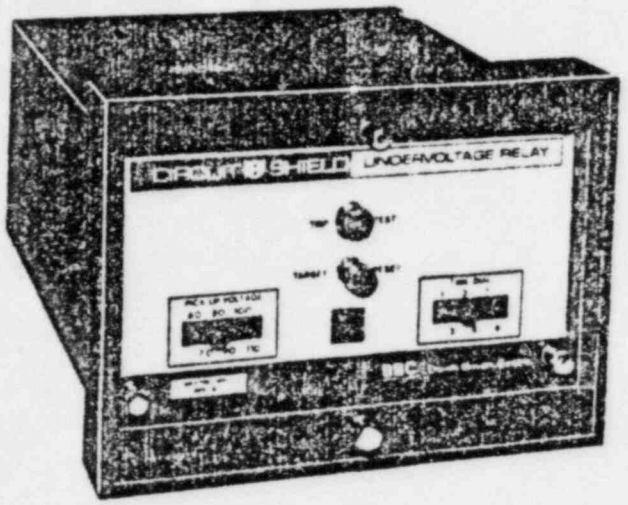
4.2 Records of surveillance and maintenance should be carefully prepared and stored.

Bulletin 7.4.1-1B
15

I-T-E Type Protective Relays Drawout

I-T-E—27D,
I-T-E—59, I-T-E—59D,

Undervoltage and Overvoltage Relays



Circuit-Shield Voltage Relays provide a wide range of protective functions, including undervoltage protection of motors, overvoltage protection, and automatic bus transfer. Inherently high seismic and transient immunity allow the use of these relays in generating stations or substations where the performance of electromechanical or other types of static relays is marginal.

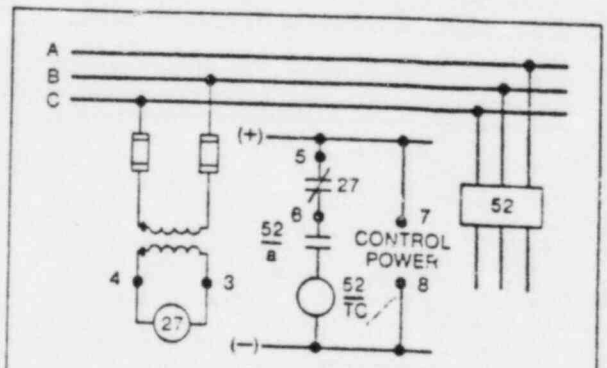
All types are frequency compensated for reliable operation from 15 to 400 Hz, and have a dual nominal frequency rating of 50 or 60 Hz.

The unique design of the output circuit does not require seal-in contacts, allowing simplification of bus-transfer schemes. Operation indicators, however, are provided as standard features on all types.

The operating characteristic of each relay in this series is indicated as follows: H suffix for high speed; D suffix for definite time; no suffix for inverse time.

Features

- Frequency compensation to 15 Hz
- Inverse, definite time, or high speed
- Accurate, repeatable characteristics
- Low burden
- Seismic capability to 6g ZPA
- Transient immunity
- Drawout construction



TYPICAL CIRCUIT SHIELD UNDERVOLTAGE RELAY APPLICATION

Undervoltage and Overvoltage Relays
I-T-E-27, I-T-E-27D, I-T-E-27H, I-T-E-59, I-T-E-59D, I-T-E-59H

