PRELIMINARY ISSUE

Date 10/18/83

VIRGIL C. SUMMER NUCLEAR STATION

SEISMIC CONFIRMATORY PROGRAM

SAMPLE EXAMPLE 3

EQUIPMENT NAME & SYSTEM	:	Motor Control Center (Electrical)
EQUIPMENT TAG NO. AND LOCATION	:	XMC - 1DA2Y Auxiliary Building El. 412'
EQUIPMENT VENDOR	:	Square D
TESTED BY	:	Wyle Laboratories
QUALIFICATION REPORT #	:	92-2196
MARGIN AGAINST ACRS	:	4.80
MARGIN AGAINST ASLB	:	6.01

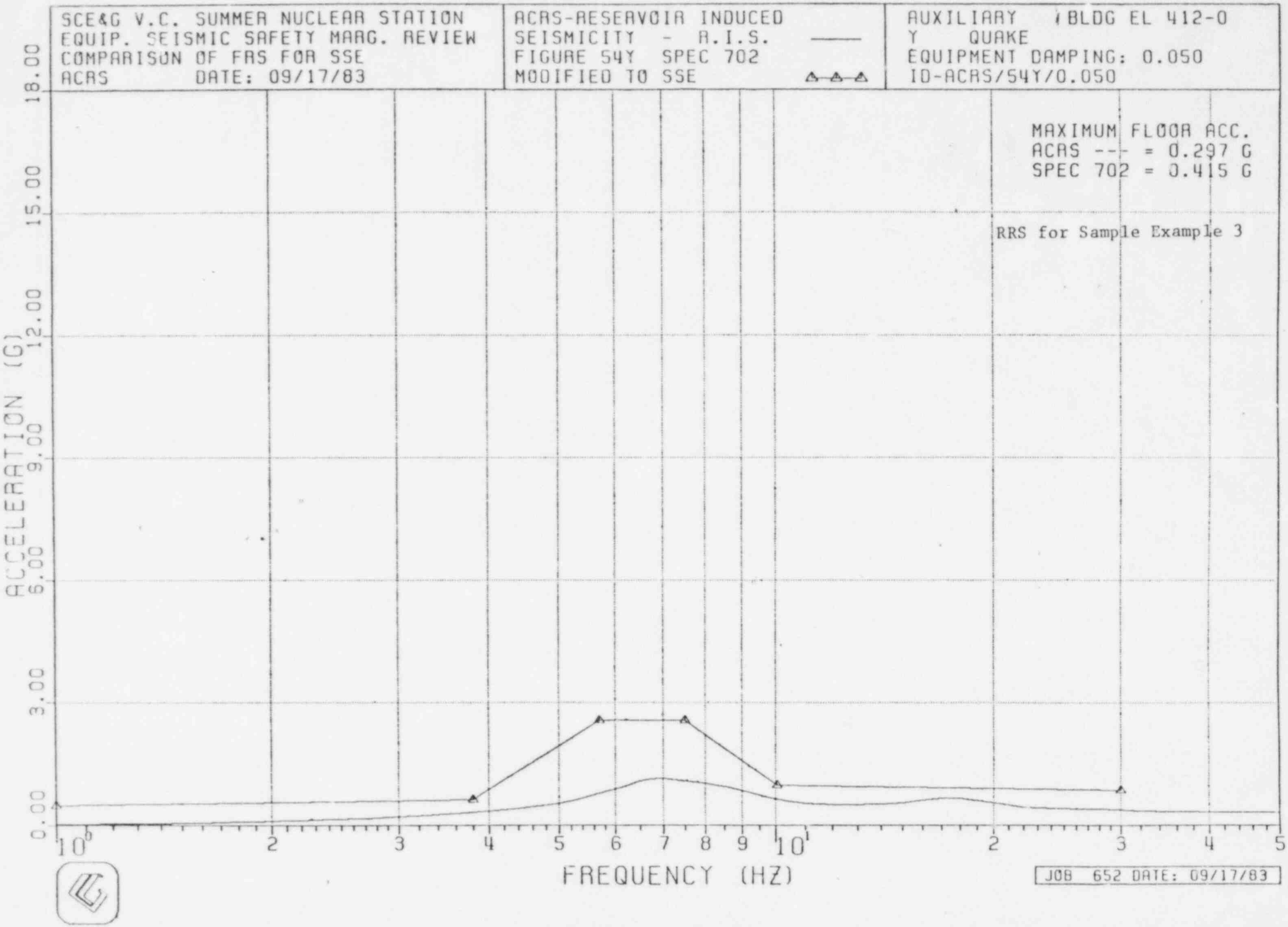
GILBERT / COMMONWEALTH
P. O. Box 1498
Reading, Pennsylvania 19603

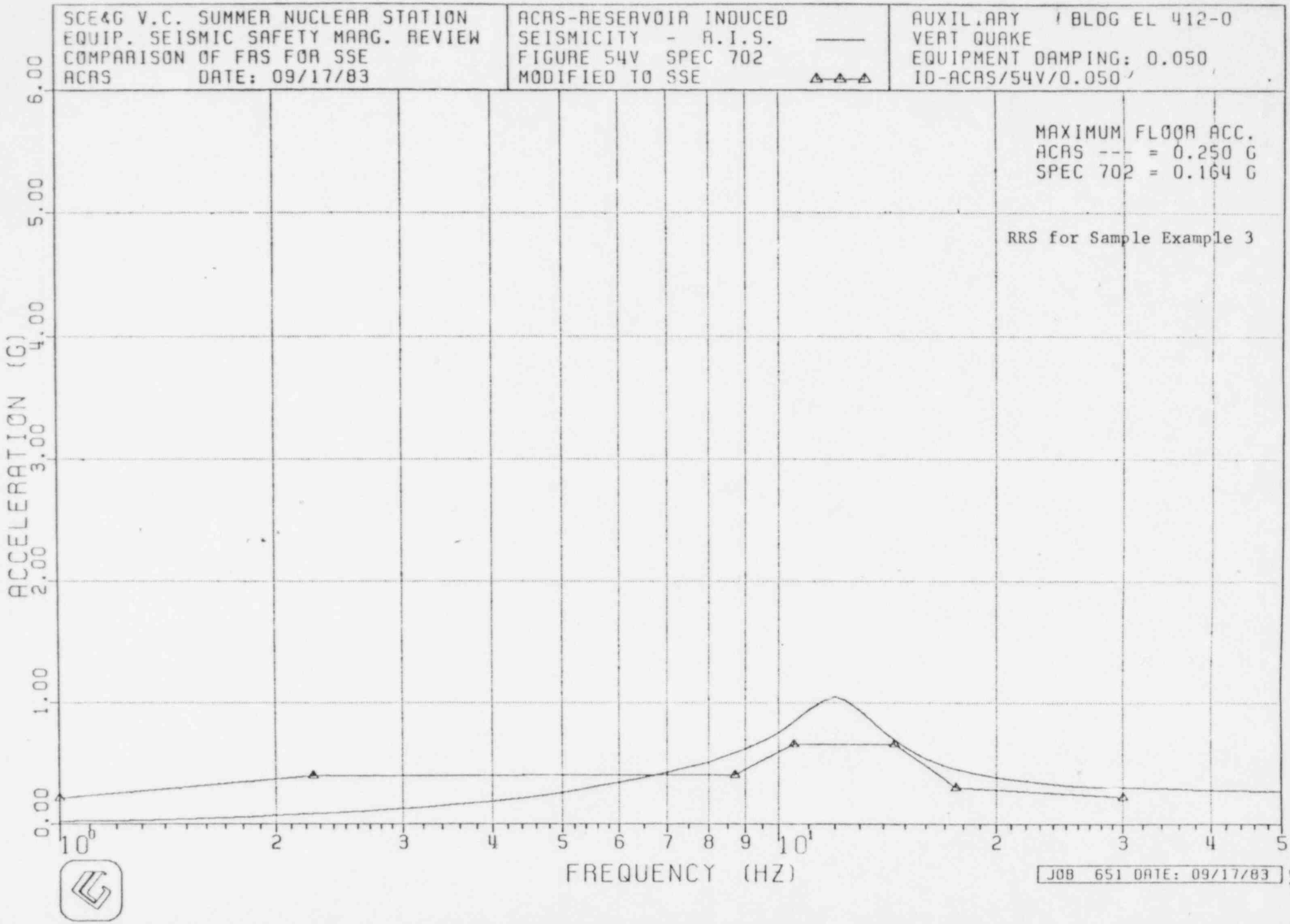
TABLE OF CONTENTS

A C R S

REQUIRED RESPONSE SPECTRA (RRS)

