MISSISSIPPI POWER & LIGHT COMPANY
Helping Build Mississippi
P. O. BOX 1640, JACKSON, MISSISSIPPI 39205

May 24, 1982

NUCLEAR PRODUCTION DEPARTMENT

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

Attention: Mr. Harold R. Denton, Director

Dear Mr. Denton:

SUBJECT: Grand Gulf Nuclear Station
Units 1 and 2
Docket Nos. 50-416 and 50-417
File 0260/L-814.2
SQRT - Additional Information Supporting Justification for Interim Operation; Response to NRC Questions at 4/21/82 Meeting
AECM-82/229

References:
1) AECM-82/128; April 5, 1982
2) AECM-82/173, April 19, 1982
3) AECM-82/190, April 26, 1982
4) AECM-82/218, May 24, 1982

Mississippi Power & Light Company's (MP&L) letters of April 19, 1982 (AECM-82/173) and April 26, 1982 (AECM-82/190) transmitted to the NRC additional information to support MP&L's initial justification for interim operation submitted on April 5, 1982 (AECM-82/128) for equipment not qualified to the SQRT criteria.

On April 21, 1982, MP&L met with the Equipment Qualification Branch (EQB) to review the additional information submitted to support MP&L's initial justification for interim operation.

The purpose of this letter is to provide the EQB with MP&L's response to the questions raised in regard to the additional information discussed during the April 21, 1982, meeting.

The following information is provided:

A. Attachment No. 1

Attachment No. 1 is the Grand Gulf SQRT program requalification schedule.

B001
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1/1

8205270014

AE3H1

B. Attachment No. 2

Attachment No. 2 is the Grand Gulf power ascension schedule.

C. Attachment No. 3

Attachment No. 3 provides the Response Spectra requested by EQB during the April 21, 1982, meeting. The enclosed Response Spectra are for the SSE, SRV, Pool Swell, and the LOCA Envelope for the Containment and Drywell in the area of the HCU floor.

NOTE: This information was hand delievered to M. D. Houston by Bechtel on April 26, 1982.

D. Attachment No. 4

Air Operated Butterfly Valves

E. Attachment No. 5

Main Steam Isolation Valves (MSIV)

F. Attachment No. 6

HPCS Diesel Generator System

G. Attachment No. 7

Conductivity Cell

H. Attachment No. 8

Miscellaneous Information

A meeting has been scheduled for June 2, 1982, to review the above information with the Equipment Qualification Branch (EQB) - Seismic. Additional information as noted in Attachment No. 8 will also be reviewed.

If you have any questions or require further information, please contact this office.

Yours truly,

John D Richardson

L. F. Dale
Manager of Nuclear Services

RAB/SHH/JDR:lm

Attachments: (See Next Page)

AE3H2

Attachments:
1. Grand Gulf SQRT Program Requalification Schedule
2. Grand Gulf Power Ascension Schedule
3. Response Spectra for SSE, SRV, Pool Swell, and LOCA Envelope
4. Air Operated Butterfly Valves
5. Main Steam Isolation Valves
6. HPCS Diesel Generator System
7. Conductivity Cell
8. Miscellaneous Information

cc: Mr. N. L. Stampley (w/o)
Mr. G. B. Taylor (w/o)
Mr. R. B. McGehee (w/o)
Mr. T. B. Conner (w/o)

Mr. Richard C. DeYoung, Director (w/o)
Office of Inspection & Enforcement
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. J. P. O'Reilly, Regional Administrator (w/a)
Office of Inspection & Enforcement
U.S. Nuclear Regulatory Commission
Region II
101 Marietta St., N.W., Suite 3100
Atlanta, Georgia 30303

AE3H3

ATTACHMENT NO. 1

SQRT Requalification Schedule
Grand Gulf SQRT Program

Component	Plant ID	Qualification Status	Qualification Schedule
Air Operated Butterfly Valves (M-257.0/258.0)	P44-F116, F117, F118 P44-F119, F120, F121 P44-F122, F123 G41-F019, F045	Qualified	None
Safety Relief Valves (M-141.1)	E12-F055A, B P75-F026A, B	Not Qualified (Justification for Interim Operation Provided)	Perform Operability Test by July 31, 1982
Main Steam Isolation Valve (MSIV)	B21-F022/F028	Not Qualified (Justification for Interim Operation Provided)	Qualify by Test by August 31, 1982
RHR Heat Exchanger	E12-B001/B002	Not Qualified (Justification for Interim Operation Provided)	Qualify by Analysis by August 31, 1982
CRD Solenoid Valve	C11-F009	Qualified	Complete Documentation by May 31, 1982
HPCS Valve Actuators	E22-F001/F010 E22-F011/F012/F015 E22-F023 E22-F004	(E22-F001/F010/F011/F012/F015/F023; Qualified) (E22-F004; Not Qualified) (Justification for Interim Operation Provided)	Complete Documentation by July 1, 1982. Replace E22-F004 during First Refueling Outage (January 1, 1984)
HPCS Diesel Generator System	E22-S001/S002 E22-S003/S004	(E22-S002/S003/S004; Qualified) (E22-S001; Not Qualified) (Justification for Interim Operation Provided)	Complete Documentation by July 1, 1982. Qualify E22-S001 by Analysis by December 31, 1982

ATTACHMENT NO. 1 (Continued)

SQRT Requalification Schedule
Grand Gulf SQRT Program

Component	Plant ID	Qualification Status	Qualification Schedule
Pressure Indicators	B21-R005 (Barton 227)	Qualified	Complete Documentation by May 31, 1982.
	B21-R009A, B (Barton 227)	Not Qualified	Qualify by Analysis by May 31, 1982.
Switches	C41A-S01 E12A-S03 E12A-S57, E21A-S07 E22A-S03, E21A-S06 E22B-S02/S07/S09 E22B-S10/S15/S16 E51A-S15 (Electroswitch)	Qualified	Completed Documentation by May 15, 1982.
Conductivity Cell	E12-N025A, B	Qualified	Complete Documentation by May 15, 1982.
Fuel Handling and Auxiliary Platforms	F11-E014 F15-E003/E005	Not Qualified (Justification for Interim Operation Provided)	Qualify by Test by December 31, 1982
In-Vessel Rack	F16-E006	Not Qualified (Justification for Interin Operation Provided)	Qualify by Test by December 31, 1982
Defective Fuel Storage Container	F16-E009	Not Qualified (Justification for Interim Operation Provided	Qualify by Test by December 31, 1982
BOP/PGCC Panels	H13-P855/P856 H13-P864/P870/P871 H13-P872/P877/P878	Not Qualified (Justification for Interim Operation Provided)	Qualify by Test/ Analysis by December 31, 1982

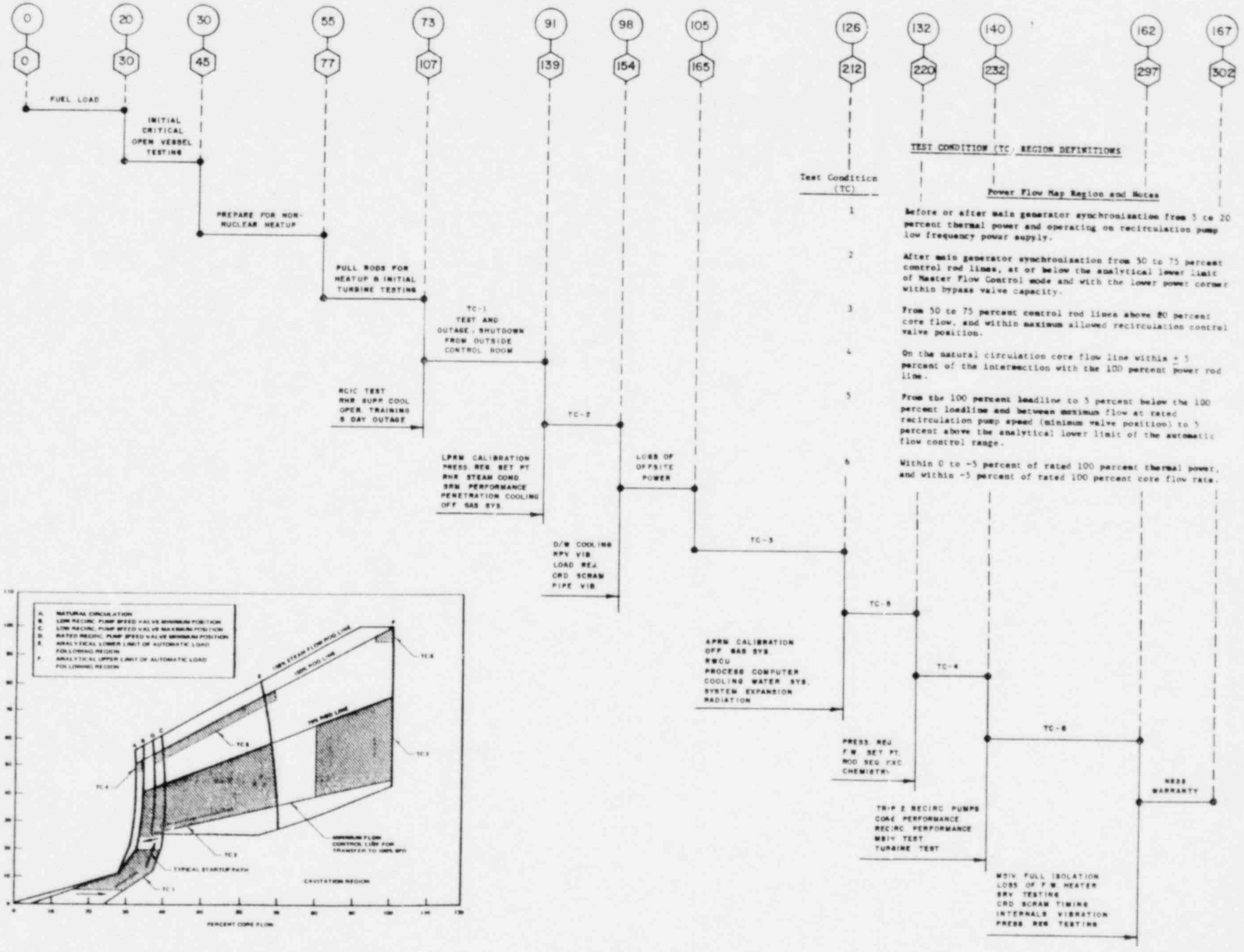
ATTACHMENT NO. 2

Grand Gulf Power Ascension Schedule

The following is an example of the power ascension schedule for Grand Gulf Unit 1 based on an "assumed" fuel load of June 1, 1982.

	OPTIMUM SCHEDULE		PROBABLE SCHEDULE	
Fuel Load:	Day 0	June 1, 1982	Day 0	June 1, 1982
Open Vessel Criticality:	Day 20	June 20, 1982	Day 30	June 30, 1982
Non-Nuclear Heatup:	Day 30	June 30, 1982	Day 45	July 15, 1982
Pull Rods for Initial Heatup:	Day 55	July 24, 1982	Day 77	August 15, 1982
Test Condition No. 1: (5% to 20% Power)	Day 73	August 11, 1982	Day 107	September 15, 1982
Test Condition No. 2: (50% to 75% Power)	Day 91	August 30, 1982	Day 139	October 16, 1982
Loss of Offsite Power:	Day 98	September 6, 1982	Day 154	November 2, 1982
Test Condition No. 3: (50% to 100% Power)	Day 105	September 13, 1982	Day 165	November 12, 1982
Test Condition No. 5: (95% to 100% Power)	Day 126	October 3, 1982	Day 212	December 28, 1982
Test Condition No. 4: (95% to 100% Power)	Day 132	October 9, 1982	Day 220	January 5, 1983
Test Condition No. 6:	Day 140	October 17, 1982	Day 232	January 17, 1983
Other Testing:	Day 162	November 9, 1982	Day 297	March 13, 1983
NSSS Warranty Commercial Operation:	Day 167	November 14, 1982	Day 302	March 28, 1983

POWER ASCENSION SUMMARY



TEST CONDITION (TC) REGION DEFINITIONS

Test Condition (TC)	Power Flow Map Region and Notes
1	Before or after main generator synchronization from 5 to 20 percent thermal power and operating on recirculation pump low frequency power supply.
2	After main generator synchronization from 50 to 75 percent control rod lines, at or below the analytical lower limit of Master Flow Control mode and with the lower power corner within bypass valve capacity.
3	From 50 to 75 percent control rod lines above 80 percent core flow, and within maximum allowed recirculation control valve position.
4	On the natural circulation core flow line within ± 5 percent of the intersection with the 100 percent power rod line.
5	From the 100 percent loadline to 5 percent below the 100 percent loadline and between maximum flow at rated recirculation pump speed (minimum valve position) to 5 percent above the analytical lower limit of the automatic flow control range.
6	Within 0 to -5 percent of rated 100 percent thermal power, and within -5 percent of rated 100 percent core flow rate.

ATTACHMENT NO. 3

Seismic Response Spectra

This information was provided to the NRC informally (via Dean Houston) on April 26, 1982.

Attached are the requested response spectra (RRS) for the SSE, SRV, Pool Swell, and LOCA Envelope for the Containment and Drywell in the area of the HCU floor. This information was requested by the Equipment Qualification Branch during the April 21, 1982, meeting.

The attached information was previously transmitted formally by MP&L via AECM-79/46 dated 5/25/79.

GRAND GULF NUCLEAR STATION

50-416, 50-417

Attachment to FSAR Amendment 30

Seismic Response Spectra
(Q110.43)

GRAND GULF NUCLEAR STATION

Seismic Response Spectra (Q110.43)

Containment Building

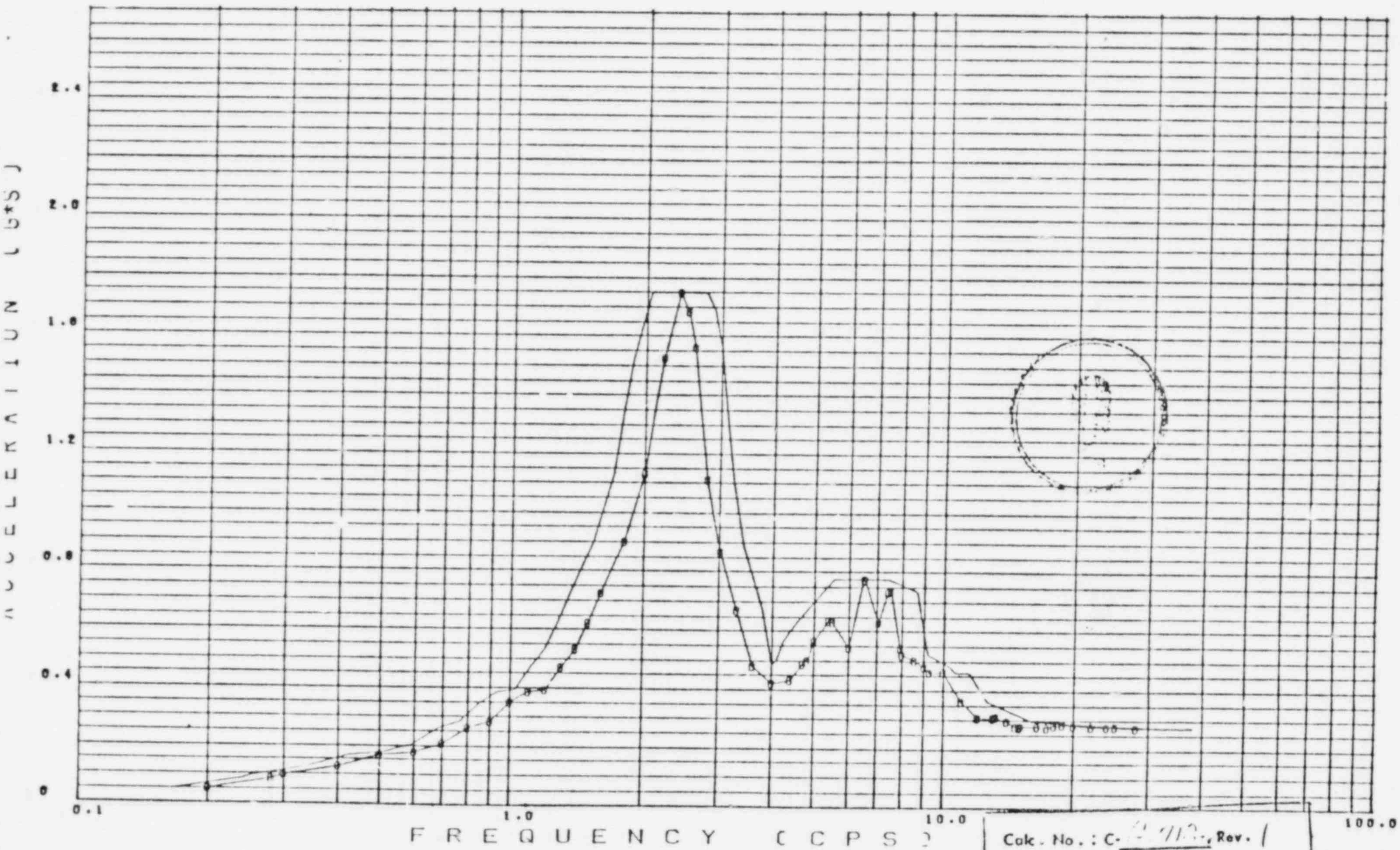
Damping: 2%, 3%

Direction: Vertical, N-S

Earthquake: ~~OBE~~, SSE

DAMPING = .0200

BECHTEL CORPORATION



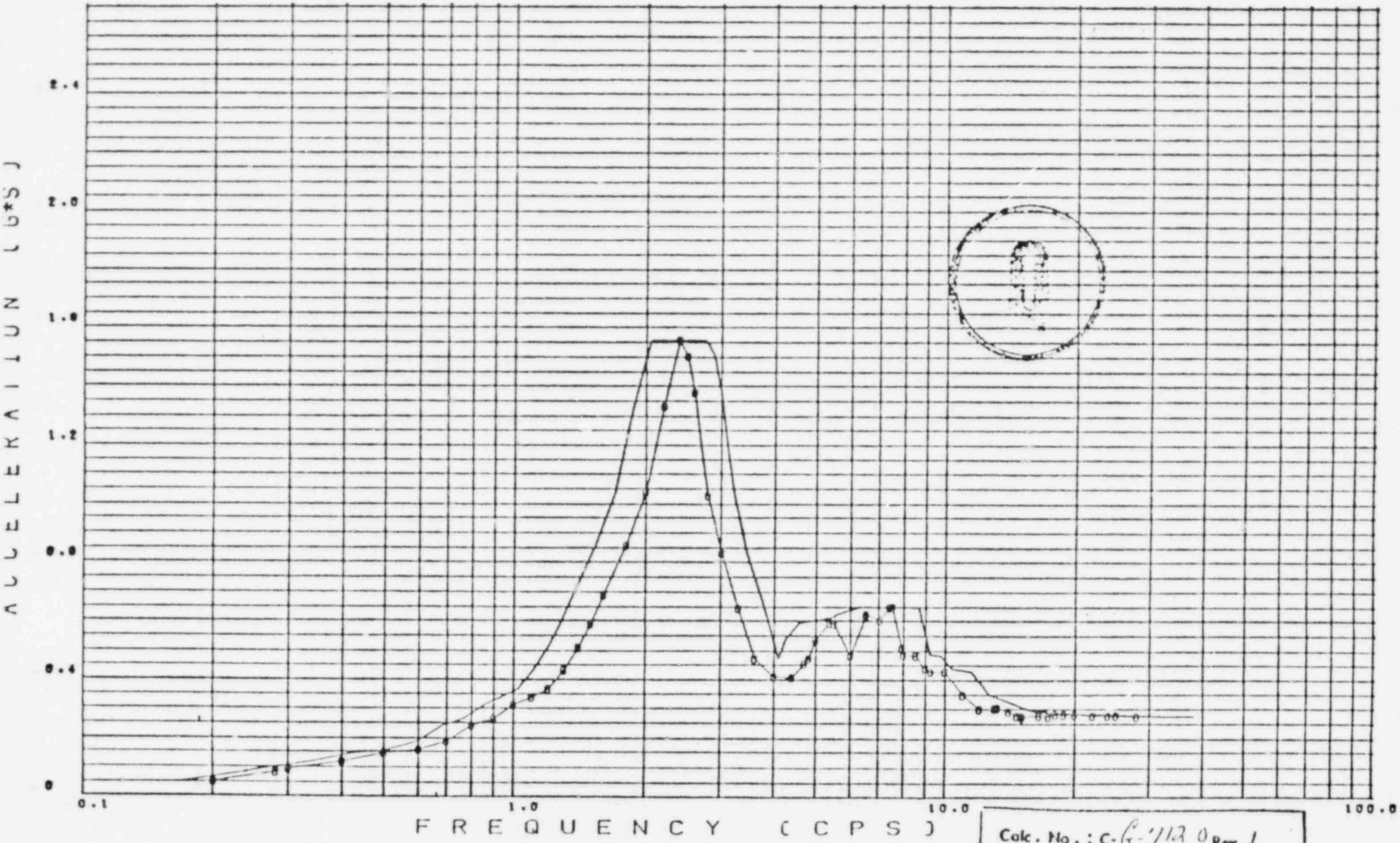
Calc. No.: C-[illegible], Rev. 1

SPECTRA NODE 3 CONTAINMENT EL. 142.33 .5%/157
SSE N-S

N313

DAMPING = .0300

BECHTEL CORPORATION



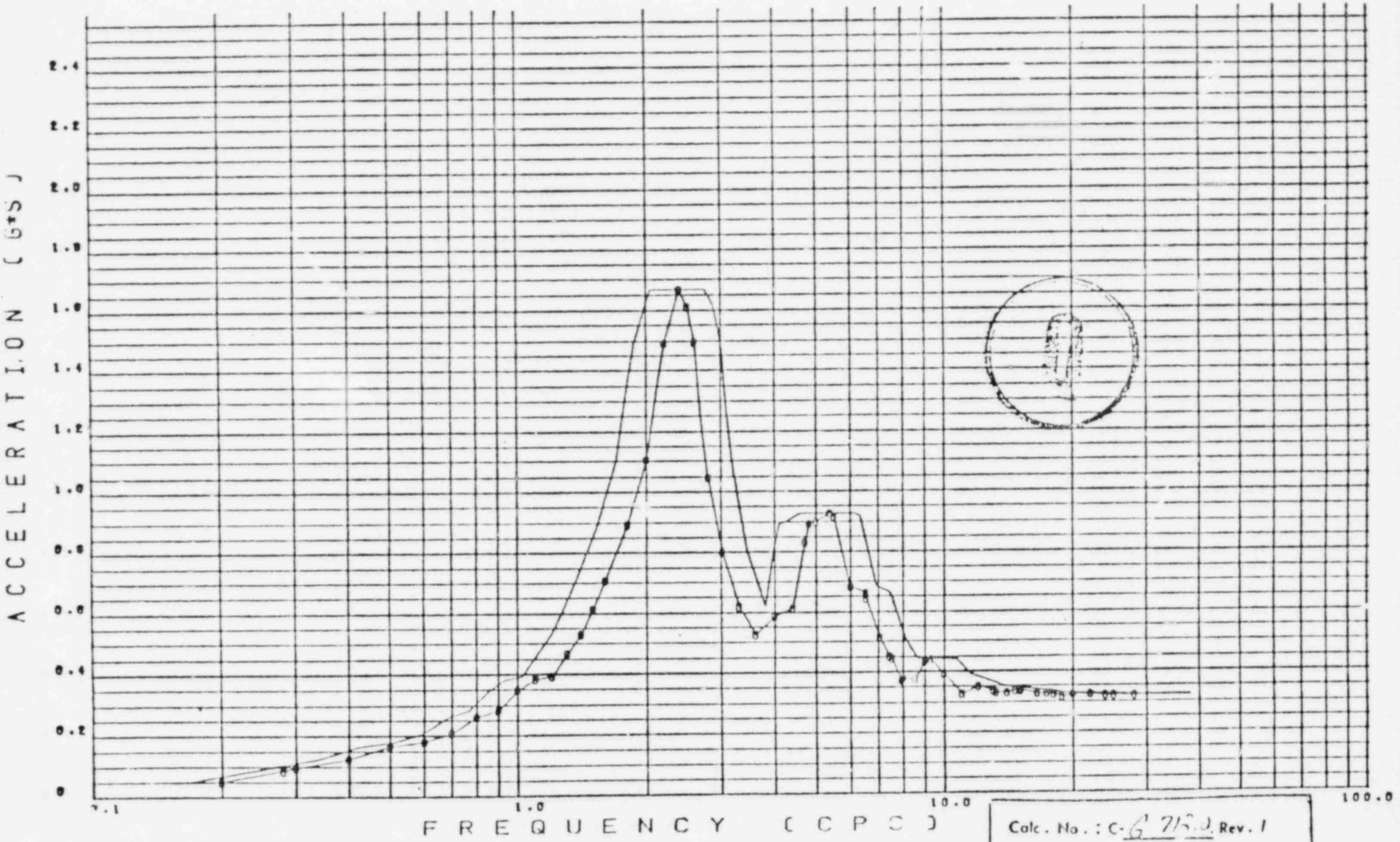
Calc. No.: C-G-7120 Rev.1

SPECTRA NODE 3 CONTAINMENT EL. 142.33 32/58
SSE N-S

N314

DAMPING = .0200

BECHTEL CORPORATION



Calc. No.: C-6 750 Rev. 1

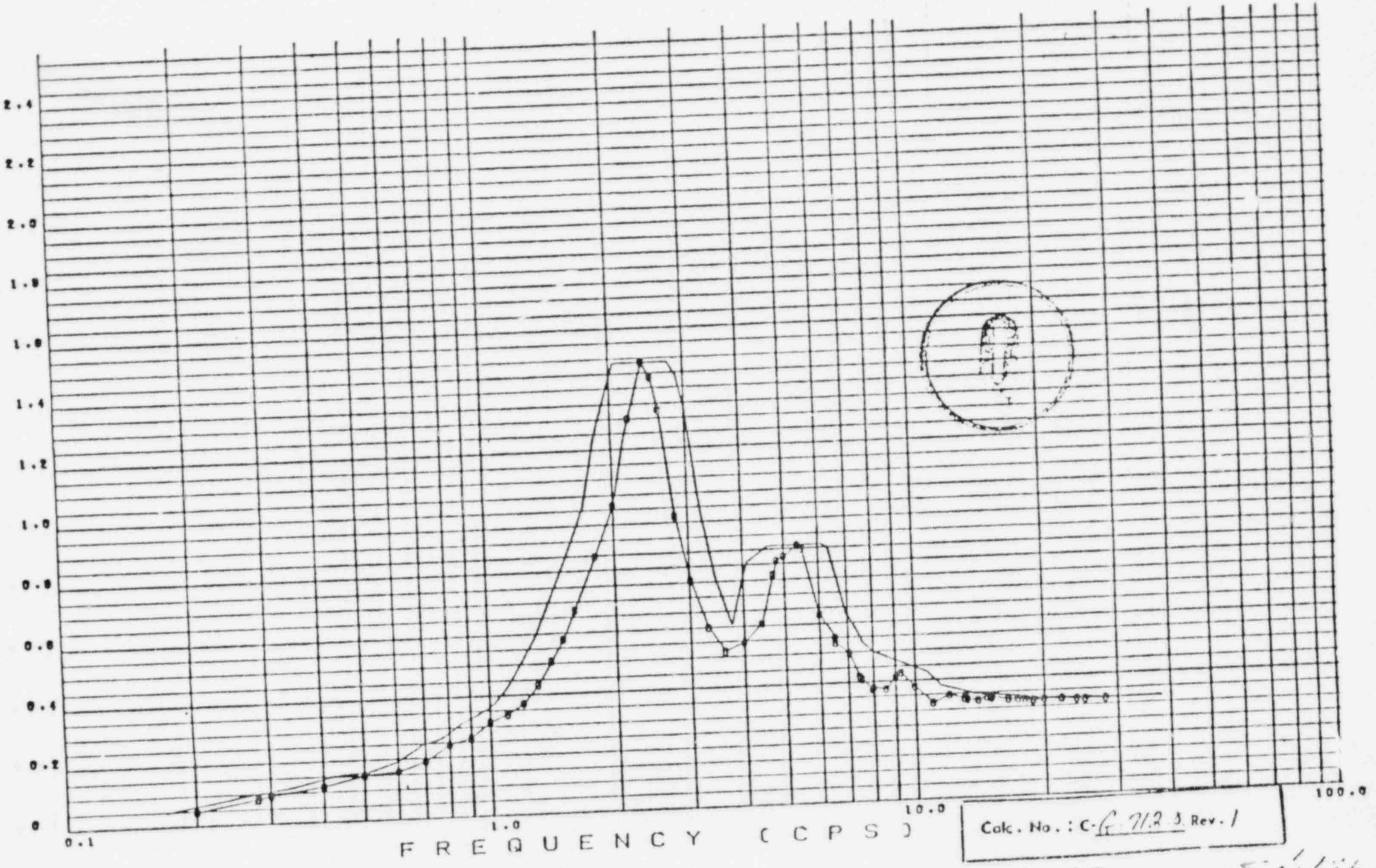
SPECTRA NODE 14 DRYWELL EL. 142.33
SSE N-S