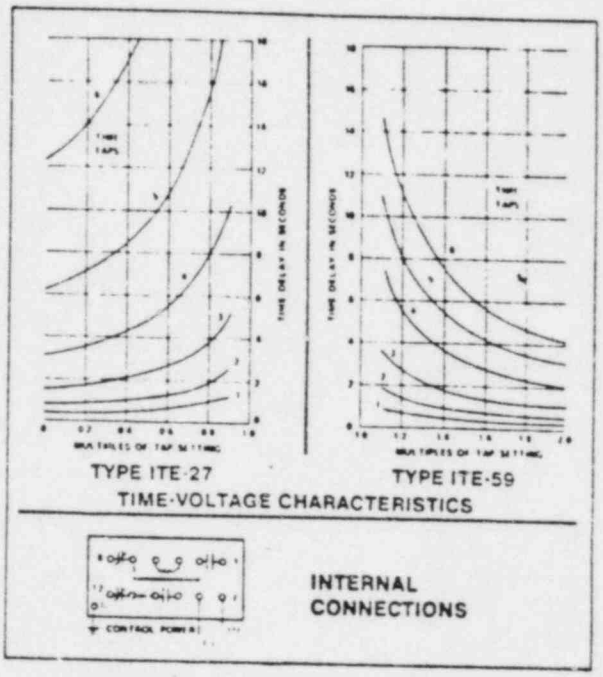
Specifications

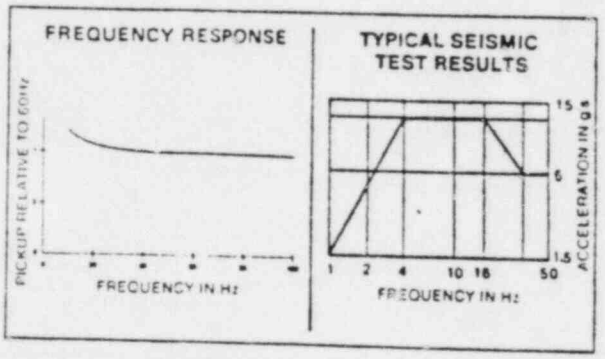
	Type 27 Type 27D Type 27H	Type 27H	Type 59 Type 59D Type 59H
PICKUP TAPS (volts)			100 110 120 130 140 150
DROPOUT TAPS (volts)	60 70 80 90 100 110	30 35 40 45 50 55	

Input Circuit Rating: 160V, 50/60 Hz continuous
Burden: 1.2 VA, 1.0 p.f. at 120V
Control Power: 48/125 Vdc, dual rated, .08A max; 24 Vdc, 0.08A max
Output Circuit Rating @ 125 Vdc: 30 Amps Tripping Duty
5 Amps Continuous
1 Amp, Opening Resistive
0.3 Amp, Opening Inductive

Temperature: Minus 20° to Plus 75°C
Seismic Capability: More than 6g ZPA biaxial multifrequency vibration without damage or malfunction.
Transient Immunity: More than 3000V, 1 MHz bursts at 60 Hz repetition rate, continuous.
Operating Time: models available:

- high speed
- inverse time delay (see curves)
- definite time delay, ranges 0.1 - 1.0 seconds, and 1.0 - 10 seconds





How To Specify

Undervoltage relay shall be type I-T-E-27 or approved equal, drawout case, capable of withstanding up to 6g ZPA seismic stress without damage or malfunction, at minimum voltage and time settings. A magnetic operation indicator shall be provided which retains position on loss of control power. Built-in means shall be provided to allow operational tests without additional equipment.

Additional Information

Instruction Book	IB 18.4.7-2
Relay Selection Sheet	7.4.0.3
IEEE Southeastcon Paper	April 1975

For a complete listing of available versions of single and three phase voltage relays see selection sheet 7.4.0.3.

All types operate from 48 or 125 Vdc control power, and 120 Vac potential transformers. For other control voltages contact the nearest District Office.

To place an order, or for further information, contact the nearest District Office, or the Sales Manager, Protective Relays.

Distribution Apparatus Division
207 Witmer Road, Horsham, PA 19044
Telephone (215) 674-5990

Supersedes Issue A and Bulletin 18.4-1C
Printed in U.S.A. 10M CMC 981

Brown Boveri Electric

Application Notes For I-T-E Protective Relays

SEISMIC TESTING ACCORDING TO IEEE STANDARD 501 (ANSI C37.98)

CONTRIBUTED BY Jim Waldron

We have recently concluded a series of tests which enable us to qualify the entire line of ITE Protective Relays according to the principles of IEEE Standard 501.

Some of the requirements of the new standard are listed below, with my explanatory notes.

The nature of the vibration is "Broad-Band Multifrequency". A "Standard Response Spectrum" (SRS) is defined as shown in Figure 1. This Spectrum is judged to be severe (Broad) enough to assure proper relay performance in any geological area. The SRS of Figure 1 is a plot of how single-degree-of-freedom bodies would respond to an arbitrary, random input vibration. The bodies have resonant-frequencies at 1/3 octave intervals between 1 and 50 Hz., and the analysis made at 5% damping. The vibration must persist for at least 15 seconds.

Tests are to be made biaxial (45° off horizontal) in all four principal axes. The acceleration (in g's) shown in the SRS is the vertical or horizontal component, which are equal.

The relay's figure of merit is the ZPA of the Test Response Spectrum (TRS) which envelopes the SRS.

The relays must be tested in the non-operating, operating, and transitional modes. The electrical quantities for each of these modes vary according to relay function, but generally require testing somewhat below pickup, above pickup, and also being switched from below to above pickup, all while being subjected to the vibration described above.

Failure is defined in several ways, including contact discontinuity of two milli-seconds or more, or substantial change in critical parameters during or after the vibration testing.

The Test Response Spectrum for each relay was virtually the same, and is shown in Figure 2. The TRS represents the physical limits of the hydraulic actuator used for the test, since no fragility was noted. The figure of merit (ZPA) of each relay is the same, 6 g's.

Figure 3 is the TRS for each relay, but analyzed at ½, 1, 2½, 5 and 10% damping. These TRS are useful when applying a relay at a site where the geological analysis was made at other than 5% damping.