SAMPLE EXAMPLE 3


SCE&G V.C. SUMMER NUCLEAR STATION
EQUIP. SEISMIC SAFETY MARG. REVIEW
COMPARISON OF FRS FOR SSE
ACRS DATE: 09/17/83
ACRS-RESERVOIR INDUCED
SEISMICITY - R.I.S.
FIGURE 54Y SPEC 702
MODIFIED TO SSE
AUXILIARY BLDG EL 412-0
Y QUAKE
EQUIPMENT DAMPING: 0.050
ID-ACRS/54Y/0.050
MAXIMUM FLOOR ACC.
ACRS --- = 0.297 G
SPEC 702 = 0.415 G
RRS for Sample Example 3
ACCELERATION (G)
0.00
3.00
6.00
9.00
12.00
15.00
18.00
10⁰
2
3
4
5
6
7
8
9
10¹
2
3
4
5
FREQUENCY (HZ)
JOB 652 DATE: 09/17/83

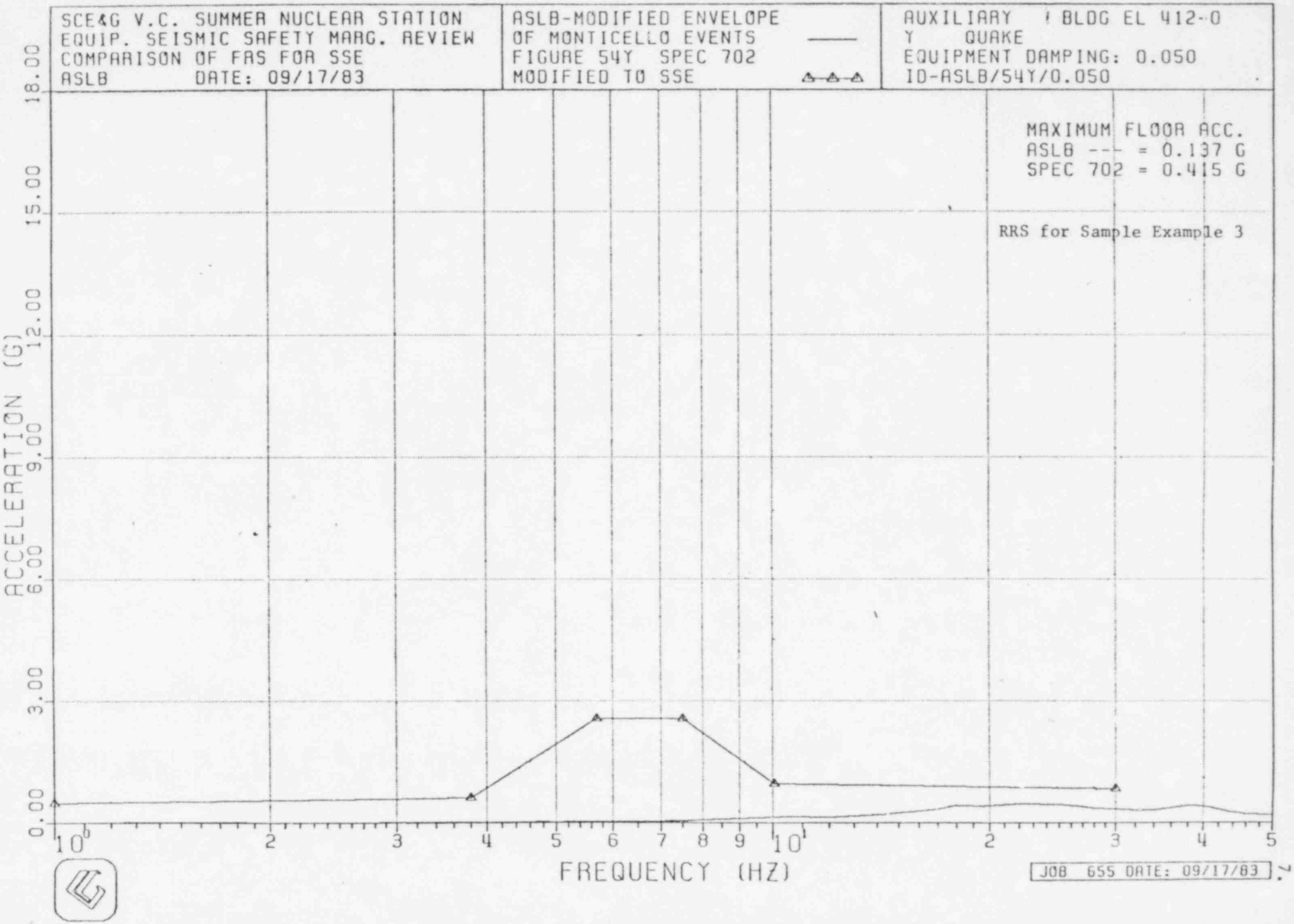


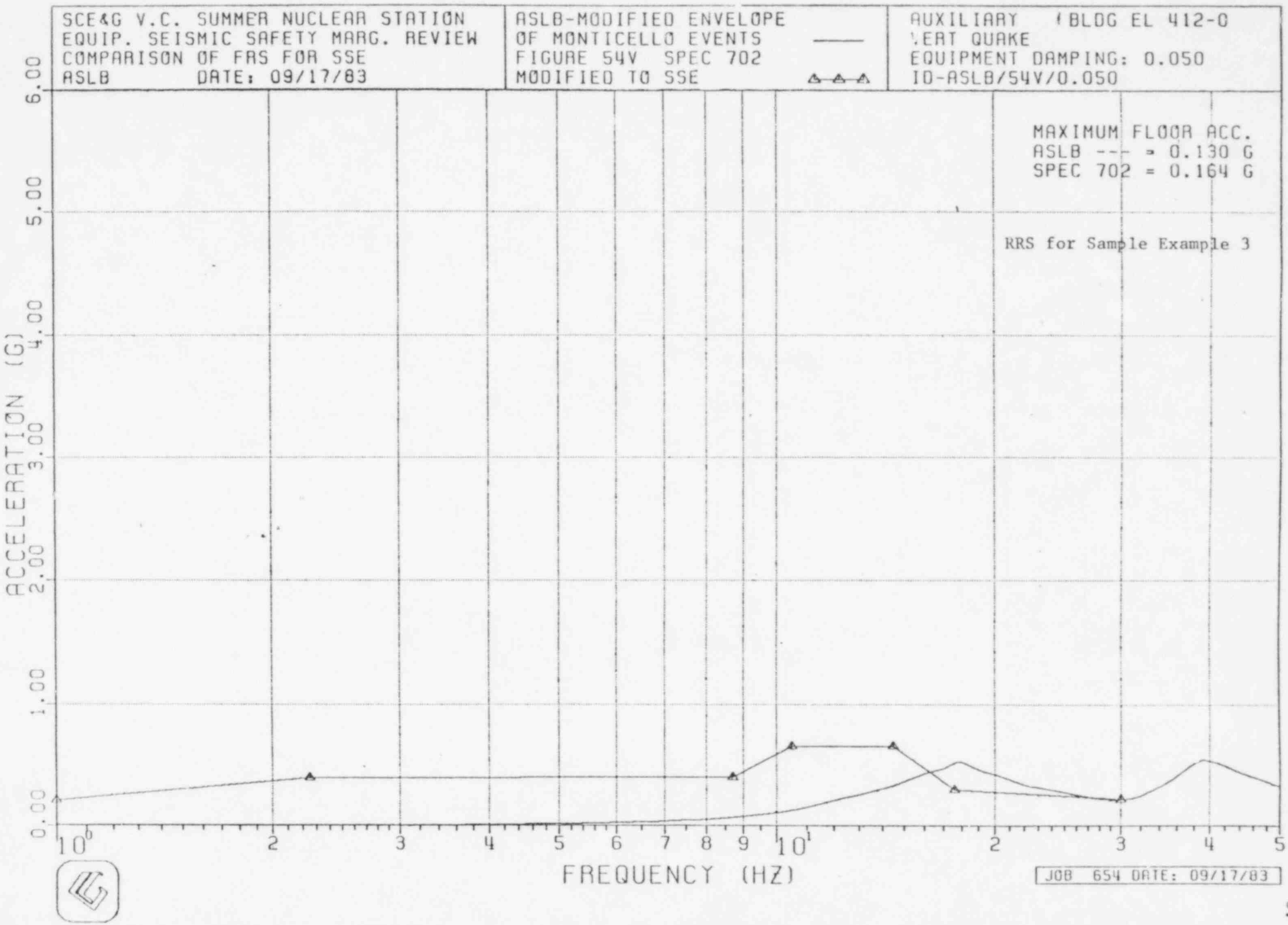
SCE&G V.C. SUMMER NUCLEAR STATION
EQUIP. SEISMIC SAFETY MARG. REVIEW
COMPARISON OF FRS FOR SSE
ACRS DATE: 09/17/83
ACRS-RESERVOIR INDUCED
SEISMICITY - R.I.S.
FIGURE 54V SPEC 702
MODIFIED TO SSE
AUXILIARY BLDG EL 412-0
VERT QUAKE
EQUIPMENT DAMPING: 0.050
ID-ACRS/54V/0.050
MAXIMUM FLOOR ACC.
ACRS --- = 0.250 G
SPEC 702 = 0.164 G
RRS for Sample Example 3
ACCELERATION (G)
0.00
1.00
2.00
3.00
4.00
5.00
6.00
FREQUENCY (HZ)
10^0
2
3
4
5
6
7
8
9
10^1
2
3
4
5
JOB 651 DATE: 09/17/83

