GENERAL ELECTRIC

NUCLEAR POWER

SYSTEMS DIVISION

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MFN 069-83
JNF 024-83

April 14, 1983

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555

Attention: Mr. D.G. Eisenhut
Division of Licensing

Gentlemen:

SUBJECT: IN THE MATTER OF 238 NUCLEAR ISLAND
GENERAL ELECTRIC STANDARD SAFETY ANALYSIS REPORT
(GESSAR II) DOCKET NO. STN 50-447

REVISED DRAFT RESPONSES

Attached please find revised draft responses to selected questions.
This information is provided in the following attachments:

Attachment Number	Revised Draft Responses to
1	Power Systems Branch Questions
2	Containment Systems Branch Questions
3	Materials Engineering Branch Questions
4	Structural & Geotechnical Engineering Branch Questions

Sincerely,

Willa for

Glenn G. Sherwood, Manager
Nuclear Safety & Licensing Operation

Attachment

cc: F.J. Miraglia (w/o attachments)
D.C. Scaletti
C.O. Thomas (w/o attachments)
L.S. Gifford (w/o attachments)

E003

ATTACHMENT NO. 1

REVISED DRAFT RESPONSES TO

POWER SYSTEMS BRANCH

QUESTIONS

430.23

Table 8.3-12 (Continued)

SUPPLEMENT TO TABLE 8.3-12

BUS	CONDITION	INDICATION	LOCATION
Div. 3 (HPCS) 125 VDC Bus "G"	Continuous Bus Voltage	Voltmeter	Local and Control Room
	Battery Output Current	Ammeter	Local
	Bus "G" Load (Amp)	Ammeter	Local
	Bus "G" Ground Fault Bus "G" Undervoltage Battery Breaker 1 Open Battery Breaker 2 Open	125 Vdc System Trouble Alarm	Control Room
	Control Power Failure to DG Cont Pnl	Control Power Failure Alarm	as "DG Trouble" and Local
	Battery Charger Input Breaker Tripped/Open Battery Charger Failure (including high voltage and ground fault) Low Battery Charger Amps	Battery Charger Trouble Alarm	Control Room
	Charger Output Voltage	Voltmeter	Local
	Charger Output Current	Ammeter	Local
	Charger Ground Fault	Ground Indication Light	Local

Change inadvertently omitted on previous submittal. New response will be provided for next amendment.

1.8.63 Regulatory Guide 1.63, Revision 1, Dated May 1977 (Continued)

(3) GE interprets "designed" in Section 1 of the regulatory position first sentence, to mean "designed and applied." This interpretation is necessary to clarify the use of circuit overload protection for penetration circuits. Overload protection may be external to the penetration and thus outside the scope of the penetration designer.

1.8.63.1 Analysis of Circuits Penetrating Primary Containment

(1) 6.9 kV circuits for recirculation pump motors are protected by two circuit breakers in series in the 6.9 kV supply circuits. The recirculation pump motors are also fed from the low frequency motor generator sets. This feed is directly protected by one 6.9 kV rated breaker. A second 6.9 KV rated circuit breaker or fuse is provided to protect the containment penetration. ~~If this single breaker should fail to trip on a fault within containment, the penetration is capable of withstanding the maximum theoretical generator fault current for 250 seconds without damage. The fault current which could be as high as 13.5 times rated current would be terminated in less than 250 seconds by one or more of the following:~~ 8.29

~~(a) Overtemperature failure of the generator output winding.~~

~~(b) Overcurrent in the field circuit.~~

~~(c) Tripping of the mg set drive motor breaker on overload.~~

Change inadvertently omitted on previous submittal. New response will be provided for next amendment.
JCM
4-12-83

ATTACHMENT NO. 2

REVISED DRAFT RESPONSES TO

CONTAINMENT SYSTEMS BRANCH

QUESTIONS

SUPPLEMENTAL INFORMATION TO CSB
QUESTION 480.40

H_2 FROM METAL CORROSION IN A BWR CONTAINMENT FOLLOWING A POSTULATED DBA LOCA

The sprays that are used to control temperature in a BWR containment come from the suppression pool and consist of essentially neutral water (pH 6.5 to 7.5). There are no sources of chemicals in the containment to appreciably change this pH. The environmental temperature profile expected is described in Figures 6.2-7 and 6.2-8 of GESSAR II.

The corrosion rates expected from the above conditions are listed in Table 1 along with the references for each. Also listed is the corrosion rate from the NRC GESSAR II question ~~[illegible]~~ 480.40.

Applying the data listed in Table 1 yields the result listed in Table 2. Note that using the conservative values chosen, the H_2 from this source is small, even at 1 week time, compared to the R.G. 1.7 calculated radiolysis source of ~30000 SCF. At the limiting concentration either recombiner could remove one weeks H_2 from corrosion in about 1 day, or to express this fact in another way, the corrosion source would cause the recombiner to be needed at about 1 week instead of 2 weeks following the initiating event. Therefore, there is ~~i.e., this source is negligible.~~ no impact on required recombiner or mixer sizing and no significant affect on required initiation times.

~~In general, except for the Al data, the corrosion data used was obtained from borated water experiments. All available supported data indicates that for Zn galvanizing and organic zinc based paint the data is conservative.~~

JOHN LANE
PAGE 2 OF 5

TABLE 1.

BWR 6 MK III H_2 BY CORROSION INPUT

Surface	Area	H_2 generation from corrosion	
Al	1×10^5 ft^2 (5)	6.4×10^{-5} $\frac{ft}{ft^2\text{-}hr}$	(1)
Zn (galvanized)	1×10^4 ft^2	2×10^{-4} $\frac{ft^3}{ft^2\text{-}hr}$	(2)
		5.4×10^{-6} $\frac{ft^3}{ft^2\text{-}hr}$	(3)
Paint Organic Zinc base	4×10^5 ft^2	1.0×10^{-4} $\frac{ft^3}{ft^2\text{-}hr}$	(4)

(1) FRID 2nd NRC/Sandia H_2 Workshop
(2) NUREG 24532, p. [redacted] 27, 150°F
(3) NRC Q [redacted] 480.40, 150°F
(4) Zittel ORNL-TM-3411
(5) A function of the type of RPV insulation chosen by the applicant (stainless steel or aluminum)

TABLE 2

BWR6 MK III H_2 by corrosion in 168 Hrs.

Al	$1X10^3$	
Zn	$0.3X10^3$	(using $2x10^{-4}$ scf/ft^{2}h)
Paint	$7X10^3$	
	$8.3X10^3$	~ 0.7% H_2 in containment from this source

JOHN LANE
PAGE 4 OF 5

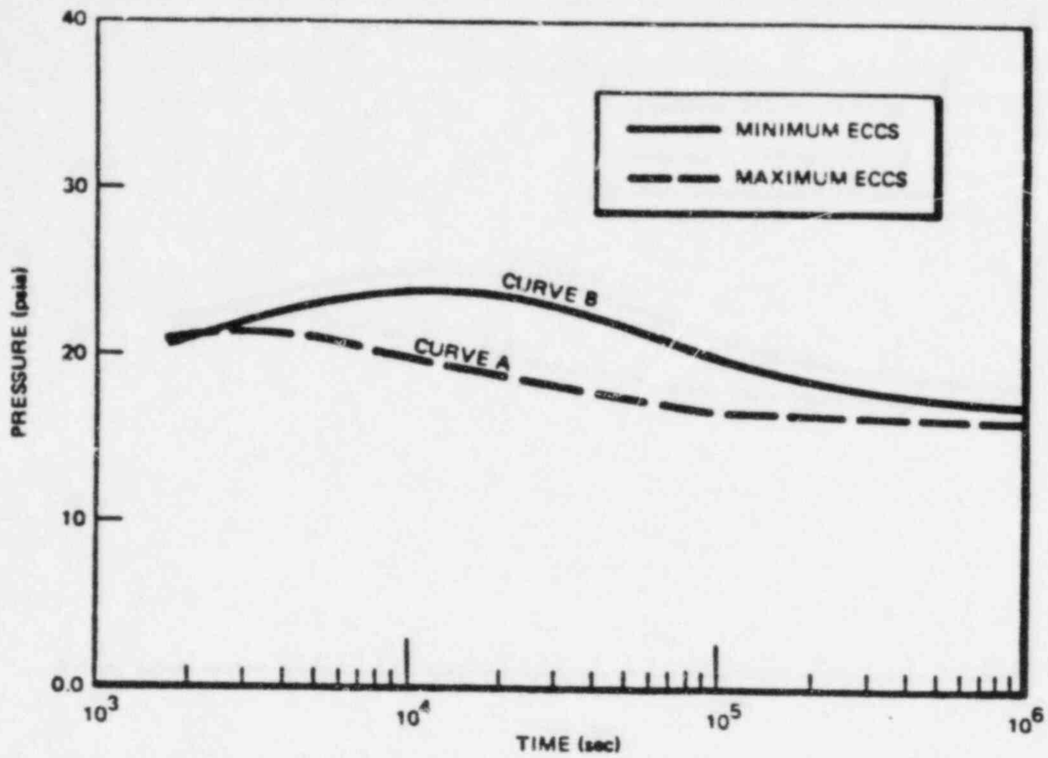


Figure 6.2-6. Long-Term Containment Pressure Response Following a Main Steamline or Recirculation Line Break