Table 1 lists the ITE relays actually tested and the other relays qualified by mechanical equivalency. Also listed are the summaries of the reports describing the tests discussed above.

TABLE 1
ITE PROTECTIVE RELAYS
SEISMIC TEST DATA

FUNCTION	RELAY TYPE TO QUALIFY	USE DATA ON	TEST SUMMARY
Synch-Check	ITE-25S ITE-25V	ITE-25V ITE-25V	18.3.3-2A
Undervoltage	ITE-27 ITE-27D ITE-27H	ITE-47D ITE-47D ITE-47D	18.4.3-4D
Overvoltage	ITE-59 ITE-59D ITE-59H	ITE-47D ITE-47D ITE-47D	18.4.3-4D
Under/Overvoltage	ITE-27/59A ITE-27/59D ITE-27/59H	ITE-47D ITE-47D ITE-47D	18.4.3-4D
Undervoltage & Phase Sequence	ITE-47 ITE-47D ITE-47H	ITE-47D ITE-47D ITE-47D	18.4.3-4D
Unbalanced Voltages	ITE-60Q	ITE-47D	18.4.3-4D
Ground Overvoltage	ITE-59G	ITE-47D	18.4.3-4D
Fuse or PT Failure	ITE-60	ITE-60	18.4.3-3B
Underfrequency	ITE-81	ITE-81	18.4.3-6A
Timing	ITE-62K	ITE-62K	18.7.3-2A
Transformer Differential	ITE-87T	ITE-87T	18.6.3-4A
Machine Differential	ITE-87M	ITE-87M	18.6.3-2A
Current Unbalance	ITE-46D ITE-46H	ITE-46D ITE-46D	18.6.3-3A
Overload	ITE-49 ITE-49/50 ITE-49/50/51	ITE-49/50/51 ITE-49/50/51 ITE-49/50/51	18.2.3-6A
Temperature	ITE-49T	ITE-49T	18.7.3-3A
Time-Overcurrent	ITE-51I ITE-51Y ITE-51E ITE-51S ITE-51D ITE-51SP ITE-51IM ITE-51YM ITE-51L ITE-50D	ITE-51Y ITE-51Y ITE-51Y ITE-51Y ITE-51Y ITE-51Y ITE-51Y ITE-51Y ITE-51Y ITE-50D	18.2.3-1D 18.2.3-3A
Instantaneous Overcurrent	ITE-50 ITE-50I ITE-50H	ITE-50 ITE-50 ITE-50D	18.2.3-5A 18.2.3-5A 18.2.3-3A
Directional	ITE-32 ITE-32D ITE-32Q	ITE-32 ITE-32 ITE-32	18.8.3-1B
Power	ITE-32R	ITE-32R	18.8.3-2A
Ground Fault Sensors	GS (All Sizes)	GS	18.1.3-6A
Ground Fault Relays	GR-5 GR-200 GRD GRM GRC & TMC	GR-5 GR-5 GRD GRM GRC & TMC	18.1.3-1B 18.1.3-1B 18.6.3-1A 18.1.3-3A 18.1.3-5A

FIGURE 1
IEEE STD 501 - STANDARD RESPONSE SPECTRUM

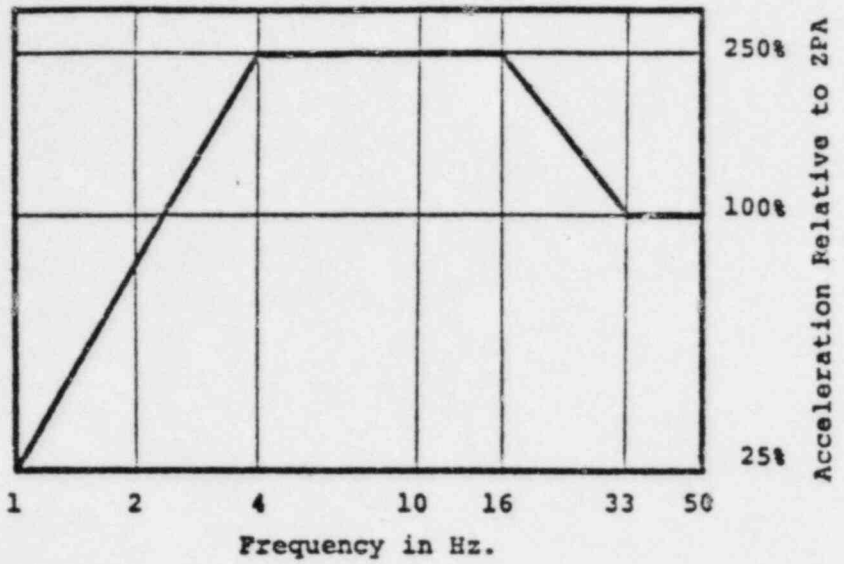


FIGURE 2
TEST RESPONSE SPECTRUM (TRS)
at 5% Damping,
Compared to Standard Response Spectrum (SRS)