A S L B

REQUIRED RESPONSE SPECTRA (RRS)

SAMPLE EXAMPLE 3


SCE&G V.C. SUMMER NUCLEAR STATION
EQUIP. SEISMIC SAFETY MARG. REVIEW
COMPARISON OF FAS FOR SSE
ASLB DATE: 09/17/83
ASLB-MODIFIED ENVELOPE
OF MONTICELLO EVENTS
FIGURE 54Y SPEC 702
MODIFIED TO SSE
AUXILIARY BLDG EL 412-0
Y QUAKE
EQUIPMENT DAMPING: 0.050
ID-ASLB/54Y/0.050
MAXIMUM FLOOR ACC.
ASLB --- = 0.137 G
SPEC 702 = 0.415 G
RRS for Sample Example 3
ACCELERATION (G)
FREQUENCY (HZ)
JOB 655 DATE: 09/17/83


SCE&G V.C. SUMMER NUCLEAR STATION
EQUIP. SEISMIC SAFETY MARG. REVIEW
COMPARISON OF FRS FOR SSE
ASLB DATE: 09/17/83
ASLB-MODIFIED ENVELOPE
OF MONTICELLO EVENTS
FIGURE 54V SPEC 702
MODIFIED TO SSE
AUXILIARY BLDG EL 412-0
VERT QUAKE
EQUIPMENT DAMPING: 0.050
ID-ASLB/54V/0.050
MAXIMUM FLOOR ACC.
ASLB --- = 0.130 G
SPEC 702 = 0.164 G
RRS for Sample Example 3
ACCELERATION (G)
FREQUENCY (HZ)
JOB 654 DATE: 09/17/83

8

RELEVANT SEISMIC QUALIFICATION

REPORT INFORMATION FROM

SEISMIC QUALIFICATION REPORT

NO. 92-2196

CERTIFICATE OF
SEISMIC COMPLIANCE

Re: Virgil C. Summer Nuclear Station - Unit 1

Gilbert Associates, Inc. Specification No. 555-044461-000, Supplement Specification No. 702-4461-00

Purchase Order No. SN-10198-SR

This certifies that the enclosed report entitled "Seismic Qualification Report," for: Model 4 Motor Control Center, supplied for: Virgil C. Summer Nuclear Station - Unit 1, supplied by: Square D Company, Report No.: 8998-10.09-L12-R, written by: Deepak H. Bhatia, dated: May 24, 1977, provides the required documentation for Seismic Qualification of Square D Company Model 4 Motor Control Centers in accordance with the requirements of Gilbert Associates, Inc. Specification No. 555-044461-000, Supplement Specification No. 702-4461-00, for the Virgil C. Summer Nuclear Station - Unit 1.

The information contained in this report is the result of complete and carefully conducted tests and is to the best of our knowledge true and correct in all respects.

D G Fischer

D. G. Fischer
Chief Engineer

W.G. Nollenberger

W. G. Nollenberger
Vice President/Group Manager
Power Equipment Group

Qualified engineering personnel, knowledgeable in the area of concern, have provided the necessary justifications to demonstrate the capability of the equipment to meet the seismic requirements of the referenced specification.

W. R. Wishard
Professional Engineer

No comments

ABSTRACT

SEISMIC TESTING OF A MODEL 4 MOTOR CONTROL CENTER

A Model 4 Motor Control Center was subjected to a Seismic Simulation Test Program to withstand the stringent seismic environment expected at the Virgil C. Summer Nuclear Station - Unit 1. The seismic testing was conducted in accordance with the Square D Company's Test Plan - Peru Project Number 8998-10.01-L12, Revision 1, dated January 7, 1977, and Wyle Laboratories' Seismic Test Plan 541/5793/ES, dated January 11, 1977, Revision A, at Wyle Laboratories in Huntsville, Alabama, from February 24, 1977 through February 26, 1977.

A representative five-section test-module, hereinafter called the specimen, was tested with at least one sample of each family and size of unit. There was a shipping split between the third and the fourth section, thus the test-module was tested as two structures. The specimen was welded to the Wyle Multiaxis Seismic Simulator Table. The specimen was tested in side-to-side versus vertical and front-to-back versus vertical axes orientations, respectively. Sine-Sweep Tests with low-level, biaxial input (approximately 0.2g horizontally and vertically) were conducted from 1 HZ to 35 HZ at the sweep rate of ½ octave per minute. Random Multifrequency Tests (biaxial) were conducted to produce the Test Response Spectra (TRS) which would successfully envelop the Required Response Spectra (RRS) at five percent damping factor. Five Operating Basis Earthquake (OBE) tests, followed by two Design Basis Earthquake (DBE) tests were performed in both test axes orientations. Change-of-state of the coils (picked up and dropped out) of various devices was performed during the seismic excitations. During the Second DBE tests, the input power was reduced to 90% of the nominal 480 VAC (432 VAC) and the coils were picked up. Then the input power was further reduced to 65% of 480 VAC (312 VAC) and the coils were maintained picked up. Electrical monitoring channels were connected to the contacts of various devices to detect chattering and malfunctioning.

It was demonstrated that the specimen possessed sufficient integrity to withstand, without compromise of structural or electrical function, the prescribed simulated seismic environment. The following report consists of detailed test procedures, results, conclusions, photographs, calculations, and data concerning seismic testing.

No comment

The cables were sized on a best-effort basis to correspond to the devices' output terminals. For the MCC sections I through III, the cables were passed through the top of each section; for the MCC sections IV and V, the cables were passed through the top of section IV (refer to Photograph 1). The dummy cables coming out of each section were tied together and were supported four (4) feet above the top of the MCC by a crane. Load cable types and approximate lengths were as given in Table II.

3.4 Sine Sweep Tests

The purpose of these tests was to study the characteristics of the structures and its response to the input acceleration. Twenty-six (26) accelerometers placed at various locations (Figure 1) were used to ascertain the resonants or natural frequencies, amplification factors and the damping of the structures.

The specimen was mounted on the test table as explained in Section 3.1. Two control accelerometers (vertical VCA and horizontal HCA) were mounted on the table to read the input accelerations of the test table. The table was subjected to a low-level (0.2g horizontally and vertically) biaxial sine sweep in both the side-to-side/vertical and the front-to-back/vertical axes orientations. The sweep rate was one-half octave per minute over the frequency range of 1 HZ to 35 HZ. Two uniaxial accelerometers were mounted at each location, one accelerometer would read vertical acceleration, indicated as nV, another accelerometer would read horizontal acceleration, indicated as nH, e.g., 1V and 2H are the top vertical and horizontal accelerometers in the first column, respectively. The horizontal accelerometers labeled as nFB (front-to-back) and nSS (side-to-side) designate the orientation of the specimen during the testing. Photographs 1 and 2 show the specimen mounted in side-to-side/vertical and front-to-back/vertical orientations, respectively.

The response of each accelerometer was recorded on tape. The transmissibility plots are obtained by:

$$\text{Amplification} = \frac{nV}{VCA} \text{ or } \frac{nH}{HCA}$$

Then from the plot, the natural frequencies, magnification factors, and the damping at the location of the accelerometer are determined. The natural frequency "f_n" is determined by the peak amplitude of the transmissibility plot. This is when the resonance occurs. The magnification factor (Q_o) is also determined at the resonant frequency. This provides the maximum magnification of the input that will occur in the desired frequency range. Generally, a peak magnification of 2.0 or greater ratio is considered as a resonance.

The damping factor "ζ" is calculated by the half-powered band-width method. The process to determine the damping factor in terms of percent of critical damping is as follows:

$$\text{Damping factor, } \zeta = \frac{f_2 - f_1}{2f_n} \times 100$$

where,

f_1 and f_2 are the frequency at which $Q = \frac{Q_o}{\sqrt{2}}$

Q_o = Resonant Magnification Factor

f_n = Resonant Frequency

The band-width method is less accurate for a damping factor greater than 10%.