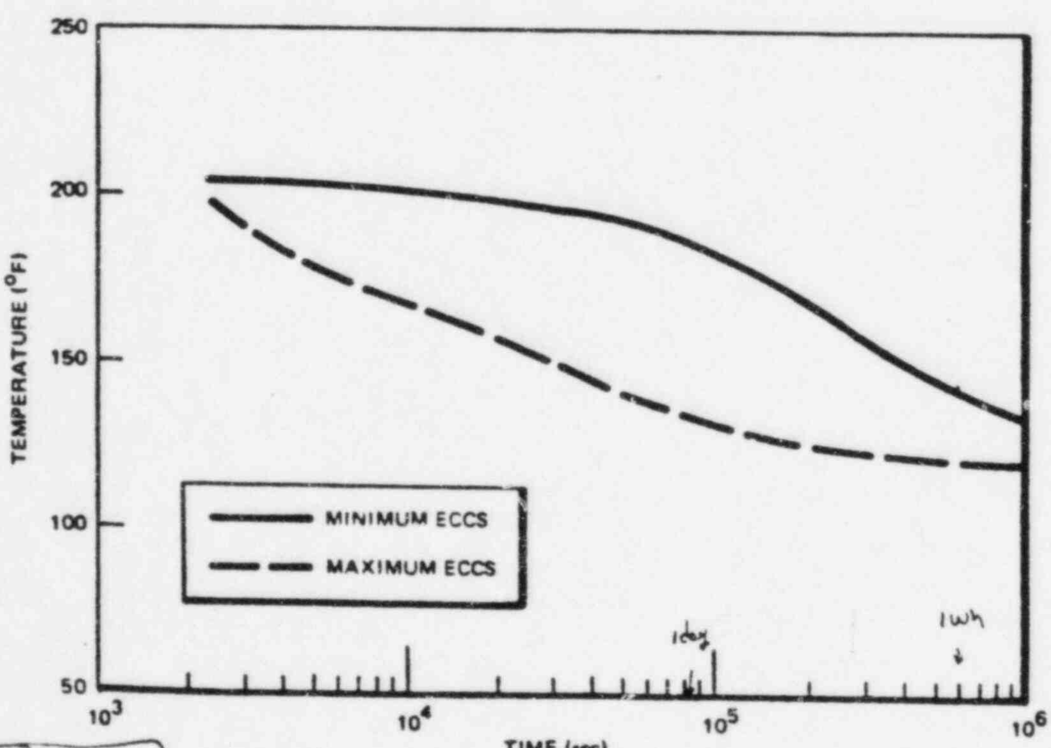


Figure 6.2-7. Long-Term Drywell Temperature Response Following a Main Steamline or Recirculation Line Break

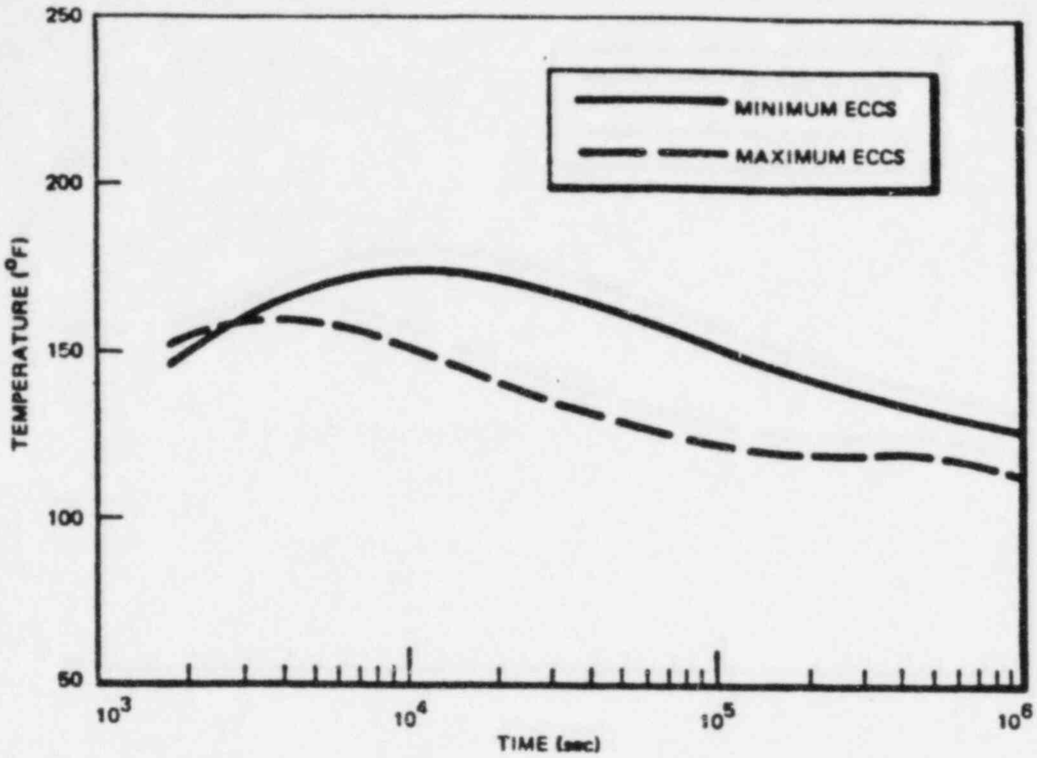


Figure 6.2-8. Long-Term Suppression Pool Temperature Response Following a Main Steamline or Recirculation Line Break

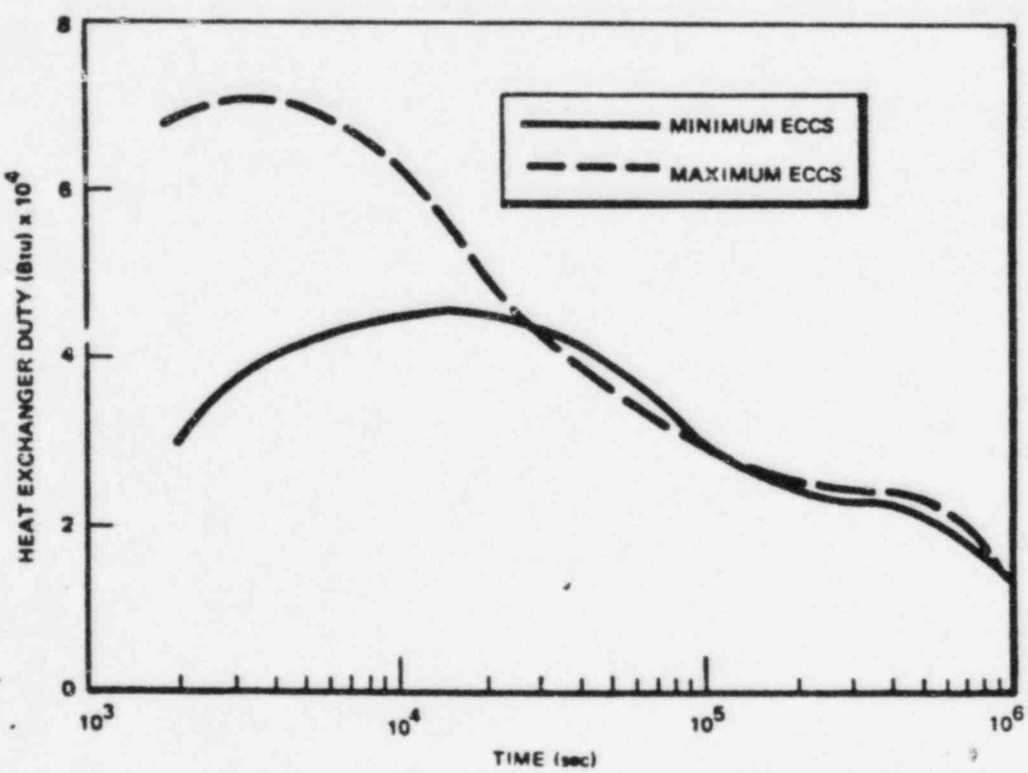


Figure 6.2-9. RHR Heat Removal Rate Following a Main Steamline or Recirculation Line Break

ATTACHMENT NO. 3

REVISED DRAFT RESPONSES TO

MATERIALS ENGINEERING BRANCH

QUESTIONS

4.5 REACTOR MATERIALS

4.5.1 Control Rod System Structural Materials

4.5.1.1 Material Specifications

a. Material List

Grades F304 and F316 are retained as Control Rod System structural materials by the exceptions allowed under RG 1.44. The specific exceptions are the following:

(1) Parts do not see temperatures above 200°F during normal operation.

(2) Parts are in a noncorrosive environment (dry environment).

(3) Parts are subjected to low stress.

(4) Parts exposed to special processing have been under surveillance programs that demonstrate that there is no problem in regard to intergranular stress corrosion.

The following material listing applies to the control rod drive mechanism supplied for this application. The position indicator and minor nonstructural items are omitted.

(1) Cylinder, Tube and Flange Assembly

		Reason ~~Exception~~ Allowed Under R.G. 1.44
Flange	ASME SA182 Grade F304	(< 200°F)
Plugs	ASME SA182 Grade F304	(< 200°F)
Cylinder	ASTM A269 Grade TP 304	(< 200°F)
Outer Tube	ASTM A269 Grade TP 304	(< 200°F)
Tube	ASME SA351 Grade CF-3	
Spacer	ASME SA351 Grade CF-3	

4.5.1.1 Material Specifications (Continued)

(2) Piston Tube Assembly

		Reason ~~Exception~~ Allowed Under R.G. 1.44
Piston Tube	ASME SA479 or SA 249 Grade XM-19	
Nose	ASME SA479 Grade XM-19	
Base	ASME SA479 Grade XM-19	
Ind. Tube	ASME SA312 Type 316	(< 200 °F) ~~(dry environment)~~
Cap	ASME SA182 Grade F316	(< 200 °F) ~~(dry environment)~~

(3) Drive Line Assembly

Coupling Spud	Alloy X-750	
Compression Cylinder	ASME SA479 or SA249 Grade XM-19	
Index Tube	ASME SA479 or SA249 Grade XM-19	
Piston Head	ARMCO 17-4 PH or its equivalent	
Piston Coupling	ASTM A312 Grade TP 304 or ASTM A269 Grade TP 304	(< 200 °F) ~~(Low stress)~~
Magnet Housing	~~ASTM A312 Grade TP 304 or~~ ~~ASTM A269 Grade TP 304 or~~ ASTM A312, A249, or A213 TP 316L	(< 200 °F) ~~(Low stress)~~

(4) Collet Assembly

Collet Piston	ASTM A269 TP 304 or ASTM A312 TP 304	(< 200 °F) ~~(Surveillance program)~~
Finger	Alloy X-750	
Retainer	ASTM A269 TP 304	
Guide Cap	ASTM A269 TP 304	

4.5.1.1 Material Specifications (Continued)

(5) Miscellaneous Parts

Stop Piston	ARMCO 17-4 PH or its equivalent
O-Ring Spacer	ASTM A240 Type 304
Nut	ASME SA479 Grade XM-19
Collet Spring	Alloy X-750
Ring Flange	ASME SA182 Grade F304
Buffer Shaft	ARMCO 17-4 PH or its equivalent
Buffer Piston	ARMCO 17-4 PH or its equivalent
Buffer Spring	Alloy X-750
Nut (hex)	Alloy X-750

The austenitic 300 series stainless steels listed under ASTM/ASME specification number are all in the annealed condition (with the exception of the outer tube in the cylinder, tube and flange assembly), and their properties are readily available. The outer tube is approximately 1/8 hard, and has a tensile of 90,000/125,000 psi, yield of 50,000/85,000 psi and minimum elongation of 25%.