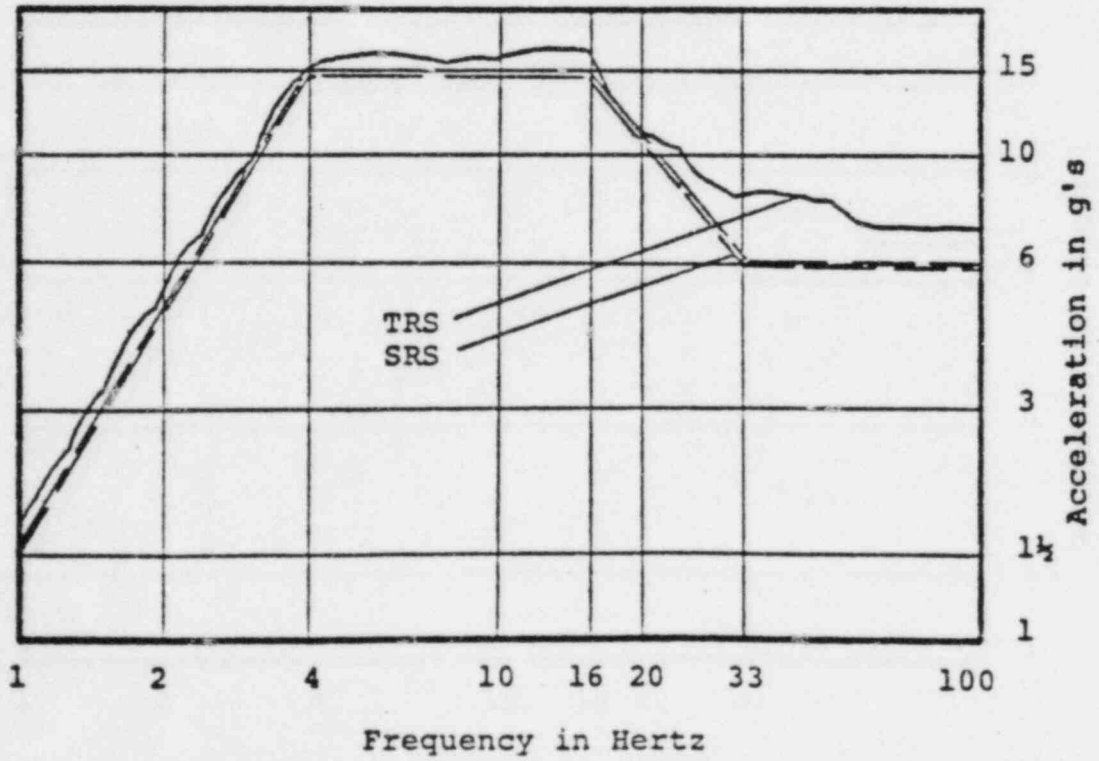
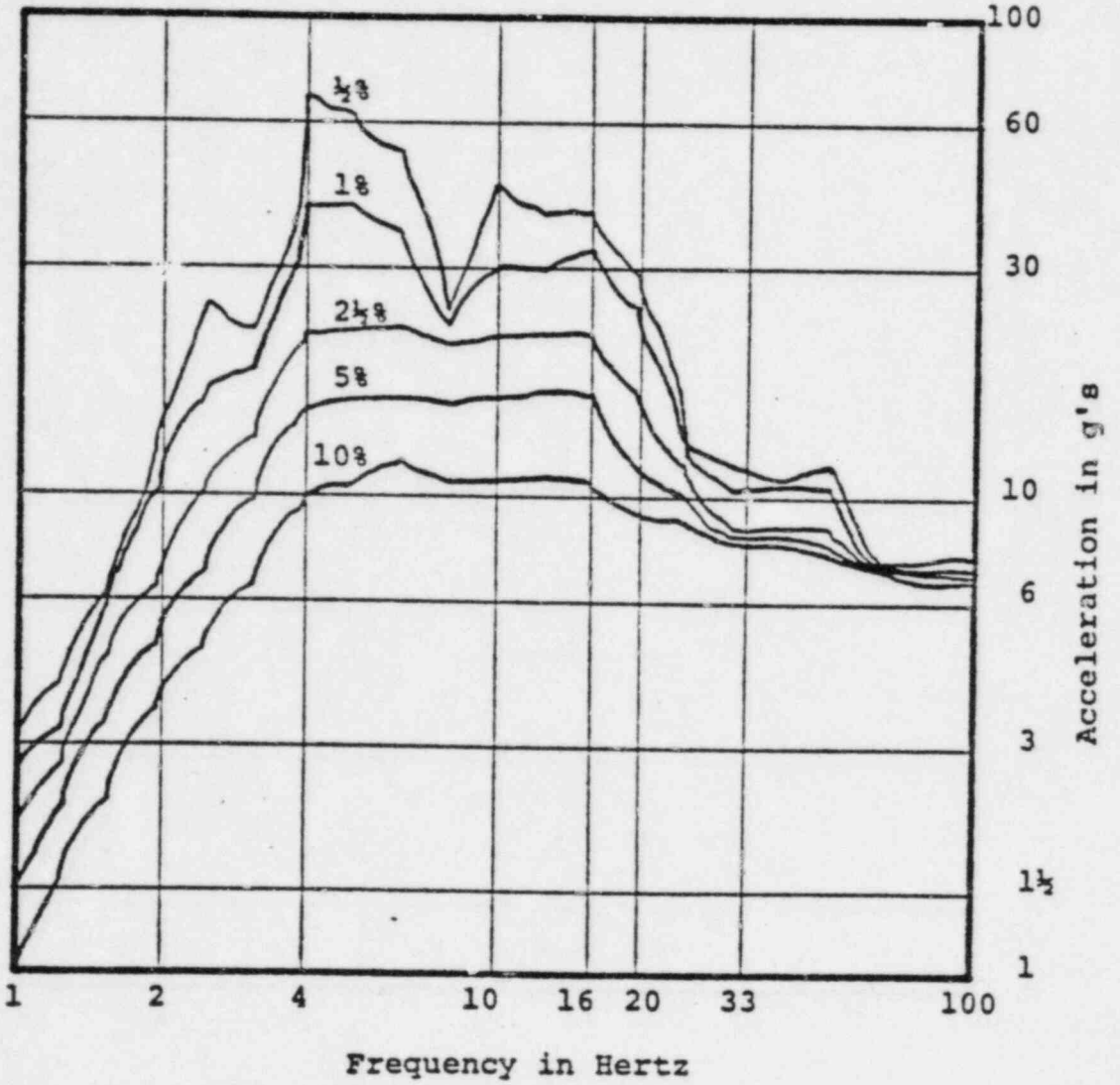