Upon completion of the required sequence of tests, the specimen was rotated 90 degrees in the horizontal plane and the required sequence of tests were repeated. The transmissibility plots for 26 accelerometers in side-to-side, vertical and front-to-back, vertical axes are given in Appendix II.

3.5 Random Multifrequency Tests

The random multifrequency tests were conducted to qualify the specimen for the specified RRS at the OBE and the DBE levels for the V. C. Summer Nuclear Station - Unit #1. Figures 2 through 5 show the RRS curves at five percent (5%) damping factor in horizontal and vertical axes at OBE and DBE levels, respectively.

The specimen was mounted on the test table in the S-S/V axes orientation (Photograph 1). The specimen was subjected to simultaneous horizontal and vertical inputs of random motion consisting of frequency bandwidths spaced one-third (1/3) octave apart over the frequency range of 1 HZ to 35 HZ. The amplitude of each one-third (1/3) octave frequency bandwidth was checked and independently adjusted in each axis until the TRS exceeds 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 (1/3) octave frequency intervals over the frequency range of interest.

Five (5) tests were conducted at the OBE level, out of which the first four tests were conducted for a duration of 30-seconds and the final OBE test was conducted for a duration of 45-seconds, respectively. First and second OBE tests were conducted with the devices monitored in Condition A for the first 10 seconds and in Condition B for the last 20 seconds. (Conditions A and B are as described in Paragraph 3.2). Third and fourth OBE tests were conducted with the devices monitored in Condition B for the first 10 seconds and in Condition A for the last 20 seconds. The final OBE test was the same as the first DBE test described below.

Two (2) 45-second duration tests were conducted at the DBE level. The first DBE level test was performed with the devices monitored in Condition A for the first 5 seconds, in Condition B for the next 20 seconds, and finally in Condition A for the last 20 seconds. The second DBE level test was performed with the varying input power during the seismic excitations. The purpose of this test was to pick up the coils of the monitored devices at 90% and maintain the coils picked up at 65% of the nominal 480 VAC. This was achieved in the following manner:

a. Due to the current limit of the three phase voltage variable transformer, the electrical loads on the FD 401, EC 401 and EF 404 Starter Units were removed.

b. The reversing starter coil of the FD 401 Starter Unit and Contactor II coil of the Emergency X-Fer Unit were de-energized prior to the test by disconnecting the coil and opening the feeder breaker supplying power to the Contactor II, respectively.

c. The input power was reduced to 432 VAC (90% of the nominal 480 VAC) and the devices were tested in Condition A for approximately the first 5 seconds.

d. The condition of the devices was changed to Condition B and the coils of the monitored devices were picked up. After approximately 5 seconds, the input power was further reduced to 312 VAC (65% of the nominal 480 VAC). The coils were held picked up for approximately the next 10 seconds. Then, the input power was raised back to 432 VAC and was maintained for the next 5 seconds.

e. Finally, the devices were monitored in Condition A for the last 20 seconds of the 45-second duration DBE level test.

Upon completion of the required series of tests in S-S/V axes orientation, the specimen was rotated 90 degrees in the horizontal plane. The series of tests in F-B/V axes orientation were performed.

The TRS plots at five percent (5%) damping in the S-S/V and F-B/V axes orientations are given in Appendix III.

4. RESULTS

This section describes the performance of the devices and the structures, characteristics of the structures calculated from the structural response, and the qualification of the specimen for the required job. The following are the results of each test performed:

4.1 Sine-Sweep Tests

The specimen was welded to the test table in the S-S/V and then F-B/V axes orientations as explained in Section 3.1. A low-level (approximately 0.2g horizontally and vertically) biaxial sine sweep was performed in both the S-S/V and F-B/V orientation to determine specimen resonant frequencies. The sweep rate was one-half octave per minute over the frequency range of 1 HZ to 35 HZ. It was demonstrated that the specimen possessed sufficient integrity to withstand, without any mechanical or electrical compromise, the resonant search tests.

The description of each resonant search test including the test number, orientation and input acceleration are given in Table III.

Transmissibility plots for each specimen mounted accelerometer (divided by the control accelerometers) from resonant search tests are presented in Appendix II.

The specimen damping factors were calculated by the half-powered bandwidth method as explained in Section 3.4. The data to calculate the damping was obtained from the transmissibility plots for the accelerometers at the highest location on the specimen.

a. During Test Number 1, the specimen was mounted in S-S/V axes orientation. The highest located vertical accelerrometer was 25V. It did not experience any resonance in the vertical axis.

b. The specimen's resonant frequencies in the horizontal (S-S) axis were calculated from the Accelerometer 26SS, which was the uppermost horizontal accelerometer. There were two modes of vibration in this axis. The first mode resonant frequency was 6.2 HZ and the damping was 9.7% of the critical damping. The second mode resonant frequency was 24.0 HZ and the damping factor was 10.4%.

c. During Test Number 13, the specimen was mounted in F-B/V axes orientation. The specimen's resonant frequency in the vertical axis (read from the accelerometer 25V) was 32.0 HZ and the damping factor was 14.0%.

d. The specimen's resonant frequencies in the horizontal (F-B) axis were calculated from the Accelerometer 26 F-B.

NU Comment

There were three modes of vibration in this axis. The first mode resonant frequency was 4.4 HZ and the damping factor was 2.4%. The second mode resonant frequency was 19.5 HZ and the damping was 2.6% of the critical damping. The third mode resonant frequency was 21.0 HZ and the damping factor was 0.4%.

Specimen Response Results

Test	Axes	Accelerometer	F_n	Q_o	Damping Factor
1	SS/V	25V	None	-	-
1	SS/V	26SS	6.2	3.7	9.7
1	SS/V	26SS	24.0	2.2	10.4*
13	FB/V	25V	32.0	4.4	14.0*
13	FB/V	26FB	4.4	12.1	2.4
13	FB/V	26FB	19.5	5.2	2.6
13	FB/V	26FB	21.0	9.0	0.4

*Damping factors calculated by the bandwidth method are less accurate at values greater than 10%.

It should be noted that the resonance above 35 HZ were not considered, since these were out of the interested frequency range.

4.2 Random Multifrequency Tests

The object of these tests was to successfully envelop the TRS at the OBE and the DBE levels, as explained in Section 3.5. The specimen demonstrated sufficient integrity to withstand, without any structural or electrical failure, the specified seismic environment.

The purpose of five (5) OBE level tests was to see the effect of low intensity earthquakes to the performance of the equipment; also to seismically age the specimen as required for IEEE 323-1974. Four (4) 30-second duration and one (1) 45-second duration OBE level tests were performed under combined Conditions A and B as explained in Section 3.5. The change of state of contacts was performed during the event of seismic excitations. Two (2) 45-second DBE level tests were performed under combined Conditions A and B with the change of state of contacts as explained in Section 3.5. All the R.M.F. tests were performed in each axes orientation. The TRS were plotted at five percent (5%) damping.

The first series of R.M.F. tests were conducted in the S-S/V axes orientation. Four (4) 30-second duration tests (Test Numbers 5 through 8) were performed at the OBE level. One (1) 45-second duration test (Test Number 9) was performed at the

OBE level. There was no structural or electrical damage experienced.

The first DBE level test (Test Number 10) was performed for a 45-second duration. The second DBE level test (Test Number 12) was performed for a 45-second duration. The purpose of this DBE level test was to pick up the coils of the monitored starters and relays at 432 VAC (90% of the full voltage of 480 VAC), and maintain the coils picked up at 312 VAC (65% of 480 VAC) for at least 10 seconds duration during the seismic excitations. The above listed DBE level tests were performed successfully without any structural or electrical damage. However, C-phase output of the FD 401 Motor Starter (Channel 3) exhibited contact chatter of up to 35 milliseconds in duration during Test Number 12.

The second series of R.M.F. tests were conducted in the F-B/V axes orientation. Four (4) 30-second duration tests (Test Numbers 15 through 18) were performed at the OBE level. One (1) 45-second duration test (Test Number 19) was performed at the OBE level.

Two (2) 45-second duration tests (Test Numbers 20 and 21) were performed at the DBE level. The coils of the monitored starters and relays remained picked up during the input varying DBE level test. There was no structural or electrical damage experienced during the OBE and DBE level tests.

It was demonstrated that the specimen possessed sufficient integrity to withstand, without compromise of structure, the prescribed simulated seismic environment.

The R.M.F. tests are described including the test numbers, test axes, input accelerations and specimen electrical operations, in Table III.

TRS plots of the horizontal and vertical accelerometers analyzed at five percent (5%) damping for each OBE and DBE level tests are presented in Appendix III. TRS plots of the monitored horizontal and vertical accelerometers analyzed at five percent (5%) damping for one (1) DBE level test in each axes orientation (Test Numbers 10 and 20) are also presented in Appendix III.