SL198

N1113

BECHTEL CORPORATION

DAMPING = .0300



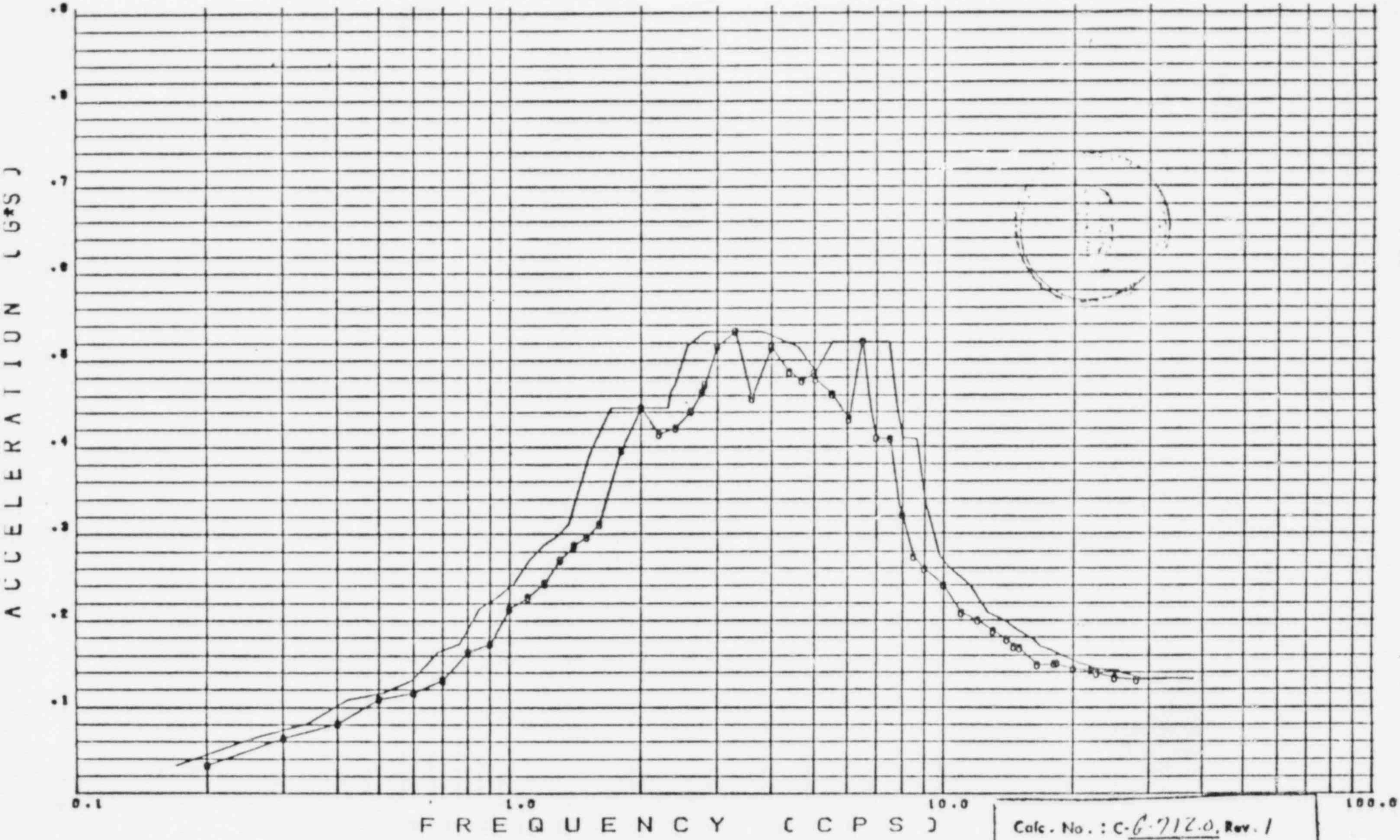
Calc. No.: C-G 712.3 Rev. 1

SPECTRA NODE 14 DRYWELL EL. 142.33

N1114

DAMPING = .0200

BECHTEL CORPORATION



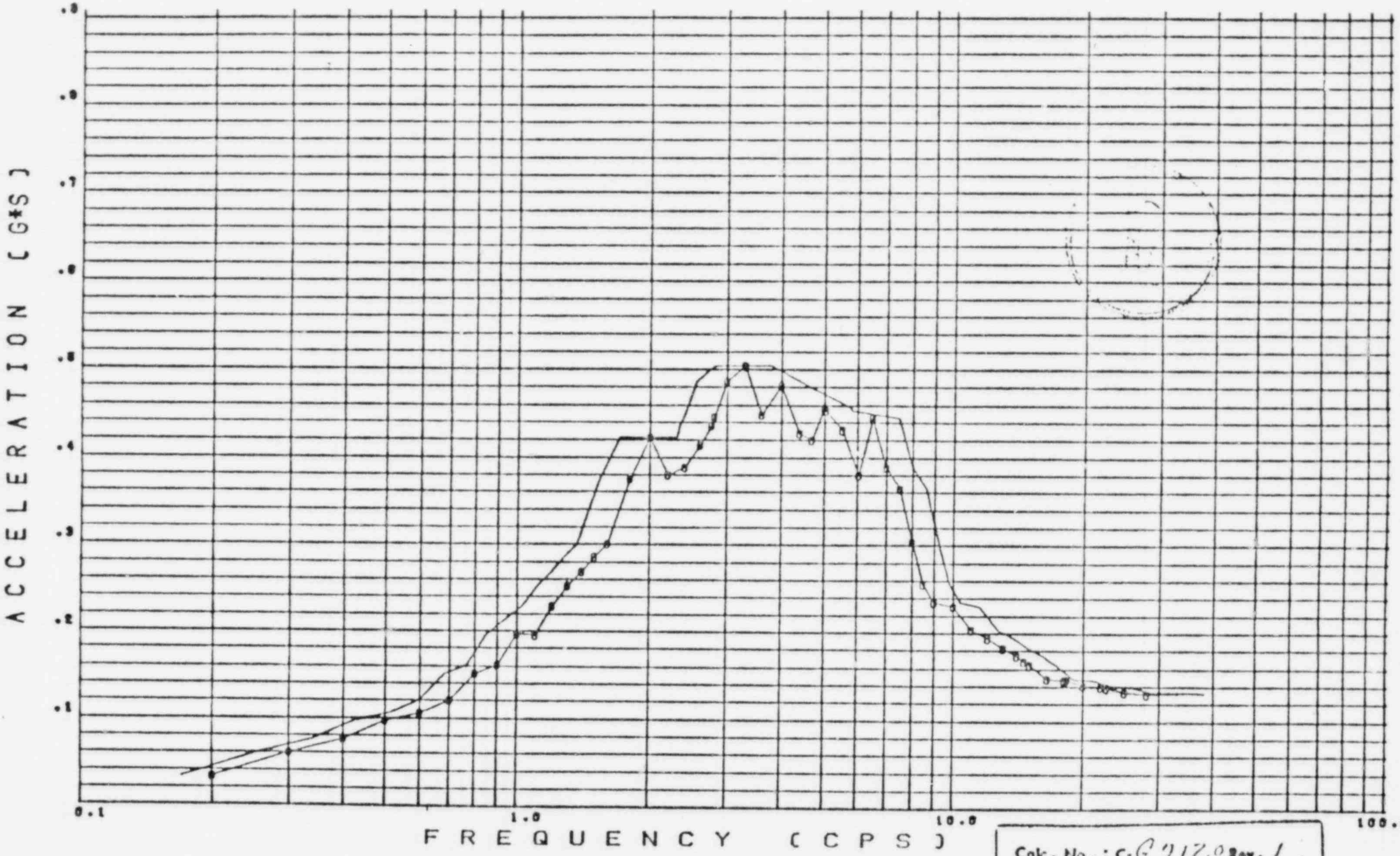
Calc. No.: C-6-712.0, Rev. 1

SPECTRA NODE 3 CONTAINMENT EL. 142.33 Sh 654
SSE VERTICAL

V313

DAMPING = .0300

BECHTEL CORPORATION



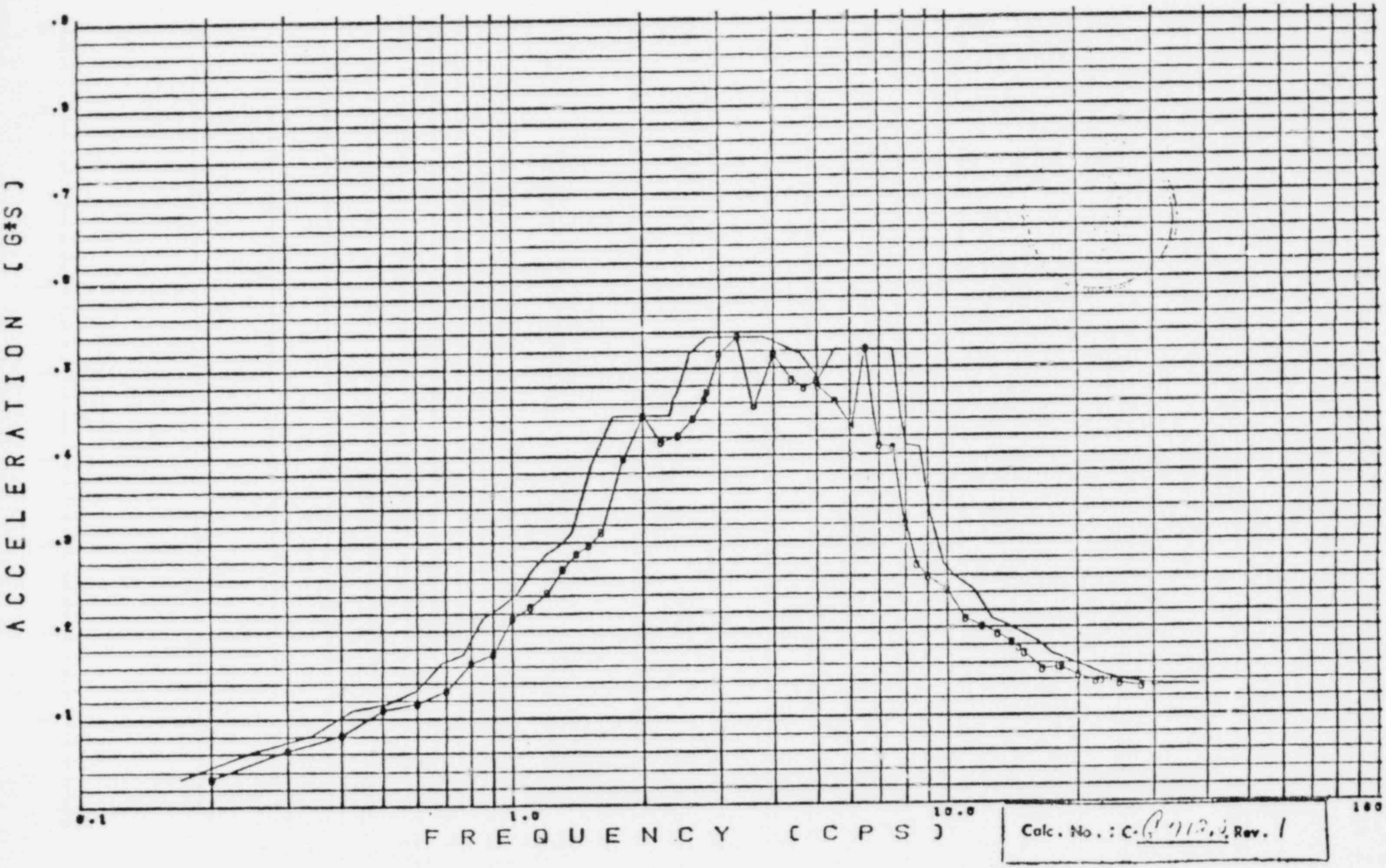
Calc. No.: C-G 712.0 Rev. 1

SPECTRA NODE 3 CONTAINMENT EL 142.33 Sh 655
SSE VERTICAL

V314

DAMPING = .0200

BECHTEL CORPORATION



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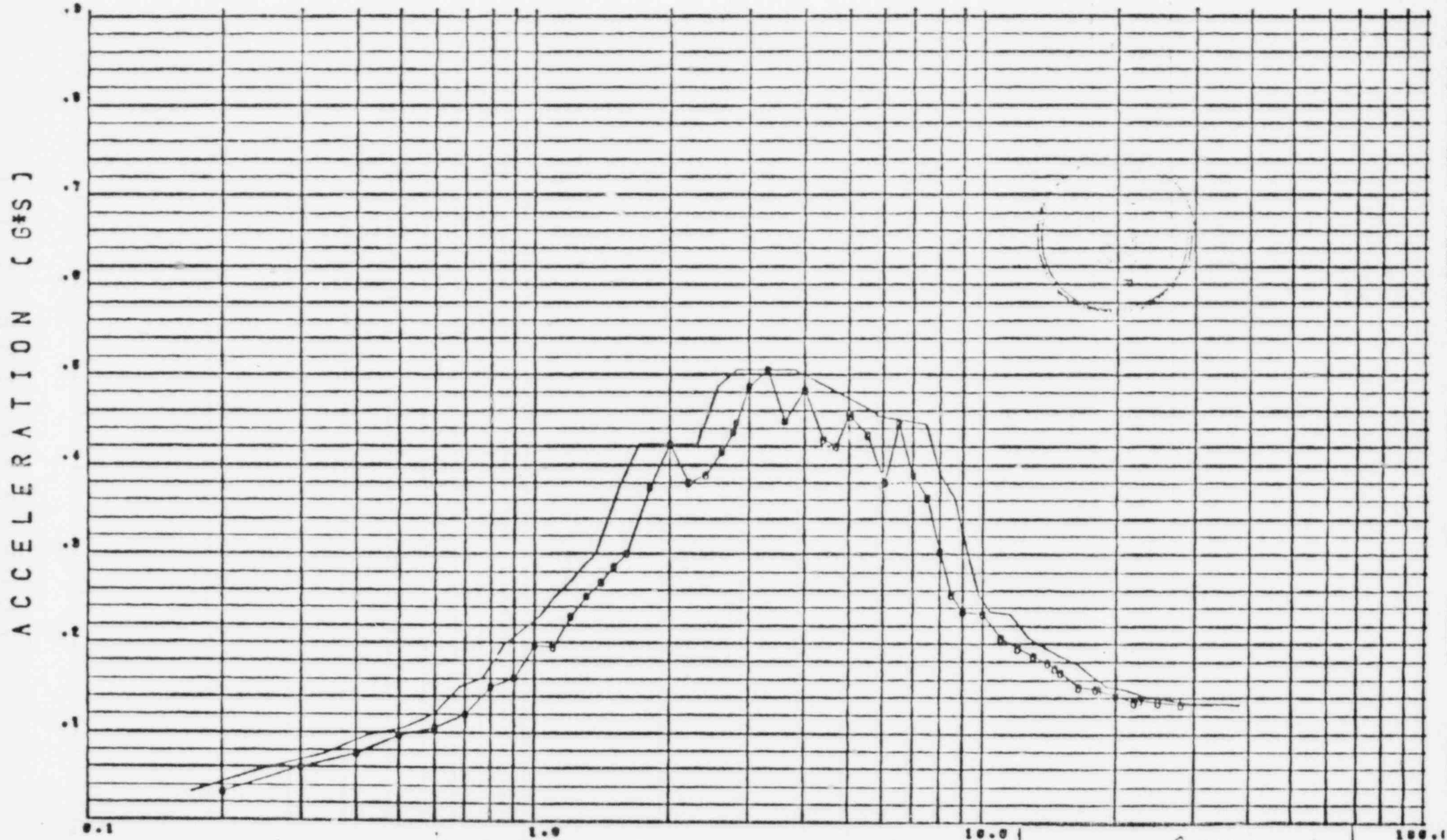
SPECTRA NODE 14 DRYWELL EL. 142.33 Sh656
SSE VERTICAL

VIII3

DAMPING = .0300

BECHTEL CORPORATION



Calc. No.: C-6.712 Rev. 1

SPECTRA NODE 14 DRYWELL EL. 142.33 Sh 687
SSE VERTICAL

V1114

GRAND GULF NUCLEAR STATION

UNITS 1 AND 2

50-416, 50-417

Special attachment to FSAR Amendment 33 in response
to NRC Question 110.43

Controlling Hydrodynamic Required Response Spectra (RRS)
For Seismic Category I Buildings (SRV)

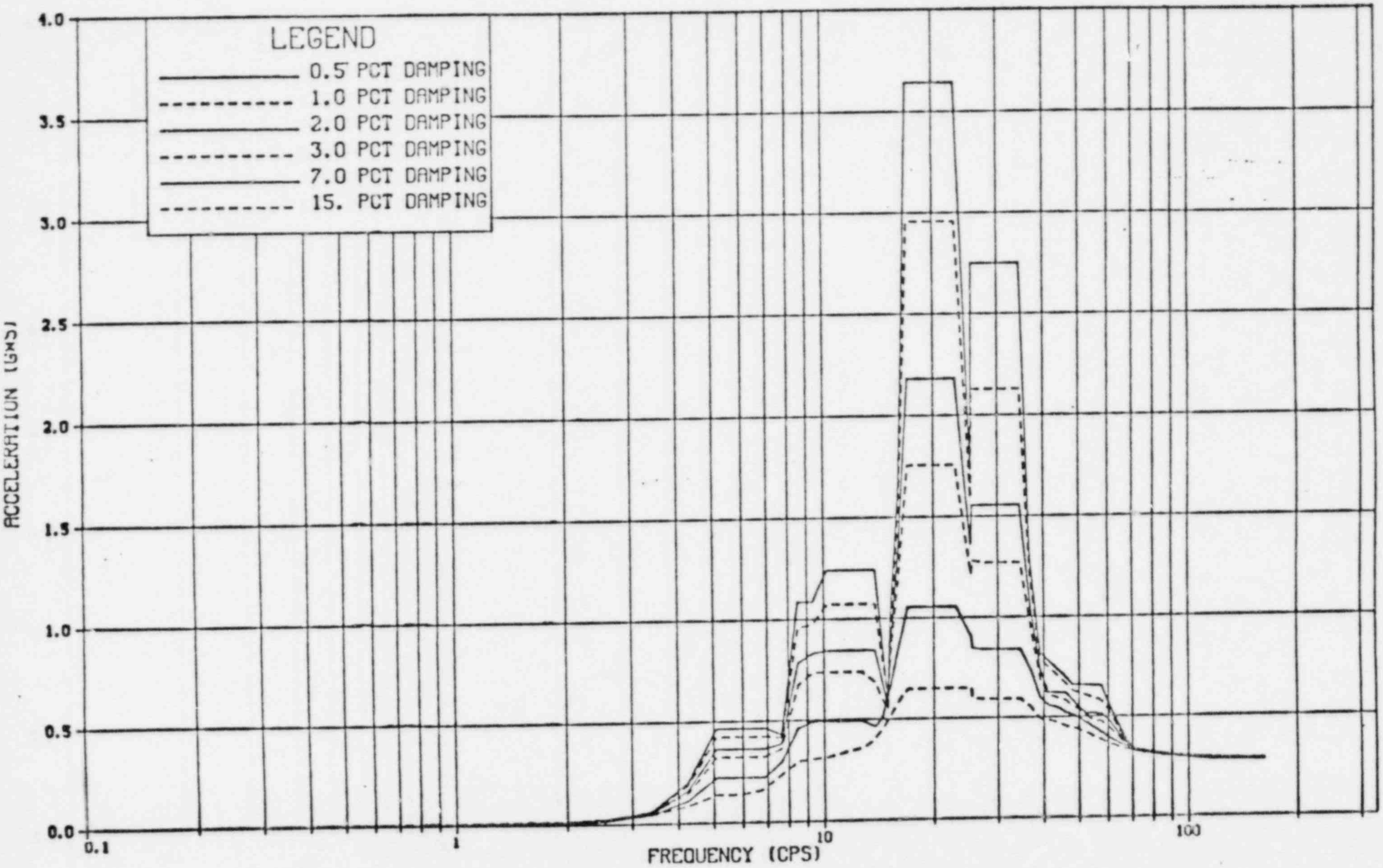
The attached information was previously transmitted formally by MP&L via AECM-79/106 dated 9/28/79.