The balance of Chapter 4 (Pages 4.5-3 through 4.5-13/4.5-14) is presently under review and will be updated in May 1983 as required to be in compliance with R.G. 1.44, Rev. 0; R.G. 1.31, Rev. 3; and NUREG-0313, Rev. 1. Any exceptions will be noted in a manner similar to that done for revised Subsection 4.5.1.

2

4.5.2.1 Material Specifications (Continued)

Shroud, core plate, and grid - ASME SA240, SA182, SA479, SA312, SA249, or SA213 (all Type 304L).

Peripheral fuel supports - ASTM A312 Grade TP-304, A479 Type-316L, ASME SA312 Grade Type-304L

Core plate and top guide studs and nuts, and core plate wedges - ASME SA479, SA193 Grade B8A, SA194 Grade 8A (all Type-304)

Control rod drive housing - ASME SA312 TP-304, SA182 Type-304, and ASME SB167 Type Alloy 600.

Control rod guide tube - ASME SA358 Grade 304, SA312 Grade TP-304; ASTM A358 Grade 304, A312 Grade TP-304, A351 Grade CF8, A249 TP-304.

Orificed fuel support - ASTM A249 TP-304, A240 TP-316L, A479 TP-316L.

Materials Employed in Other Reactor Internal Structures.

(1) Shroud Head and Separators Assembly and Steam Dryer Assembly

All materials are [redacted] 304L or 316L stainless steel.

Plate, Sheet and Strip	ASTM A240, TP-304, 304L or 316L
Forgings	ASTM A182 Grade F304 or 304L
Bars	ASTM A276 TP-304 or 316L
Pipe	ASTM A312 Grade TP-304

4.5.2.1 Material Specifications (Continued)

Tube	ASTM A269 Grade TP-304L
Castings	ASTM A351 Grade CF8

(2) Jet Pump Assemblies

The components in the Jet Pump Assemblies are a Riser, Inlet Mixer, Diffuser, and Riser Brace. Materials used for these components are to the following specifications:

Castings	ASTM A351 Grade CF8 and ASTM SA351 Grade CF3
Bars	ASTM A276 TP-304L, ASTM A479 TP-316L ASTM A637 Grade 688
Bolts	ASTM A193 Grade B8 or B8M and ASME SA479 TP-316L
Sheet and Plate	~~ASTM A240 TP-304, and~~ ASME SA240 TP-304L or 316L
Pipe	ASTM A358 [redacted] 316L and ASME SA312 Grade [redacted] 316L
Forged or Rolled Parts	ASME SA182, Grade [redacted] F316L, ASTM B166, and ASTM A637 Grade 688.

1.8.44 Regulatory Guide 1.44, Revision 0, Dated May 1973

Title: Control of the Use of Sensitized Stainless Steel

This guide describes acceptable methods of implementing the requirements of GDC 1 and 4 of Appendices A and B to 10CFR50, with regard to control of the application and processing of stainless steel to avoid severe sensitization that could lead to stress corrosion cracking. This guide applies to light-water-cooled reactors.

Evaluation

The GESSAR II design complies with this regulatory guide and with the guidelines of NUREG 0313, revision 1 as well.

All applications of nuclear grade stainless steel are specified as either 304L or 316L (or LN) grade. See revised [redacted] Subsections 5.2.3.4 and 4.5.2 for additional discussion. As stated, the General Electric Company is complying with the intent of R. G. 1.44 by controlling the application and processing of stainless steel to avoid severe sensitization that could lead to stress corrosion cracking through the use of IGSCC resistant materials. In addition, stress rule evaluation is being performed on GE scope of supply to predict other areas where IGSCC might be possible due to high stress. This effort will allow appropriate modifications to be made where appropriate.

Induction Heating Stress Improvement (IHSI) treatment on stainless steel weld joints to preclude intergranular stress corrosion cracking will also be considered and implemented by GE and plant owners when approved by the NRC.

1.8.44 Regulatory Guide 1.44, Revision 0, Dated May 1973 (Continued)

CRC

Where solution heat treatment is not practical, and where stress analyses indicate potentially high stresses, the weld joint inside surfaces will be protected with corrosion resistant cladding before making the final weld ferrite content of weld metal, and castings will be above the minimum 5% required by Regulatory Guide 1.44.

WHIC/RIST

Where neither of the above processes is possible, it is proposed that welding heat input control for both shop and field welds be applied. A special process may be used that reduces the inside surface temperature of the pipe subsequent to the root pass. This minimizes sensitization and reduces residual stresses in the inside diameter of piping. Accelerated stress corrosion tests on actual pipes will be used to qualify this process.

In addition to service sensitive lines, all major stainless steel lines, and many reactor internal components, will be analyzed according to IGSCC stress rules formulated by General Electric. The formulation of these stress rules was based on laboratory and field data and relies on the fact that for uncreviced parts, sustained stress must exceed the material 0.2% offset yield strength for IGSCC to become a potential problem. General Electric proposes to identify highly stressed areas within the GE scope of supply by means of these stress rules and to make appropriate processing modifications similar to those used on service sensitive lines.

1.8.44 Regulatory Guide 1.44, Revision 0, Dated May 1973 (Continued)

For all components and pipes, material process controls are employed to assure that material susceptibility to IGSCC is minimized. Examples of these controls include the control of solution heat treatment and degree of cold work.

As summarized above, the General Electric Company is complying with the intent of Regulatory Guide 1.44 by controlling the application and processing of stainless steel to avoid severe sensitization that could lead to stress corrosion cracking through the use of IGSCC resistant materials. In addition, stress rule evaluation is being performed on GE scope of supply to predict other areas where IGSCC might be possible due to high stress. This effort will allow appropriate modifications to be made where appropriate.

ATTACHMENT NO. 4

REVISED DRAFT RESPONSES TO

STRUCTURAL AND GEOTECHNICAL

ENGINEERING BRANCH

QUESTIONS

Question 220.11

220.11 (3.7.2) At the time of this review, Appendix 3H which decribes the effect of the concrete between the containment and the shield building on the seismic analysis, is not available. Indicate when this appendix will be provided. This information should be made available prior to the forthcoming structural audit in December 1982.

Response

In the Suppression Pool region of the containment vessel the shell has been stiffened by filling the annulus between the Containment and the Shield Building with reinforced concrete. A seismic dynamic analysis was performed to determine the effects of this added concrete on the seismic responses of various structures in the Reactor Building. These structures include the Shield Building, Containment vessel, Drywell, Shield wall and the RPV pedestal.

Specifically, the objective of this analysis was to ~~establish~~ verify that the original seismic envelope curves used in the plant design envelope the seismic response of the Reactor Building structures with the added concrete. If this is not the case new envelope curves as required will be provided.

Soil Cases

Four soil cases were used in the seismic dynamic analysis for the horizontal ground motion. They are the following:

CASE NUMBER	DESIGNATION
2	GE-75-A-H2
4	GE-75-VP3
6	GE-75-HR-H2
7	GE-FB-H2 (Fixed Base)

Two soil cases were used in the analysis for the vertical motion. They are the following:

CASE NUMBER	DESIGNATION
11	GE-75-A-V
12	GE-FB-V (Fixed Base)

The case numbers above refer to those listed in GESSAR Table 3A-1.

Mathematical Model

The mathematical model originally used for the analysis to develop the design loads and building responses did not include the concrete added to the region between the containment and the Shield Building below elevation (-) 5 ft 3 in.

For this analysis, solid elements were added to represent the annular concrete (see figure attached). The rest of the model is similar to that used previously, (See Figure -1). The computer program for axisymmetric structures (AXIS) was used in the analysis.

Dynamic Analysis

The horizontal and vertical analyses were performed separately. Shell forces, shell moments and element stresses were obtained for individual soil cases. These results were then enveloped to arrive at a set of final responses for horizontal and vertical motions respectively. Tables 1 through 18 depict the final results. These tabulated values were then compared with those in Section 3.7.

Response spectra were generated for the soil cases studied. They were enveloped to arrive at a final set of curves.

Conclusions

A review of the seismic forces indicated that in a few locations they are slightly higher than the envelope (in the range of 3%) However the resulting stresses are within the allowables. Since the containment structure was stiffened by the additional concrete and the shield building participation increases in the load distribution Some minor shifting in frequency was observed

(in the range of 5 to 10 %)
The revised response spectra are listed below and are attached

Figure	Title
3.10-1	RPV Floor Response Spectra Horizontal Acceleration OBE El 54.00, 2 Percent Damping
3.10-3	RPV Floor Response Spectra Horizontal Acceleration OBE El 17.83, 2 Percent Damping
3.10-8	Shield Wall Floor Response Spectra Vertical Acceleration OBE, El 43.00, 2 Percent Damping
3.10-19	Containment Response Spectra Horizontal Acceleration OBE, El 149.00, 2 Percent Damping
3.10-20	Containment Response Spectra Vertical Acceleration OBE, El 149.00, 2 Percent Damping
3.10-21	Containment Response Spectra Horizontal Acceleration OBE, El 110.83, 2 Percent Damping
3.10-23	Containment Response Spectra Horizontal Acceleration OBE, El 93.20, 2 Percent Damping
3.10-29	Shield Building Response Spectra Horizontal Acceleration OBE, El 115.90, 2 Percent Damping

GESSAR will be revised as follows.

- See revision on page 3.7-15, attached
- New response spectra will replace corresponding spectra in GESSAR.

3.7.2.1.5.1 Description of Mathematical Models (Continued)

of the support building is developed to include the effect of lateral/torsional coupling.

3.7.2.1.5.1.1 Reactor Building and Reactor Pressure Vessel

Every structure in the Reactor Building is idealized by an axisymmetric finite-element model of shell or solid elements. All equipments and piping systems which weigh more than 5 kips are identified and included as masses. Lighter weights for equipment with unidentified systems are considered as uniform loads. The models are shown in Figures 3.7-23 and 3.7-24.

The Shield Building is a domed, cylindrical structure which is modeled by shell elements. At the joint of the dome and the top of cylindrical wall, an equivalent thickness is used.

The containment is also a domed, cylindrical structure and is, therefore, also modeled by shell elements. At the crane support, the modulus of elasticity of the shell element is modified to a higher value to reflect the stiffness of the shell in the local area. A study has been conducted which shows that interaction between the steel containment and the crane can be ignored and the crane mass can be lumped into the containment model at that level. Furthermore, the ovaling modes have very little modal response as well as small participation factors and, hence, are not significant. In the suppression pool region where the shell is stiffened by filling the annulus between the containment and the Shield Building with concrete, composite properties have been developed for the region. The water in the suppression chamber is modeled by hydrodynamic mass elements which act between the drywell nodes and containment nodes at the same elevations. To signify vertical excitation, the water is lumped at the bottom of the pool.