FIGURE 3
TEST RESPONSE SPECTRA
Analyzed at ½, 1, 2½, 5 and 10% Damping



Jim

Jim Waldron
Application Manager,
Protective Relays

Gould-Brown Boveri, Switchgear Division
Protective Relays
207 Witmer Road, Horsham, PA 19044
Telephone (215) 674-5990

GOULD-BROWN BOVERI

ATTACHMENT D

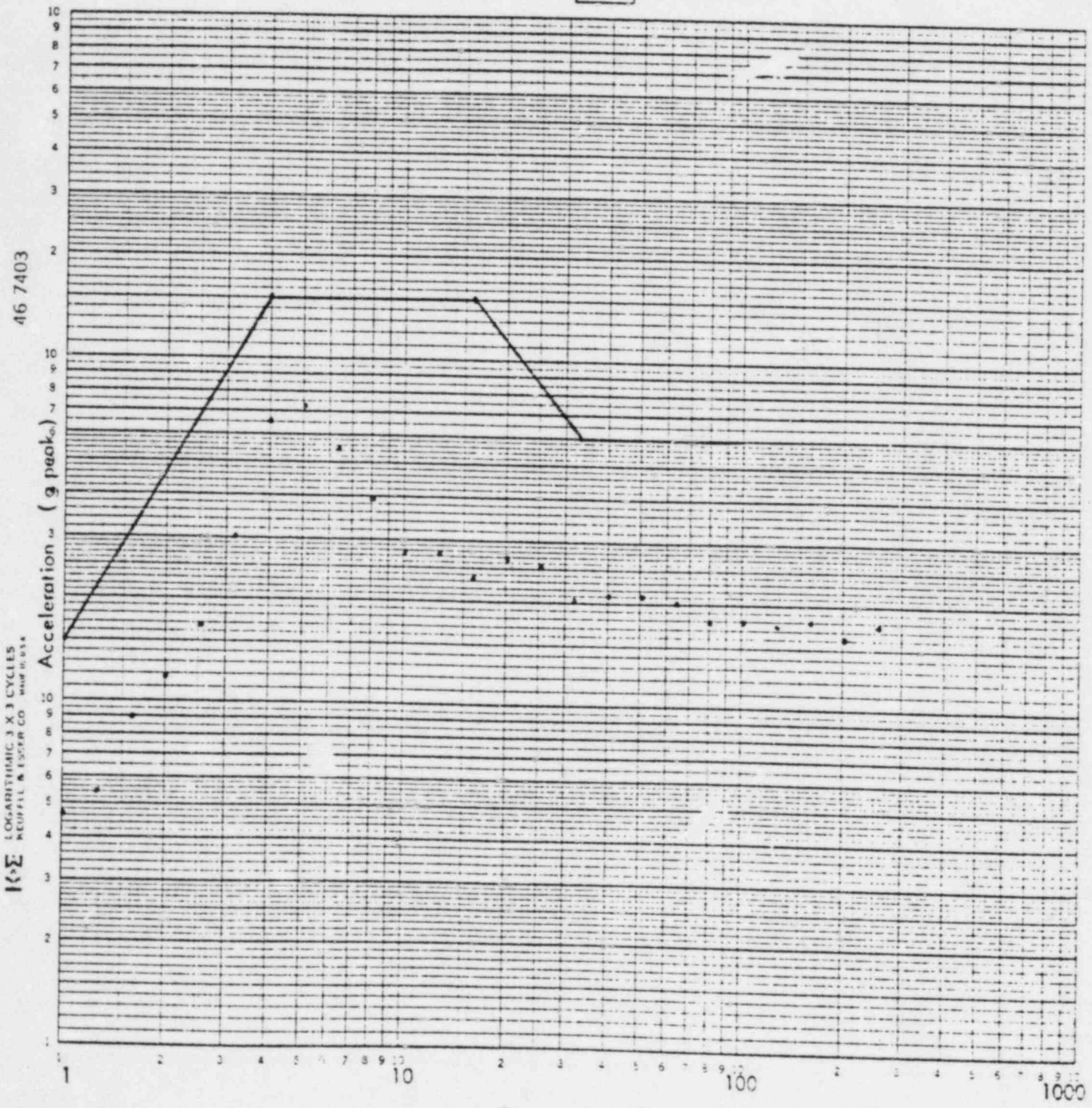
SSE TRS Curves for Specimen Mounted
Accelerometers from Seismic Test R-STS-16,
Wyle Report No. 43472-1