SRVA

One Valve Second Actuation

RRS

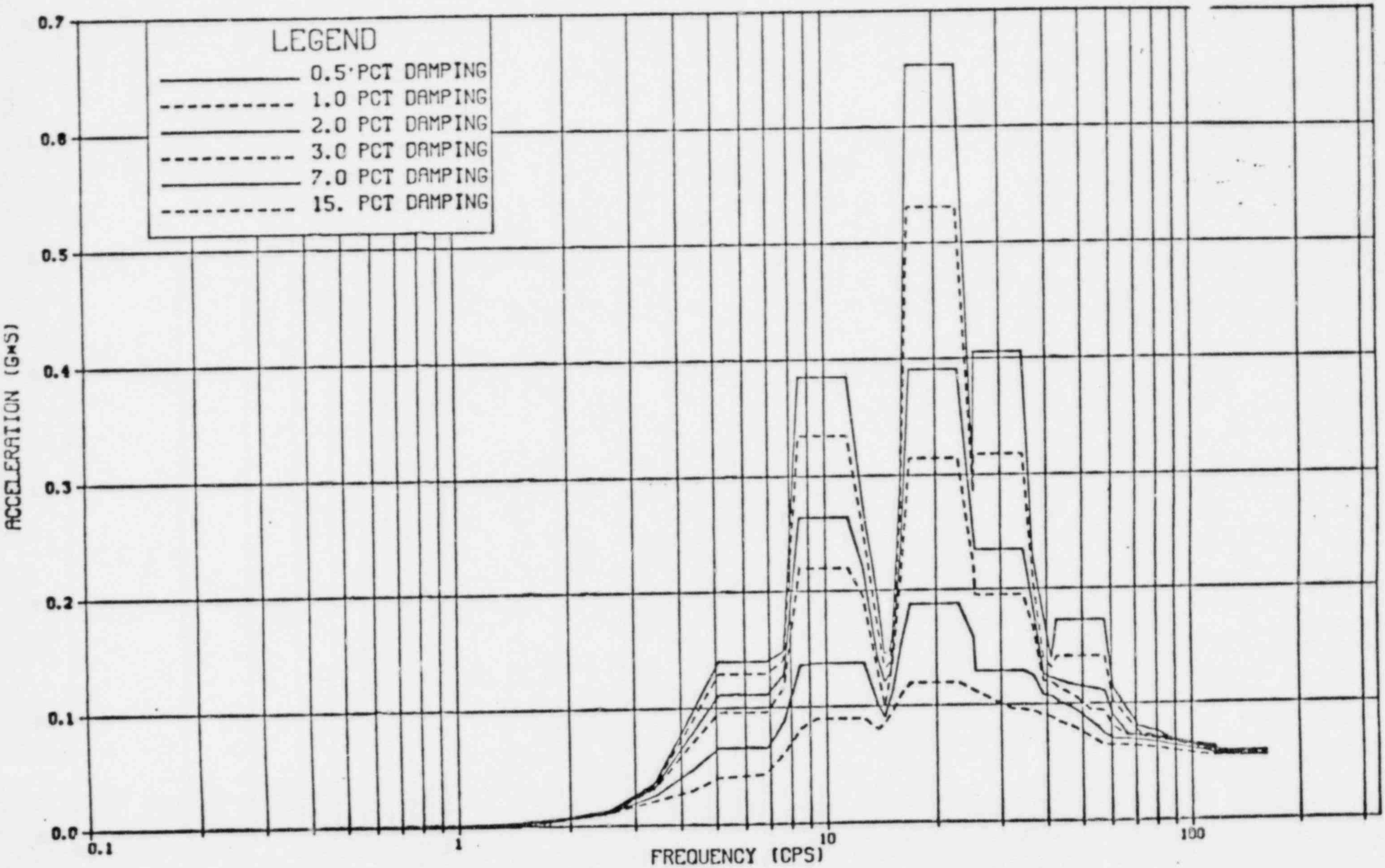
RESPONSE SPECTRA ENVELOPES



SPECTRA NODE287 CONTMNT EL.120.83 HORZTL
SRVA 1 VALVE - 2ND ACT SCALE FACTOR - .65

H211

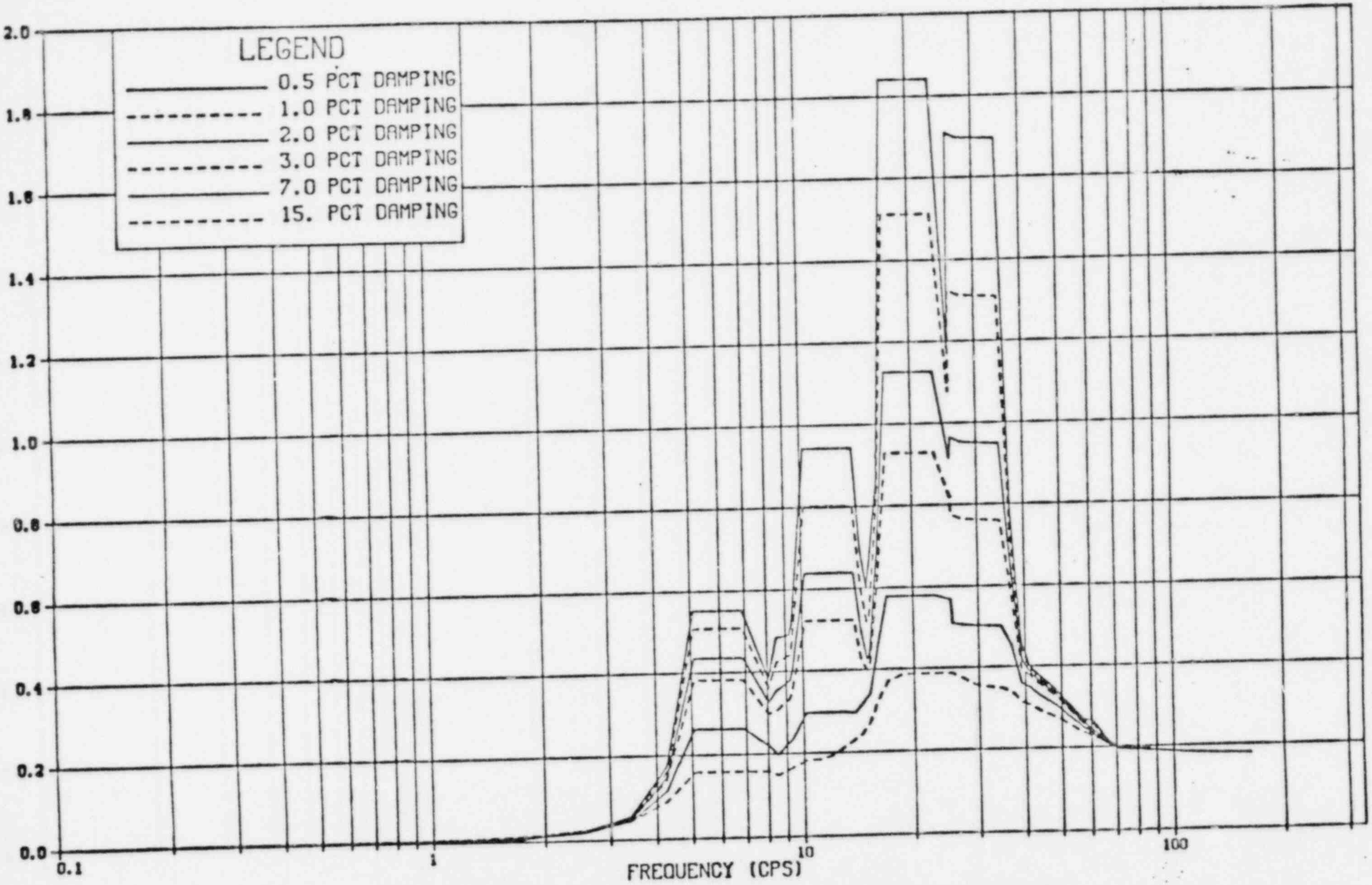
RESPONSE SPECTRA ENVELOPES



SPECTRA NODE287 CONTMNT EL.120.83 VERTCL
SRVA 1 VALVE - 2ND ACT SCALE FACTOR - .65

V211

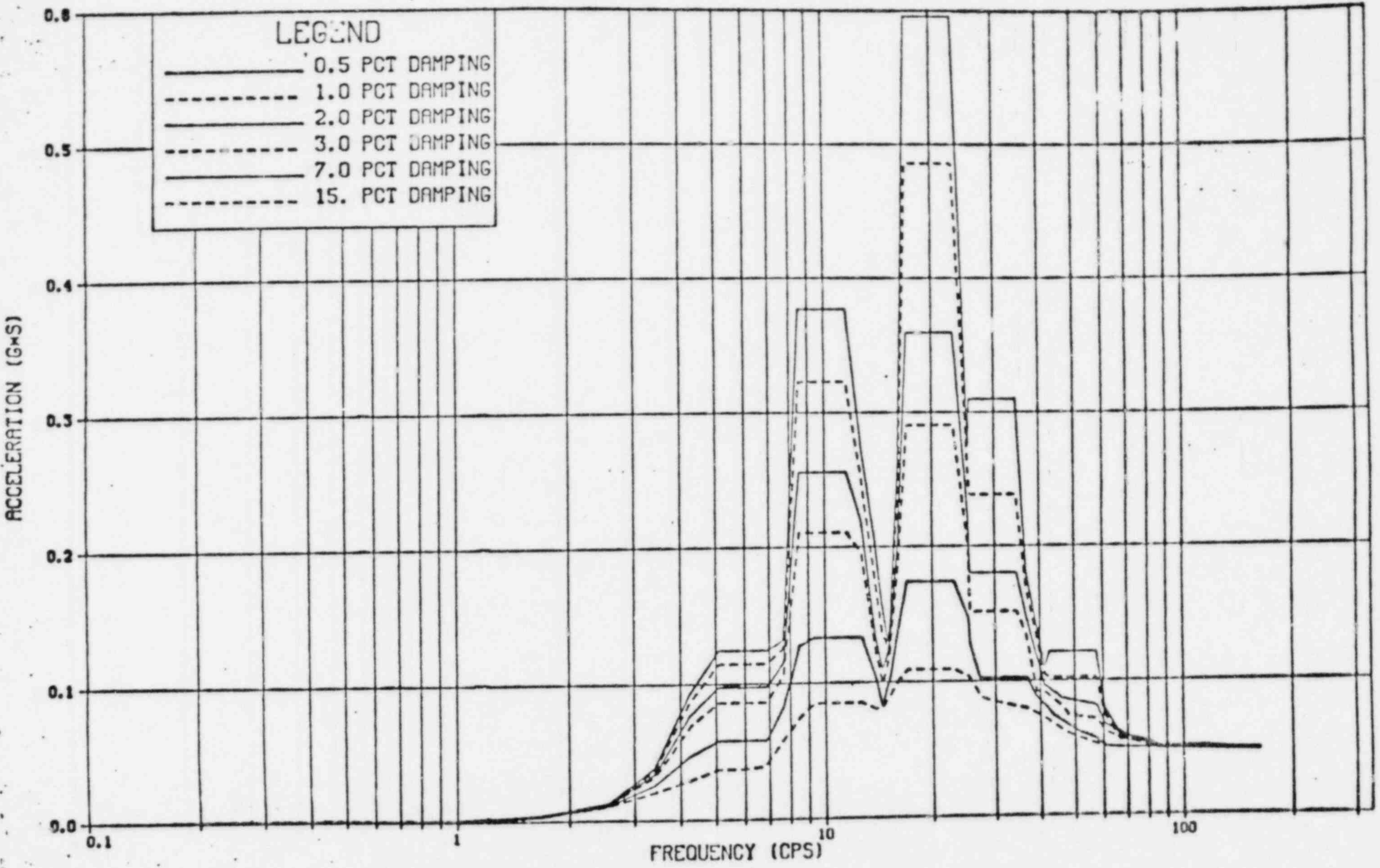
RESPONSE SPECTRA ENVELOPES



SPECTRA NODE291 CONTMNT EL.147.58 HORZTL
SRVA 1 VALVE - 2ND ACT SCALE FACTOR - .65

H311

RESPONSE SPECTRA ENVELOPES

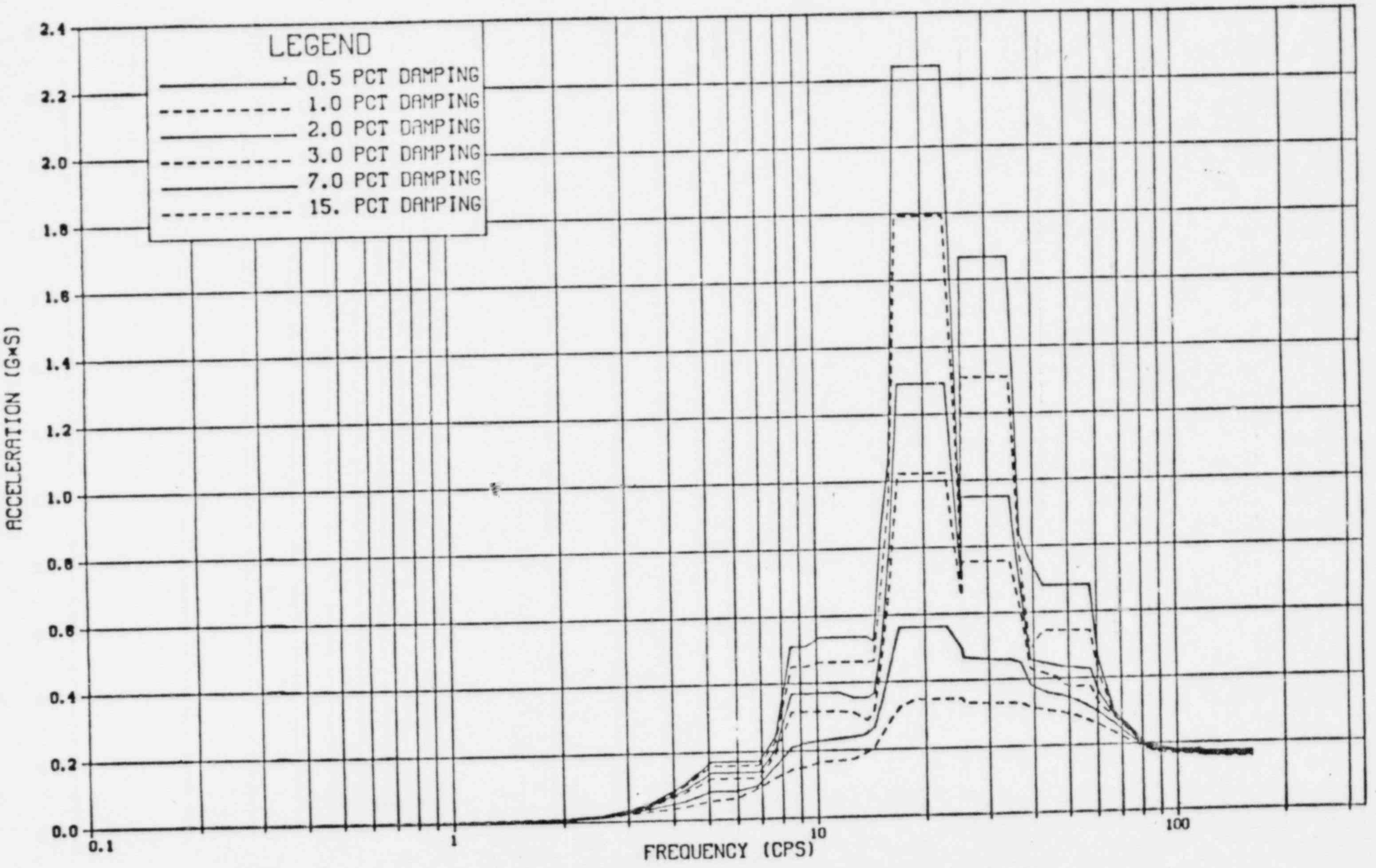


SPECTRA NODE291 CONTMNT EL.147.58 VERTCL

SRVA 1 VALVE - 2ND ACT SCALE FACTOR - .65

V311

RESPONSE SPECTRA ENVELOPES

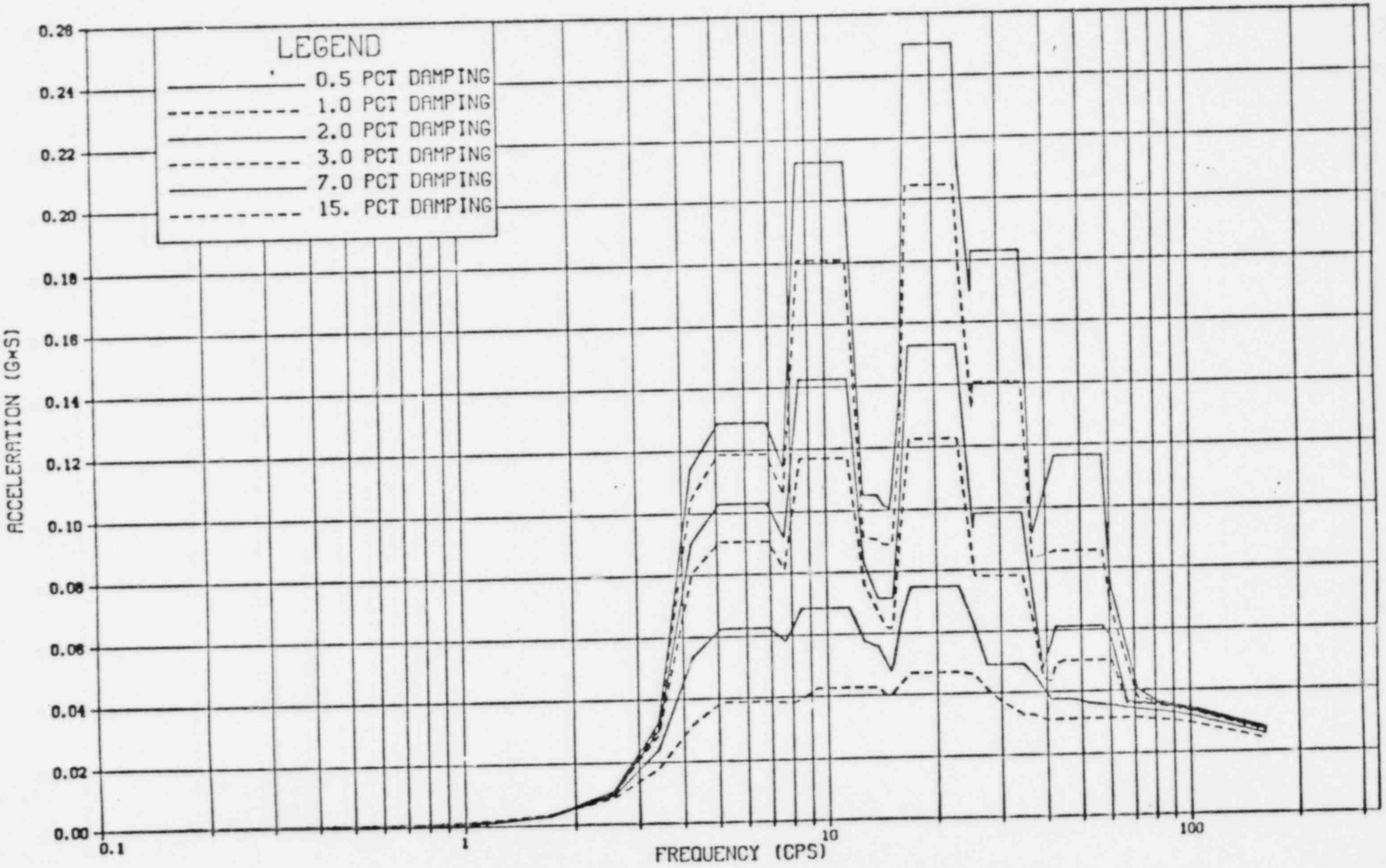


SPECTRA NODE48 DRYWELL EL.120.83 HORZTL
SRVA 1 VALVE - 2ND ACT SCALE FACTOR - .65

H1011

33 13.29.55 MON 2 JUL, 1979 JOB-RCML282 . CYBERNET SCOPE3.4 DISSPLA VER 7.5

RESPONSE SPECTRA ENVELOPES

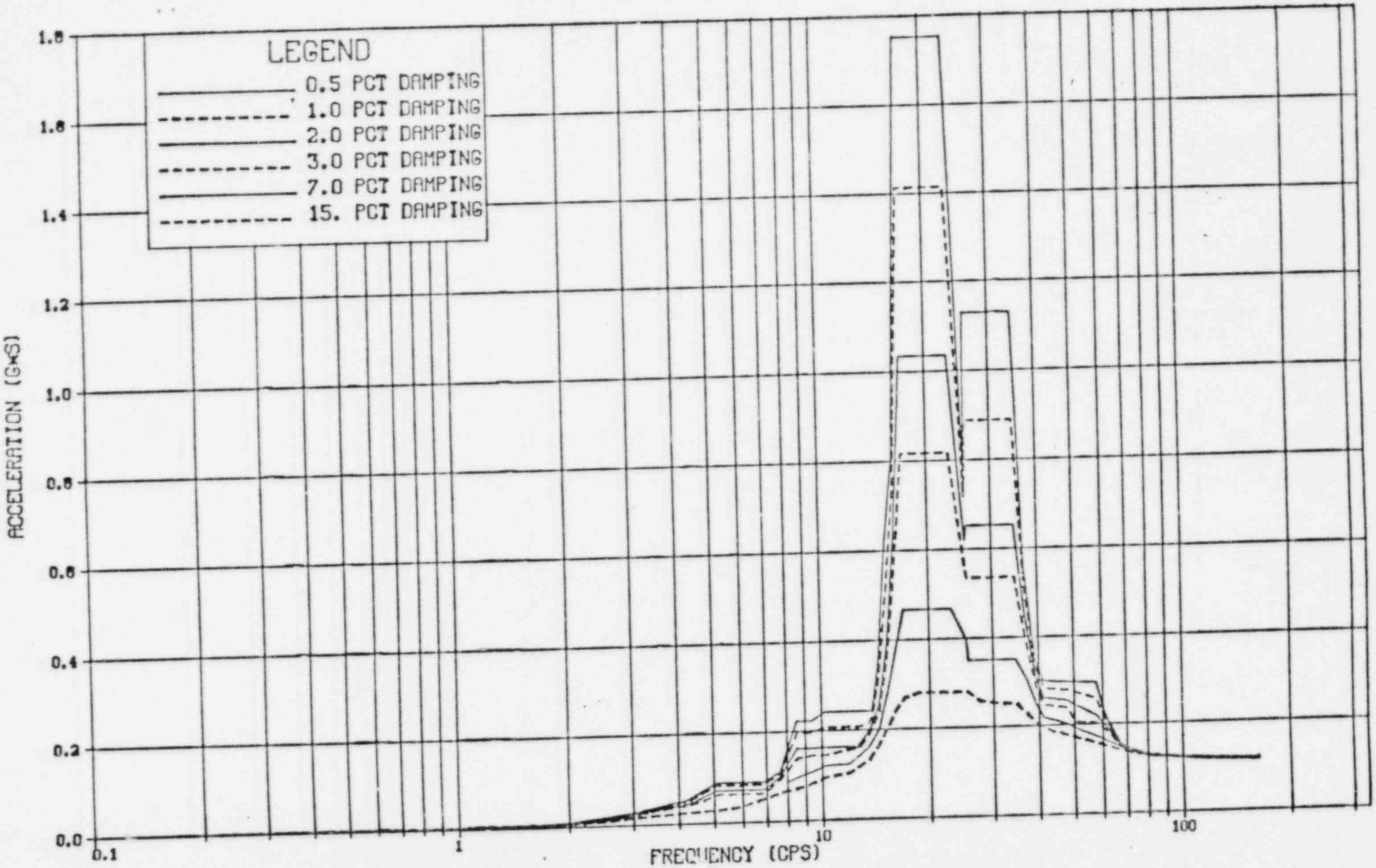


SPECTRA NODE48 DRYWELL EL.120.83 VERTCL
SRVA 1 VALVE - 2ND ACT SCALE FACTOR - .65

V1011

34 13.29.57 MON 2 JUL, 1979 JOB=RCMLEB2 , CYBERNET SCOPE3.4 DISSPLA VER 7.5

RESPONSE SPECTRA ENVELOPES



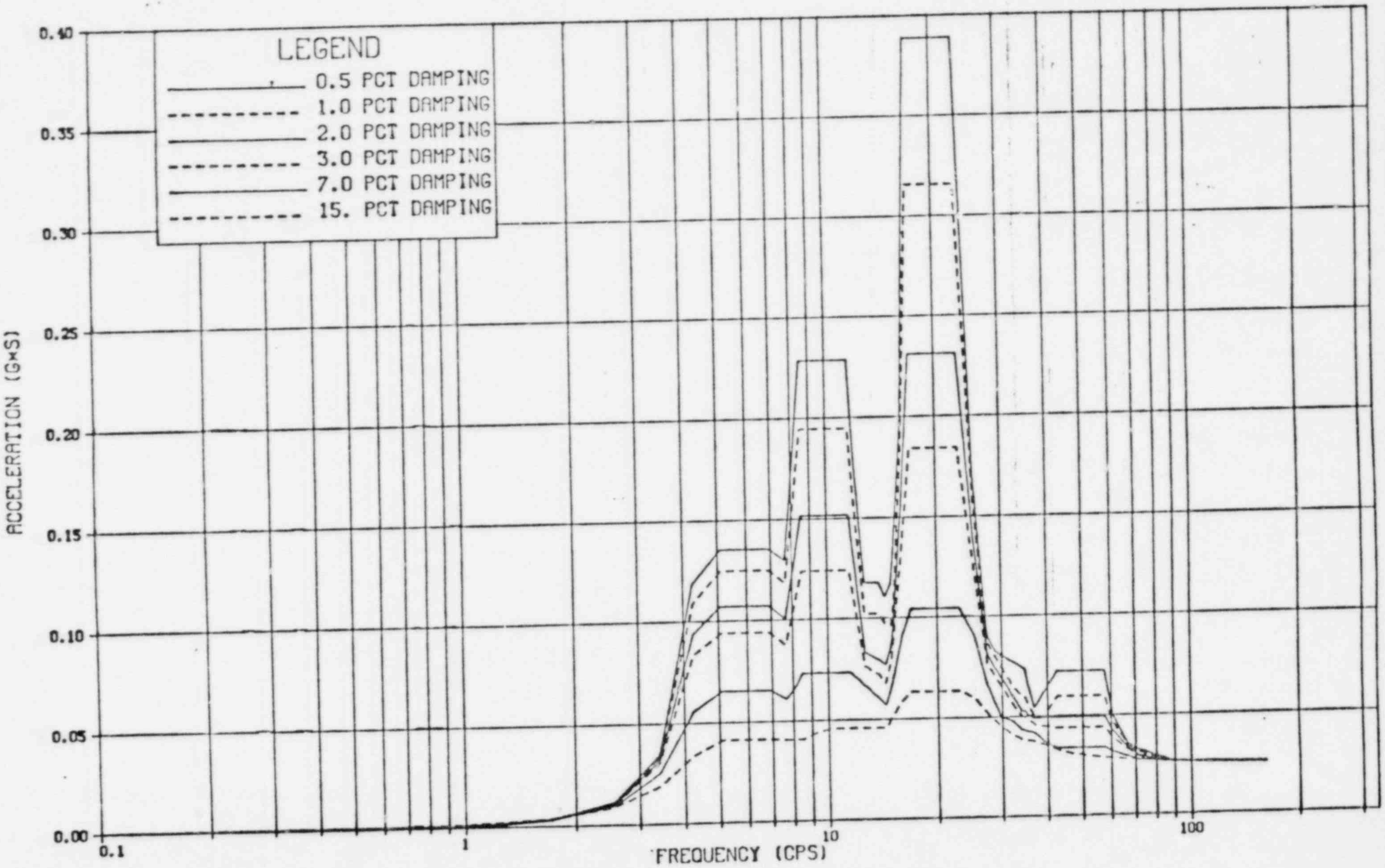
SPECTRA NODE30 DRYWELL EL.147.58 HORZTL
SRVA 1 VALVE - 2ND ACT SCALE FACTOR - .65

H1111

OT 13 13.28.13 MON 2 JUL, 1979 JOB-RCYLEB2 . CYBERNET SCOPE3.4 DISSPLA VER 7.3

14 13.29.14 MON 2 JUL, 1979 JOB-ACMLEB2 , CYBERNET SCOPE3.4 DISSPLA VER 7.5

RESPONSE SPECTRA ENVELOPES



SPECTRA NODE30 DRYWELL EL.147.58 VERTCL
SRVA 1 VALVE - 2ND ACT SCALE FACTOR - .65

V////

Grand Gulf Nuclear Station

Units 1 and 2

Dockets 50-416, 50-417

Revised Special Attachment to FSAR Amendment No. 44
in Response to NRC Question 110.43

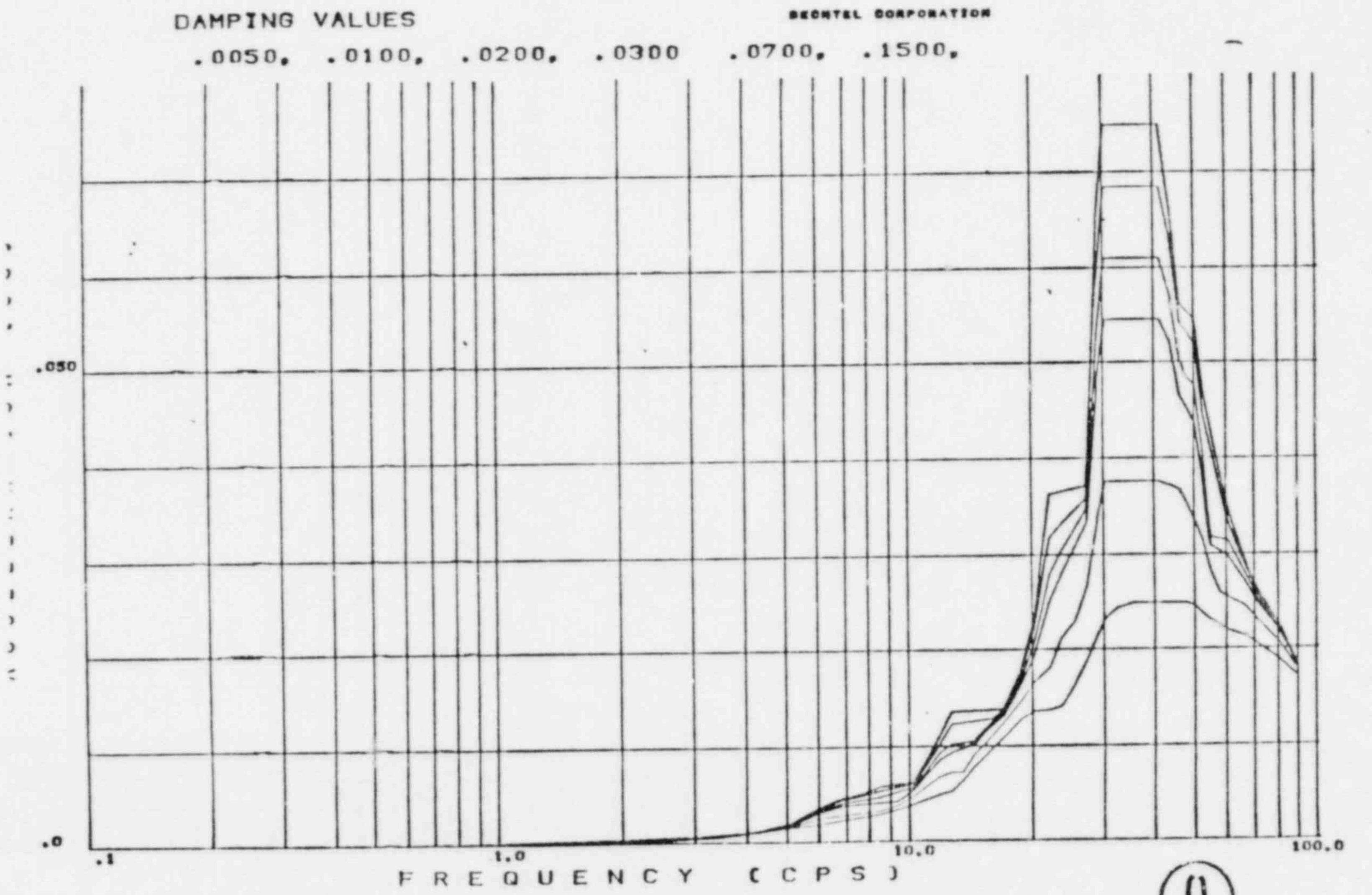
Controlling Hydrodynamic Required Response Spectra
(RRS) For Seismic Category I Buildings

The attached information was previously transmitted formally by MP&L via AECM-80/258 dated 11/26/80.