3.7.2.1.5.1.1 Reactor Building and Reactor Pressure Vessel (Continued)

→ Add

The mathematical model used for the analysis to develop the design loads and building responses did not include the concrete added to the region between the containment and the Shield Building below elevation (-) 5 ft 3 in. Appendix 3H describes the effect of this concrete on the seismic design loads and building responses.

← delete

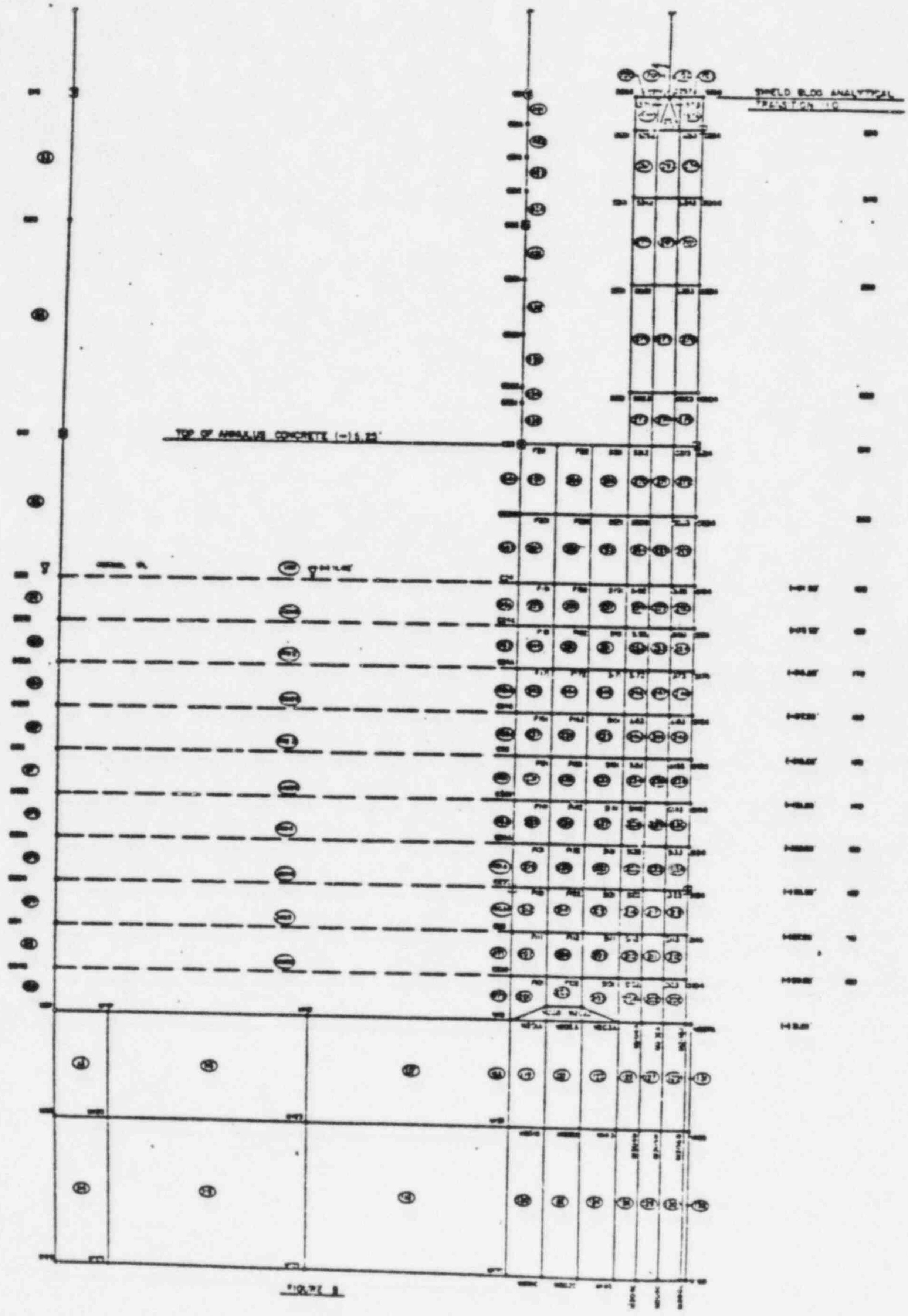
The drywell is modeled by shell elements while the upper ... modeled by solid elements. For th... concrete are ...

The effect of the concrete in the annular region is neglected in the response spectra. The effect was to stiffen the structure which consequently shifted some of the responses but in general the accelerations were decreased.

... model.

... pressure vessel (RPV) is modeled by shell elements. The stiffness of reactor internals is neglected, but its mass is lumped onto the cylindrical shell. The weight of water in the vessel is also included. This simplified reactor pressure vessel model has been included in the overall Reactor Building model to provide proper interaction with other structures.

The RPV pedestal is modeled by shell elements while the concrete pad around it is modeled by solid elements and linked to the pedestal node points by stiff, horizontal shell elements. Steel



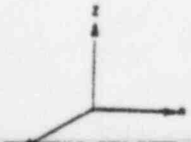


Figure 1
Mathematical model for
the annular concrete

Table 1

UPPER SHEILD BUILDING SEISMIC FORCE
ENVELOPE DUE TO OBE HORIZONTAL EXCITATIONS

Node No	Elev (ft)	Long Mom (ft-Kips [illegible])	Circ Mom (ft-Kips/ft)	Long Force (Kips/ft)	Circ Force (Kips/ft)	Shear Flow (Kips/ft)
S1	160.75	0.07	0.46	2.97	9.50	5.41
S3	158.81	0.53	0.30	3.13	5.75	3.98
S5	153.16	2.41	0.91	5.78	11.80	7.66
S7	145.63	0.98	0.73	6.71	24.05	11.79
S9	136.71	19.29	4.70	7.30	44.51	19.59
S11	115.70	2.84	0.31	17.47	19.50	34.15
S13	104.20	0.63	0,32	26.00	16.38	40.64
S15	84.58	0.71	0.37	42.30	13.24	48.35
S17	55.00	0.47	0.31	67.27	12.23	57.48
S19	27.67	4.79	1.13	91.95	3.70	63.71

Table . 2

CONTAINMENT SEISMIC FORCE
ENVELOPE DUE TO OBE HORIZONTAL EXCITATION

Node No	Elev (ft)	Long Mom (ft.Kip/ft)	Circ Mom (ft/Kip/ft)	Long Force (Kips/ft)	Circ Force (Kips/ft)	Shear Flow (Kips/ft)
C1	152.00	0.00	0.03	0.11	0.05	0.15
C6	143.22	0.21	0.06	0.64	6.71	1.73
C10	122.00	0.35	0.10	0.75	14.77	4.18
C13	93.20	0.10	0.03	5.24	5.93	9.31
C16	55.00	0.00	0.00	12.93	1.44	11.47
C19	27.67	0.00	0.00	18.54	1.23	12.43
C21	11.00	0.01	0.03	22.08	1.25	12.73
C23	-5.25	0.41	0.06	19.32	7.40	8.85
C24A	-15.58	0.02	0.00	7.67	0.00	12.44
C25A	-23.58	0.01	0.00	11.27	0.00	11.85
C26	-27.58	0.02	0.00	17.96	0.00	12.37
M131	-31.58	0.09	0.01	20.35	1.86	12.33

Table 3

DRYWELL SEISMIC FORCE ENVELOPE
DUE TO OBE HORIZONTAL EXCITATIONS

Node	Elev (ft)	Long Mom (ft-Kips/ft)	Circ Mom (ft-Kips/ft)	Long Force (Kips/ft)	Circ Force (kips/ft	Shear Flow (kips/ft)
D1	75.38	0.23	0.80	5.00	16.39	4.91
D3	67.34	0.01	0.00	0.17	3.68	1.33
D5	57.58	2.52	1.32	2.00	20.67	5.59
D11	57.58	32.69	13.50	46.93	51.68	69.35
D16	36.83	2.12	2.90	137.43	26.82	145.73
D18	20.25	12.23	1.04	204.96	17.93	161.89
D20	4.83	4.47	4.10	276.22	10.26	172.22
D22	-11.58	15.03	2.23	344.10	19.54	181.49
D23	-19.58	71.04	15.49	384.41	71.51	168.99
D24	-27.58	245.92	62.31	417.69	113.45	149.24
M91	-31.58	454.93	293.74	162.94	284.64	45.15

Table 4

SHIELD WALL SEISMIC FORCE ENVELOPE
DUE TO OBE HORIZONTAL EXCITATIONS

Node No	Elev (ft)	Long Mom (ft-Kips/ft)	Circ Mom (ft-Kips/ft)	Long Force (Kips/ft)	Circ Force (Kips/ft)	Shear Flow (Kips/ft)
SW1	50.38	0.94	0.06	0.14	4.17	1.39
SW3	36.83	0.10	0.17	3.56	2.33	4.79
SW5	20.25	1.24	0.80	14.18	3.83	12.84
SW7	4.84	0.89	0.42	29.78	6.13	15.50

Table 5

DRYWELL UPPER POOL AND PEDESTAL MASS CONCRETE
SEISMIC STRESS ENVELOPE DUE TO OBE HORIZONTAL EXCITATIONS

Element No	Radial Stress (Kips/ft^2)	Longitudinal Stress (Kips/ft^2)	Circumferential Stress (Kips/ft^2)	Shear (τ_{rz}) (Kips/ft^2)	Shear (τ_{rt}) (Kips/ft^2)	Shear (τ_{zt}) (Kips/ft^2)
56	0.42	0.55	1.53	0.79	0.09	1.88
57	0.04	0.77	1.06	0.34	0.70	0.96
96	1.54	7.64	1.06	4.78	0.68	1.37
97	2.73	1.60	0.75	2.88	1.61	0.30

Table 6

ANNULAR MASS CONCRETE SEISMIC STRESS DUE TO HORIZONTAL EXCITATIONS

Element No	Radial Stress (Kips/ft)	Longitudinal Stress (Kips/ft)	Circumferential Stress (Kips/ft)	Shear (τ_{rz}) (Kips/ft)	Shear (τ_{rt}) (Kips/ft)	Shear (τ_{zt}) (Kips/ft)
267	0.79	6.51	9.36	2.67	4.19	6.11
268	1.48	4.59	8.59	0.68	7.01	5.96
243	0.33	8.48	1.04	0.94	0.20	11.60
244	0.23	13.56	1.39	1.39	0.23	10.74
213	1.10	12.91	3.75	2.63	0.19	10.95
214	2.11	14.28	4.19	1.57	0.07	10.06
201	2.44	15.21	4.23	8.06	9.91	12.74
202	6.36	.94	0.72	5.37	1.33	4.61