No comments

5. CONCLUSIONS

We conclude that the performed seismic testing satisfies the requirements for the V. C. Summer Project. There were no structural, mechanical, or electrical failures detected during the sine sweep or R.M.F. tests. The MCC test-module was subjected to more severe simulated excitations, and different operating conditions than would be expected during its lifetime. Thus, these tests demonstrated the Model 4 Motor Control Center's ability to operate properly under the estimated seismic environment at the Virgil C. Summer Nuclear Generating Station - Unit #1, and to meet the stringent operational safety requirements specified by Gilberts Associates, Inc.

TABLE III

DESCRIPTION OF TESTS

TEST NO.	AXES	TYPE OF TEST	NOMINAL LEVEL	INPUT ACCELERATIONS (g's) HZPA	VZPA	REMARKS
1	SS/V	Sine Sweep	-	.2	.2	
2	SS/V	RMF	< OBE	2.1	.36	Specimen operated from condition A to Cond. B after 10 sec of the 30 sec test.
3	SS/V	RMF	< OBE	2.7	.52	Same operation as Test 2.
4	SS/V	RMF	< OBE	3.0	.36	Same operation as Test 2.
5	SS/V	RMF	OBE	2.4	.54	Same operation as Test 2.
6	SS/V	RMF	OBE	2.7	.40	Same operation as Test 2.
7	SS/V	RMF	OBE	2.6	.40	Specimen operated from Cond. B to Cond. A after 10 sec of test.
8	SS/V	RMF	OBE	2.6	.38	Same operation as Test 7.
9	SS/V	RMF	OBE	2.7	.75	Specimen operated as follows: Cond. A for 5-seconds, Cond B for 20 sec. and Cond. A for 20 sec. 45 sec. total test time.
10	SS/V	RMF	DBE	4.2	1.0	Same operation as Test 9.
11	SS/V	RMF	DBE	5.2	1.2	Specimen incorrectly operated by the Square D technical Representative. Repeat Test (see Test No. 12).
12	SS/V	RMF	DBE	4.5	.75	Started test in Cond. A with 3-phase input power at 432 vac. After 5 sec. of test, operated to Cond. B and then reduced power to 312 vac. After approx. 16 sec. at 312 vac, power was increased to 432 vac. After 8 more sec, the specimen was operated back to Cond. A. Up to 35 millisecond duration chatter on Ch. 3 (FD401).

TABLE III (Continued)

TEST NO.	AXES	TYPE OF TEST	NOMINAL LEVEL	INPUT ACCELERATIONS (g's) HZPA	VZPA	REMARKS
13	FB/V	Sine Sweep	---	.2	.2	
14 *	FB/V	RMF	<OBE	2.2	.30	Same operation as Test 2.
15	FB/V	RMF	OBE	2.7	.42	Same operation as Test 2.
16	FB/V	RMF	OBE	2.7	.44	Same operation as Test 2.
17	FB/V	RMF	OBE	2.4	.42	Same operation as Test 7.
18	FB/V	RMF	OBE	2.7	.48	No power to specimen.
19	FB/V	RMF	OBE	3.0	.75	Test duration of 45 sec. Same operation as Test 9.
20	FB/V	RMF	DBE	4.2	1.1	Test duration of 45 sec. Same operation as Test 9.
21	FB/V	RMF	DBE	4.5	1.3	Test duration of 45 sec. Same operation as Test 12.

*Chatter on Channels 17, 18 and 20

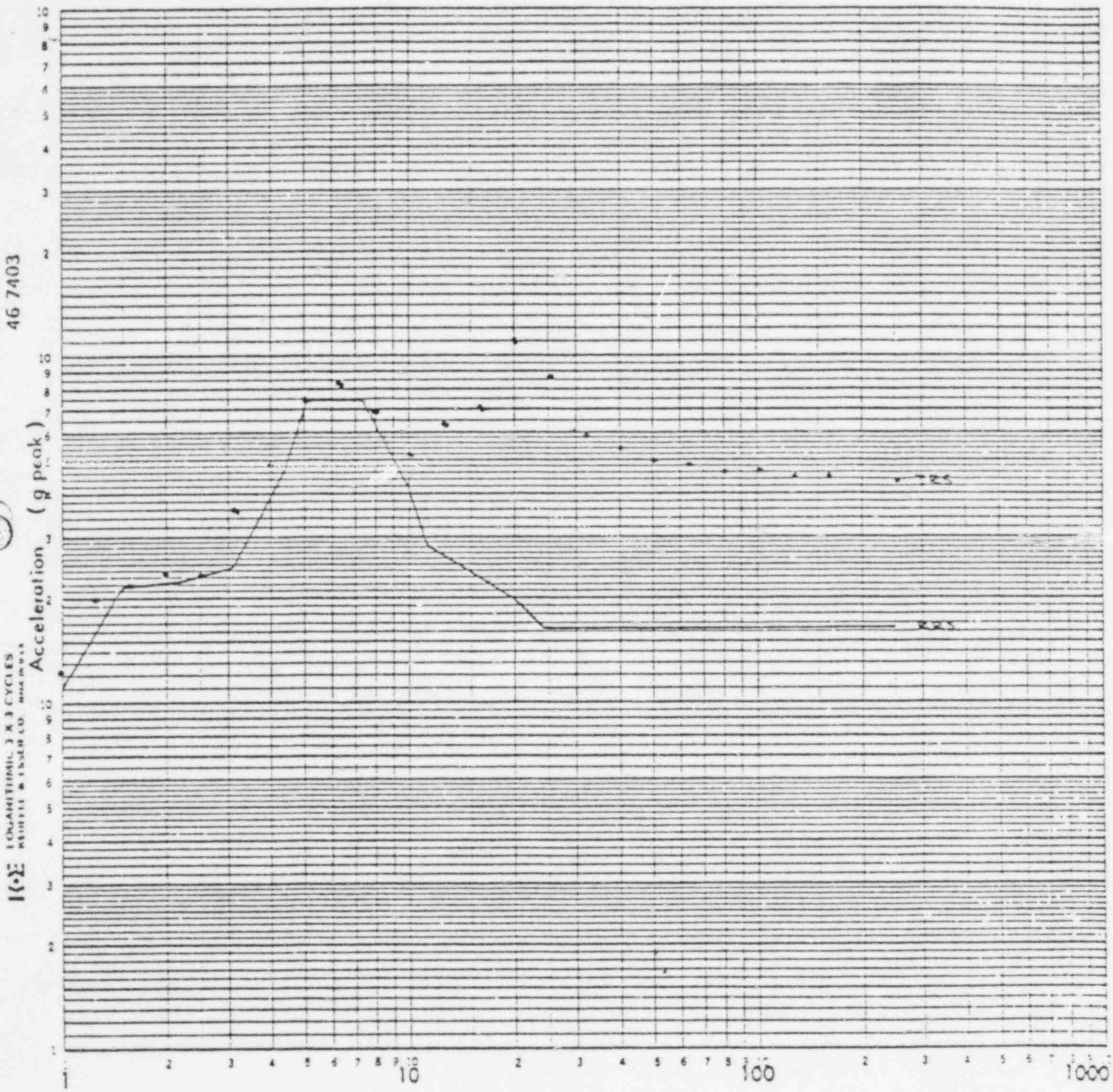
NOTE: During Test Nos. 11, 12 and 21, the coils of the FD401 Reversing Starter and the ETU Contactor II coil were de-energized prior to test by disconnecting the coil and opening the feeder breaker, respectively.