Loss of Coolant Accident

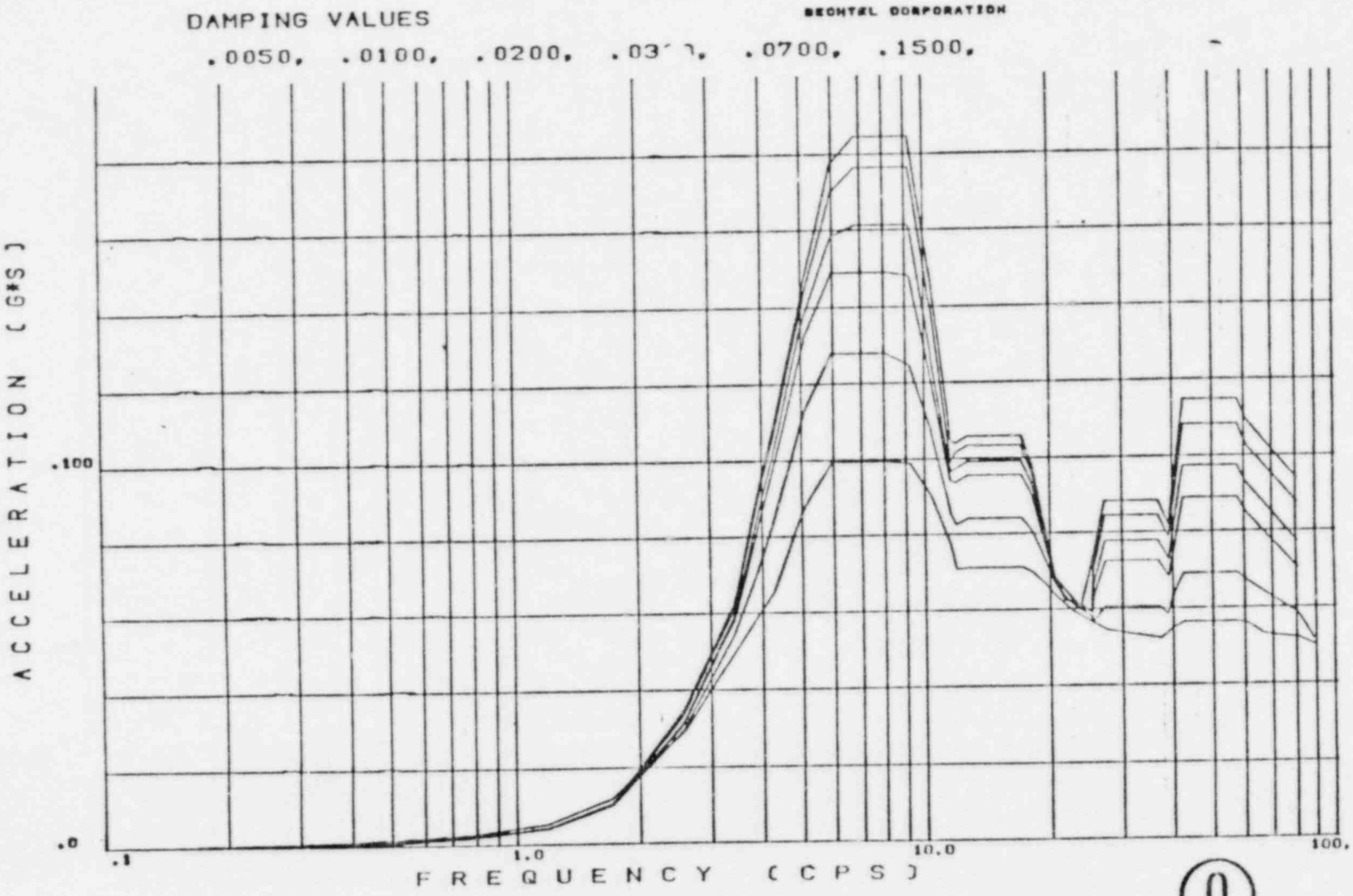
Pool Swell Pressure Transient RRS

Only

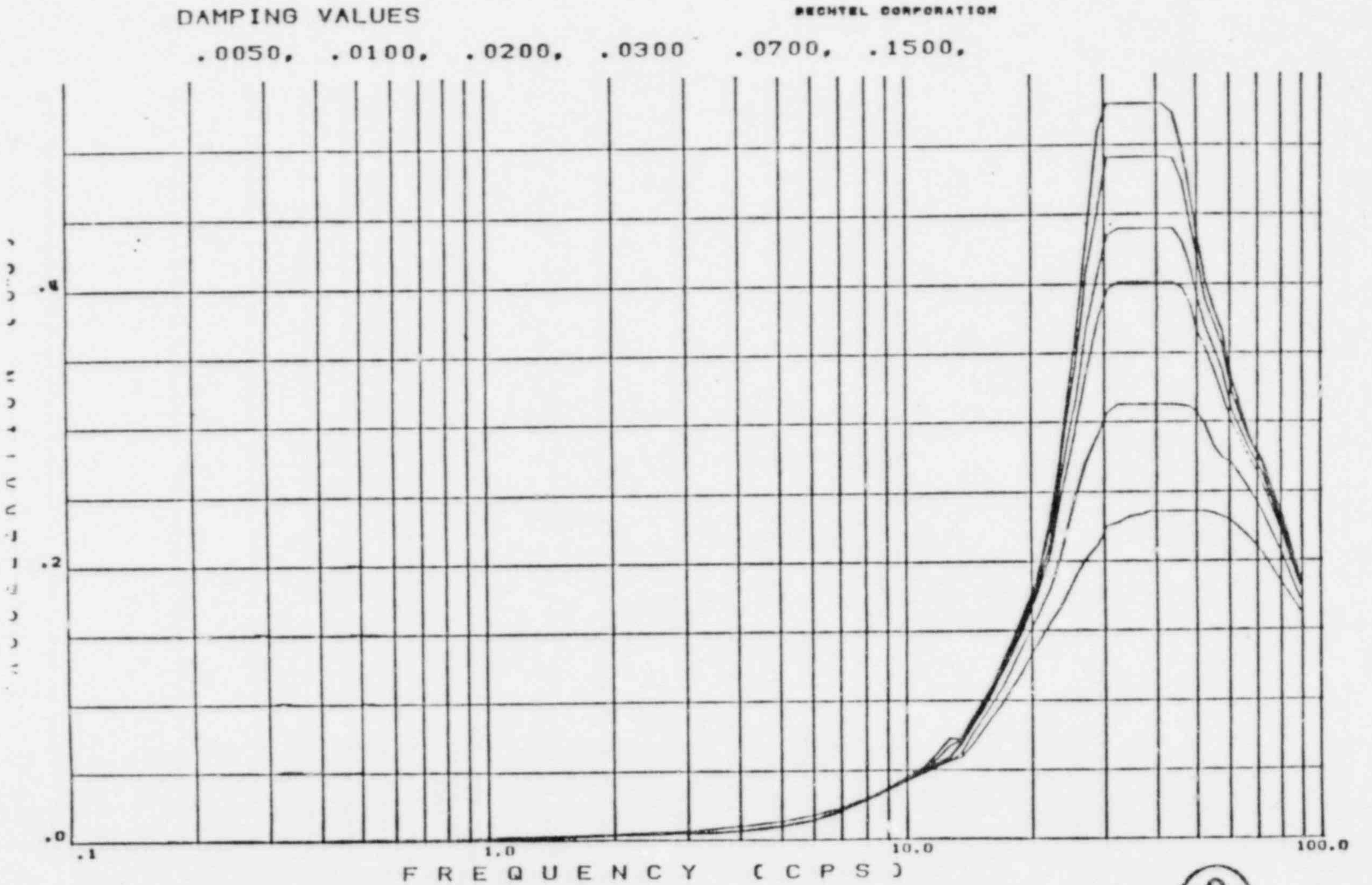


SPECTRA NODE30 DRYWELL EL.147.58 RADIAL
LOCA -- POOL SWELL

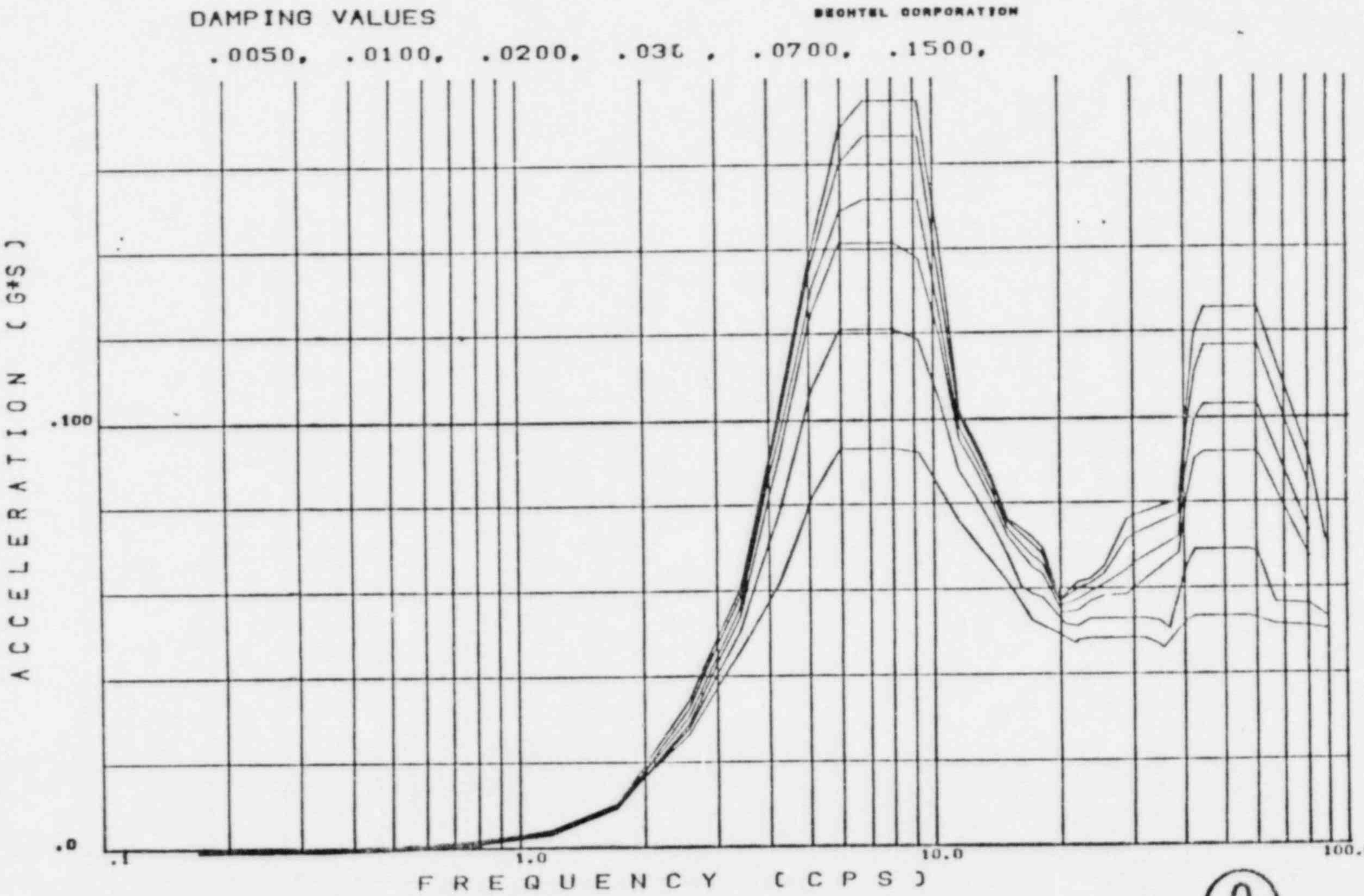
Ⓠ



SPECTRA NODE30 DRYWELL EL.147.58 VERTCL
LOCA - POOL SWELL

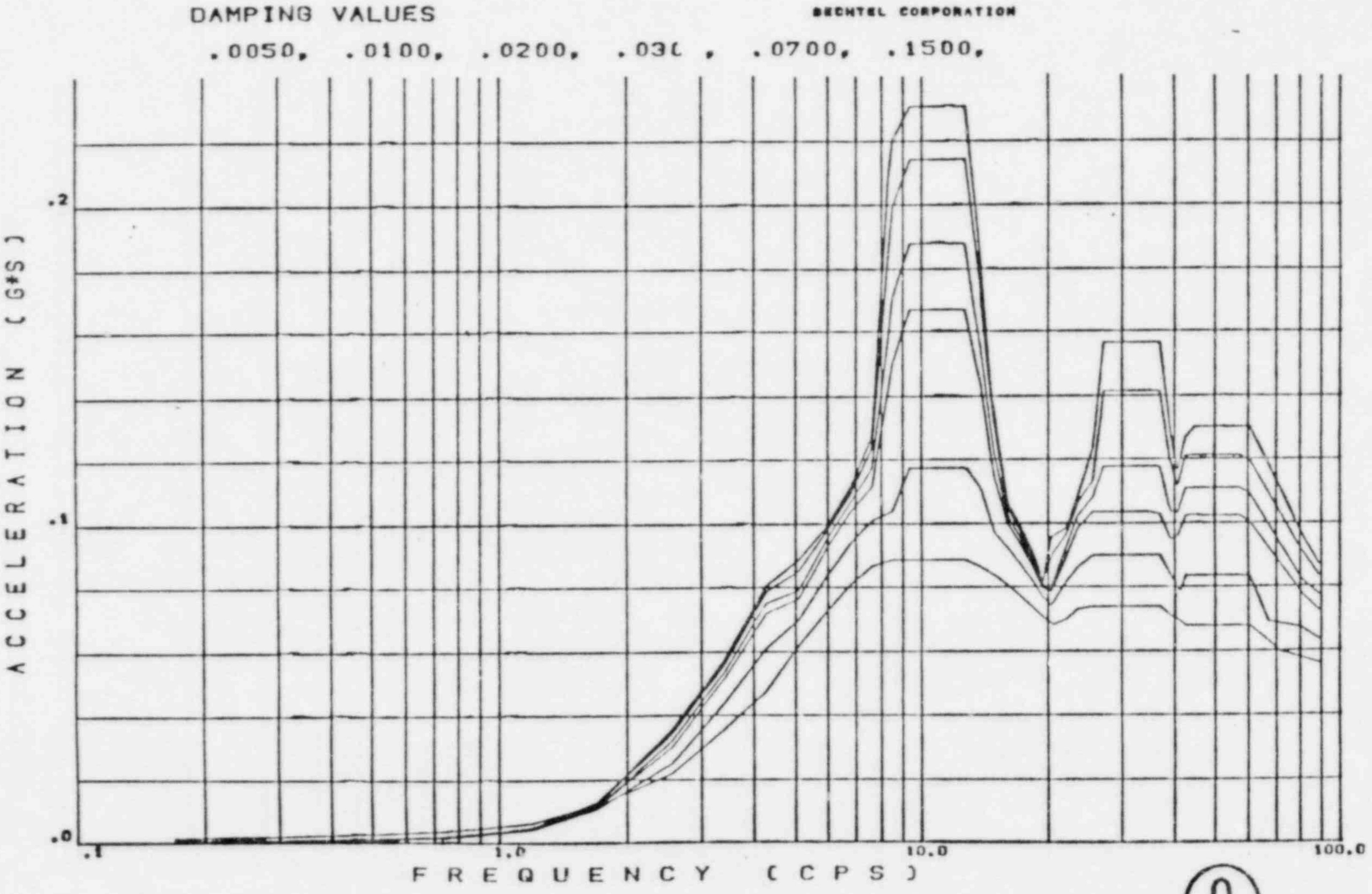


SPECTRA NODE48 DRYWELL EL.120.83 RADIAL Ⓠ
LOCA - POOL SWELL

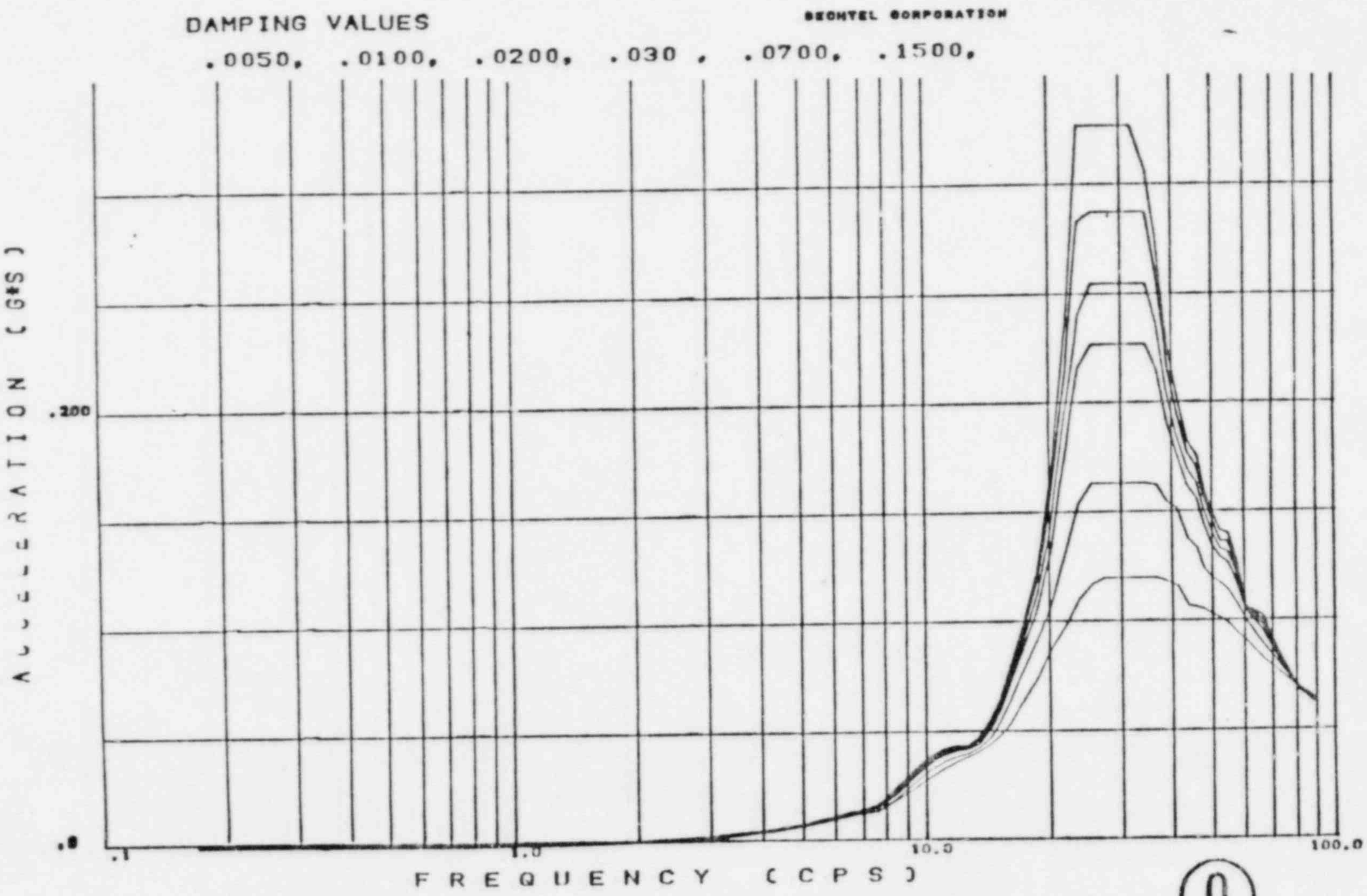


SPECTRA NODE48 DRYWELL EL.120.83 VERTCL
LOCA - POOL SWELL

Ⓠ

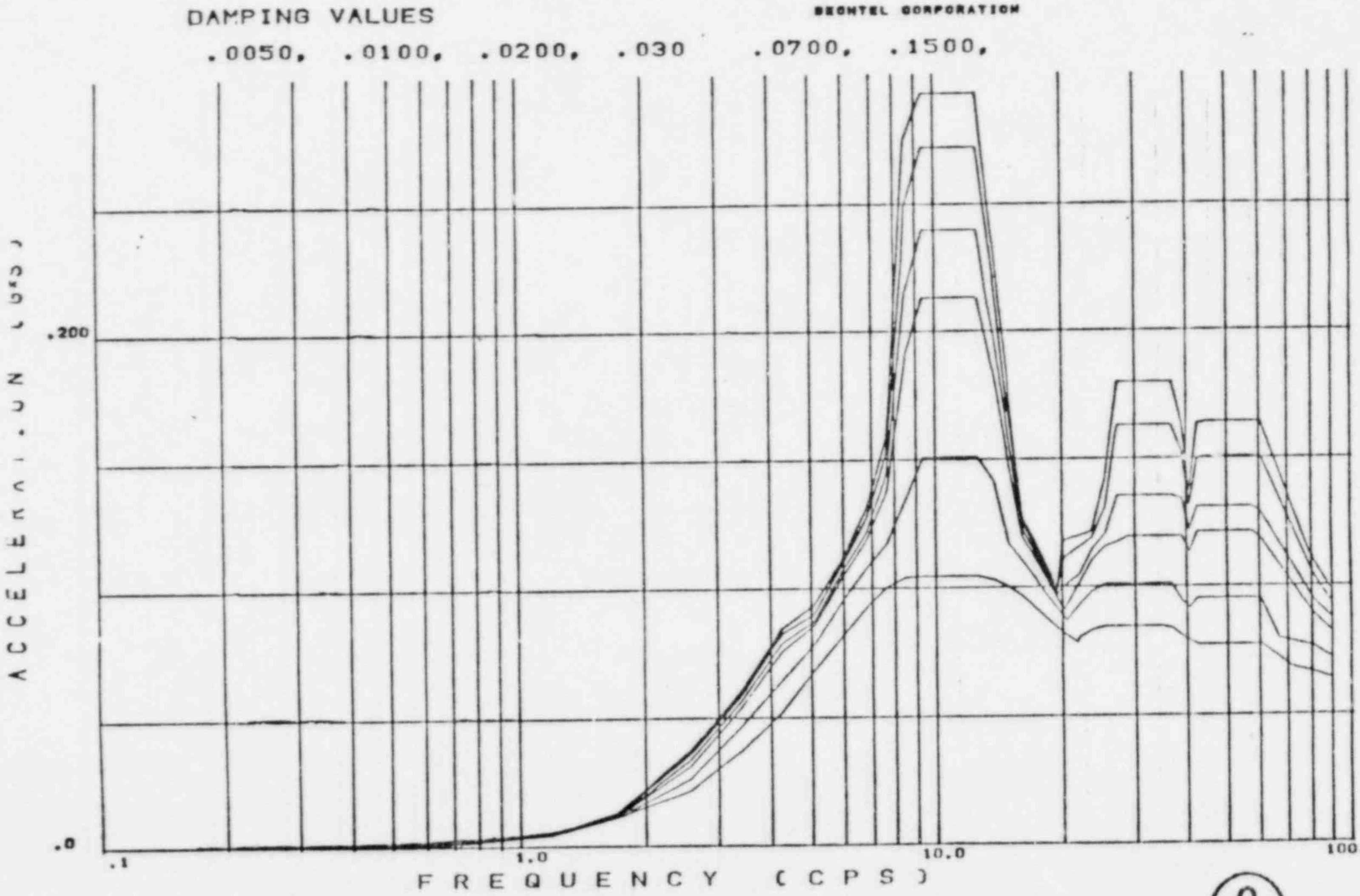


SPECTRA NODE287 CONTMNT EL.120.83 VERTCL Ⓠ
LOCA - POOL SWELL



SPECTRA NODE291 CONTMNT EL.147.58 RADIAL
LOCA - POOL SWELL

Ⓠ



SPECTRA NODE291 CONTMNT EL.147.58 VERTCL Q
LOCA - POOL SWELL

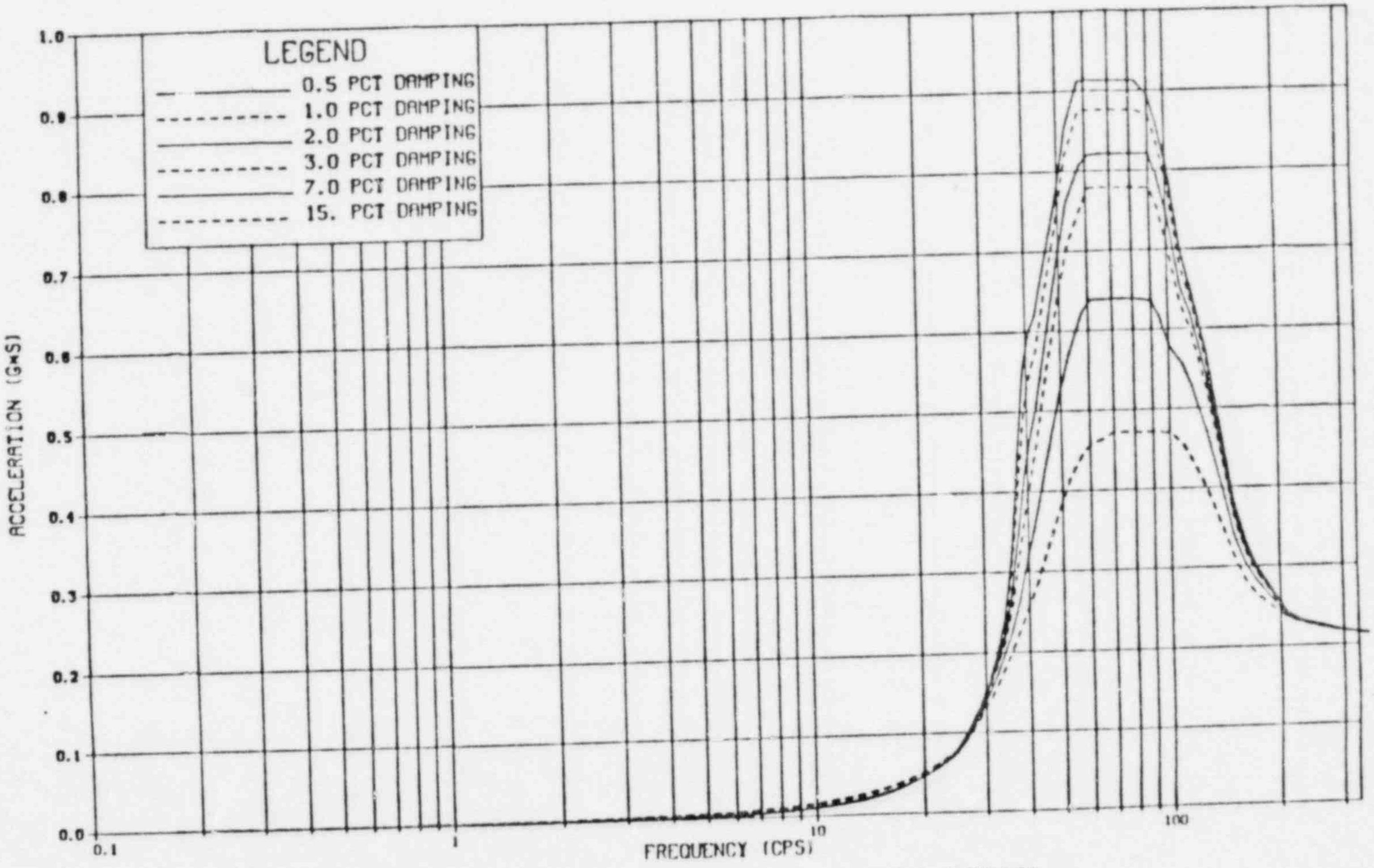
CEB02E1 RECSEXE 11/29/79 FRAME 52

Loss of Coolant Accident

RRS-LOCA DBA - Envelope of Main Vent Clearing
Pool Swell Pressure Transient
Condensation Oscillation Weir
Chugging Suppression Pool Chugging