Table 7

WEIR WALL SEISMIC FORCE
ENVELOPE DUE TO HORIZONTAL EXCITATIONS

Node No	Elev (ft)	Long Mom (ft-Kips/ft)	Circ Mom (ft-Kips/ft)	Long Force (Kips/ft)	Circ Force (Kips/ft)	Shear Flow (Kips/ft)
W1	-5.50	0.56	0.03	0.41	7.54	0.67
W2	-12.00	0.47	0.06	0.35	2.70	1.07
W3	-15.00	0.23	0.04	0.37	1.20	1.52
W4	-18.67	0.39	0.08	0.63	0.99	1.67

Table 8

LOWER SHIELD BUILDING MASS CONCRETE
SEISMIC STRESS ENVELOPE DUE TO OBE HORIZONTAL EXCITATIONS

Element No	Radial Stress (Kips/ft^2)	Longitudinal Stress (Kips/ft^2)	Circumferential Stress (Kips/ft^2)	Shear (τ_{rz}) (Kips/ft^2)	Shear (τ_{rt}) (Kips/ft^2)	Shear (τ_{zt}) (Kips/ft^2)
273	4.12	57.64	3.26	4.24	5.27	27.53
248	0.03	30.44	4.25	0.35	0.05	8.36
218	0.06	29.58	6.44	0.45	0.13	8.98
206	0.50	32.10	7.26	0.78	0.35	9.88

Table 9

RPV PEDESTAL SEISMIC FORCE ENVELOPE
DUE TO OBE HORIZONTAL EXCITATIONS

Node No	Elev (ft)	Long Mom (ft-Kips/ft)	Circ Mom (ft-Kips/ft)	Long Force (Kips/ft)	Circ Force (Kips/ft)	Shear Flow (Kips/ft)
P2	-1.33	46.26	99.18	65.13	35.82	30.67
P5	-11.58	73.73	3.94	205.28	19.91	46.44
P6	-15.75	175.65	35.86	220.93	37.33	29.09
P7	-21.00	262.56	88.54	133.95	29.01	10.33
P8	-26.29	46.63	17.56	68.29	8.56	10.03
M41	-31.58	76.81	106.97	24.44	32.22	2.12

TABLE 10

UPPER SHEILD BUILDING SEISMIC FORCE
ENVELOPE DUE TO OBE VERTICAL EXCITATIONS

Node No	Elev (ft)	Long Mom (ft-Kips/ft)	Circ Mom (ft/Kips/ft)	Long Force (Kips/ft)	Circ Force (Kips/ft)	Shear Flow (Kips/ft)
S1	160.75	2.21	9.39	10.99	14.77	0.00
S3	158.81	1.03	0.64	10.00	9.23	0.00
S5	153.16	2.31	1.20	9.46	4.96	0.00
S7	145.63	0.92	0.94	7.56	6.87	0.00
S9	136.71	14.48	2.90	5.02	17.49	0.00
S11	115.70	2.84	0.57	6.22	2.36	0.00
S13	104.20	0.97	0.19	7.15	0.60	0.00
S15	84.58	0.35	0.07	8.91	0.36	0.00
S17	55.00	0.14	0.03	11.62	0.87	0.00
S19	27.67	0.58	0.12	13.67	0.95	0.00

TABLE 11

CONTAINMENT SEISMIC FORCE
ENVELOPE DUE TO OBE VERTICAL EXCITATIONS

Node No	Elev (ft)	Long Mom (ft-Kip/ft)	Circ Mom (ft-Kip/ft)	Long Force (Kips/ft)	Circ Force (Kips/ft)	Shear Flow (Kips/ft)
C1	152.00	0.00	0.15	1.38	3.65	0.00
C6	143.22	0.21	0.06	0.77	4.78	0.00
C10	122.00	0.13	0.04	0.46	4.69	0.00
C13	93.20	0.02	0.01	1.83	0.64	0.00
C16	55.00	0.00	0.00	2.76	0.07	0.00
C19	27.67	0.00	0.00	3.18	0.19	0.00
C21	11.00	0.00	0.00	3.38	0.48	0.00
C23	-5.25	0.02	0.00	2.67	0.39	0.00
C24A	-15.58	0.00	0.00	1.65	0.00	0.00
C25A	-23.58	0.00	0.00	2.31	0.00	0.00
C26	-27.58	0.00	0.00	3.19	0.00	0.00
M131	-31.58	0.01	0.00	3.20	0.14	0.00

TABLE 12

DRYWELL SEISMIC FORCE ENVELOPE
DUE TO OBE VERTICAL EXCITATIONS

Node No	Elev (ft)	Long Mom (ft-Kips/ft)	Circ Mom (ft-Kips/ft)	Long Force (Kips/ft)	Circ Force (Kips/ft)	Shear Flow (Kips/ft)
D1	75.38	0.09	0.39	22.03	62.01	0.00
D3	67.34	0.01	0.00	1.27	3.97	0.00
D5	57.58	0.64	1.41	1.02	7.16	0.00
D11	57.58	4.29	0.35	12.64	1.53	0.00
D16	36.83	0.78	0.16	28.17	1.39	0.00
D18	20.25	0.69	0.14	31.55	1.18	0.00
D20	4.83	1.12	0.25	33.94	0.91	0.00
D22	-11.58	3.41	0.85	35.21	0.13	0.00
D23	-19.58	2.46	0.61	35.58	3.03	0.00
D24	-27.58	4.49	1.12	35.84	7.32	0.00
M91	-31.58	33.33	25.33	13.04	6.53	0.00

TABLE 13

SHIELD WALL SEISMIC FORCE ENVELOPE
DUE TO OBE VERTICAL EXCITATIONS

Node No	Elev (ft)	Long Mom (ft-Kips/ft)	Circ Mom (ft-Kips/ft)	Long Force (Kips/ft)	Circ Force (Kips/ft)	Shear Flow (Kips/ft)
SW1	50.38	0.00	0.00	0.33	0.04	0.00
SW3	36.83	0.01	0.00	1.21	0.01	0.00
SW5	20.25	0.00	0.00	3.69	0.18	0.00
SW7	4.84	0.48	0.14	5.07	0.61	0.00

TABLE 14

Element No	Radial Stress (Kips/ft^2)	Longitudinal Stress (Kips/ft^2)	Circumferential Stress (Kips/ft^2)	Shear (τ_{rz}) (Kips/ft^2)	Shear (τ_{rt}) (Kips/ft^2)	Shear (τ_{zt}) (Kips/ft^2)
56	0.07	0.11	0.04	0.25	0.00	0.00
57	0.00	0.25	0.03	0.13	0.00	0.00
96	0.07	0.67	0.08	0.26	0.00	0.00
97	0.07	0.06	0.09	0.27	0.00	0.00

TABLE 15

ANNULAR MASS CONCRETE SEISMIC STRESS
DUE TO VERTICAL EXCITATIONS

Element No	Radial Stress (Kips/ft^2)	Longitudinal Stress (Kips/ft^2)	Circumferential Stress (Kips/ft^2)	Shear (τ_{rz}) (Kips/ft^2)	Shear (τ_{rt}) (Kips/ft^2)	Shear (τ_{zt}) (Kips/ft^2)
267	0.10	0.91	1.09	0.40	0.00	0.00
268	0.17	0.74	1.10	0.16	0.00	0.00
243	0.00	1.53	0.30	0.12	0.00	0.00
244	0.00	1.94	0.21	0.18	0.00	0.00
213	0.14	2.13	0.14	0.38	0.00	0.00
214	0.27	1.95	0.13	0.26	0.00	0.00
201	0.26	2.50	0.33	1.34	0.00	0.00
202	0.52	0.19	0.30	0.10	0.00	0.00

TABLE 16

WEIR WALL SEISMIC FORCE ENVELOPE DUE TO VERTICAL EXCITATIONS

Node No	Elev (ft)	Long Mom (ft/Kips/ft)	Circ Mom (ft-Kips/ft)	Long Force (Kips/ft)	Circ Force (Kips/ft)	Shear Flow (Kips/ft)
W1	-5.50	0.01	0.00	0.03	0.15	0.00
W2	-12.00	0.04	0.01	0.02	0.07	0.00
W3	-15.00	0.06	0.01	0.05	0.19	0.00
W4	-18.67	0.00	0.00	0.05	0.30	0.00

TABLE 17

LOWER SHIELD BUILDING MASS CONCRETE SEISMIC STRESS ENVELOPE DUE TO OBE VERTICAL EXCITATIONS

Element No	Radial Stress (Kips/ft^2)	Longitudinal Stress (Kips/ft^2)	Circumferential Stress (Kips/ft^2)	Shear (τ_{rz}) (Kips/ft^2)	Shear (τ_{rt}) (Kips/ft^2)	Shear (τ_{zt}) (Kips/ft^2)
273	0.69	7.87	0.40	0.68	0.00	0.00
248	0.00	3.12	0.08	0.04	0.00	0.00
218	0.00	2.71	0.22	0.02	0.00	0.00
206	0.03	2.72	0.29	0.01	0.00	0.00

TABLE 18

RPV PEDESTAL SEISMIC FORCE ENVELOPE DUE TO OBE VERTICAL EXCITATIONS

Node No	Elev (ft)	Long Mom (ft-Kips/ft)	Circ Mom (ft/Kips/ft)	Long Force (Kips/ft)	Circ Force (Kips/ft)	Shear Flow (Kips/ft)
P2	-1.33	3.73	9.58	5.11	5.[illegible]8	0.00
P5	-11.58	3.87	0.97	16.06	2.83	0.00
P6	-15.75	0.90	0.23	16.43	3.31	0.00
P7	-21.00	6.42	3.20	9.54	2.01	0.00
P8	-26.29	0.27	0.51	6.18	1.01	0.00
M41	-31.58	7.74	12.36	2.18	5.86	0.00