LEGEND:
- SS/V = Side-to-Side/Vertical
- FB/V = Front-to-Back/Vertical
- RMF = Random Multifrequency
- OBE = Operating Basis Earthquake
- DBE = Design Basis Earthquake
- HZPA = Horizontal Zero Period Acceleration
- VZPA = Vertical Zero Period Acceleration

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5%



AXIS SIDE TO SIDE / VERT

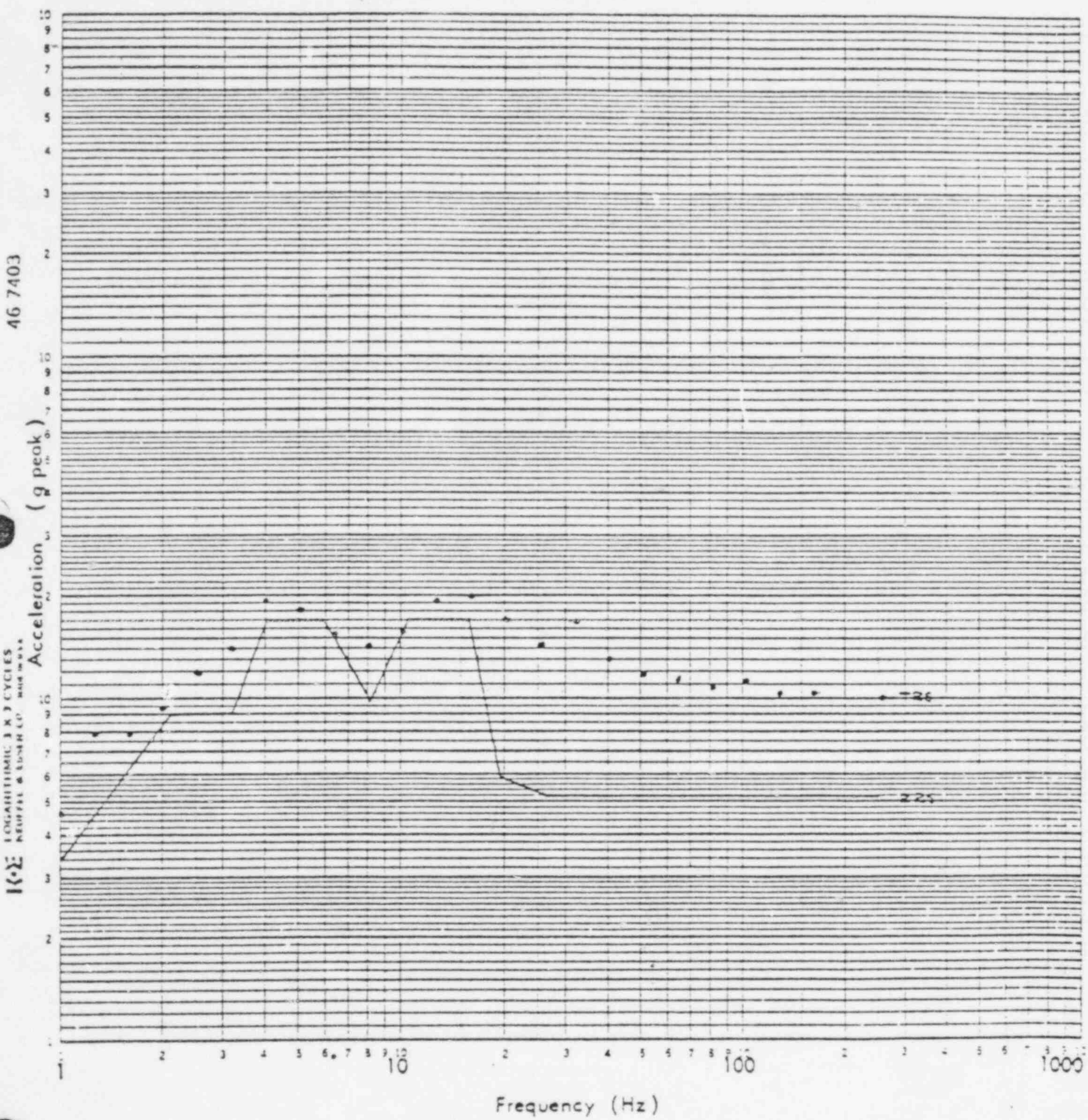
LOCATION NO. HCA

TEST RUN NO. 10

FULL SCALE SHOCK SPECTRUM (g Peak)

1.0 ☐ 10 ☐ 100 ☒ 1000 ☐

DAMPING 5 %



AXIS SIDE TO SIDE / VERT

LOCATION NO. VCA

TEST RUN NO. 10

COMPARISON PLOTS

OF

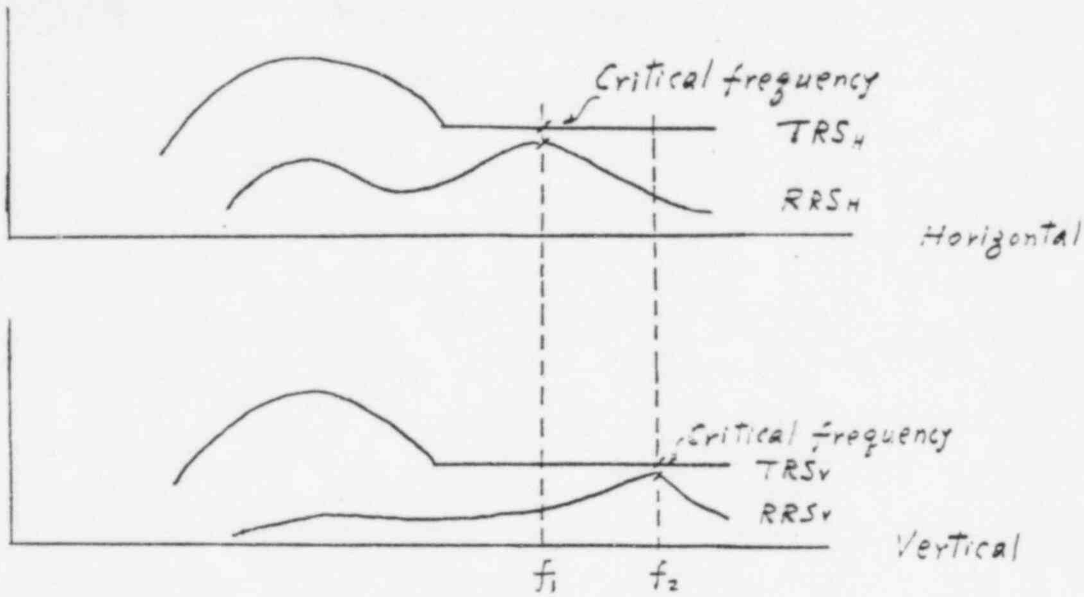
TRS AND RRS (ACRS)

AND

MARGIN CALCULATION

Margin for Equipment Qualified by Biaxial Test

Equipment margin can be calculated as shown below.



Calculate margin m_1, m_2 for frequencies f_1 and f_2 as

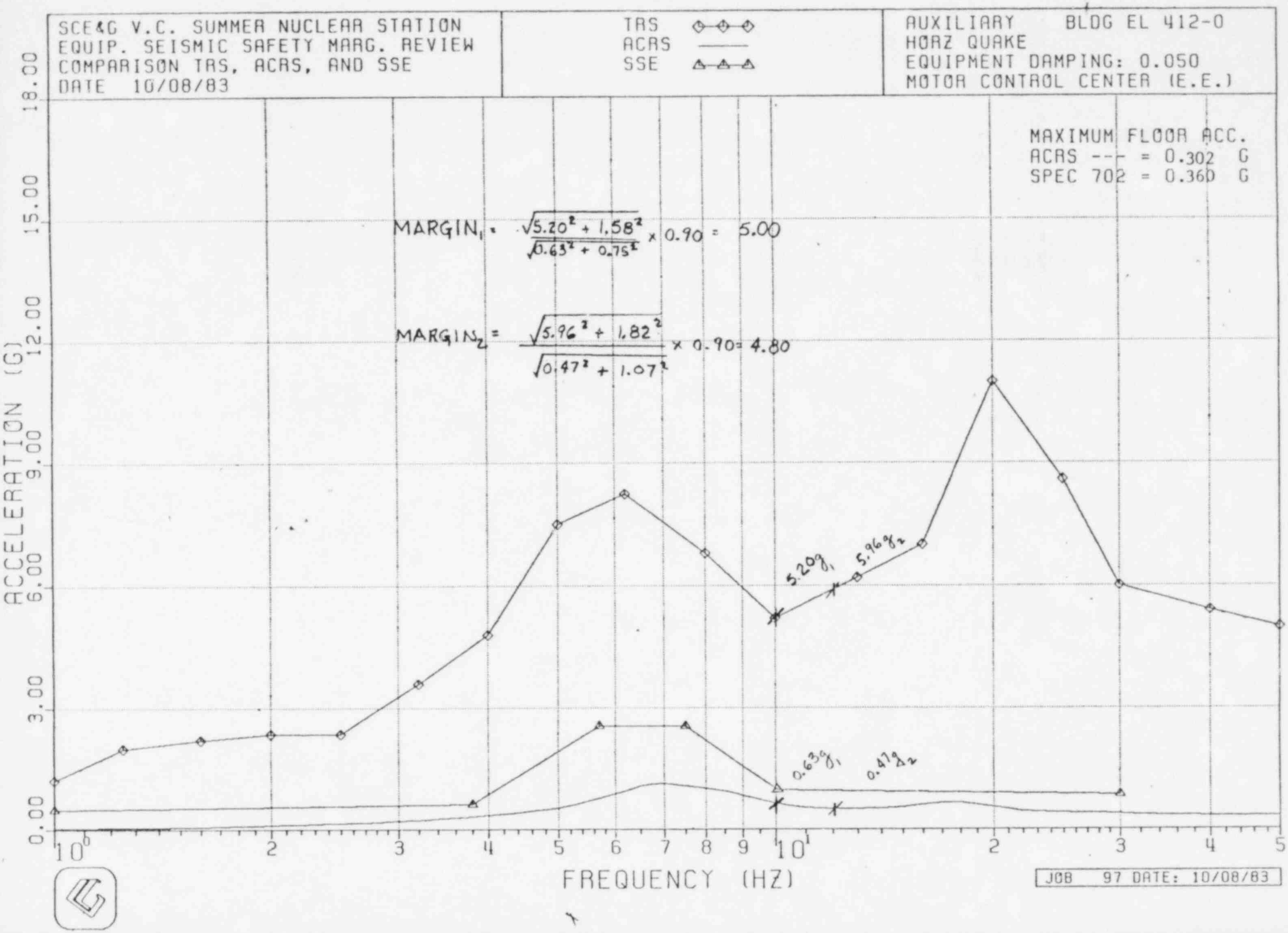
$$m_1 = \sqrt{(TRS_{Hf_1})^2 + (TRS_{Vf_1})^2} \Big/ \sqrt{(RRS_{Hf_1})^2 + (RRS_{Vf_1})^2} \times 0.9$$