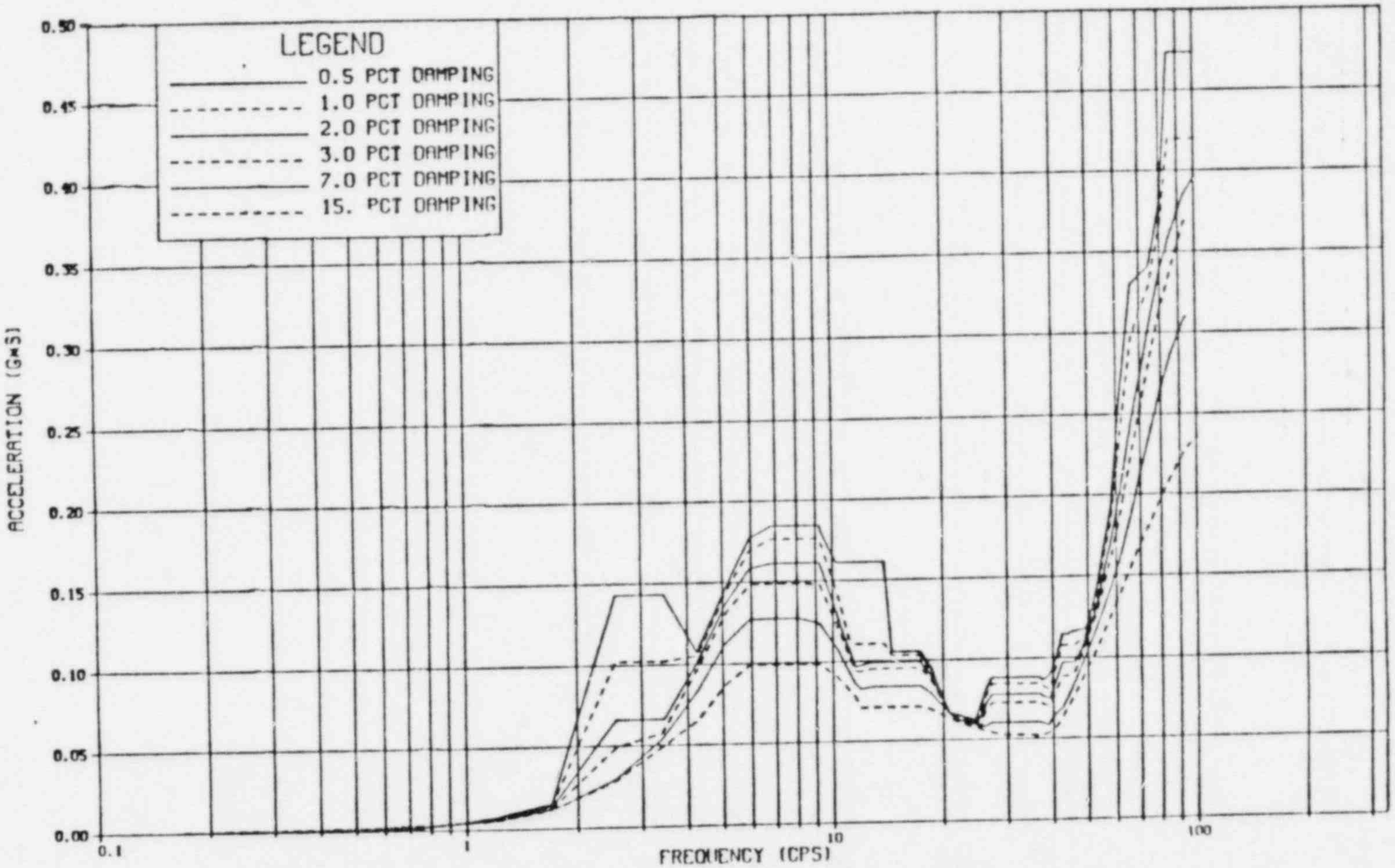
All

RESPONSE SPECTRA ENVELOPES



SPECTRA NODE30 DRYWELL EL.147.58 RADIAL
LOCA DBA ENVELOPE AT 0.0 DEGREES

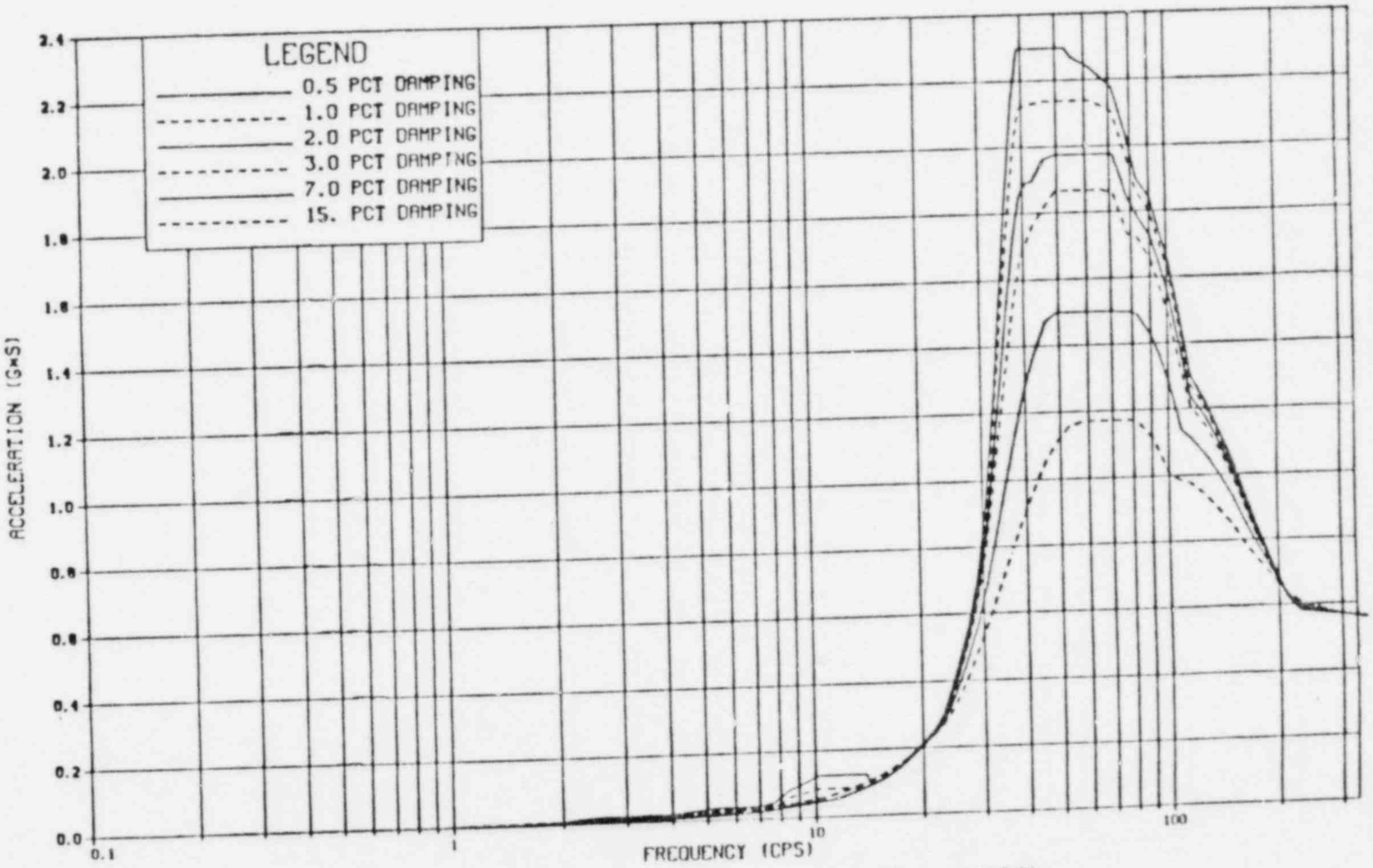
RESPONSE SPECTRA ENVELOPES



SPECTRA NODE30 DRYWELL EL.147.58 VERTCL
LOCA DBA ENVELOPE AT 0.0 DEGREES

JT 30 23.43.54 MON 9 JUN, 1980 JOB-RCELEST , CYBERNET SCOPE3.4 DISSPLA VER 8.2

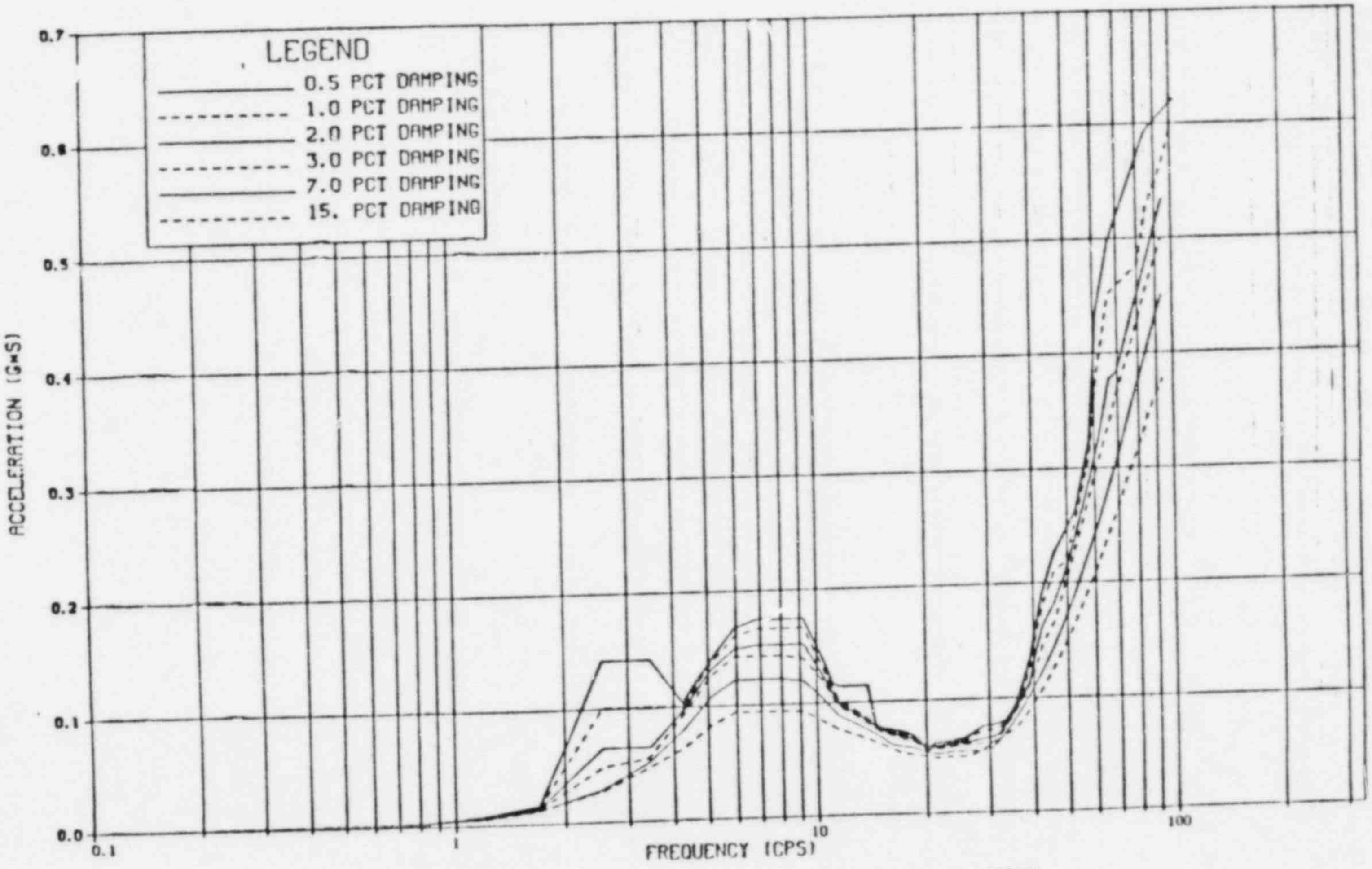
RESPONSE SPECTRA ENVELOPES



SPECTRA NODE48 DRYWELL EL.120.83 RADIAL
LOCA DBA ENVELOPE AT 0.0 DEGREES

22.57.27 MON 9 JUN, 1980 JOB-ACCLEST . CYBERNET SCOPE3.4 DISSPLA VER 9.2

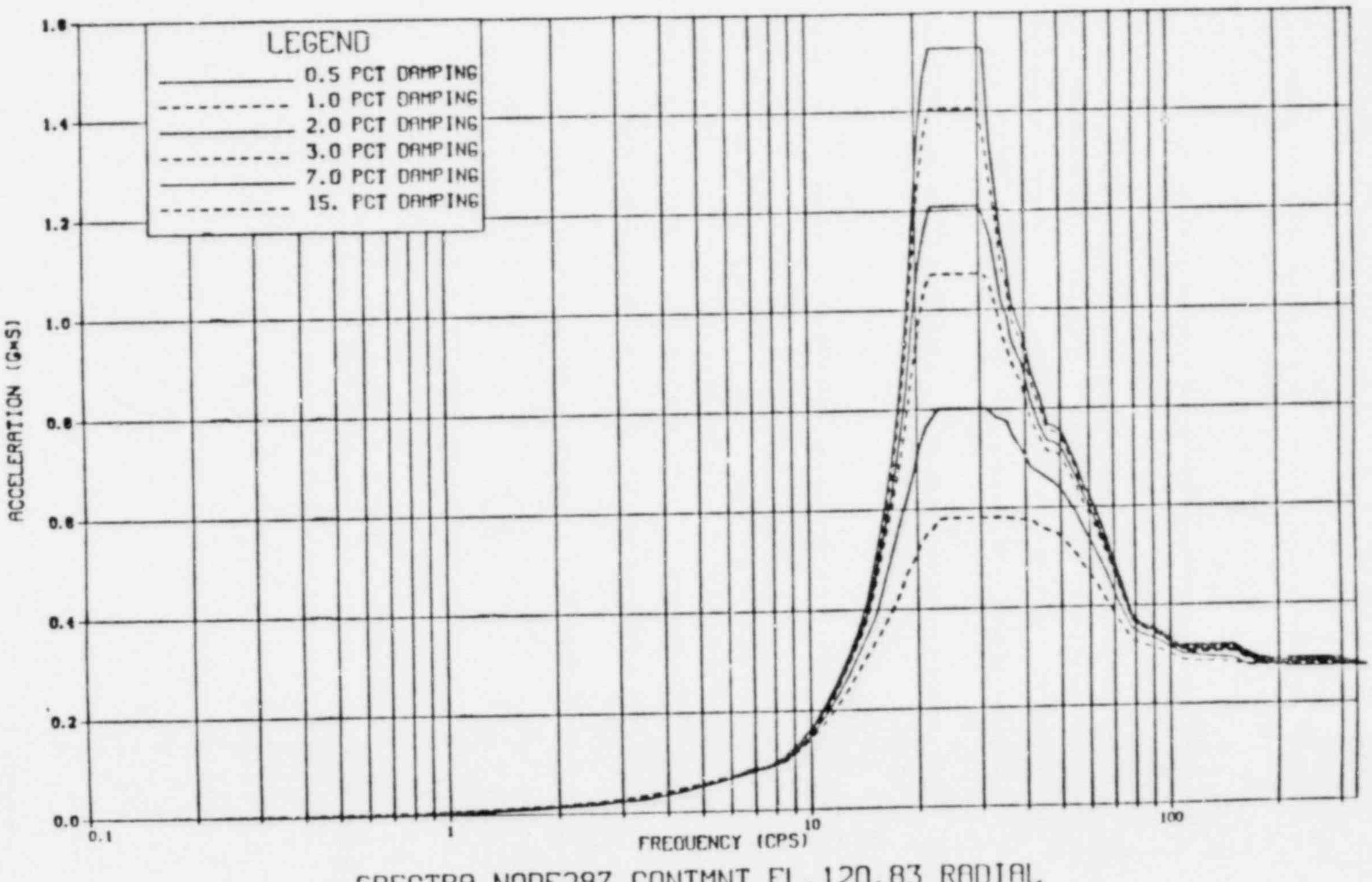
RESPONSE SPECTRA ENVELOPES



SPECTRA NODE48 DRYWELL EL.120.83 VERTCL
LOCA DBF ENVELOPE AT 0.0 DEGREES

MON 9 JUN, 1980 CYBERNET DISSPLA VER 8.2

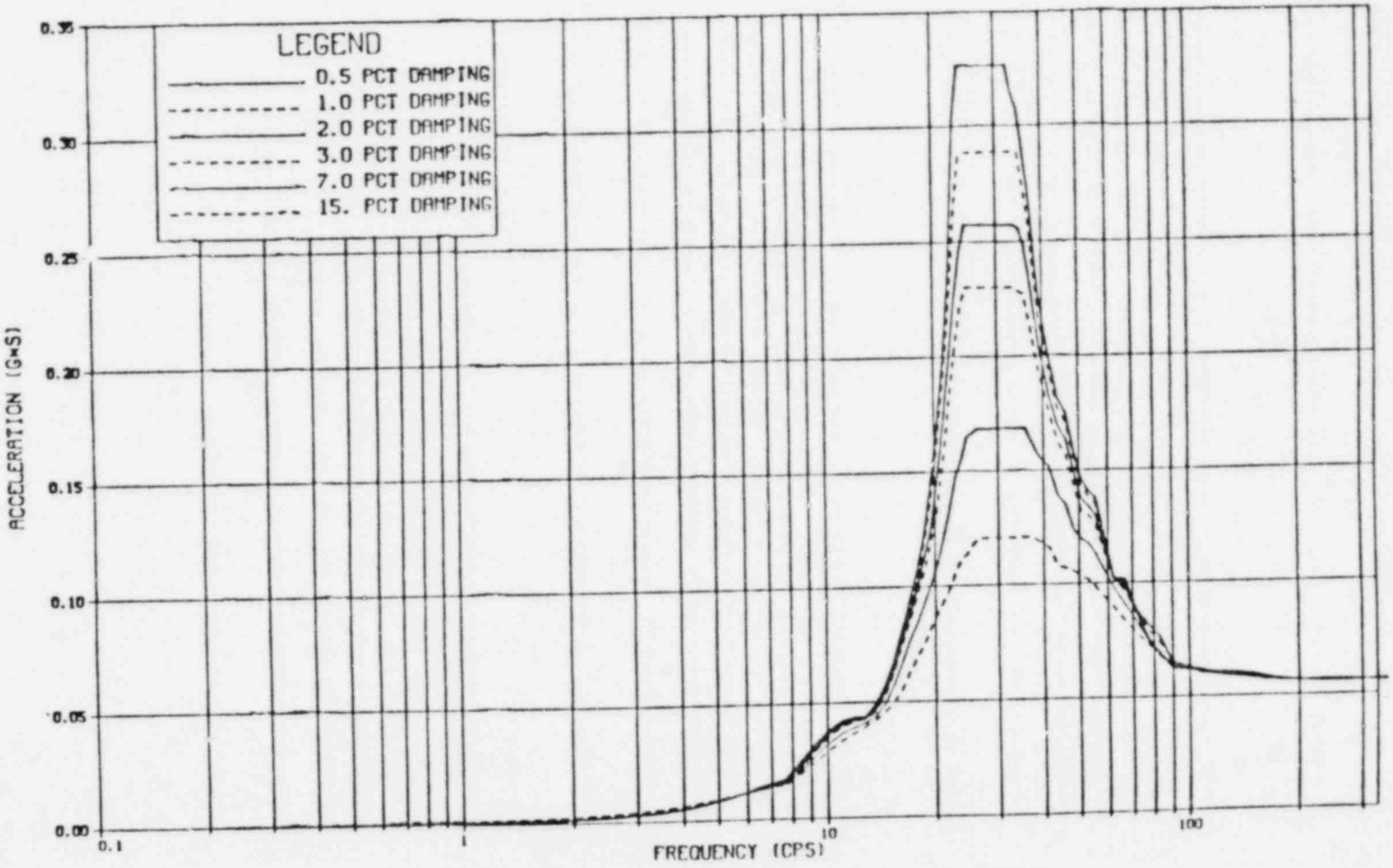
RESPONSE SPECTRA ENVELOPES



SPECTRA NODE287 CONTMNT EL.120.83 RADIAL
LOCA DBA ENVELOPE AT 0.0 DEGREES

JT 73 20.48.28 MON 9 JUN, 1980 JOB=ACCLIST , CTSCHACT SCDPC3.4 DISSPLA VER 8.2

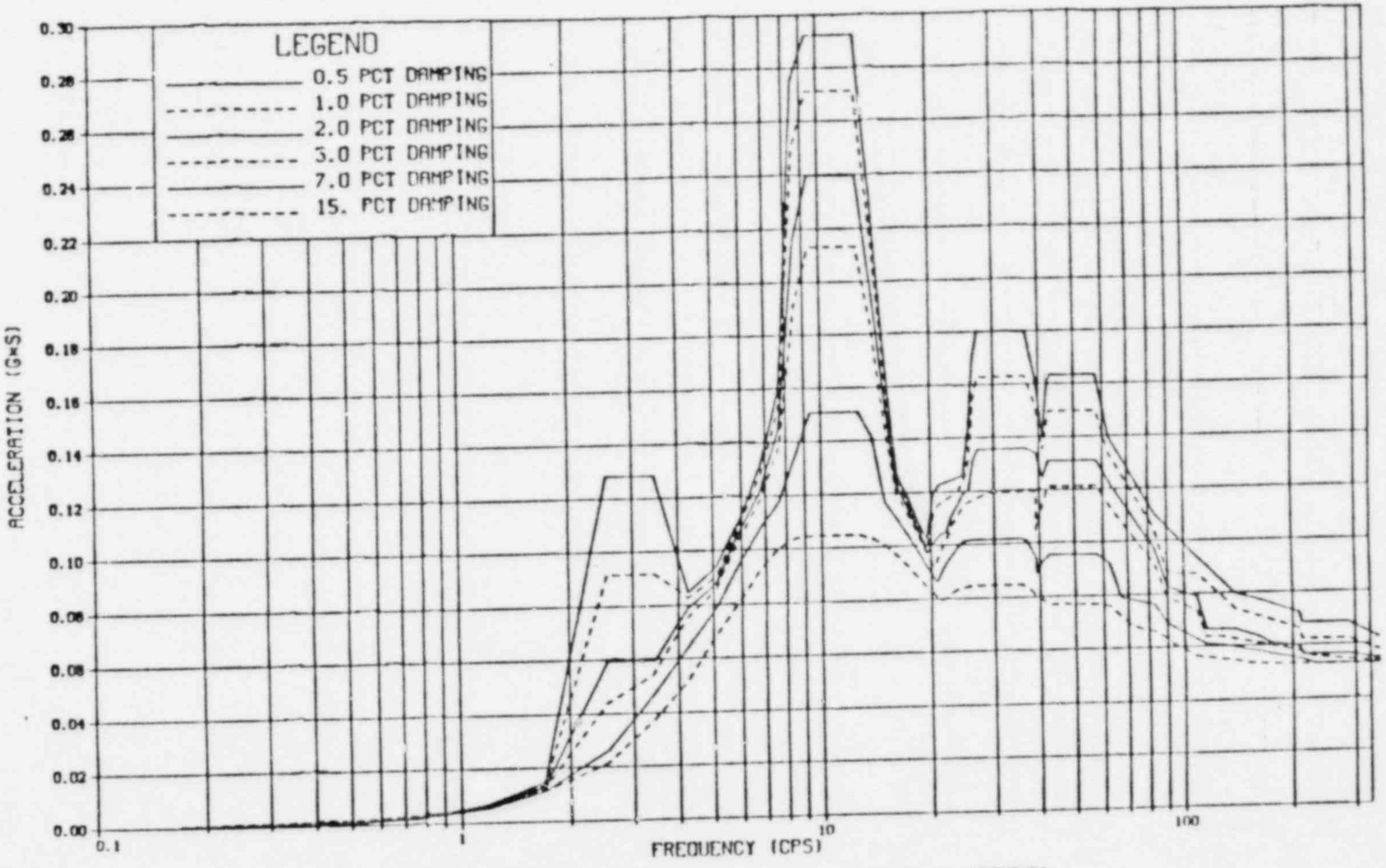
RESPONSE SPECTRA ENVELOPES



SPECTRA NODE291 CONTMNT EL.147.58 RADIAL
LOCA DBA ENVELOPE AT 0.0 DEGREES

JT 78 20.48.58 MON 9 JUN, 1980 JOB-ACCLCST . CTBOKCT SCOPE3.4 DISSPLA VER 8.2

RESPONSE SPECTRA ENVELOPES



SPECTRA NODE291 CONTMNT EL.147.58 VERTCL
LOCA DBA ENVELOPE AT 0.0 DEGREES

T 77 20.48.38 MON 9 JUN, 1980 JOB=ACCLEST . CTSDYNCT SCOPE3.4 DISSPLA VER 8.2

ATTACHMENT NO. 4

Air Operated Butterfly Valves
(M-257.0/258.0)

Concern

How are flow induced loads (design flow loads) accounted for in the seismic qualification of the valves?

Response

Actual physical piping configurations; showing elbows, flanges, tees, etc., were not furnished to the valve manufacturer. However, the vendor furnished valve data sheets (see Attachment A) containing maximum flow, maximum shutoff pressure, a description at the connecting piping (material, OD, ID, flanged or plain end) and all of the other information to be furnished by the purchaser, as required by AWWA Standard C504, Rubber-seated Butterfly Valves.

Testing specified in the Design Specifications (M-257.0/258.0) is consistent with the "Proof-of-Design Test" required by Section 5.5 of AWWA-C504 (see Attachment B).

The torque required to operate butterfly valves takes into account seating/unseating torque, bearing friction, dynamic torque due to differential pressure and hydrostatic torque if the valve is to be mounted in the horizontal position.

The valves in question are installed in hydraulic lines (water). System head characteristics are included in the specified maximum shut-off pressure and maximum flow. The valve manufacturer calculates the torques associated with seating and bearing frictions.

We feel that sufficient design data has been furnished to and input by the valve manufacturer to ensure that these valve assemblies (including actuators) are adequately designed to perform their intended function. The valve vendor has confirmed that the assembly designs (disc, shaft, calculated torques, actuator torque rating) do comply with AWWA-C504 requirements.

Once the valve has been manufactured to meet the specified design values (maximum flow, maximum shut-off pressure, etc.), the valve is then subjected to seismic qualification requirements as specified in design specification M-257.0/258.0.

Concern

The Equipment Qualification Branch requested a copy of the TRS be provided for the Pratt Test Report.

Response

To clarify the concerns addressed by the NRC reviewer on the omission of the Required Response Spectra (RRS) and the enveloping Test Response curves in valve assembly qualification test reports D-0038-3 and D-0089-4.

ATTACHMENT NO 4 (Continued)

Air Operated Butterfly Valves
(M-257.0/258.0)

The curves in the referenced reports are from the sine sweeps done to identify any resonant frequencies for the valve assembly. Endurance tests were run at any identified resonant frequencies and at 33 Hz, to demonstrate integrity without compromise to structure and function (to demonstrate operability, the assemblies were stroked and times were recorded). Since the valve assemblies were statically tested for seismic qualification, neither RRS nor TRS curves were required.

On May 21, 1982, a conference call took place between MP&L, NRC, EG&G, NUTECH, and Bechtel to clarify the test data in Henry Pratt valve reports for the 36" (D-0038-3) and 12" (D-0089-4) parent valves. As addressed during the conference call, the Pratt 36" parent valve was tested for 3.0g static loads and subjected to a vibration test to determine natural frequencies to demonstrate rigidity. The 36" parent valve qualifies the Grand Gulf 36", 30", and 24" candidate valves. Likewise, the 12" Pratt parent valve was tested for 6.0g static loads and subjected to a vibration test to determine natural frequencies to demonstrate rigidity. The 12" parent valve qualifies the Grand Gulf 10" candidate valve. The 10" Grand Gulf candidate valve design load is 3.0g's.

The May 21, 1982, conference call resulted in all parties understanding how the Henry Pratt Valve Test Report was performed and how the data is to be interpreted.

Included as Attachment C to this attachment (Attachment No. 4) is the requested acceleration data for the Grand Gulf valves in question. This information was requested during the May 21, 1982, conference call.

Conclusion

Based on the above information and the May 21, 1982, conference call, the Grand Gulf 36", 30", 24", and 10" candidate valves are qualified to the SQRT criteria.

ATTACHMENT "A"

for Attachment No. 4 Page 1 of 2

SERVICE CONDITIONS	VALVE IDENTIFICATION NO. △3	SQ-36-HBC-BF AO-F019, F020-OWV	SQ-44-HBC-BF AO-F003,F004-OWY	SQ-24-HBC-BF AO-F006,F007-OUWY		SQ-36-HBC-BF- AO-F120;F121-OL
	INLET PSIG M OPER. MAX.	ATM ATM ATM	ATM ATM ATM	ATM ATM ATM		0 90 100
	OUTLET PSIG OPER. MAX.					0 90 100
	TEMP°F OPER. MAX.	15-95 150	15-95 150	15-95 150		65 75
	SPEC GRAV. Gas/Vapor MOL. WT.	1.0 29.0	1.0 29.0	1.0 29.0		
	Tsh °F or % H OPER. VISC.-C.P.	NA .019	NA .019	NA .019		
	CRIT PRESS-Pc VAPOR PRESS-Pv	NA	NA	NA		
	OPER. FLOW SIZING FLOW ★	24000	33400	7200		21,000
	MIN. FLOW MAX. FLOW	0 24000	0 33400	0 7200		0 21,000
	FLOW UNITS ΔP SIZING ★	CFM	CFM	CFM		GPM
	ΔP SHUT OFF ΔP MIN.	3psi	3psi	3psi		120 0
	Cv@ SIZING ΔP & FLOW ★ MIN. Cv ★					
	Cv VALVE SELECTED ★ FACTORS ★					
	FLUID	Air	Air	Air		River Water
	QUANTITY OPEN/CLOSE	2 Open	2 Open	2 Open		2 Open
VALVE BODY	SIZE TYPE	36" FLGD	44" Flg'd.	24" FLGD		36" Flanged
	PRESS. RATING CLASS	150# HBC	150# HBC	150# HBC		150# HBC
	MATERIAL	SA-516 GR55	SA-516 GR55	SA-516 GR55		SA-516 GR55
	LINING OR SEAL TYPE ★ MATERIAL ★					
	SHAFT PACKING TYPE ★ MATERIAL ★	CHEVRON EPT	CHEVRON EPT	CHEVRON EPT		
	BEARINGS TYPE ★ INT./EXT. ★					
	LUBRICATOR ★ ★ ISOLATING VALVE					
	EXT. SHAFT HOUSING ★					
	END CONN. / SCHEDULE △4	Tech Spec. →				
INTERNALS	DISC DESIGN ★					
	PORT SIZE ★ DISC MATERIAL ★	SA516 GR70	SA516 GR70	SA516 GR 70		SA516GR70
	SHAFT SIZE ★ SHAFT MAT. ★	SA564TP630	SA564TP630	SA564TP630		SA564TP630
	SHAFT DESIGN FOR ACT. CONN. ★					
	SEAT MATERIAL	EPT	EPT	EPT		EPT
ACTUATOR	ACTUATOR TYPE	Air Cylinder	Air Cylinder	Air Cylinder		Air Cylinder
	MANUFACTURER ★	Bettis	Bettis	Bettis		
	PRESS/VOLTAGE POS. ON POWER FAIL	close	close	close		Ref
	FORCE OR TORQUE REQ. ★ ♂ FLOWING ★					
	SIZE ★ MAX. OUTPUT ★					
	MANUAL O'RIDE ★ POS. FEEDBACK TYPE ★					
	POSITIONER OUTPUT ★ SINGLE/DUAL ★					
	INPUT SIGNAL ★ SUPPLY PSIG	Ref.	Ref.	Ref.		
	CLOSING TIME (SEC.)	4	4	4		△7 90 sec.
PURCH.	REQ./PO. ITEM NO. △3	2.03 a,b	2.04 a,b	2.02 a,b		2.03c,d
	MANUFACTURER ★	Henry Pratt	Henry Pratt	Henry Pratt		Henry Pratt
	MODEL NO. ★					
GENERAL	SYSTEM	T42	T42	T41	△3	P44
	ASME SECTION III, CLASS	3	3	3		3

△4 Added

• DENOTES INFORMATION SUPPLIED BY SELLER

•• DENOTES CALCULATED

REFERENCE - TECHNICAL SPECIFICATION

△2 page revised

NO	DATE	REVISIONS	BY	CH'K	DESIGN SUPV	ENG'R	PROJ ENG'R	APPR
△4	10-28-75	Revised as Noted	LL					
△3	5/21/75	Revised as Noted	LL			KST		
△7	10-12-76	Revised Closing Time for Items 2.03c,d						

GRAND GULF NUCLEAR STATION
UNITS 1 AND 2
BUTTERFLY VALVES
C.S. 24" & LARGER-NUCLEAR SERVICE
DATA SHEET UNIT 1 SHT 3 △3

JOB No. 9645

DRAWING No. APPENDIX Q SPEC. 9645-M-257.0

REV. 7

ATTACHMENT "A" Pg 2 of 2

FORM NO. J-G51 (8/69)

	VALVE IDENTIFICATION NO.	SQ-24-HBC-BF-AO -F116;F117-OW			SQ-24-HBC-BF-AO -F118;F119-OUW			SQ-30-HBC-BF-AO- F122; F123-OUW		
SERVICE CONDITIONS	INLET PSIG MIN. OPER. MAX.	0	70	80	0	70	80	0	90	100
	OUTLET PSIG MIN. OPER. MAX.	0	70	80	0	70	80	0	90	100
	TEMP°F OPER. MAX.	85	100		85	100				
	SPEC GRAV (Gas) Vapor MOL. WT.									
	Tsh °F or % FLASH OPER. VISC - C.P.									
	CRIT. PRESS - Pc VAPOR PRESS - Pv									
	OPER. FLOW SIZING FLOW *	11,700			11,700			18,000		
	MIN. FLOW MAX. FLOW	0	11,700		0	11,700		0	18,000	
	FLOW UNITS ΔP SIZING *	GPM			GPM			GPM		
	ΔP SHUT OFF ΔP MIN.	120	0		120	0		120	0	
	CvΦ SIZING ΔP & FLOW * MIN. Cv *									
	Cv VALVE SELECTED * FACTORS *									
	FLUID	River Water			River Water			River Water		
	QUANTITY OPEN/CLOSE	2	Open		2	Open		2	Open	
VALVE BODY	SIZE TYPE	24"	Flanged		24"	Flanged		30"	Flanged	
	PRESS. RATING CLASS	150#	HBC		150#	HBC		150#	HBC	
	MATERIAL	SA516 Gr.55			SA516 Gr.55			SA516 Gr. 55		
	LINING OR SEAL TYPE * MATERIAL*									
	SHAFT PACKING TYPE * MATERIAL*									
	BEARINGS TYPE * INT./EXT. *									
	LUBRICATOR* * ISOLATING VALVE									
	EXT. SHAFT HOUSING *									
	END CONN. / SCHEDULE	Tech. Spec. →								
INTERNALS	DISC DESIGN *									
	PORT SIZE * DISC MATERIAL*		SA516Gr70	—		SA516Gr70			SA516Gr70	
	SHAFT SIZE * SHAFT MAT. *		SA564TP630			SA564TP630			SA564TP63	
	SHAFT DESIGN FOR ACT. CONN. *									
	SEAT MATERIAL	EPT			EPT			EPT		
ACTUATOR	ACTUATOR TYPE	Air Cylinder			Air Cylinder			Air Cylinder		
	MANUFACTURER *									
	PRESS/VOLTAGE POS. ON POWER FAIL.	Ref			Ref			Ref		
	FORCE OR TORQUE REQ.* ♂ FLOWING*									
	SIZE * MAX. OUTPUT *									
	MANUAL O'RIDE. POS. FEEDBACK TYPE*									
	POSITIONER OUTPUT * SINGLE/DUAL*									
	INPUT SIGNAL * SUPPLY PSIG									
	CLOSING TIME (SEC.)	△7 90 sec.			△7 90 sec.			△7 90 sec.		
PURCH.	REQ. / PO. ITEM NO.	2.02c,d			2.02e,f			2.05a,b		
	MANUFACTURER *	Henry Pratt			Henry Pratt			Henry Pratt		
	MODEL NO. *									
GENERAL	SYSTEM	P44			P44			P44		
	ASME SECTION III, CLASS	3			3			3		

* DENOTES INFORMATION SUPPLIED BY SELLER

** DENOTES CALCULATED

REFERENCE - TECHNICAL SPECIFICATION

Q

No	DATE	REVISIONS	BY	CHK	DESIGN SUPV	ENG'R	PROJ ENGR	APPR
△7	10-12-76	Revised closing times for items 2.02c,d, e, f and 2.05a, b.	LL					
△4	10-28-75	Sheet Added	LL					

GRAND GULF NUCLEAR STATION
UNITS 1 AND 2
BUTTERFLY VALVES
C.S. 24" & LARGER-NUCLEAR SERVICE
DATA SHEET UNIT 1 SHT 4

JOB No. 9645

DRAWING No. APPENDIX Q SPEC. 9645-M-257.0

REV. 7

ATTACHMENT "B"
FOR
ATTACHMENT No. 4

American Water Works Association

ANSI/AWWA C504-80
(Revision of
AWWA C504-74)

AWWA STANDARD

for

RUBBER-SEATED BUTTERFLY VALVES

AMERICAN NATIONAL
STANDARD

First edition approved by AWWA Board of Directors May 27, 1954.
This edition approved Jan. 28, 1980.