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April 13, 1983

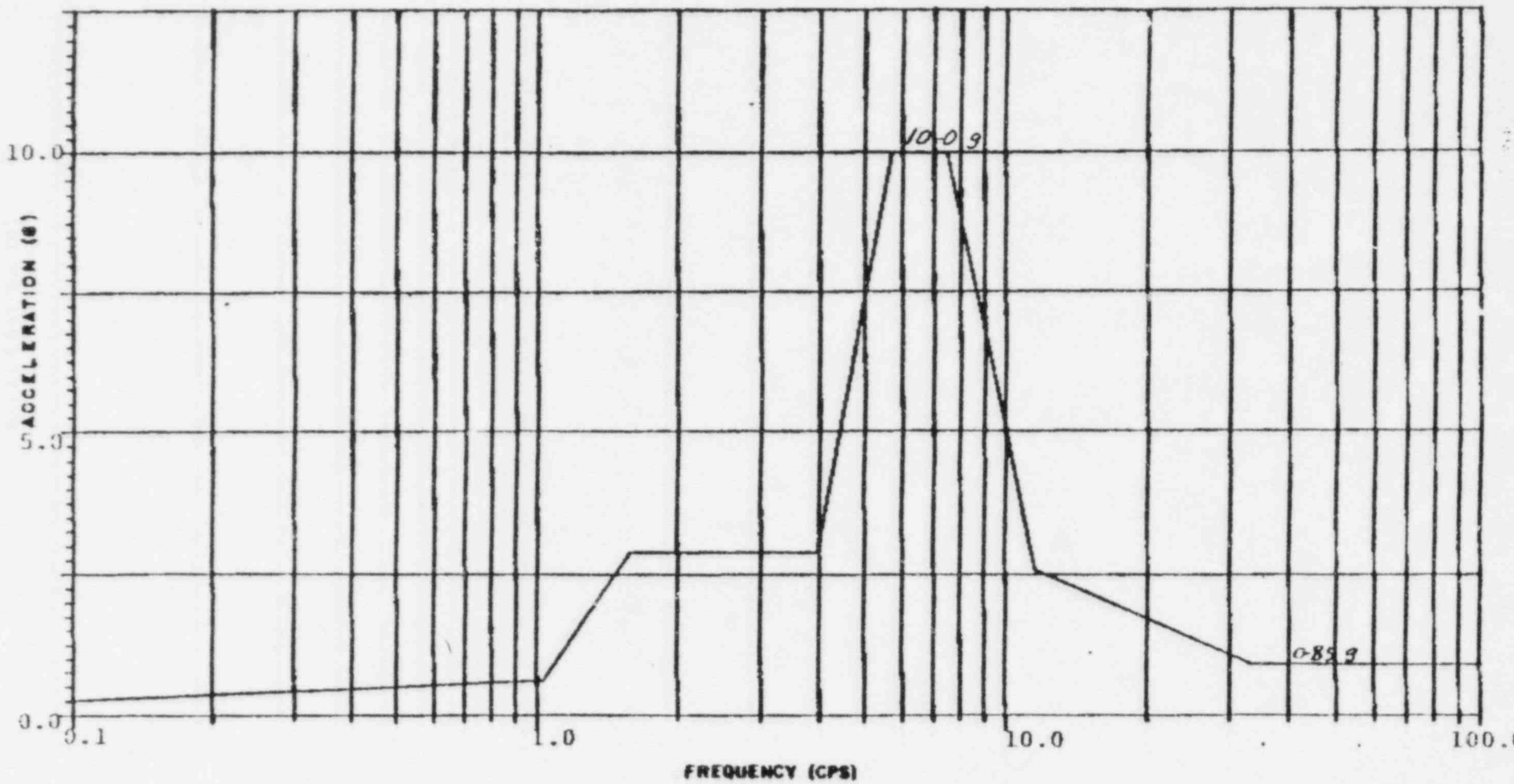

Fig. 3.1a-1

RPV RESPONSE SPECTRA
HORIZONTAL ACCELERATION OBE
EL 54.0 2 PERCENT DAMPING

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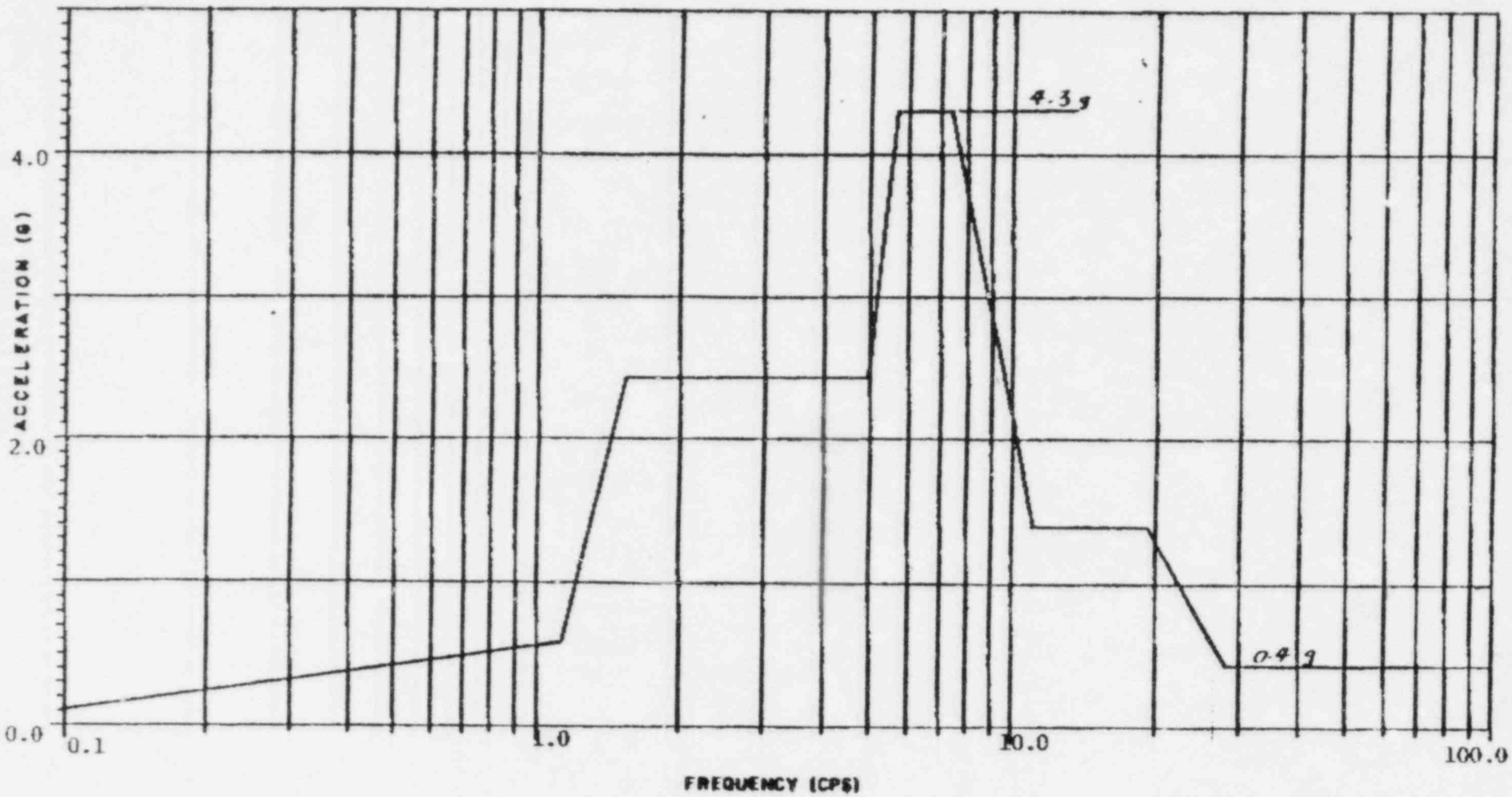

Fig. 3.10-3.