$$m_2 = \sqrt{(TRS_{Hf_2})^2 + (TRS_{Vf_2})^2} \Big/ \sqrt{(RRS_{Hf_2})^2 + (RRS_{Vf_2})^2} \times 0.9$$

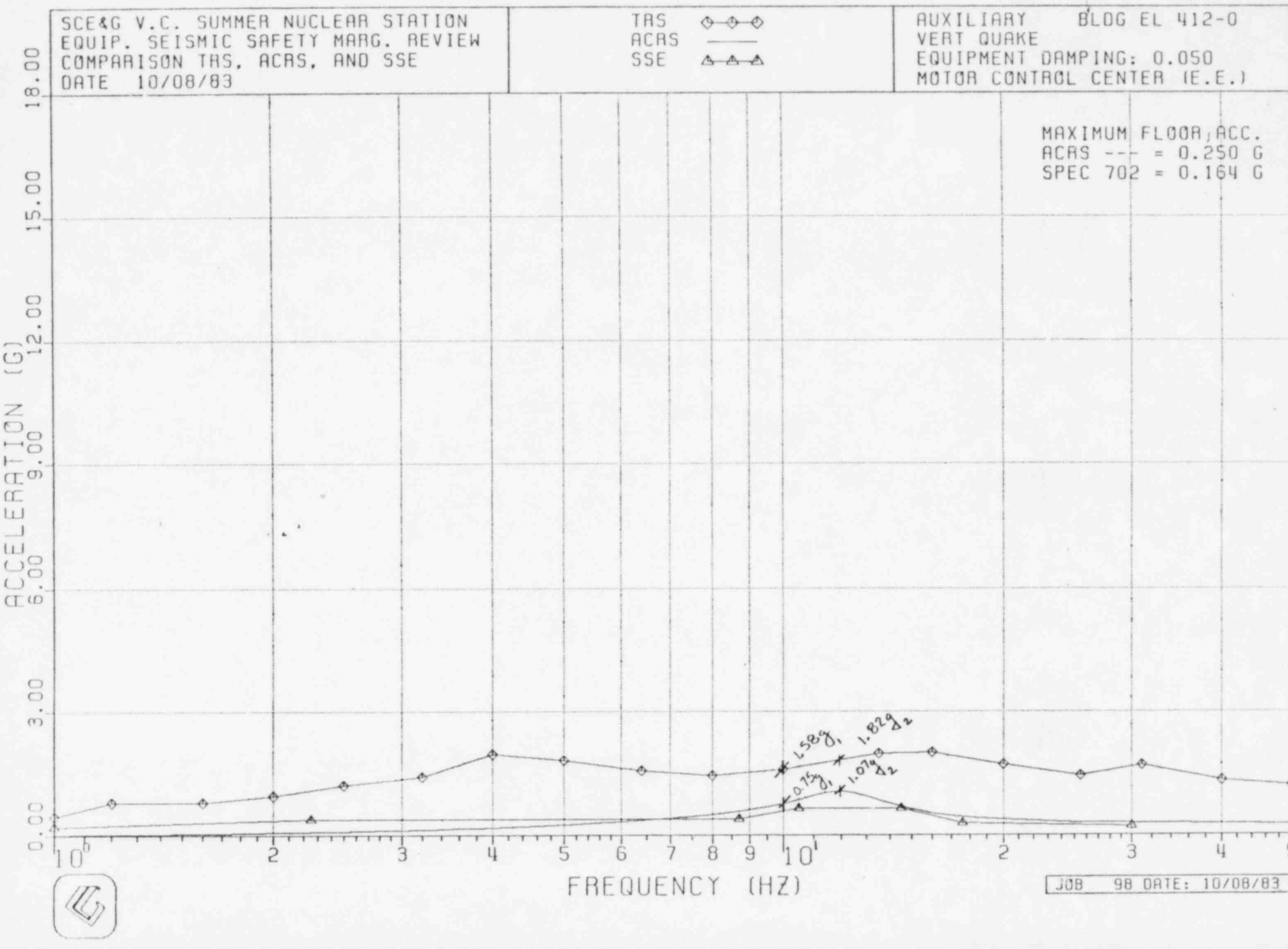
The smaller value of m_1 and m_2 is defined as the margin of the equipment.

Critical frequency is defined as the frequency which has the smallest TRS/RRS ratio.

A constant 0.9 is applied to incorporate the 10% increase of RRS.



SCE&G V.C. SUMMER NUCLEAR STATION
EQUIP. SEISMIC SAFETY MARG. REVIEW
COMPARISON TRS, ACRS, AND SSE
DATE 10/08/83
TRS
ACRS
SSE
AUXILIARY BLDG EL 412-0
HORZ QUAKE
EQUIPMENT DAMPING: 0.050
MOTOR CONTROL CENTER (E.E.)
MAXIMUM FLOOR ACC.
ACRS --- = 0.302 G
SPEC 702 = 0.360 G
$MARGIN_1 = \frac{\sqrt{5.20^2 + 1.58^2}}{\sqrt{0.63^2 + 0.75^2}} \times 0.90 = 5.00$
$MARGIN_2 = \frac{\sqrt{5.96^2 + 1.82^2}}{\sqrt{0.47^2 + 1.07^2}} \times 0.90 = 4.80$
$5.20g_1$
$5.96g_2$
$0.63g_1$
$0.47g_2$
ACCELERATION (G)
FREQUENCY (HZ)
JOB 97 DATE: 10/08/83


SCE&G V.C. SUMMER NUCLEAR STATION
EQUIP. SEISMIC SAFETY MARG. REVIEW
COMPARISON TRS, ACRS, AND SSE
DATE 10/08/83
TRS
ACRS
SSE
AUXILIARY BLDG EL 412-0
VERT QUAKE
EQUIPMENT DAMPING: 0.050
MOTOR CONTROL CENTER (E.E.)
MAXIMUM FLOOR ACC.
ACRS --- = 0.250 G
SPEC 702 = 0.164 G
1.58g f_1
1.82g f_2
0.75g f_1
1.07g f_2
ACCELERATION (G)
0.00
3.00
6.00
9.00
12.00
15.00
18.00
FREQUENCY (HZ)
10^0
2
3
4
5
6
7
8
9
10^1
2
3
4
5
JOB 98 DATE: 10/08/83