Approved by American National Standards Institute, Inc., Jan. 24, 1980.

AMERICAN WATER WORKS ASSOCIATION
6666 West Quincy Avenue, Denver, Colorado 80235

Committee Personnel

The Standards Committee on Butterfly Valves that reviewed and approved this standard had the following personnel at the time of approval:

H. H. Benjes, *Chairman*
R. P. Saar, *Secretary*

Consumer Members

F. C. Campbell, Louisville Water Company, Louisville, KY	(AWWA)
W. S. Flynn, Cincinnati Water Works, Cincinnati, OH	(AWWA)
C. E. Johnson, Water and Wastewater Department, Austin, TX	(AWWA)
H. T. Kobata, Department of Water & Power, Los Angeles, CA	(AWWA)
R. J. Kocol, Department of Public Works, Milwaukee, WI	(AWWA)
G. H. Larsen, Bureau of Water, Chicago, IL	(AWWA)
J. R. Popalisky, Water Department, Kansas City, MO	(AWWA)
H. L. Pratt, Water Department, Seattle, WA	(AWWA)
I. M. Schuraytz, Metropolitan Water Department, Detroit, MI	(AWWA)
O. W. Summers, Indianapolis Water Company, Indianapolis, IN	(AWWA)
C. E. Vickerman, Water Department, Philadelphia, PA	(AWWA)

General Interest Members

H. H. Benjes, Black & Veatch, Kansas City, MO	(AWWA)
Wendle Snapp, Hayes, Seay, Mattern & Mattern, Roanoke, VA	(AWWA)

Producer Members

K. J. Ashar, Crane Company, Chicago, IL	(AWWA)
W. C. Gilmore, Dresser Manufacturing Division, Bradford, PA	(AWWA)
H. L. Goldman, Allis-Chalmers Manufacturing Company, York, PA	(AWWA)
T. C. Jester, American-Darling Valve, Birmingham, AL	(AWWA)
R. P. Saar, Henry Pratt Company, Aurora, IL	(MSS)
D. Szilagyi, BIF Unit of General Signal, West Warwick, RI	(AWWA)

Table of Contents

Foreword

This foreword is for information only and is not a part of AWWA C504.

I. History of Standard

Rubber-seated butterfly valves have been in use in pipelines carrying liquids and gases for at least 40 years. Manufacturers of butterfly valves developed tight-closing rubber-seated types for cooling-water systems and power stations, so that most new valves installed in this service since 1940 have been rubber-seated butterfly valves.

Since the later 1940's, rubber-seated butterfly valves have gained increasing acceptance for use in water treatment plants and water-supply and distribution lines because they provide tight shutoff, are relatively easy to operate even with large pressure drops across the valves, and require relatively little space for installation. The need for standardization of butterfly valves was recognized by AWWA in June 1953.

The committee appointed for the task developed AWWA C504, which was approved as tentative and published in September 1954. Four years later, in 1958, the tentative standard was accepted as a standard

The 1954 tentative standard was written to describe the types of standard rubber-seated butterfly valves then available and in successful operation for at least 5 years prior to 1954. The standard established three pressure and two velocity classifications, standards for materials, laying lengths, minimum body and disc designs, and operator sizes for valves having rubber seats in the valve body.

Since the publishing of AWWA C504 in 1954, thousands of rubber-seated butterfly valves have been installed in water utility applications. In the decade following 1954, butterfly valve designs were improved and refined. In September 1962 a new committee was charged with the task of reviewing AWWA C504 and recommending revisions to the standard to render it current with the proven "state of the art" of rubber-seated butterfly valves.

Generally, modern butterfly valve designs for water service include cast-body construction in 25 psi, 75 psi, and 150 psi pressure classes; flanged, mechanical joint, and wafer bodies; rubber seats in valve bodies as well as on the valve discs; and operating conditions (limited by the design shutoff pressure and velocities of water flow) that produce torques considered maximum for the shaft size used. These modern practices were the basis for the revisions included in the 1966 edition of AWWA C504.

The revisions included in the 1970 edition were undertaken in order to minimize corrosion of seating surfaces, to provide more adequate specifications for stainless steel, and to provide for painting of all valve interiors with asphalt varnish.

Torque requirements for valve operation vary considerably with differential pressure across the valve and with fluid velocity. Conditions under which a valve is to be operated must be evaluated carefully by the purchaser to determine the hydraulic characteristics of the system in which the valve will be installed and thus establish the maximum transient and static combinations of differential pressure across the valve disc and flow through the valve under the most adverse operating conditions.

A method whereby the required operating torque can be computed from the hydraulic characteristics of the system is included in the Appendix to this standard.

II. Information to be Furnished by Purchaser

When placing orders for valves to be manufactured in accordance with this standard, the purchaser should specify the following details:

1. Designation of applicable AWWA standard; that is, AWWA C504 of latest revision.
2. Size of valve.
3. Quantity required.
4. Type of body: flanged (short body or long body), wafer, or mechanical-joint end.
5. Class of valve.
6. Maximum nonshock shutoff pressure.
7. Flow through valve:
    - 7.1 Under normal conditions.
    - 7.2 Under extreme maximum-flow conditions.
        - a. When opening (consider such factors as fire flow).
        - b. When closing (consider such factors as line break).
8. The furnishing of records of the tests that are specified under Sec. 2.3, 3.8.3, 5.2, 5.3, 5.4, and 5.5 of this standard.
9. Description of connecting piping: material, OD and ID, flanged, or plain end.
10. Detailed description of nonstandard end connections (Sec. 3.1).
11. Type of shaft seal (Sec. 3.7).
12. Body and disc materials (Sec. 3.1 and Sec. 3.4).
13. Type of installation: buried, submerged, or in-plant.
14. Type of operator required: handwheel, chainwheel, lever, crank, key, electric motor, air cylinder, water cylinder, or oil cylinder. Complete information for motor or cylinder operators, including power characteristics for motor, maximum and minimum air, water, or oil pressure for cylinders, any control scheme, special devices such as positioners, position indicators, or adjustable cushions, and complete information for any extension stems, floorstands, or similar appurtenances, and size of operator nut.
15. Direction in which to turn operating stem to open valves equipped with manual operators (unless otherwise specified, counterclockwise direction to open the valve will be furnished).
16. Valve and operator arrangement and position.
17. Time of operation for motor operators, if other than specified in Sec. 3.8 of this standard.
18. Protective coatings, if other than as specified in Sec. 4.2 of this standard.
19. Whether affidavit of compliance is to be furnished (Sec. 1.5).
20. Whether manufacturer shall furnish dimensions of the clearance required for the valve discs (Sec. 1.4).
21. Whether certified drawings are to be furnished by the bidder, the manufacturer, or both (Sec. 1.3 and 1.4).

III. Major Revisions

Revisions included in this edition consist of the following:

1. Sec. 2.2 was expanded to include physical and chemical requirements for all materials specified in other sections of the standard. References to ASTM designations were removed from other sections.
2. Sec. 3.3.3 has been clarified to require wrought materials for valve shafts.
3. Sec. 3.6 has been clarified to require a bearing of corrosion-resistant material to support the valve shaft outboard of the shaft seal.
4. Sec. 5.4 has been rewritten to conform with modern practice for hydrostatic tests. The requirement of striking the valve body with a hammer several times has been deleted. The duration of tests for valve sizes 20 in. and smaller has been decreased.
5. Sec. 3.5.2 has been rewritten to describe more clearly the requirements for rubber-seat installation.

American Water Works Association

ANSI/AWWA C504-80
(Revision of
AWWA C504-74)

AWWA Standard for

Rubber-Seated Butterfly Valves

Section 1—General

Sec. 1.1 Scope

This standard covers cast-iron and ductile-iron body, rubber-seated, tight-closure butterfly valves, 3–72 in. in size, with various body types and body ends for maximum shutoff pressures and operating torques, as indicated in Table 1, and for fresh water having a pH greater than 6 and temperatures generally less than 125°F (52°C). Valves covered by this standard are furnished in four body types and in classes (as listed in Table 1) as follows:

1.1.1 *Wafer valves.* Class 150B, in sizes through 20 in.

1.1.2 *Short-body flanged valves.* All classes, in sizes 3–72 in.

1.1.3 *Long-body valves.* Class 75A, 75B, 150A, and 150B, in sizes 3–72 in.

1.1.4 *Mechanical-joint-end valves.* Class 150B, in sizes 3–24 in., and all classes in sizes 30–48 in.

Sec. 1.2 Referenced Standards

This standard references the following documents. They form a part of this standard to the extent specified herein. In any case of conflict, the requirements of this standard shall prevail.

ANSI[*] A21.11	*Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings.*
ANSI B16.1	*Cast Iron Pipe Flanges and Flanged Fittings.*
ANSI B46.1	*Surface Texture.*
ASTM[†] A36	*Specification for Structural Steel.*
ASTM A48	*Specification for Gray Iron Castings.*
ASTM A108	*Specification for Steel Bars, Carbon, Cold-Finished, Standard, Quality.*

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[*] American National Standards Institute, 1430 Broadway, New York, NY 10018.

[†] American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103.

ASTM A126	*Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.*
ASTM A216	*Specification for Carbon-Steel Castings Suitable for Fusion Welding for High Temperature Service.*
ASTM A276	*Specification for Stainless and Heat-Resisting Steel Bars and Shapes.*
ASTM A296	*Specification for Corrosion-Resistant Iron-Chromium, Iron-Chromium-Nickel, and Nickel Base Alloy Castings for General Application.*
ASTM A436	*Specification for Austenitic Gray Iron Castings.*
ASTM A439	*Specification for Austenitic Ductile Iron Castings.*
ASTM A516	*Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.*
ASTM A536	*Specification for Ductile Iron Castings.*
ASTM B117	*Salt Spray (Fog) Testing.*
ASTM B127	*Specification for Nickel-Copper Alloy (UNS NO4400) Plate, Sheet and Strip.*
ASTM B154	*Mercurous Nitrate Test for Copper and Copper Alloys.*
ASTM D471	*Test for Rubber Property—Effect of Liquids.*
ASTM D1149	*Test for Rubber Deterioration—Surface Ozone Cracking in a Chamber (Flat Specimens).*

TABLE 1

*Maximum Operating Torques**

Valve Diameter in.	Maximum Torque—*ft-lb*					
	Class 25A†	Class 25B†	Class 75A†	Class 75B†	Class 150A†	Class 150B†
3	8	8	12	12	19	19
4	14	14	22	22	36	36
6	33	33	52	52	93	93
8	61	63	95	95	175	175
10	98	115	160	165	320	320
12	146	200	240	280	510	510
14	205	310	340	450	720	720
16	275	470	470	670	1,030	1,030
18	360	660	600	940	1,350	1,480
20	445	920	770	1,300	1,800	2,050
24	680	1,550	1,200	2,200	2,900	3,500
30	1,250	3,100	2,100	4,350	5,300	6,750
36	2,150	5,400	3,400	7,550	8,500	11,600
42	3,400	8,450	5,350	12,000	12,800	18,400
48	5,050	12,700	8,000	18,000	18,500	27,500
54	7,250	17,000	12,000	25,500	29,500	40,000
60	9,900	24,800	16,100	35,000	38,500	54,000
66	13,300	33,000	21,400	46,000	49,500	71,000
72	17,000	42,500	27,000	60,000	60,500	90,000

* Torques represent maximum capability for which valves are to be applied.

† In each case, numerical class designation is the maximum nonshock shutoff pressure, in pounds per square inch.

Sec. 1.3 Data to be Furnished by Bidder

When required, the bidder shall furnish certified drawings and material specifications of the equipment he is proposing to supply. The drawings shall show valve port diameter and shall be in sufficient detail to show that the equipment proposed meets the specifications of the purchaser. The bidder shall furnish a statement of the total net assembled weight for each valve.

Sec. 1.4 Data to be Furnished by Manufacturer

Most butterfly valve discs extend beyond the laying length of the valve body when in the open position. Upon request, the manufacturer shall furnish the dimensions of the clearance required for the valve disc. When required, the manufacturer shall submit, for approval by the purchaser, certified drawings showing the principal dimensions, general construction, and materials used for all parts of the valve and operator. All work shall be performed and all valves shall be furnished in accordance with the certified drawings after they have been approved by the purchaser.

Sec. 1.5 Affidavit of Compliance

Whether the purchaser has an inspector at the plant or not, he may require an affidavit from the manufacturer or vendor that the valves furnished under the purchaser's order comply with all applicable provisions of this standard.

Section 2—Materials

Sec. 2.1 General

All materials designated hereinafter, when used in valves produced under this standard, shall conform to the requirements designated in Sec. 2.2 for each material listed. When reference is made to American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), or other standards as may be stipulated, the latest revision thereof shall apply.

Sec. 2.2 Physical and Chemical Properties

Materials shall be in conformance with the physical and chemical requirements of this subsection as follows:

2.2.1 *Cast iron.* ASTM A126 Class B or ASTM A48 Class 40.

2.2.2 *Ductile iron.* ASTM A536, Grade 65-45-12.

2.2.3 *Alloy cast iron.* ASTM A436, Type 1 or 2, or ASTM A439, Type D2, with a maximum lead content of 0.003 percent.

2.2.4 *Stainless steel.* ASTM A276, Type 304 or 316, or ASTM A296, Grade CF8 or CF-8M.

2.2.5 *Monel.* ASTM B127.

2.2.6 *Carbon steel.* ASTM A108.

2.2.7 *Cast steel.* ASTM A216, Grade WCB.

2.2.8 *Fabricated steel.* ASTM A36, ASTM A516 or better.

TABLE 2

Chemical and Physical Requirements for Bronze

Grade of Bronze	Minimum Yield Strength *psi*	Minimum Elongation in 2 in.* *percent*	Copper Minimum *percent*	Zinc Maximum *percent*
A	14,000	15	79	16
B	20,000	15	57	—
C	32,000	10	57	—
D	20,000	15	79	16
E	32,000	10	79	16

* Gage length of sample.

2.2.9 *Rubber seats.* See Sec. 3.5.2.

2.2.10 *Brass or bronze.* Components of brass or bronze shall be made to ASTM or Copper Development Association (CDA) recognized alloy specifications. The chemical and physical requirements shown in Table 2 shall apply.

2.2.10.1 Any bronze alloy used in the cold-worked condition shall be capable of passing the mercurous nitrate test in accordance with ASTM B154 to minimize susceptibility to stress corrosion.

2.2.10.2 Because of dezincification considerations, Grades B and C bronze may be used only for those parts not wetted by line content, such as operator components. All bronze parts subject to wetting by line content shall be of Grades A, D, or E. If aluminum bronze is used, the alloy shall be inhibited against dealuminization by receiving a temper anneal at 1200°F (650°C) ±50°F (10°C) for 1 hr per inch of section thickness followed by cooling in moving air or by water quenching.

Sec. 2.3 Tests

Whenever valve components are to be made in conformance with ANSI, ASTM, or other standards that include test requirements or testing procedures, such requirements or procedures shall be met by the valve manufacturer. The records of such tests shall, if required by the purchaser, be made available to him.

Section 3—General Design

Sec. 3.1 Valve Bodies

Laying lengths for flanged-end and wafer valves shall be as specified in Table 3. There is no standard for laying lengths of valve bodies having mechanical-joint ends. The bodies of all valves shall have two hubs for shaft-bearing housings cast integrally with the valve bodies. Wafer valve bodies shall be designed for installation between ANSI B16.1, Class 125 cast-iron flanges, and no part of the valve internals shall extend beyond the body ends when the

TABLE 3

Laying Lengths for Flanged and Wafer Valves and Minimum Body Shell Thicknesses for All Body Types

Valve Size *in.*	Laying Length—*in.**			Minimum Body Shell Thicknesses—*in.*†		
	Short Body	Long Body	Wafer	Class 25A, B	Class 75A, B	Class 150A, B
3	5	5	2	0.37	0.37	0.37
4	5	7	2¼	0.40	0.40	0.40
6	5	8	2 13/16	0.43	0.43	0.43
8	6	8½	2 13/16	0.46	0.46	0.46
10	8	15	3⅛	0.50	0.50	0.54
12	8	15	3⅜	0.54	0.54	0.58
14	8	16	3¾	0.54	0.58	0.63
16	8	16	4⅛	0.58	0.63	0.68
18	8	16	4⅜	0.63	0.68	0.79
20	8	18	5⅛	0.66	0.71	0.83
24	8	18		0.74	0.80	0.93
30	12	22		0.87	0.94	1.10
36	12	22		0.97	1.13	1.22
42	12	24		1.07	1.16	1.35
48	15	26		1.18	1.37	1.48
54	15	28		1.30	1.51	1.63
60	15	30		1.39	1.62	1.89
66	18	34		1.625	1.80	2.00
72	18	36		1.75	2.00	2.375

* Includes rubber if rubber extends over flange face. Tolerance for valves 10 in. and smaller is ± 1/16 in.; tolerance for valves 12 in. and larger is ± ⅛ in.

† At no point shall the shell thickness be more than 12½ percent below the metal thickness shown in Table 3.

disc is in the closed position. Mechanical-joint ends shall meet the requirements of ANSI/AWWA C111/A21.11. Minimum body shell thicknesses shall conform to the specifications listed in Table 3. Unless otherwise specifically requested by the purchaser, bodies of all valves shall be of cast iron, ductile iron, or alloy cast iron.

Sec. 3.2 End Flanges

End flanges shall conform in dimensions and drilling to ANSI B16.1, Class 125 cast-iron flanges. As an alternative, valves of Class 25A and Class 25B may, if requested by the purchaser, be furnished with flange drilling conforming to ANSI B16.1 for Class 25 cast-iron flanges. All flanges shall have full-drilled holes through the body flanges, except that drilled and tapped holes in wafer valves and in flanges of short-body valves are acceptable.

Sec. 3.3 Valve Shafts

All valve shafts may consist of a one-piece unit extending completely through the valve disc, or may be of the "stub shaft" type, which comprises two separate shafts inserted into the valve disc hubs. If of "stub shaft" construction, each stub shaft shall be inserted into the valve disc hubs for a distance of at least 1½ shaft diameters. Valve shafts shall have a minimum diameter extending through the valve bearings and into the valve disc, as specified in Table 4.

3.3.1 *Connection.* The connection between the shaft and disc shall be designed to transmit shaft torque equivalent to at least 75 percent of the torsional strength of the mini-

TABLE 4

*Minimum Shaft Diameters**

Valve Diameter *in.*	Shaft Diameter—*in.*					
	Class 25A	Class 25B	Class 75A	Class 75B	Class 150A	Class 150B
3	½	½	½	½	½	½
4	⅝	⅝	⅝	⅝	⅝	⅝
6	¾	¾	¾	¾	1	1
8	⅞	⅞	⅞	⅞	1⅛	1⅛
10	1	1	1⅛	1⅛	1⅜	1⅜
12	1⅛	1⅛	1¼	1¼	1½	1½
14	1¼	1⅜	1⅜	1½	1¾	1¾
16	1⅜	1½	1½	1⅝	2	2
18	1½	1⅝	1⅝	1⅞	2⅛	2¼
20	1½	1⅞	1¾	2⅛	2⅜	2½
24	1¾	2¼	2	2½	2¾	3
30	2	2¾	2½	3	3½	3⅝
36	2½	3½	3	3⅝	4	4⅜
42	2⅞	3¾	3⅜	4¼	4½	5
48	3¼	4¼	3⅞	4⅞	5⅛	5⅝
54	3⅝	4⅞	4¼	5½	5¾	6¾
60	4	5½	4¾	6	6¼	7¼
66	4½	6	5	6¾	7	7¾
72	4⅞	6½	5¾	7½	7½	8½

* Based on the use of stainless steel.

mum required shaft diameters. Dowel and taper pins, if used, shall be mechanically secured. The closeness of fit of the shaft-to-disc connection shall be such that valve performance during operation and closure is not adversely affected.

3.3.2 *Size.* Valve shafts shall be full size for the portion of the shaft that extends through the valve bearings, valve disc, and shaft seal. In the event that the valve shaft is turned down to fit connections to the valve-operating mechanism, the turned-down portion shall have fillets with radii equal to the offset to minimize the possibility of stress concentration at the junction of the two different shaft diameters. The turned-down portion of the shaft shall be capable of transmitting torque equivalent to at least 75 percent of the torsional strength of the minimum required shaft diameter, and shall be capable of transmitting the maximum operator torque without exceeding a torsional shear stress of 11,500 psi.

3.3.3 *Material.* All valve shafts shall be wrought stainless steel, Monel, or carbon steel with stainless-steel journals. When carbon-steel shafts and stainless-steel journals are used, static seals shall be provided to isolate the interior of the disc and the shaft from water. Any deviation from these materials shall be only at the specific request of the purchaser.

Sec. 3.4 Valve Discs

Valve discs shall be of a cast or fabricated design with no external ribs transverse to the flow. The design shall be such as to sustain full differential pressures across a closed valve disc without exceeding a working stress of one fifth of the tensile strength of the material used. The thickness of the valve disc shall not be more than 2¼ times the shaft diameter listed in Table 4. Valve discs shall be of cast iron, cast steel, fabricated steel, bronze Grade A, D, or E referenced in Sec. 2.2.10, alloy cast iron, ductile iron, or stainless steel.

Sec. 3.5 Valve Seats

3.5.1 *Design.* Valve seats shall be designed to provide tight shutoff at the following pressure differentials:

1. Class 25A and 25B: 25 psi upstream; 0 psi downstream.
2. Class 75A and 75B: 75 psi upstream; 0 psi downstream.
3. Class 150A and 150B: 150 psi upstream; 0 psi downstream.

Valve seats shall be of a design that permits removal and replacement at the site of the installation for valves 30 in. and larger.

3.5.2 *Rubber seats.* Rubber seats shall mate with the following acceptable seat surfaces: stainless steel, Monel, bronze Grade A, D, or E referenced in Sec. 2.2.10, or alloy cast iron. Sprayed or plated mating seat surfaces are not acceptable.* Rubber seats may be applied to either the body or the disc, shall be of new natural or synthetic rubber, and may be reinforced by the manufacturer. Rubber seats shall be clamped, mechanically secured, bonded, or vulcanized to the body or disc. Rubber seats that are applied to the valve body and are penetrated by the valve shaft shall be adequately reinforced to prevent the seat from becoming inflated by pressure behind the seat, or if not adequately reinforced, shall be clamped and bonded, or bonded, or vulcanized to the valve body. The design of the seat shall be such as to provide tight shutoff under the tests required by Sec. 5 of this standard. Rubber seats shall be resistant to microbiological attack, copper poisoning, and ozone attack.

3.5.2.1 Rubber compounds shall contain no more than 8 ppm of copper ion and shall include copper inhibitors to prevent copper degradation of the rubber material.

3.5.2.2 Rubber compounds shall be capable of withstanding an ozone resistance test when tested in accordance with ASTM D1149. The tests shall be conducted on unstressed samples for 70 hr at 104°F (40°C) without visible cracking in the surfaces of the test samples after tests.

3.5.2.3 Rubber compounds shall be free of vegetable oils, vegetable-oil derivatives, animal fats, and animal oils.

3.5.2.4 Reclaimed rubber shall not be used.

3.5.2.5 Rubber compounds shall contain no more than 1.5 parts of wax per 100 parts of rubbber hydrocarbon.

3.5.2.6 Rubber compounds shall have less than 2 percent volume increase when tested in accordance with ASTM D471 after being immersed in distilled water at 73.4°F, (23°C), ±2°F for 70 hr.

3.5.3 *Clamps and retaining rings.* All clamps and retaining rings for rubber seats shall be of corrosion-resistant material with a maximum zinc content of 16 percent and a maximum aluminum content of 3 percent. All nuts and screws used with clamps and retaining rings shall be of stainless steel.

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* In cases where valves are to be operated frequently (more than once per month), seating surfaces of stainless steel or Monel are preferred.

Sec. 3.6 Valve Bearings

Valves shall be fitted with sleeve type bearings contained in the hubs of the valve body. The maximum distance from the inside metal surface of the valve body to the inside end of the sleeve bearing shall not exceed ⅛ in. Bearings shall be designed for a pressure not exceeding the published design load for the bearing material, or one fifth of the compressive strength of the bearing or shaft material. Bearing materials shall have a proven record of service of not less than 5 years. Valve shafts or extensions of the valve shaft shall be designed for connection to operators as described in Sec. 3.8. A bearing of corrosion-resistant material shall be provided on the shaft outboard of the shaft seal or in the operator housing to protect the shaft seal from side thrust forces developed in the operating mechanisms. Each valve shall be equipped with either one or two thrust bearings set to hold the valve disc securely in the center of the valve seat, except for valves 20 in. and smaller without hydraulic or external axial shaft loads. Sleeve and other bearings fitted into the valve body proper shall be of "self-lubricated" materials that do not have a harmful effect on water or rubber and that do not have a coefficient of friction in excess of 0.25 when run at the maximum bearing pressure.

Sec. 3.7 Shaft Seals

Where shafts project through the valve bodies for operator connection, a shaft seal shall be provided. Shaft seals shall be designed for the use of standard split-V type packing, for standard O ring seals or for a pull-down packing. If O rings are used as shaft seals, they shall be contained in a removable corrosion-resistant recess. Shaft seals shall be of a design allowing replacement of seals without removing the valve shaft. When the purchaser specifically requests that the shaft seals be of the type utilizing a stuffing box and pull-down packing gland, the design of the valve and stuffing box assembly shall be such that the packing can be adjusted or completely replaced without disturbing any part of the valve or operator assembly except the packing gland follower. Stuffing boxes shall have a depth sufficient to accept at least four rings of packing. Gland or gland assemblies shall be of bronze Grade A, D, or E referenced in Sec. 2.2.10. Packing for stuffing boxes shall be of asbestos or flax.