RPV FLOOR RESPONSE SPECTRA
HORIZONTAL ACCELERATION OBE
EL 17.83 2 PERCENT DAMPING

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April 13, 1981

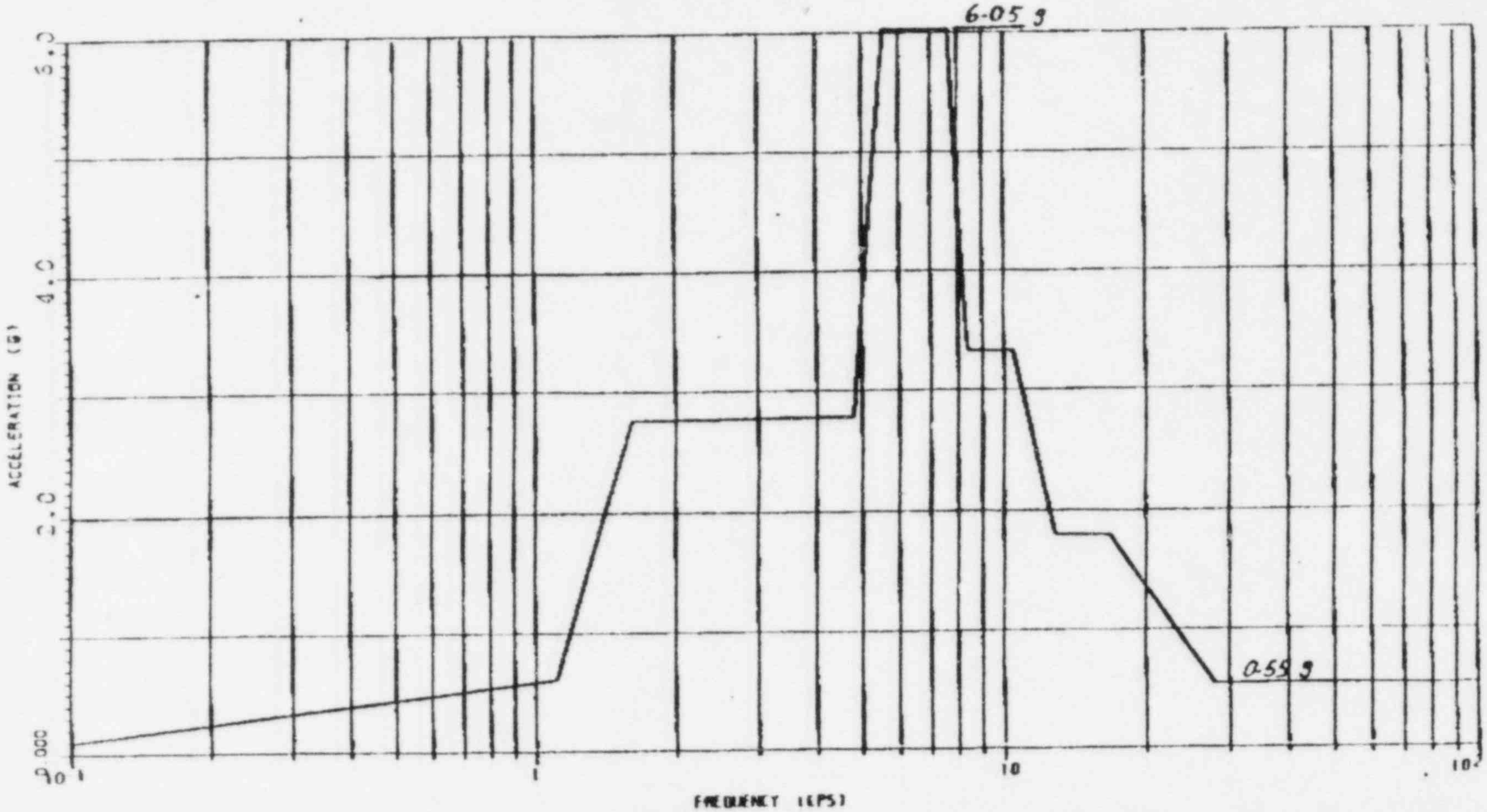

Fig. 3.10-8

SHIELD WALL RESPONSE SPECTRA
HORIZONTAL ACCELERATION OBE
EL 43.0 2 PERCENT DAMPING

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April 13, 1983

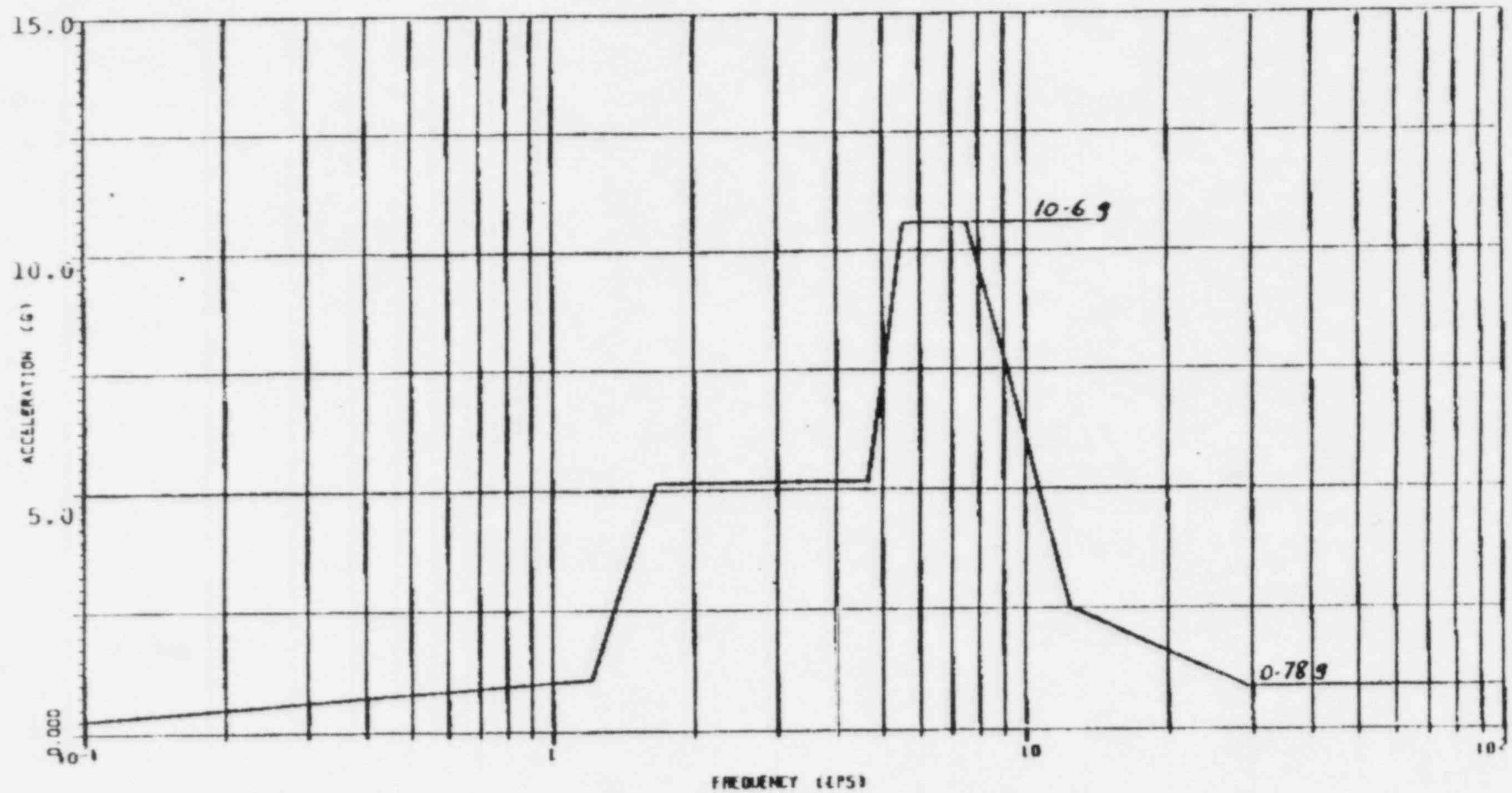

fig. 3.10-15

CONTAINMENT RESPONSE SPECTRA
HORIZONTAL ACCELERATION OBE
EL 149.08 2 PERCENT DAMPING

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April 13, 1983

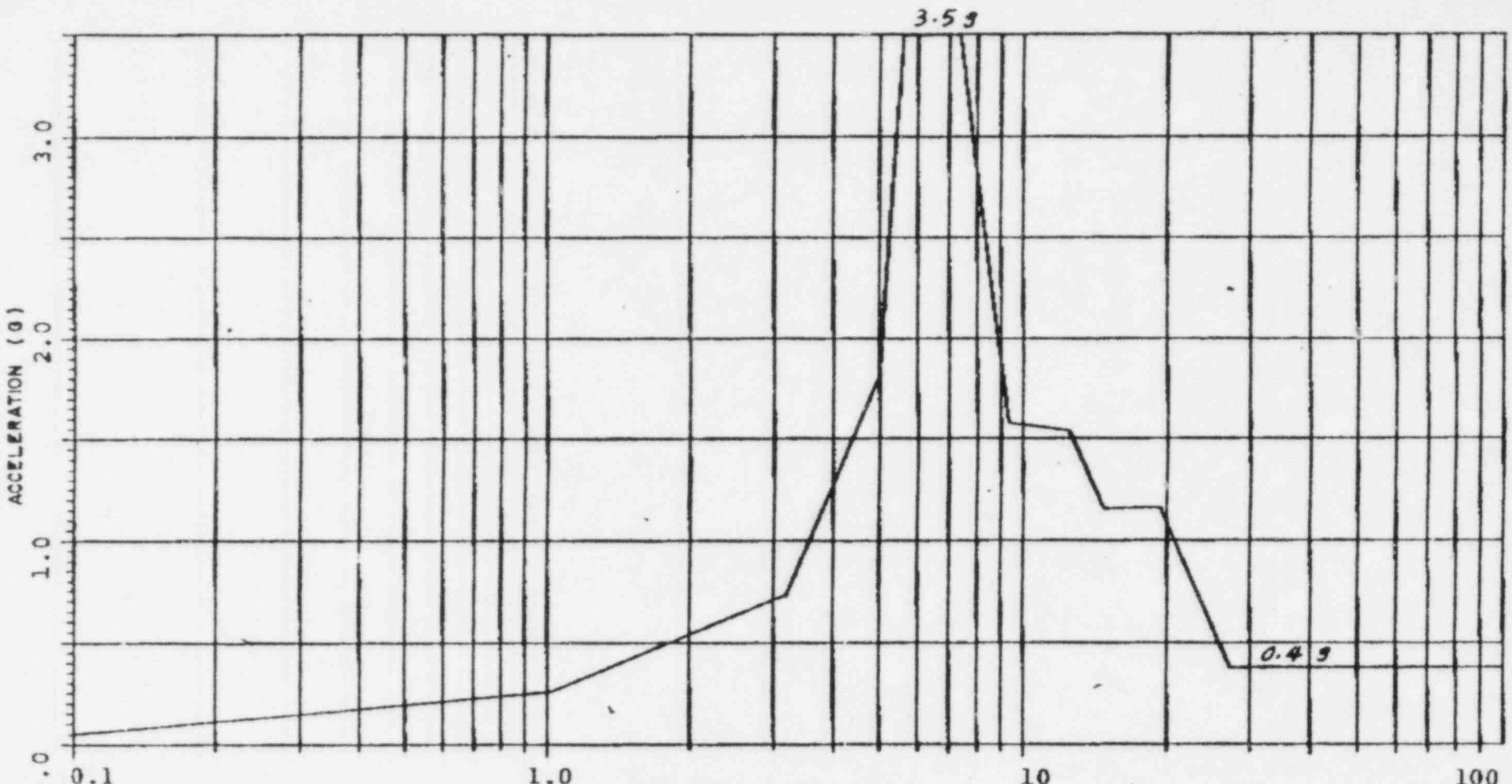

Fig. 3.10-10

CONTAINMENT RESPONSE SPECTRA