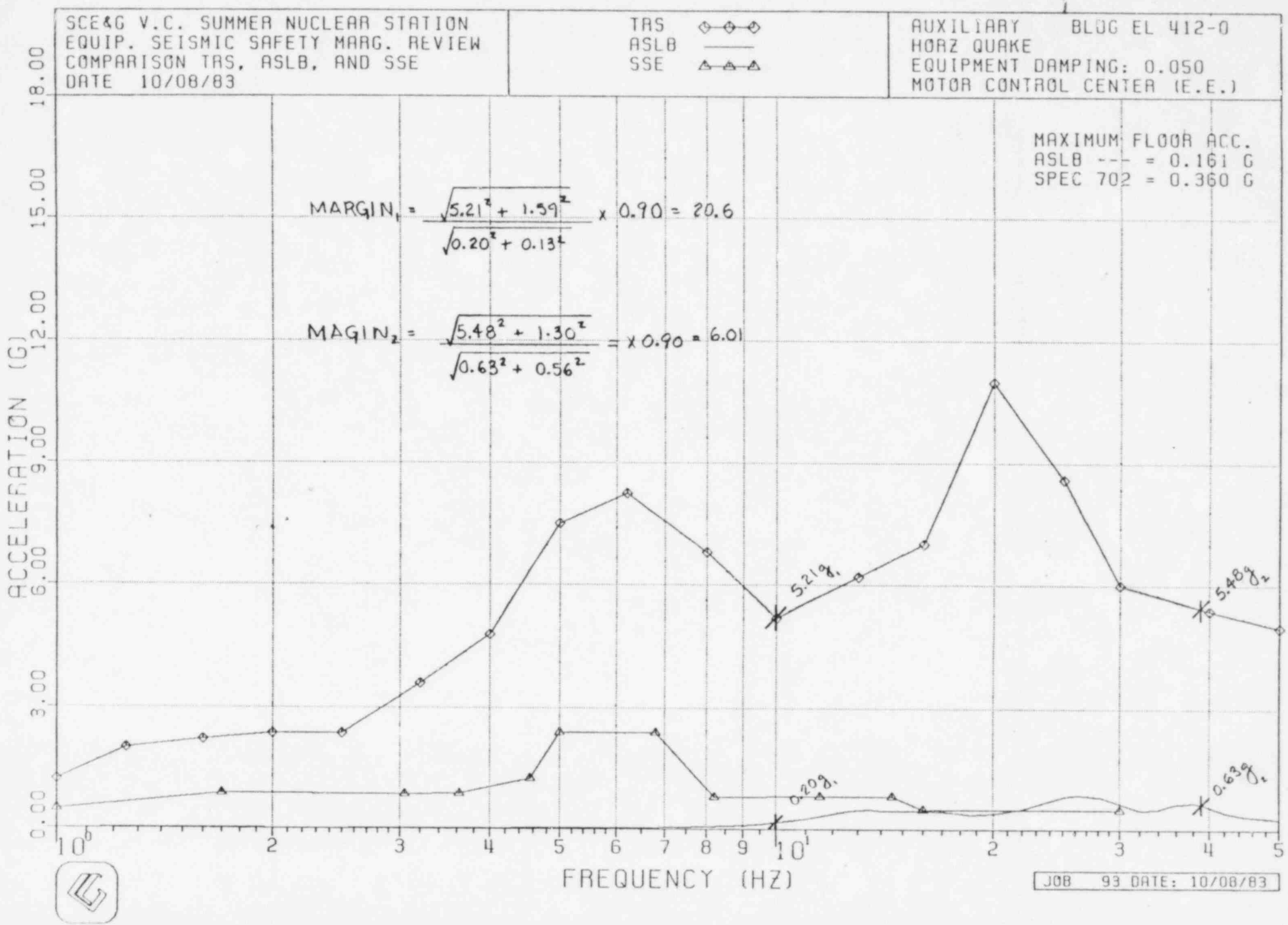
COMPARISON PLOTS

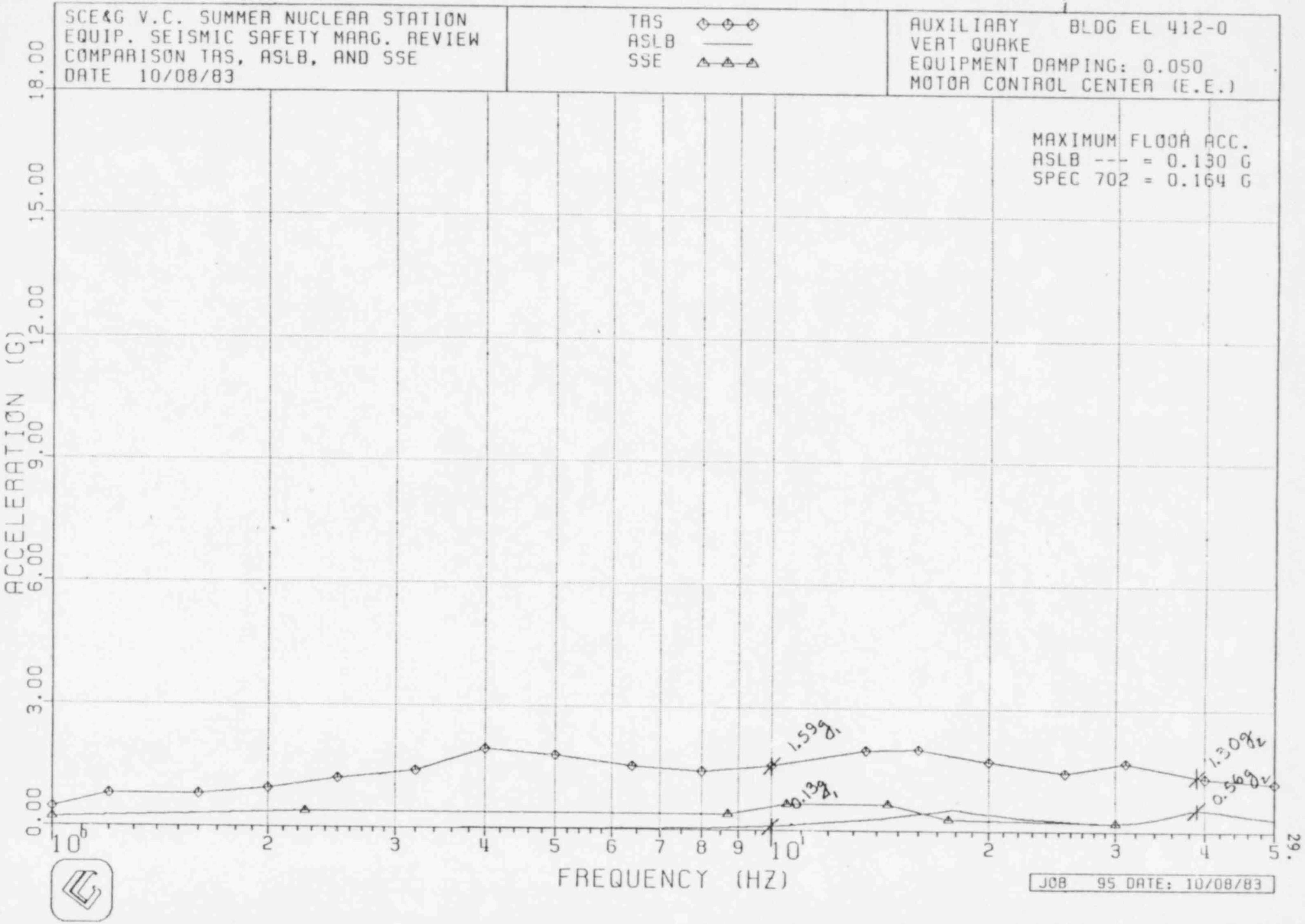
OF

TRS AND RRS (ASLB)

AND

MARGIN CALCULATION


SCE&G V.C. SUMMER NUCLEAR STATION
EQUIP. SEISMIC SAFETY MARG. REVIEW
COMPARISON TRS, ASLB, AND SSE
DATE 10/08/83
TRS
ASLB
SSE
AUXILIARY BLDG EL 412-0
HORZ QUAKE
EQUIPMENT DAMPING: 0.050
MOTOR CONTROL CENTER (E.E.)
MAXIMUM FLOOR ACC.
ASLB --- = 0.161 G
SPEC 702 = 0.360 G
$\text{MARGIN}_1 = \frac{\sqrt{5.21^2 + 1.59^2}}{\sqrt{0.20^2 + 0.13^2}} \times 0.90 = 20.6$
$\text{MAGIN}_2 = \frac{\sqrt{5.48^2 + 1.30^2}}{\sqrt{0.63^2 + 0.56^2}} = \times 0.90 = 6.01$
5.21g₁
5.48g₂
0.20g₁
0.63g₂
ACCELERATION (G)
18.00
15.00
12.00
9.00
6.00
3.00
0.00
FREQUENCY (HZ)
JOB 93 DATE: 10/08/83


SCE&G V.C. SUMMER NUCLEAR STATION
EQUIP. SEISMIC SAFETY MARG. REVIEW
COMPARISON TRS, ASLB, AND SSE
DATE 10/08/83
TRS
ASLB
SSE
AUXILIARY BLDG EL 412-0
VERT QUAKE
EQUIPMENT DAMPING: 0.050
MOTOR CONTROL CENTER (E.E.)
MAXIMUM FLOOR ACC.
ASLB --- = 0.130 G
SPEC 702 = 0.164 G
ACCELERATION (G)
0.00
3.00
6.00
9.00
12.00
15.00
18.00
FREQUENCY (HZ)
1.59g1
0.13g1
1.30g2
0.56g2
JOB 95 DATE: 10/08/83