Sec. 3.8 Valve Operators

The operator is essentially an integral part of a butterfly valve. The rated torque capability of each operator shall be sufficient to seat, unseat, and rigidly hold in any intermediate position the valve disc it controls under the operating conditions specified by the purchaser. All values shall be equipped with adjustable mechanical stop-limiting devices to prevent over-travel of the valve disc in the open and closed positions. Operator housings, supports, and connections to the valve shall be designed with a minimum safety factor of 5, based on the ultimate strength, or 3, based on the yield strength, of materials used.

3.8.1 *Manual operators.* Each manual operator shall have all gearing totally enclosed. Operators shall be designed to produce the specified torque with a maximum pull of 80 lb on handwheel or chainwheel operators and a maximum input of 150 ft-lb on operating nuts. Stop-limiting devices shall be provided in the operators for the open and closed positions. All operator components between the input and these stops shall be designed to withstand, without damage, a pull of 200 lb for handwheel or chainwheel operators and an input torque of 300 ft-lb for operating nuts.

3.8.2 *Electric operators.*

3.8.2.1 In electric operators, motors shall be capable of producing not less than 1½ times the required operator torque.

3.8.2.2 Electric-motor drives shall be equipped with limit switches and torque switches for both open and closed positions.

3.8.2.3 Any gearing in direct association with the electric-motor drive shall be totally enclosed and shall operate in a lubricant.

3.8.2.4 Each electric operator shall be provided with an auxiliary handwheel for manual operation.

3.8.2.5 Unless otherwise specified, electric-motor-operated valves shall operate from fully open to fully closed positions, or the reverse, in approximately 60 s.

3.8.3 *Gearing.* All gear operators or traveling-nut operators shall be self-locking and designed to transmit twice the required operator torque without damage to the faces of the gear teeth or the contact faces of the screw or nut. This shall be proved by subjecting one prototype operator of each model and torque-rating to a shop torque test equal to or greater than twice the rated torque. In addition, manual operators shall be tested while the operator components are against the open and the closed stop-limiting devices referred to in Sec. 3.8.1 by applying a 200-lb pull to a handwheel or chainwheel operator and an input torque of 300 ft-lb to an operating nut. After testing, the operator shall be completely dismantled and carefully examined for any evidence of damage. Upon request, the manufacturer shall furnish the purchaser with certified copies of reports describing the procedures and results of the tests for each model and torque rating of operator to be furnished. Sec. 2.2 does not apply to materials specified in Sec. 3.8.3.

3.8.3.1 Operators composed of worm gearing shall be totally enclosed in a gear case and shall have worm gears of bronze and worms of hardened steel that operate in a lubricant.

3.8.3.2 Operators of the traveling-nut type shall have threaded reach rods of steel and shall have a bronze or ductile-iron nut with internal threads. Operators shall be enclosed.

3.8.4 *Hydraulic cylinders.* With cylinder operation, pressures shall be maintained on the cylinder piston at each end of its stroke, unless other means are provided to prevent drifting. Unless otherwise specified by the purchaser, hydraulic cylinders shall comply with the following requirements:

3.8.4.1 Cylinder bodies shall be of a low zinc content (not more than 16 percent) bronze, with the inside diameter honed to at least a 16-μin. finish (in accordance with ANSI B46.1).

3.8.4.2 Cylinder piston and head and cap ends shall have complete corrosion protection on all surfaces exposed to water. The corrosion protection shall withstand a salt spray test of not less than 144 hr in accordance with ASTM B117.

3.8.4.3 Cylinder piston rods shall be of stainless steel having a 4–8 μin.

finish, with a surface of hard chrome plating about 0.0005 in. thick.

3.8.4.4 Piston rod bushings shall be of bronze and shall be pilot-fitted into the cylinder head.

3.8.4.5 Cylinders shall be equipped with a dirt wiper to clean the piston rod before it enters the cylinder.

3.8.4.6 Cylinders shall be equipped with rod seals of a nonadjustable, wear-compensating type.

3.8.4.7 Rod seals and piston cups shall be of "Buna-N" rubber or other material equally suitable for hydraulic service.

3.8.4.8 Cylinders shall require not more than the pressure listed in Table 5 to be cycled a complete stroke in either direction before they are connected to the butterfly valve.

3.8.5 *Pneumatic cylinders.* With cylinder operation, pressures shall be maintained on the cylinder piston at each end of its stroke, unless other means are provided to prevent drifting. Unless otherwise specified by the purchaser, pneumatic cylinders shall comply with the following requirements:

3.8.5.1 Cylinder bodies shall be of hard-drawn brass or centrifugally cast bronze with the inside diameter honed to at least a 16-μin. finish (in accordance with ANSI B46.1), or of steel, bored, honed, chromium plated, and rehoned to at least a 16-μin. finish.

3.8.5.2 Cylinder head and cap ends shall be of corrosion-protected ferrous material.

3.8.5.3 Cylinder pistons shall be of chromium-plated steel, hard-coated alumilited aluminum or cadmium-plated cast iron.

TABLE 5

Pressure Required to Move Cylinder

Cylinder Bore *in.*	Pressure *psi*
≤2	5
>2–5	4
>5	3

3.8.5.4 Cylinder piston rods shall be of stainless steel having a 4–8 μin. finish, with a surface of hard chrome plating approximately 0.0005 in. thick.

3.8.5.5 Piston rod bushings shall be of bronze and shall be pilot-fitted into the cylinder head.

3.8.5.6 Cylinders shall be equipped with a dirt wiper to clean the piston rod before it enters the cylinder.

3.8.5.7 Cylinders shall be equipped with rod seals of a nonadjustable, wear-compensating type.

3.8.5.8 Rod seals, rod wiper, and piston cups shall be of neoprene, "Buna-N" rubber, or equivalent material suitable for air service.

3.8.5.9 Cylinders shall be equipped with adjustable cushions at each end of the stroke if so specified.

3.8.5.10 The structure of the cylinder shall have a safety factor of at least 5, based on the working pressure. When cast iron is used, the safety factor shall be at least 10.

3.8.5.11 Cylinders shall require not more than the pressure listed in Table 5 to be cycled a complete stroke in each direction before they are connected to the butterfly valve.

Section 4—Workmanship and Painting

Sec. 4.1 Workmanship

Valve parts shall be designed, and manufacturing tolerances set, to provide interchangeability of parts between units of the same size and type produced by any one manufacturer. When assembled, valves manufactured in accordance with this standard shall be well fitted and smooth operating, and body and shaft seal shall be watertight. All equipment shall be guaranteed against defects in workmanship or materials or both for one year after installation or two years after shipment, whichever time lapses first.

Sec. 4.2 Painting

Unless otherwise specified by the purchaser, all internal steel or cast-iron surfaces of each valve, except finished or bearing surfaces, shall be shop-painted with two coats of asphalt varnish conforming to Federal Specification TT-V-51c, and exterior steel or cast-iron surfaces of each valve, except finished or bearing surfaces, shall be shop-painted with two coats of zinc chromate conforming to Federal Specification TT-P-645, or, in the case of valves for buried service, with two coats of asphalt varnish conforming to Federal Specification TT-V-51c.

Section 5—Inspection, Testing, and Rejection

Sec. 5.1 Inspection

All work performed in accordance with this standard shall be subject to inspection and approval by the purchaser's duly authorized engineer or inspector, who shall at all times have access to all places where materials are being produced or fabricated or where tests are being conducted and who shall be accorded full facilities for inspection and observation of tests. If the purchaser has no inspector at the plant, the manufacturer shall, if requested at the time the order is placed, certify that the required tests on the various materials and on the completed valves will be made and that no component or valve shall be furnished that has not been tested and found to conform to the requirements of this standard.

Sec. 5.2 Performance Tests

Each valve that has the operator mounted directly on the valve shall be shop-operated three times from the fully closed to the fully opened position, and the reverse, under a no-flow condition to demonstrate that the complete assembly is workable.

Sec. 5.3 Leakage Tests

Each valve shall be shop-tested for leaks in the closed position. The test shall be conducted with the body flanges in a horizontal plane. With the disc in the closed position, air pressure shall be supplied to the lower face of the disc for the full test duration as follows:

Class 25A and 25B: 25 psi.
Class 75A and 75B: 75 psi.
Class 150A and 150B: 150 psi.

The upper surface of the valve disc shall be visible and shall be covered with a pool of water at 0 psi pressure. The length of test shall be at least 5 min., and there shall be no indication of leakage past the valve disc (visible in the form of bubbles in the water pool on top of the disc) during the test period. As an alternative to this test procedure, Class 150A or 150B valves may be given a 150-psi hydrostatic test. During the test, the valves shall be droptight.

Sec. 5.4 Hydrostatic Test

All valve bodies shall be subjected to an internal hydrostatic pressure equivalent to two times the specified shutoff pressure. During the hydrostatic test, there shall be no leakage through the metal, the end joints or the shaft seal, nor shall any part be permanently deformed. The time duration of the hydrostatic test shall be sufficient to allow visual examination for leakage and shall be at least 1 min. for valves 8 in. and smaller, 3 min. for valves 10 in. through 20 in. and 10 min. for valves 24 in. and larger.

Sec. 5.5 Proof-of-Design Tests

Upon request, the manufacturer shall furnish certified copies of the reports covering the tests. One prototype valve of each size and class of a manufacturer's design shall be hydrostatically tested with twice the specified shutoff pressure applied to one side of the disc and zero pressure on the other side. The test is to be made in each direction across the disc, and, in the case of flanged valves, the valve body shall be bolted to a flanged test head. Under the hydrostatic test, the manufacturer may make special provisions to prevent leakage past the seats. No part of the valve or disc shall be permanently deformed by the test. It is the purpose of this section to provide evidence of the adequacy of each basic type offered by a manufacturer to perform under design pressures within the applicable rating for a sufficient number of operations simulating a full service life. The adequacy is to be proved by tests, made on valves selected to represent each basic type of seat design of a size within each applicable group in Table 6 and in a pressure class or classes equal to or greater than the valves being purchased. The required number of cycles appears in Table 6. Every cycle shall consist of applying the differential pressure to the disc in the closed position, then opening the valve (which will relieve the pressure) to the wide-open position and then closing the disc. The valve shall be droptight under the rated pressure differntial upon completion of the cycle test.

TABLE 6

Test Cycles Required

Size Group—in.	No. of Cycles
3–20	10,000
24–42	5,000
48–72	1,000

Sec. 5.6 Rejection

Any butterfly valve or part that the inspector may condemn as not conforming to the requirements of this standard shall be made satisfactory or shall be rejected and replaced.

Section 6—Marking and Shipping

Sec. 6.1 Marking

Markings for other than wafer valves shall be cast on the body or shall be on cast plates with raised letters attached to the valve body. The markings shall show the valve size, manufacturer, class, and year of manufacture. The minimum size of letters shall be ¼ in. for valves 3–12 in. in diameter and ½ in. for valves larger than 12 in. in diameter. Corrosion-resistant plates attached to the body and with ⅛-in. etched or engraved letters may be used for marking wafer valves.

Sec. 6.2 Shipping

Valves shall be complete in all respects when shipped. The manufacturer shall use care in preparing them for shipment so that no damage owing to the manufacturer's negligence will occur in handling or transit. All cavities shall be drained of water. Valves larger than 36 in. in size shall be bolted or otherwise fastened to skids in such a manner as to preclude damage in subsequent handling. All unpainted steel- and iron-machined surfaces shall be coated with a protective slushing compound. Full-face flange protectors of waterproof plywood or weather-resistant pressboard, of a least the diameter of the flange OD, shall be fastened to each flange to protect both it and the valve interior. Small valves may be fully packaged at the manufacturer's option. Components shipped unattached shall be adequately protected and identified for correct field assembly.

APPENDIX

Method for Calculating Torques Required to Operate Butterfly Valves

This appendix is for information only and is not a part of AWWA C504.

The following factors affect the torque required to operate rubber-seated butterfly valves:

1. Valve diameter
2. Shaft diameter
3. Bearing friction coefficient
4. Type of seat and seat material
5. Shutoff pressure
6. Velocity
7. Type of disc
8. System head characteristics
9. Piping arrangement

These factors combine to make up the following four classes of torque:

1. *Seating or unseating torque.* This is the torque required to overcome the rubber seat friction when the valve disc is being seated or unseated.

2. *Bearing friction torque.* This is the torque required to overcome the friction between the valve shaft and the shaft bearings.

3. *Dynamic torque.* This is the torque developed by the disc on the valve shaft because of the difference in pressures that exist across the faces of the disc as a result of flow.

4. *Hydrostatic torque.* This is the torque caused by the difference in static head of water on the valve disc above and below the valve shaft when the shaft is horizontal. It is added to or subtracted from the seating or unseating torque.

Operator torques can be calculated using the following formulas:

$$T_s = C_s D^3 \qquad (1)$$

$$T_b = 4.71\, D^2 d\, f\, P \qquad (2)$$

$$T_d = C_t D^3 P \qquad (3)$$

$$T_h = 3.06\, D^4 \qquad (4)$$

$$V = C_f \sqrt{P} = \frac{Q}{0.785 D^2} \qquad (5)$$

in which:

T_s = seating or unseating torque, in foot-pounds

T_b = bearing torque, in foot-pounds

T_d = dynamic torque, in foot-pounds

T_h = hydrostatic torque, in foot-pounds

Q = flow, in cubic feet per second

V = velocity, in feet per second

D = diameter of valve, in feet

d = diameter of shaft, in inches

P = pressure drop across valve, in pounds per square inch

*C_s = coefficient of seating or unseating torque

*C_t = coefficient of dynamic torque

*C_f = coefficient of flow

f = bearing friction coefficient (usually assumed to be 0.25 for metal bearings)

The required operator torque, T_o, is determined from the higher value given by the two formulas:†

$$T_o = (T_b + T_s + T_h) \qquad (6)$$

$$T_o = (1.2\, T_b \pm T_d) \qquad (7)$$

Equation 6 is solved by using the maximum pressure drop across the valve with the disc in the closed position; Eq 7 must be solved successively for several values of velocity to determine the maximum combination of dynamic and bearing torques. The head loss that will occur across the valve for each value of velocity can only be determined by considering the hydraulics of the entire system.

Figure A1 illustrates a graphic method of determining the pressure drop across a valve for any velocity between the valve-open and closed position for two typical conditions: (1) where the elevation of the energy gradient at the source of supply is constant, as in the case of a large

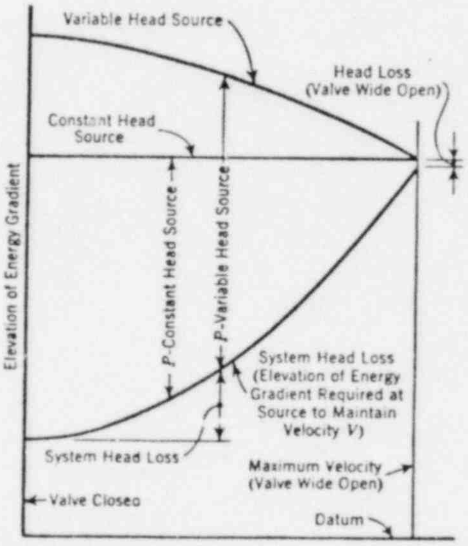

Fig. A1. Relation Between Velocity and Pressure Drop in Butterfly Valves

The figure illustrates a graphic method for determining pressure drops across a valve under the two conditions described in the text.

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* The relationship of C_t, C_f, and disc angle varies depending upon the shape of the disc and how it is mounted on the shaft. Characteristic curves showing this relationship and the value of C_s may be obtained from the valve manufacturer. The values of these coefficients should not be applied indiscriminately when calculating torque requirements for operation of valves produced by another manufacturer.

† Use the plus value for T_d when calculating opening torque and the negative value when calculating closing torque.

reservoir, and (2) where the elevation of the energy gradient is variable, depending on flow, as in the case of a centrifugal pump. It should be noted that all heads are measured to energy gradients and therefore must include velocity head, if any. The ordinate difference between the head source curve (or line) and the system head curve represents the total head loss (total dynamic head) across the valve at any velocity; therefore, the pressure drop across the valve corresponding to each value of velocity can be determined and tabulated.

The coefficient, C_f, corresponding to each value of velocity can be calculated by means of Eq 5, and the corresponding coefficient, C_t, determined by using the valve characteristic curves showing the relationship of C_t, C_f, and disc angle. The dynamic torque, T_d, and the corresponding bearing torque, T_b, can then be calculated using Eq 3 and 2, respectively.

The following is an example illustrating the method for calculating the operating torque required for a valve.

Given: A 54-in. valve, a maximum discharge rate, Q, with the valve full open, of 254 cfs, a maximum shutoff pressure across the valve of 25 psi, a shaft diameter of 4⅞ in., valve shaft horizontal, a system characteristic such that head loss varies as the square of the velocity and the head source is a constant elevation, a C_f value of 22 with valve fully open, and a C_t value of 85

Problem: What is the maximum operator torque?

Solution: The velocity and pressure drop with the valve fully open will be:

$$V = \frac{254}{0.785 \times 4.5^2} = 16 \text{ fps}$$

$$P = \left(\frac{16}{C_f}\right)^2 = 0.53 \text{ psi (Eq 5)}$$

Because head loss varies as the square of the velocity and the head source is a constant elevation, the pressure drop across the valve corresponding to any velocity will be:

$$P = 25 - \frac{(25 - 0.53)\,V^2}{16^2}$$

$$= 25 - 0.0956\ V^2$$

For any pressure drop across the valve, the bearing torque will be:

$$T_b = 4.71 \times 4.5^2 \times 4.875 \times 0.25\ P \text{ (Eq 2)}$$

or

$$T_b = 116.2P$$

Table A1 gives the various factors

TABLE A1

Factors Indicated for Velocities at 1-ft Intervals From Maximum Velocity

V fps	Item					
	P psi	C_f	C_t	T_d ft-lb	$1.2T_b$ ft-lb	$T_d+1.2T_b$ ft-lb
16	0.53	22.00				
15	3.49	8.03	15.12	4,809	487	5,296
14	6.26	5.59	9.36	5,339	873	6,212
13	8.84	4.37	7.49	6,034	1,233	7,267
12	11.23	3.58	6.19	6,334	1,566	7,900
11	13.43	3.00	5.33	6,523	1,873	8,396
10	15.44	2.54	4.18	5,881	2,153	8,034

indicated for velocities at 1-ft intervals from the maximum velocity to that lower velocity at which the required operator torque begins to decrease. This tabulation indicates that the maximum value of $T_e = (T_d + 1.2T_b)$ is 8,396 ft-lb. The unseating torque for the example would be:

$$T_u = (T_b + T_s + T_h) = 116.2 \times 25 + 85 \times 4.5^2 + 3.06 \times 4.5^4 = 2,905 + 1,721 + 1,255 = 5,881 \text{ ft-lb.}$$

It should be noted that Eq 7 is the algebraic sum of the two values, T_d and $1.2T_b$. When closing a valve, T_d is negative and the theoretic operator torque required is the difference between the two values. It is customary, however, to assume T_b to be zero under a closing condition since the amount of friction that can be counted upon is indeterminate. If it is assumed, in the example given above, that the maximum velocity occurs only under a linebreak condition, then the required operator torque would be 6,523 ft-lb. This value should be checked against the maximum torque required to open the valve under the normal maximum pipeline velocity and shutoff head to determine the maximum operator requirement.

Manual and electric-motor operators to be applied to butterfly valves should have a rated torque capability not less than the maximum required operator torque, T_e. Cylinder operators should be sized on the basis of the minimum cylinder pressure to be expected with a safety factor depending upon the kind of service.

It is recommended that the minimum safety factors for cylinder torques be not less than those shown in Table A2. Safety factors are the ratio of cylinder torque to required operator torque. Cylinder torque is equal to:

TABLE A2

Recommended Safety Factors for Cylinder Torques

Type of Service	Operating Fluid	Safety Factor
Open-shut	liquid	1.25
Throttling	liquid	1.25
Open-shut	gas	1.25
Throttling with positioner	gas	1.5 for cylinders greater than 80 cu in.; 2.0 for smaller cylinders
Throttling without positioner	gas	10.0

$$(A - a)L(P - p)E$$

in which:

A = area of cylinder ID.

a = area of piston rod in one direction and zero in other direction.

L = moment arm (shortest distance between piston rod axis and valve disc axis for given disc position).

P = cylinder operating pressure.

p = pressure required to move piston (Table 5 gives maximums).

E = efficiency factor, taking into account increase in piston and piston rod seal friction with pressure, linkage friction, and friction of the valve shaft in the outboard bearing caused by cylinder thrust.

The safety factor must be considered for all disc positions, because both the moment arm and the required operator torque vary with disc position.

ATTACHMENT "C"

Valve Acceleration Data

Valve No.	Valve Acceleration (g's)	Actuator Acceleration (g's)
P44-F116	1.6380	1.4440
P44-F117	1.6380	1.6680
P44-F118		
P44-F119		
P44-F120		
P44-F121		
P44-F122	0.4485	0.4899
P44-F123	0.0920	0.0920
G41-F019	0.7380	0.8040
G41-F045	1.3240	1.4640

ATTACHMENT NO. 5

Main Steam Isolation Valves
B21-F022/F028

Concern

Provide a copy of the following:

1. NEDE-24122-1, Class II, May 1978, entitled, "Final Test Report, Seismic Qualification Test for Atwood & Morrill 26-inch MSIV Actuator, Volume I," by B. J. Uebelhoer.
2. NEDE-24122-2, Class II, May 1978, entitled, "Final Test Report, Seismic Qualification Test for Rockwell Manufacturing 24-inch MSIV Actuator, Volume II," by B. J. Uebelhoer.
3. Atwood & Morrill Vendor Test Report No. 207-13561-0, dated November 20, 1975.

Response

The above requested information is being provided under separate cover due to it being proprietary information. The transmittal letter is AECM-82/218.

Concern

Are the MSIV air accumulators and the check valve seismically qualified?

Response

The MSIV air accumulators are seismically qualified by a static analysis. The check valves have been procured as ASME Class 3 valves. No seismic requirements have been specified for the check valves.

Concern

What is the basis for the solenoid valve (pilot) being classified as a non-Class 1E item?

Response

The Main Steam Isolation Valve (MSIV) is designed to open and remain open on pneumatic pressure. During normal plant operation, the dual solenoid valve (pilot) must be energized in order for the pneumatic pressure to keep the MSIV open during normal plant operation.

When the dual solenoid valve (pilot) is deenergized, a spring within the solenoid valve returns the disc to the deenergized state which in turn then exhausts the air that was maintaining the MSIV open. Air is also injected onto the top side of the MSIV (from air accumulator and instrument air) actuator which in combination with the large MSIV actuator spring closes the MSIV in a prescribed time. (NOTE: The MSIV would also close under the force of the spring alone.)

Main Steam Isolation Valves
B21-F022/F028

The dual solenoid valve (pilot) is classified as "Fail-Safe" since the solenoid valve operation in its safety mode is mechanical in nature. In other words, the mechanical operation of the dual solenoid valve (pilot) is its only safety mode of operation. Since no electrical mode of operation is involved in the dual solenoid valve (pilot) safety operational mode, it has been classified as non-Class 1E. However, potential failure modes must be reviewed from its mechanical features to assure that it will perform its intended function of exhausting the air from the under side of the MSIV actuator.

There are two potential failure modes which could possibly prevent the exhaust air from bleeding from the valve. One is potential blockage of the exhaust line due to possible oil and/or debris contamination. This blockage is highly unlikely since the use of instrument air is required by "design specification" which is clean, oil and debris free, and final filtered to 50 microns. There is another 50 micron filter downstream of the solenoid to further prevent debris from entering the four-way pilot valve. Finally, the exhaust line is ¼" in diameter, further minimizing any potential for blockage.

A second postulated failure mode is the potential of the solenoid valve to "hang up" and not release when subjected to a seismic event. The MSIV solenoid used on Grand Gulf was tested in conjunction with the 24" MSIV Seismic Qualification Test (Reference: NEDE-24122-1, dated May 1978) and performed its intended function during the test. Note that the test response spectra maximum acceleration values were significantly higher than those at Grand Gulf.

All of the solenoid valves are powered from a 120 Vac, 60 Hz, power supply. The dual solenoids ("A" and "B") are redundant in function with either solenoid being capable of operating (opening) the valve. The test solenoids are used to test the valve both in full and partial closure position. Separation of power supplies is provided for reliability. The Inboard solenoids and Outboard solenoids are powered from Reactor Protection System (RPS) Bus A and Bus B, respectively. During normal operations the "A" and "B" solenoids are energized while the "test" solenoid is normally de-energized.

Concern

What is the quality of the air supplied by the Instrument Air System to the MSIV Control System?

Response

The instrument air system for each unit consists of one full-capacity, multistage, packaged centrifugal compressor, complete with inlet filter, inlet air controller, and aftercooler. The compressor has a receiver and a purge-regenerative (heatless) desiccant air dryer.

Main Steam Isolation Valves
B21-F022/F028

Instrument air is distributed to the plant after drying to a dew point of -40°F and filtration to remove particles 0.9 microns and larger. In addition, each instrument or group of instruments has a pressure regulating valve with an integral filter located in its instrument air supply. The instrument air systems of Units 1 and 2 can be connected by opening two air-operated valves from the control room. While both units are connected through this intertie, one instrument air compressor can supply all instrument air demands with the other compressor as a backup. The air-operated intertie valves fail open upon loss of air to their operators, thereby assuring instrument air supply to both units.

Concern

Has MP&L evaluated the failure of MSIV to close?

Response

MP&L has conducted an evaluation of the Grand Gulf Instrument Air System as noted in IE Circular 81-14, "Main Steam Isolation Valve Failures to Close" and IE Notice 81-38, "Potentially Significant Equipment Failures Resulting from Contamination of Air-Operated Systems." The results of the evaluation is as follows:

A. An engineering evaluation of the Grand Gulf Instrument Air System was conducted as noted in IE Circular 81-14 and IE Notice 81-38.

B. The following design features were noted as a result of the evaluation of the Grand Gulf Instrument Air System to prevent occurrences as described in IE Circular 81-14 and IE Notice 81-38:

   1. Use of oil-free compressors with instrument air receivers for collecting and draining moisture and crud.

   2. Instrument air-dryer inlet features.

   3. Instrument air-dryer (regenerative type).

   4. Instrument air-dryer after filters.

   5. The air supply piping and tubing design consists of low point dirt legs with manually operated valves to allow for blowdown of any accumulated moisture and crud.

   6. The Service Air System when used for Instrument Air System backup is directed through the instrument air-dryer system.

Main Steam Isolation Valves
B21-F022/F028

C. As a result of the engineering evaluation, the following change is being implemented:

> Qualified dew point monitoring equipment with annunciation to be provided at all Main Instrument Air System branch headers and at the inlet to the MSIV Valve Control Systems.

ATTACHMENT NO. 6

HPCS Diesel Generator System
E22-S001/S002/S003/S004

Concern

Have the relays for the Grand Gulf HPCS Diesel Generator System been qualified for all states (energized and de-energized)?

Response

The following methods are used in the General Electric (GE) SQRT programs to qualify panels and mounted relays.

The Grand Gulf HPCS switchgear was seismically qualified by comparing the Grand Gulf panel to a similar panel tested to IEEE 344-1975. The TRS envelopes the Grand Gulf RRS. All devices, except one of the safety essential relays on the Grand Gulf panel, were on the tested panel. This particular relay was qualified by GE's normal qualification methodology for relays not qualified as part of a panel test.

This qualification methodology reviews the relay configurations of normally closed, normally open, energized, and de-energized independent of how the relay is used in its safety function. The seismically most limiting configuration is determined. The GE relay qualification methodology requires comparing the relay's lowest chatter capability (in the relay's seismically most limiting configuration) with the maximum expected acceleration.

The particular relay not tested on the E22-S004 test panel was tested in accordance with the following procedure:

1. The lowest tested chatter capability for this relay is for normally open contacts in the non-operating mode. The chatter detector was set at 2.0 milliseconds, and the relay was tested per IEEE 37.98-1978. The seismic capability is in g's at the ZPA. The peak of the TRS is 250% of the ZPA.

2. The maximum expected acceleration for the relay was obtained by multiplying the transmissibility recorded during resonance search times the ZPA for the Grand Gulf control building. The transmissiblity was obtained by using an accelerometer mounted on the test panel near the location where this relay is mounted, and was calculated by dividing this reading by the test input acceleration.

As long as the maximum expected acceleration is less than the lowest tested seismic capability, the relay is qualified. For this particular relay on the Grand Gulf HPCS switchgear, this is the case.