VERTICAL ACCELERATION OBE
EL 149.08 2 PERCENT DAMPING

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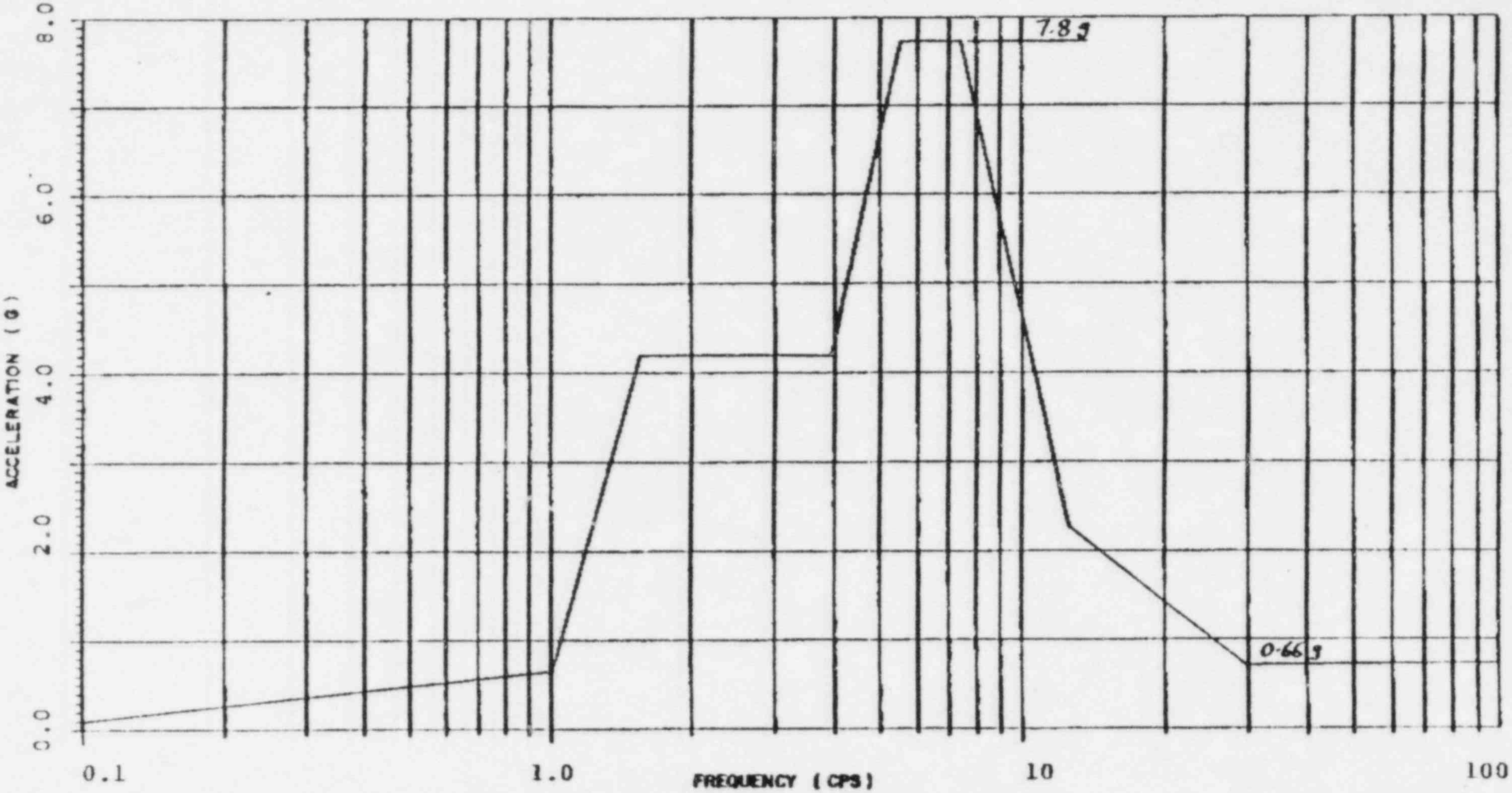

Fig. 3.10-2.1

CONTAINMENT RESPONSE SEPCTRA
HORIZONTAL ACCELERATION OBE
EL 110.83 2 PERCENT DAMPING

C F BRAUN & CO

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April 13, 198

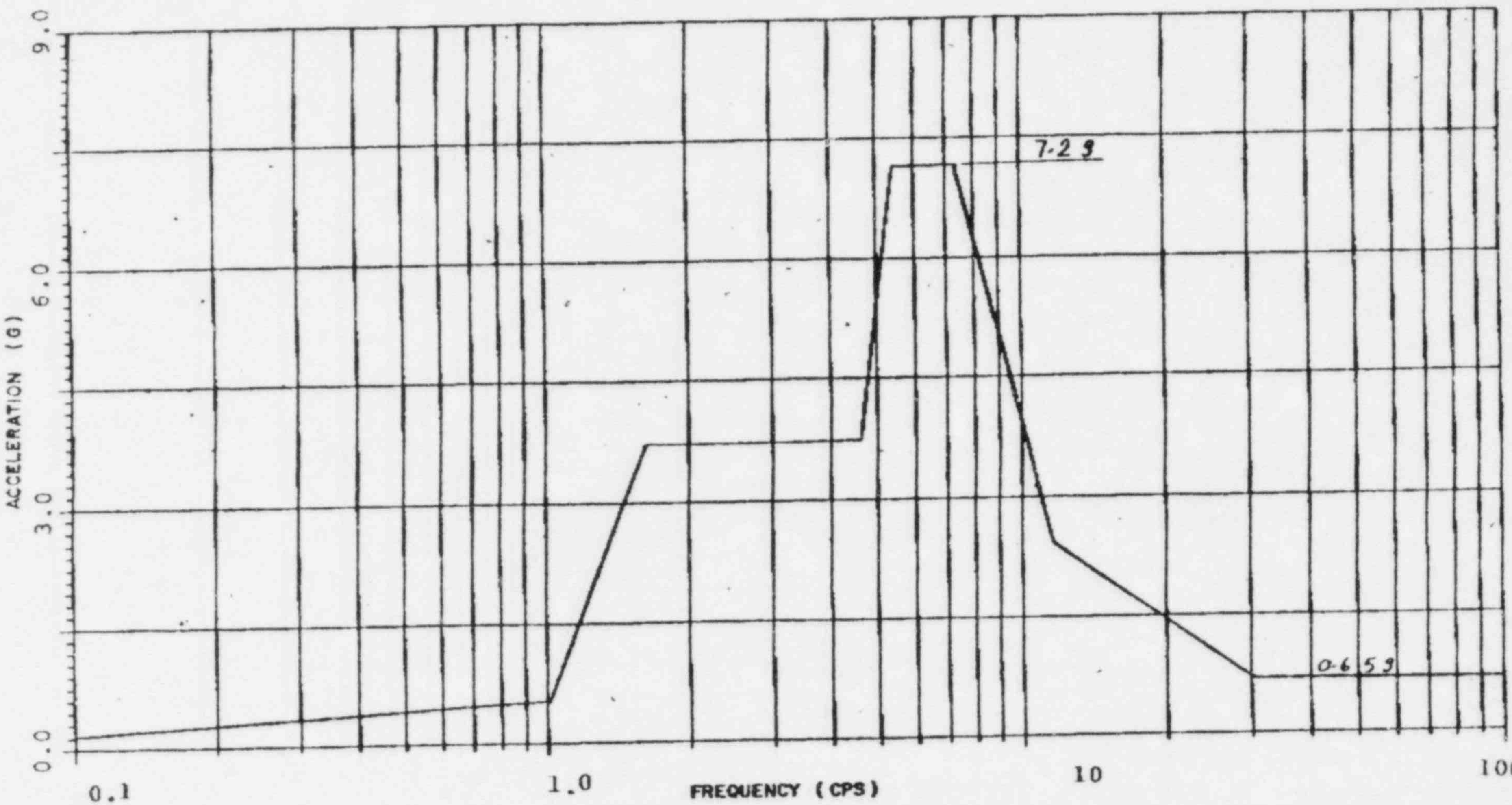

Fig. 3.10-23

CONTAINMENT RESPONSE SPECTRA
HORIZONTAL ACCELERATION OBE
EL 93.20 2 PERCENT DAMPING

C F BRAUN & CO

General Electric

San Jose

April B, 19

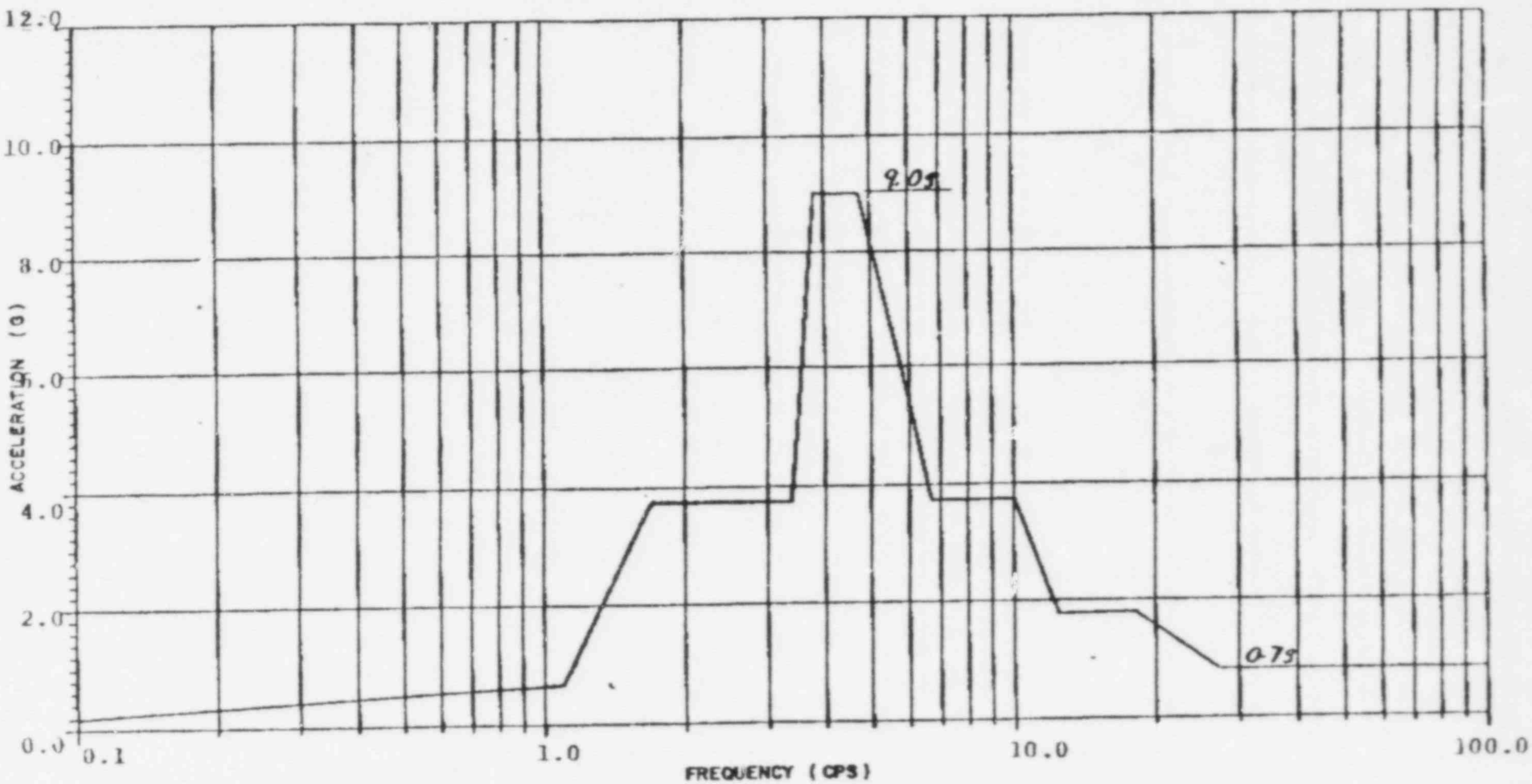

Fig. 3.10-29

SHIELD BUILDING RESPONSE SPECTRA
HORIZONTAL ACCELERATION OBE
EL 115.90 2 PERCENT DAMPING