22

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



AXIS F-B | VERT

LOCATION NO. 3 F B

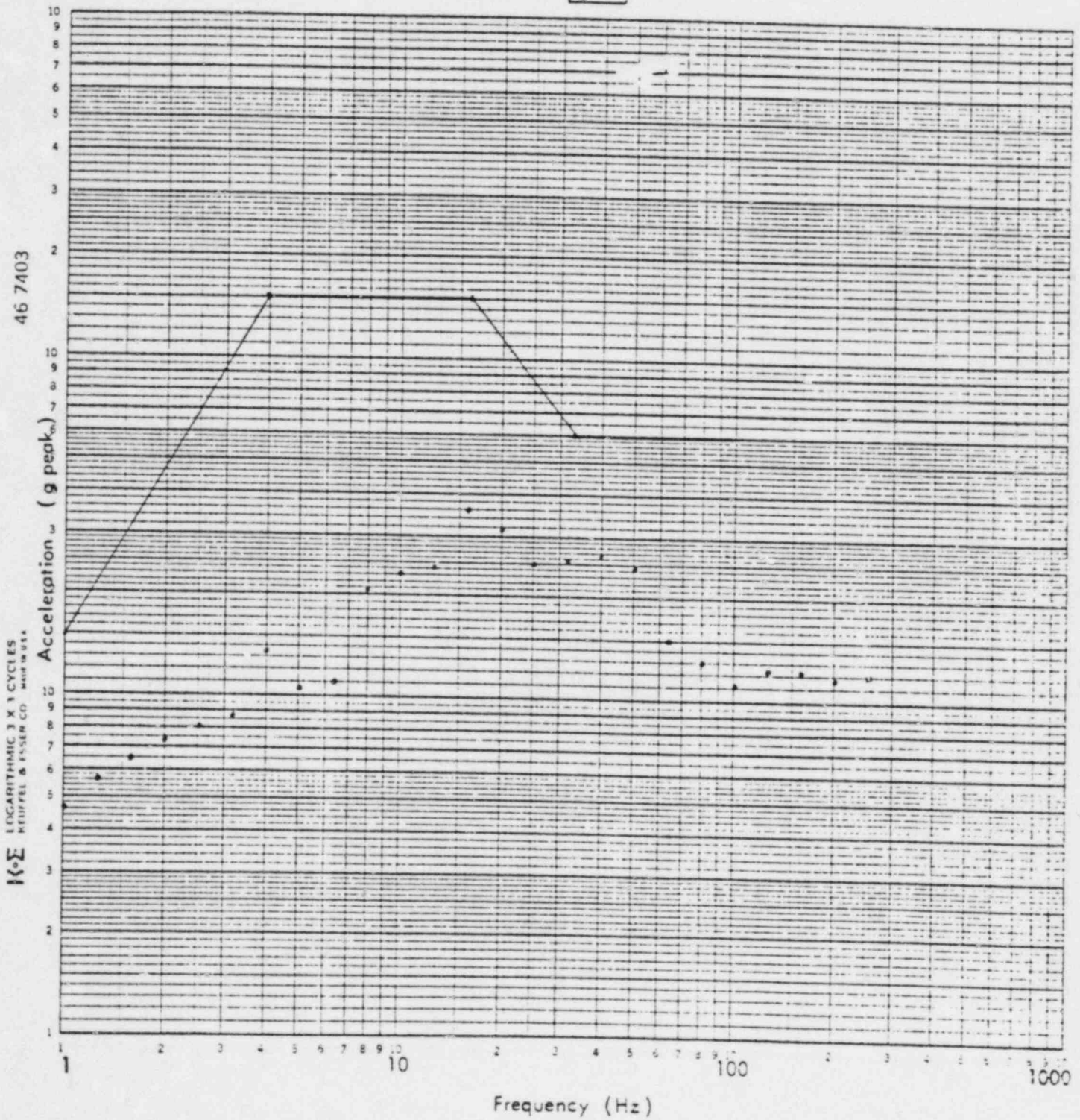
TEST RUN NO. 17

23

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



AXIS F.B/VERT

LOCATION NO. 10 V

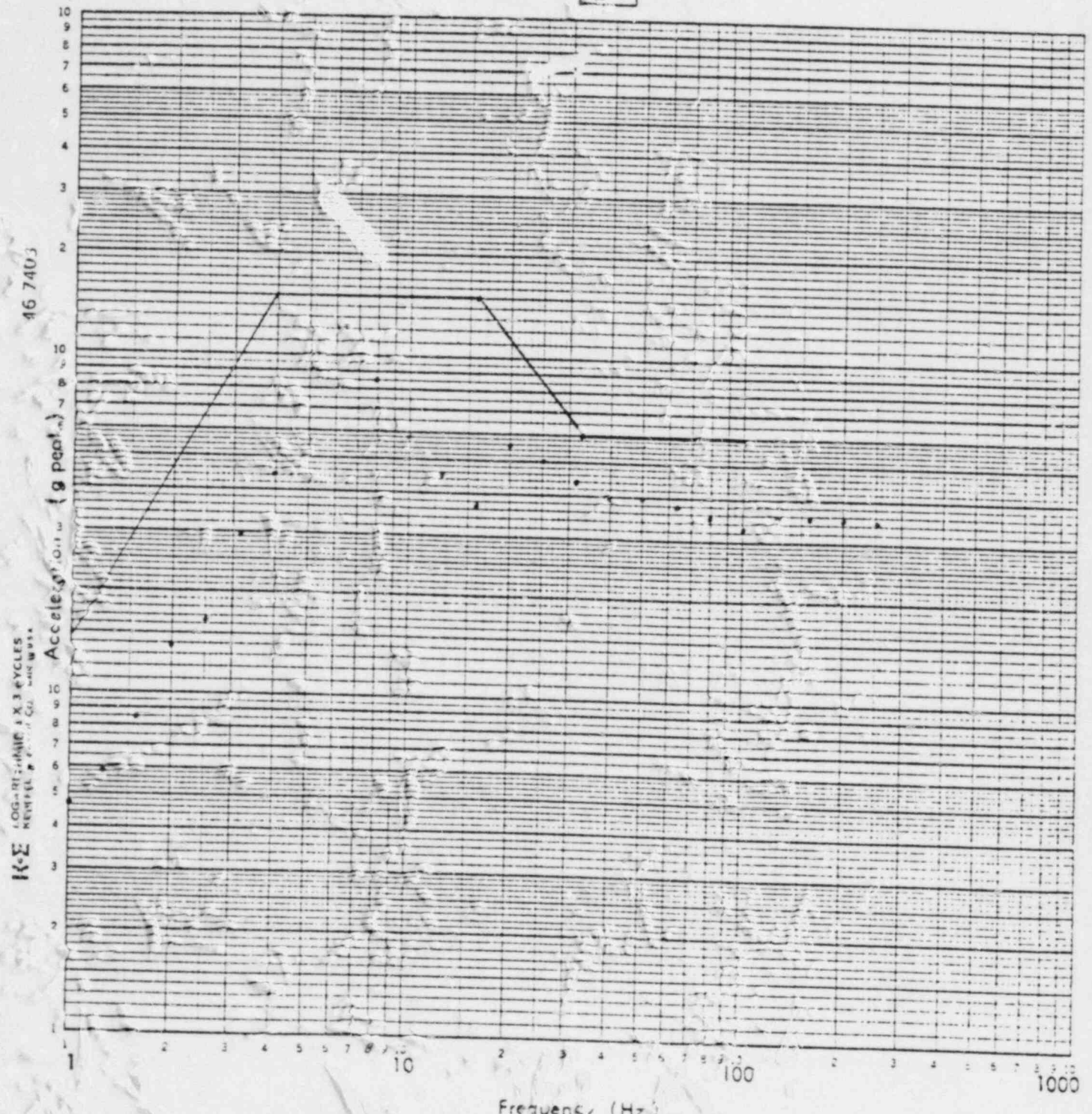
TEST RUN NO. 17

24

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5%



AXIS S-S / VERT

LOCATION NO. 3 S-S

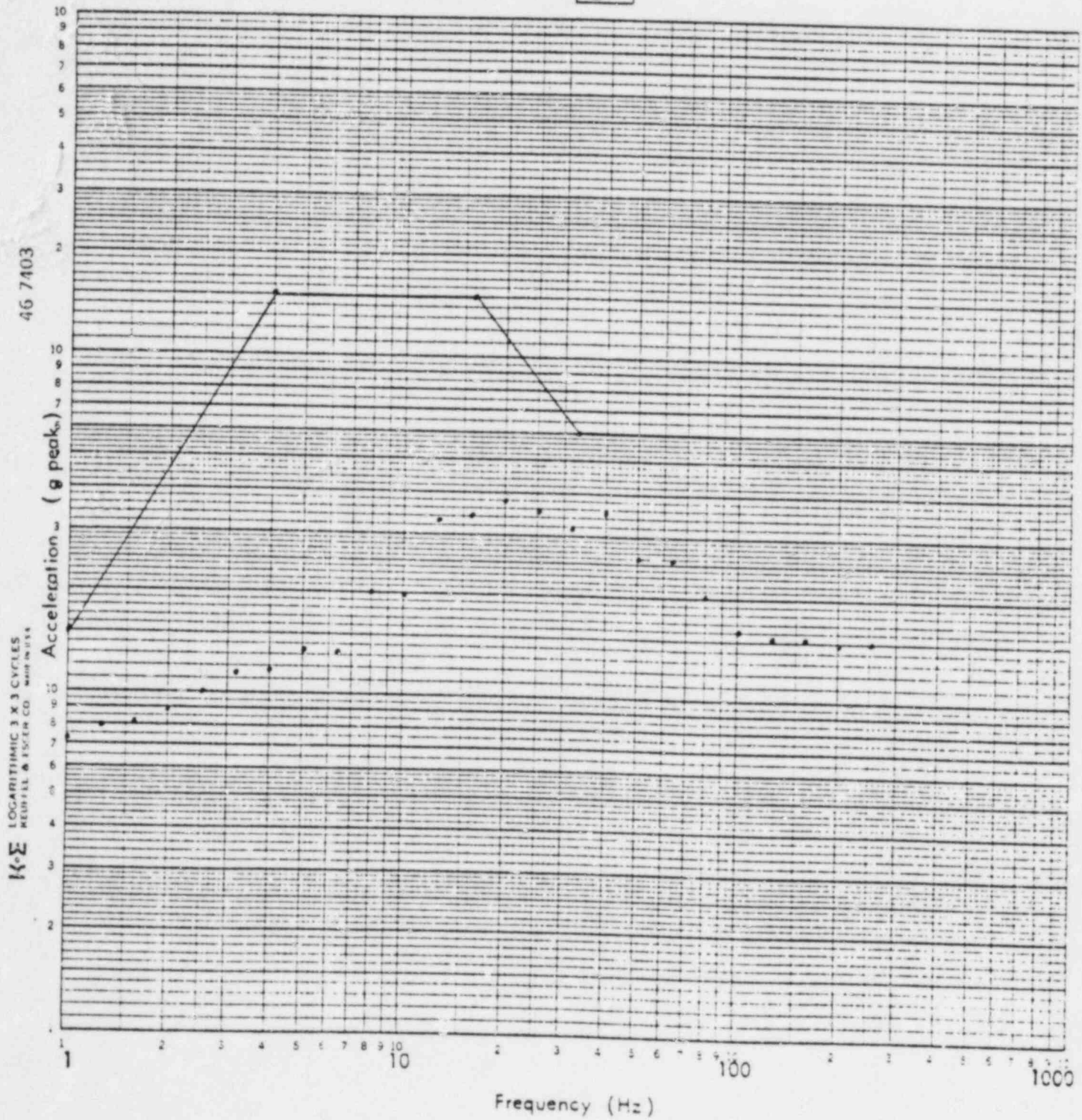
TEST RUN NO. 25

25

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



AXIS S-3/VERT

LOCATION NO. 10 V

TEST RUN NO. 25