ATTACHMENT NO. 7

Conductivity Cell
E12-N025A, B

The following information is being provided:

1. Seismic and hydrodynamic loads requalification certification for the conductivity cell.
2. Specification 9645-M-220.0, "Design Specification for Nuclear Piping Systems."

GRAND GULF
NUCLEAR STATION
UNIT1

SEISMIC AND HYDRODYNAMIC LOADS

REQUALIFICATION CERTIFICATION

JOB NO. MPL-06

EQUIPMENT NAME: Conductivity Cell

SPEC. NO: 163C1544P012

EQUIPMENT NO: E12-N025A, B

LOCATION: Auxiliary Building, 93'-0"

EQUIPMENT CLASSIFICATION: ☐ ACTIVE ☒ PASSIVE

SEISMIC QUALIFICATION REPORT REFERENCE:

THE ABOVE SEISMIC QUALIFICATION REPORT(S) HAVE BEEN REEVALUATED AND REQUALIFIED WHERE NECESSARY TO SHOW THAT THE ABOVE-MENTIONED COMPONENT IS CAPABLE OF PERFORMING ITS INTENDED SAFETY FUNCTION UNDER ALL THE APPLICABLE LOADING COMBINATIONS INCLUDING THE POOL DYMANIC LOADS.

PREPARED: R.P. Morton
R.P. Morton
APPROVED: for C E Nakayama
V.J. Brocato
DATE: 4/29/82

GRAND GULF NUCLEAR STATION UNIT 1

QUALIFICATION SUMMARY

1. Equipment Name Conductivity Cell
2. Equipment No. E12-N025A, B
3. Qualification Documentation (Enclosed with this report.)

A. Qualification Summary of Equipment (SQRT form), including required response spectra with TRS plotted on RRS graph as appropriate.

The conductivity cell assembly is qualified for combinations of dead weight, internal pressure, thermal expansion and seismic loads for ASME Code class 2 service levels A through D.

B. Reference Documents

Reference Number	Document Identification	Revision or Date	Title/Subject
1	Spec. 9645-M-220.0	Rev. 13	Design Specification for Nuclear Piping System for Mississipp Power & Light Compan Grand Gulf Nuclear Station, Units 1 and 2, Grand Gulf, Mississippi

C. Additional Supporting Documents

Document Identification	Revision or Date	Title/Subject
NUTECH File Number 32.1206.0200	Rev. 1	Seismic Qualification Analysis for the Conductivity Cell (1" Valve Connected to the RHR Line) See Attached

EQUIPMENT NO. E12-N025A,B

4. Functional Requirements

The conductivity cell must maintain its pressure retaining capability during and after a seismic event. Operability is not required.

5. Demonstration Capability

Calculations demonstrate that the attachment nipple is capable of withstanding a seismic event of greater than 6g's multiplied by a calculated DLF.

6. Rationale for Qualification Certification

(Include Decision analysis with comparison to acceptance criteria, approach for demonstrating operability, and consideration of high-frequency response.)

The most critical component affecting the pressure integrity of the conductivity cell is the 1" attachment nipple. Nipple stress was determined for combinations of dead weight, internal pressure, thermal expansion and seismic loads for ASME code class 2 service levels A through D. In no case were the calculated stresses greater than 60 percent of the allowable stresses.

Qualification Summary of Equipment

I. Plant Name: Grand Gulf Nuclear Station Unit I

Type:

1. Utility: Mississippi Power and Light Co.

PWR ________

2. NSSS: G.E.

3. A/E: Bechtel Power Corp.

BWR 6, Mark III

II. Component Name: Conductivity Cell

1. Scope: ☒ NSSS ☐ BOP

2. Model Number: GV1-2-N/910-.1T-1HN Quantity: 2

3. Vendor: Balsbaugh (Division of Foxboro Corp.)

4. If the component is a cabinet or panel, name and model No. of the devices included: N/A

5. Physical Description a. Appearance 1" Valve with 1" NPT Nipple & 1" NPS Attached Pipe

   b. Dimensions 10" Maximum with nipple and 1" NPS pipe

   c. Weight Valve (10 lbs.) + pipe & Nipple = 12 lbs.

6. Location: Building: Auxiliary Building

   Elevation: 93'-0"

7. Field Mounting Conditions ☐ Bolt (No.____, Size____)
   ☐ Weld (Length____)
   ☒ 1" NPT nipple

8. a. System in which located: Residual Heat Removal

   b. Functional Description: Monitor water quality during a line flush prior to activating system

   c. Is the equipment required for ☐ Hot Standby ☐ Cold Shutdown ☒ Both ☐ Neither

9. Pertinent Reference Design Specifications: G.E. Purchase Part Drawing 163C1544P012

Prepared by: R. P. Morton 4/29/82

Verified by: 4/29/82

12/80

III. Is Equipment Available for Inspection in the Plant: ☒ Yes ☐ No

IV.- Equipment Qualification Method:

☐ Test ☒ Analysis ☐ Combination of Test and Analysis

Qualification Report*: Seismic Qualification for the Conductivity Cell

(No., Title and Date) (1" Valve Connected to the RHR Line, 4/16/82
NUTECH File: 32.1206.0200

Company that Prepared Report: NUTECH

Company that Reviewed Report: NUTECH

V. Vibration Input:

1. Loads considered: a. ☒ Seismic only
   b. ☐ Hydrodynamic only
   c. ☐ Combination of (a) and (b)
2. Method of Combining RRS: ☐ Absolute Sum ☐ SRSS ☒ N/A (other, specify)
3. Required Response Spectra (attach the graphs): N/A
4. Damping Corresponding to RRS: OBE ________ SSE N/A
5. Required Acceleration in Each Direction: ☐ ZPA ☒ Other per Bechtel Spec. (specify)

   OBE S/S = ________ F/B = ________ V = ________
   SSE S/S = 6.0g F/B = 6.0g V = 6.0g
6. Were fatigue effects or other vibration loads considered?

   ☐ Yes ☒ No

   If yes, describe loads considered and how they were treated in overall qualification program: ________

*NOTE: If more than one report complete items IV thru VII for each report.

VI. If Qualification by Test, then Complete*: N/A

1. [ ] Single Frequency [ ] Multi-Frequency: [ ] random
   [ ] sine beat
   [ ] __________

2. [ ] Single Axis [ ] Multi-Axis

3. No. of Qualification Tests: OBE ________ SSE ________ Other ________ (specify)

4. Frequency Range: ____________________

5. Natural Frequencies in Each Direction (Side/Side, Front/Back, Vertical):

   S/S = __________ F/B = __________ V = __________

6. Method of Determining Natural Frequencies

   [ ] Lab Test [ ] In-Situ Test [ ] Analysis

7. TRS enveloping RRS using Multi-Frequency Test [ ] Yes (Attach TRS & RRS graphs
   [ ] No

8. Input g-level Test: OBE S/S = ________ F/B = ________ V = ________

   SSE S/S = ________ F/B = ________ V = ________

9. Laboratory Mounting:

   1. [ ] Bolt (No. _____, Size _____) [ ] Weld (Length _____) [ ] _____

10. Functional operability verified: [ ] Yes [ ] No [ ] Not Applicable

11. Test Results including modifications made: ____________________

    ____

12. Other test performed (such as aging or fragility test, including results):

    ____

    ____

*Note: If qualification by a combination of test and analysis also complete Item VII.

VII. If Qualification by Analysis, then complete:

1. Method of Analysis:

   [ ] Static Analysis [x] Equivalent Static Analysis

   [ ] Dynamic Analysis: [ ] Time-History [ ] Response Spectrum

2. Natural Frequencies in Each Direction (Side/Side, Front/Back, Vertical):

   S/S = 182. F/B = 182. V = 182.

3. Model Type: [X] 3D [ ] 2D [ ] 1D

   [ ] Finite Element [X] Beam [ ] Closed Form Solution

4. [ ] Computer Codes: PISTAR

   Frequency Range and No. of modes considered: 182. Hz to 771. Hz, 4 modes

   [X] Hand Calculations

5. Method of Combining Dynamic Responses: [ ] Absolute Sum [ ] SRSS
   [X] Other: SRSS moments in three directions (absolute sum in each direction)

6. Damping: OBE 1% SSE 1% Basis for the damping used: Reg. Guide 1.61

7. Support Considerations in the model: Valve cantilevered at nipple.

8. Critical Structural Elements:

A.

Identification	Location	Governing Load or Response Combination	Seismic Stress	Total Stress	Stress Allowable	ASME Code Class 2
Bending + Axial	Valve Nipple	Seismic + DL + Int. Pressure + Thermal	8.5ksi	10.8ksi	21.1ksi	(level B)
			17.0ksi	19.3ksi	31.9ksi	(level C)

B.

Max. Critical Deflection	Location	Maximum Allowable Deflection to Assure Functional Operability
N/A		

nutech

San Jose, California

Project Grand Gulf Nuclear Station File No. 32.1206.0200

Owner Mississippi Power and Light Co.

Client Mississippi Power and Light Co.

SEISMIC QUALIFICATION ANALYSIS
FOR THE CONDUCTIVITY CELL
(1" VALVE CONNECT TO
THE RHR LINE)

Revision	0	1			
Prepared By/Date	BF/4-16-82	BF/4-28-82			

Contents

Rev.1

Project Grand Gulf Nuclear Station File No. 32.1206.0200

Owner Mississippi Power and Light Co.

Client Mississippi Power and Light Co.

I. Purpose

Evaluate (based on seismic category 1, and ASME Class 2 equipment) the pressure integrity of the conductivity cell when subjected to combined operating and seismic loading.

II. Conductivity Cell Environment

Design Condition (Reference 1)

Temperature = 350° F
Pressure = 500 psi

Operating Condition (Reference 1)

Temperature = 250° F
Pressure = 310 psi

Seismic Loads (Reference 2)

Peak excitation acceleration = 6g

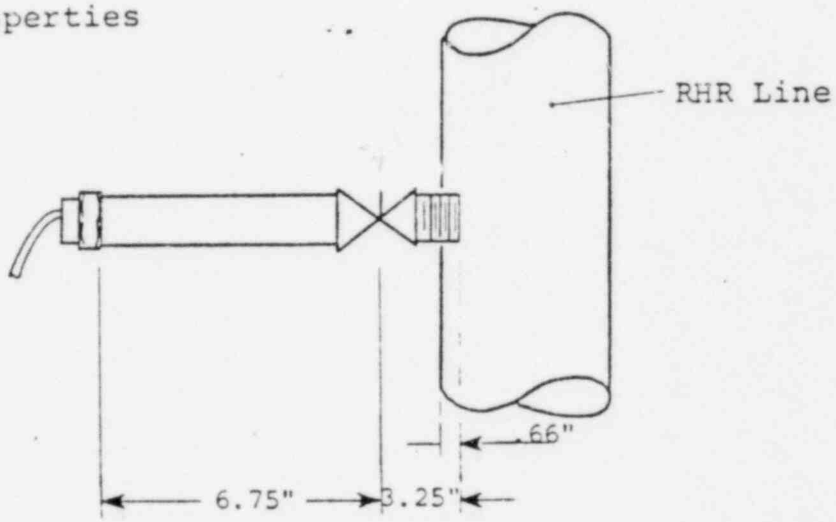
III. Method of Analysis

The most critical component affecting the pressure integrity of the conductivity cell is the 1" nipple. (Which connects the 1" valve to the RHR line.) The stress in the 1" nipple is estimated according to dead weight, thermal expansion, and seismic loads.

Revision	0	1			
Prepared By/Date	CF/4-16-82	BF/4-28-82			
[illegible]	[illegible]	[illegible]			

The seismic response is calculated with the conservative assumption that the excitation is the harmonic force with a frequency to which the conductivity cell responds most critically.

IV. Dimensions and Properties



Properties:

Nipple:

Size = 1" N.P.T. schedule 80 (3)

O.D. = 1.315" (4)

I.D. = .957" (4)

Wall Thickness = .179" (4)

Height of Thread = .06957" (5)

Engagement Length = .66" (5)

Material = 316 SS (6)

Damping = ξ = 1% (small pipe) (8)

SIF = .75*2.3= 1.725

S_C = 18.7 ksi (@100 °F)

S_H = 17.7 ksi (@350 °F)

S_A = 1.25*18.7 + .25*17.7 = 27.8 ksi (7) Rev. 1

Valve:

Material = Stainless Steel ASTM A351
CF - 8M
CF - 3M (3)

Weight = 10 pounds (6)

<u>Assumption</u>

- The 6.75" pipe is made of the same material that the 1" nipple is made of (316 SS)

  Weight of the 6.75" pipe = $\frac{6.75}{12} * 2.172 = 1.22$ lb

- The weight of the nut and the assembly at the end of the 1" pipe is conservatively estimated to be 2.5 lbs. Rev. 1

V. Calculation of the section modulus and the cross-sectional area of the nipple.

Assume the weakest point is the bottom of the thread.

$$z_N = \frac{I}{C}$$ Rev. 1

Where

$$I = \frac{\pi}{64}\left[(OD_{min})^4 - ID^4 \right]$$

$$= \frac{\pi}{64}\left[(1.315 - 2* .06957)^4 - .957^4 \right]$$

$$= .05267 \ \ in^4$$

and

$$C = OD/2 - \text{Thread Height}$$
$$= 1.315/2 - .06957$$
$$= .5879 \ \ in$$

Substituting the values for I and C into equation (1), the section modulus of the nipple can be calculated

Rev. 1

$$z_N = .05267/.5879$$

$$= .0896 \ \ in^3$$

$$A_N = \frac{\pi}{4}\left[(OD_{min})^2 - ID^2 \right]$$

$$= \frac{\pi}{4}\left[(1.315 - 2* .06957)^2 - .957^2 \right]$$

$$= .367 \ \ in^2$$

Revision	0	1			
Prepared By/Date	Kr/4-16-82	BC/4-28-82			

VI. Stress Calculation Due to Dead Weight

The whole assembly is mounted vertically. Let the mass center of the valve be d = 6" off-center. (conservative estimation reached by scaling from reference 1)

$$\sigma_{DW} = \left(\frac{M}{Z_N}\right) * SIF$$

$$= \left(\frac{10 * 6}{.0896}\right) * 1.725$$

$$= 1,155 \text{ psi}$$

Rev. 1

VII. Stress Calculation Due to Thermal Expansion

Since one side of the 1" pipe is connected to a flexible wire, then the entire assembly can grow without any

Revision	0	1			
Prepared By/Date	BF/4-16-82	BF/4-25-82			

restriction. Consequently, the stress due to thermal expansion is zero.

$$\sigma_{TH} = 0$$

VIII. Stress Calculation Due to Internal Pressure

$$\sigma_P = \frac{Pr}{2t}$$

Rev. 1

$$= \frac{500\ (.957/2)}{2(.179 - .06957)}$$

$$= 1{,}093 \text{ psi}$$

IX. Stress Calculation Due to Seismic Loads

A simple finite element model of the entire assembly is set up (for details see Appendix A). Natural frequencies for the entire assembly are then obtained.

First natural frequency = W_N = 182. Hz

Rev. 1

The dynamic magnification factor can now be calculated from the following equation (9)

$$\text{DLF} = \frac{1}{\sqrt{\left[1 - \left(\frac{W}{W_N}\right)^2\right]^2 + \left[2\,\xi\left(\frac{W}{W_N}\right)\right]^2}}$$

(harmonic excitation, Conservative)

using

$$W_N = 182.\ \text{Hz}$$

$$W = 33\ \ \text{Hz}$$ (highest frequency content of an earthquake)

One can calculate the DLF to be

$$\text{DLF} = \frac{1}{\sqrt{\left[1 - \left(\frac{33}{182}\right)^2\right]^2 + \left[2 * .01\left(\frac{33}{182}\right)\right]^2}}$$

$$= 1.03$$ (The assembly responds almost statically to earthquakes)

Rev. 1

Responds acceleration = 6*1.03 = 6.2 g

A. Bending moment due to horizontal excitation: The bending moment at the base of the 1" nipple due to horizontal excitation can be calculated by multiplying the inertia forces (F = ma) by the appropriate moment arms.

$$M_H = 10 * 6.2 * (3.25 - .66) + 1.22 * 6.2 * (6.75/2 + 3.25 - .66)$$

$$+ 2.5 * 6.2 * (6.75 + 3.25 - .66)$$

$$= 350\ \text{in-lb}$$ (acting in two directions)

B. Bending Moment due to vertical excitation: The bending moment at the base of the 1" nipple due to vertical excitation can be calculated by multiplying the inertia force (F = ma) by the appropriate moment arm.

$$M_V = 10 * 6.2 * 6$$

$$= 372 \text{ in-lb}$$

Rev. 1

C. Torque: The torque created due the off-centeredness of the mass of the valve can be calculated as follows:

$$M_T = 10 * 6.2 * 6$$

$$= 372 \text{ in-lb}$$

And finally the seismic moment can be calculated as follows:

$$M_{seismic} = M_s = \sqrt{(M_H + M_V)^2 + (M_H)^2 + (M_T)^2}$$

$$= 884 \text{ in-lb}$$

$$\sigma_{SSE} = \left(\frac{M_s}{Z_N}\right) * SIF$$

$$= \left(\frac{884}{.0896}\right) * 1.725$$

$$= 17,019 \text{ psi} \qquad \text{(for SSE)}$$

$$\sigma_{OBE} = 8,510 \text{ psi} \qquad \text{(for OBE)}$$

Revision		1				
Prepared By/Date		BF/4-28-82				
Checked By/Date		(A) 4/29/82				

X. Stress Summary and Code Evaluation

The following is a summary of the stress calculated for the conductivity cell.

Event	Stress (psi)
Dead Weight	1,155
Thermal Expansion	0
Internal Pressure	1,093
Seismic (SSE)	17,019
Seismic (OBE)	8,510

The following is the code evaluation table:

Rev. 1

Service Level	Code Requirement (equation)	Calculated Stress (psi)	Allowable Stress (psi)	Pass/fail
A	$\sigma_{TH} \leq 1.S_A$	0	27,800	pass
A	$\sigma_P + \sigma_{DW} \leq 1.S_H$ (8)	2,248	17,700	pass
B	$\sigma_P + \sigma_{DW} + \sigma_{OBE} \leq 1.2S_H$ (9)	10,758	21,240	pass
C	$\sigma_P + \sigma_{DW} + \sigma_{SSE} \leq 1.8S_H$ (9)	19,267	31,860	pass
D	$\sigma_P + \sigma_{DW} + \sigma_{SSE} \leq 2.4S_H$ (9)	19,267	42,480	pass
TEST	$1.25\sigma_P + \sigma_{DW} \leq 1.S_H$	2,521	17,700	pass

XI. Conclusion

Since all the calculated stresses (for all service levels) are below allowable stress limits, it is then concluded that the 1" nipple (which is the weakest point) and consequently the entire assembly for the conductivity cell, will meet the requirements of the ASME Boiler and Pressure Vessel Code, 1980 Edition.

1

Rev. 1

This qualifies the conductivity cell to be Safe to operate in the environments explained in Section II of this report.

Revision		1			
Prepared By/Date		SF/4-28-82			
Checked By/Date		RJ 4/29/82			

Project Grand Gulf Nuclear Station File No. 32.1206.0200

Owner Mississippi Power and Light Co.

Client Mississippi Power and Light Co.

References

1. General Electric DWG 163C1544 SH No.2, "Purchased Part Conductivity Cell", Rev. 4.

2. Bechtel Spec. No 9645-M-220.0, "Design Specifiction for Nuclear Piping Systems for MP&L, Grand Gulf Nuclear Station, Units No. 1 and 2, Grand Gulf Mississippi", Page 15, Paragraph 7.12.B., Rev. 13, 12-23-81. Rev.1

3. General Electric DWG 163C1544 SH No. 1, "Purchased Part Conductivity Cell", Rev. 4.

4. Properties of Pipe Table, Bergen-Paterson catalog.

5. Machinery's Handbook, 18th Edition, Industrial Press, Southeast.

6. NUTECH Communication Record, Telephone Conversation between Steven Hicks (from Foxboro Corp.) and R. Morton, File 32.1206.0001, 4-9-82.

7. ASME Boiler and Pressure Vessel Code, 1980, Section III, Division 1. Rev.1

8. U.S. Atomic Energy Commission, Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants."

9. William T. Thomson, "Theory of Vibration With Applications", 2nd Edition, Prentice Hall, 1981.

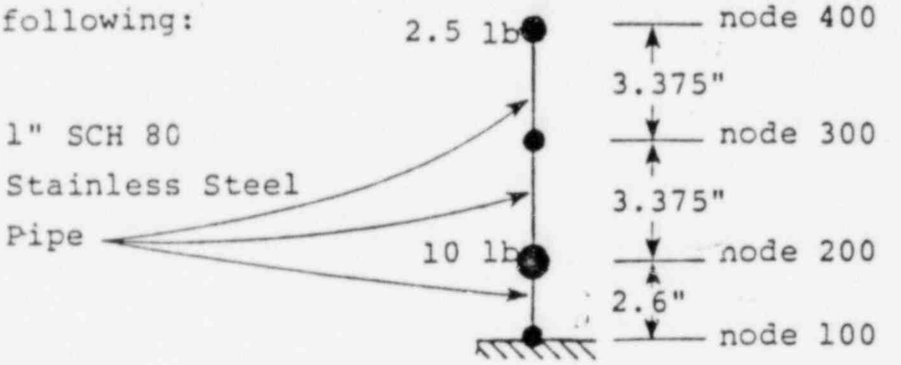
Revision	0	1				
Prepared By/Date	/4-16-8	BF/4-28-82				

Project Grand Gulf Nuclear Station File No. 32.1206.0200
Owner Mississippi Power and Light Co.
Client Mississippi Power and Light Co.

APPENDIX A

Simple Finite Element Model of the Entire Assemble of the Conductivity Cell:

PISTAR computer program is used to build a finite element model for the following: Rev. 1



Natural frequencies are calculated from a PISTAR model extraction run (Run ID = BOF32AC). The next two pages are copies of inputs and outputs extracted from the referenced PISTAR model computer run.

Rev. 1

Revision	0	1			
Prepared By/Date	/11-16-81	/4-28-82			

Page A-1
of 3

```
PISTAR INPUT PROCESSOR (PASS 1)    -- VERSION 1.5.2 --    04/27/82        15.56.46.        PAGE  2

                                       INPUT DATA ECHO PRINT

    1         11        21        31        41        51        61        71        81
    :         :         :         :         :         :         :         :         :

  1 TITLE     CONDUCTIVITY CELL
  2 ID        CLIENT=GRAND GULF NUCLEAR STATION
  3 ID        PROJECT NAME=EQUIPMENT QUALIFICATION
  4 ID        PROJECT NUMBER=MPL-0607
  5 ID        PREPARED BY=B. FATEMI
  6 ID        CHECKED BY=
  7 GEOMETRY  CONDUCTIVITY CELL
  8 START     100
  9 CLASS 2
 10 PIPE      100  200  0.0       2.6       0.0                 1    1
 11 PIPE      200  300  0.0       3.375     0.0                 1    1
 12 PIPE      300  400  0.0       3.375     0.0                 1    1
 13 ADD WEIGHT200       10.0      10.0      10.0
 14 ADD WEIGHT400       2.50      2.50      2.50
 15 PROPERTY  1                                       1.00SCH80 WATER
 16 MATERIAL  1                                       STAINLESS
 17 ANCHOR    100
 18 END GEOM
 19 LOADING   DW,MOD. EXT.
 20 CASE      DW
 21 DEAD LOAD
 22 PRINT               YES
 23 CASE      MX
 24 FREQUENCY           10        1000.
 25 END LOADS

    :         :         :         :         :         :         :         :         :
    1         11        21        31        41        51        61        71        81
```

Rev. 1

Revision 1

Prepared by/date BF/4-28-82

Checked by/date RJ 4/29/82

```
**************************************************************************************************
*  04/27/82                        N-U-T-E-C-H / P-I-S-T-A-R                        PAGE    18  *
*                        F R E Q U E N C I E S   A N D   P E R I O D S                          *
*                                  -- VERSION 1.5.2 --                                           *
**************************************************************************************************
*  EIGENVALUE PROBLEM                                                 LOADING CONDITION MX       *
**************************************************************************************************

                MODE        CIRCULAR
                NUMBER      FREQUENCY      FREQUENCY        PERIOD
                            (RAD/SEC)    (CYCLES/SEC)       (SEC)


                  1         .1142E+04      .1817E+03      .5503E-02

                  2         .1142E+04      .1817E+03      .5503E-02

                  3         .4847E+04      .7714E+03      .1296E-02

                  4         .4847E+04      .7714E+03      .1296E-02
```

Rev. 1

Revision 1
Prepared by/date BF/4-28-82
Checked by/date AJ 4/29/82

Specification No. 9645-M-220.0

DESIGN SPECIFICATION

FOR

NUCLEAR PIPING SYSTEMS

FOR

MISSISSIPPI POWER & LIGHT COMPANY

GRAND GULF NUCLEAR STATION, UNITS NO. 1 AND 2

GRAND GULF, MISSISSIPPI

RECORD DOCUMENT

CERTIFICATION:

I, LOKANATHA JHA, certify that this design specification is correct, complete and in compliance with the requirements of ASME Section III, Division 1, Paragraph NA 3250.

Registered Professional Engineer

Signature	Rev.	Date
Lokanatha Jha	8	7/31/80
Lokanatha Jha	9	10/17/80
Lokanatha Jha	10	7/29/81
Lokanatha Jha	11	9/25/81
Lokanatha Jha	12	11/5/81
Lokanatha Jha	13	12/23/81

LOKANATHA JHA
No. 10003
PROFESSIONAL ENGINEER

Stamp

BECHTEL POWER CORPORATION
GAITHERSBURG, MARYLAND

No.	Date	Revisions	By	G.L.	C.E.	P.E.	
0	10-17-75	Issued for Client Approval					
1	4-16-76	Revised as Noted and Issued for Use	EW				PQE
2	7-15-76	Revised as Noted	EW		N/A		PQE
3	5-3-77	Revised as Noted	EW		N/A		LQE
4	12-29-78	Revised as Noted			N/A		PQE
5	3-16-79	Revised as Noted	HES		N/A		QE

BECHTEL

Specification No. 9645–M-220.0

DESIGN SPECIFICATION

FOR

△9 NUCLEAR PIPING SYSTEMS

BECHTEL POWER CORPORATION
GAITHERSBURG, MARYLAND

No.	Date	Revisions	By	Ch'k	G.S.	C.E.	P.Q.E.	P.E.
6	8-1-79	Revised as Noted		EW				
7	2-28-80	Revised ASME Certification Statement		EW		N/A		
8	7-31-80	Revised as Noted / REVISED ASME CERT.		EW		N/A		
9	10-17-80	Revised Para. 7.9.4 and as Noted		EW		N/A		
10	7-29-81	Revised Para. 7.12.4, 7.12.8, & App'x S & T	RC	EW		N/A		
11	9-25-81	Updated Appendix H.4	DPK	WM		N/A		
12	11-5-81	Revised Para. 7.9.3, 7.9.4	CET	EW		N/A		
13	12-23-81	Revised Appendix H.4	WCM	EW		N/A		

CONTENTS

PART I

PREFACE

This Design Specification consists of design information as prescribed by Section III of the ASME Code and of design information that is not specifically related to the Code. Of necessity, the two categories are interspersed.

△3 For those primarily concerned with ASME Criteria, such as enforcement authorities, reference should be made to the ASME Criteria Locator (Appendix D), which identifies that information prescribed by the Code.

Specification No. 9645-M-220.0

TECHNICAL SPECIFICATION
FOR
NUCLEAR PIPING SYSTEMS
FOR
MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION UNITS 1 AND 2
GRAND GULF, MISSISSIPPI

RECORD DOCUMENT

Q

BECHTEL POWER CORPORATION
GAITHERSBURG, MARYLAND

No.	Date	Revisions	By	G.L.	C.E.	P.E.	
1	4-16-76	Revised as Noted and Issued for Use	EW		aRF		PQE
2	7-15-76	Revised as Noted	EW		N/A		PQE
3	5-3-77	Revised as Noted	EW		N/A		PQE
4	12-29-78	Revised as Noted			N/A		PQE
5	3-16 79	Added Appendix H.4, Rev. 0	HES		N/A		QE

Specification No. 9645-M-220.0

TECHNICAL SPECIFICATION

FOR

NUCLEAR PIPING SYSTEMS

BECHTEL POWER CORPORATION
GAITHERSBURG, MARYLAND

No.	Date	Revisions	By	Ch'k	G.S.	C.E.	P.O.E.	P.E.
6	8-1-79	Revised Loading Combinations and Added Appendices S and T		EW				
7	2-28-80	Revised ASME Certification Statement		EW		N/A		
8	7-31-80	Revised as Noted / REVISED ASME CERT		EW		N/A		
9	10-17-80	Revised Para. 7.9.4 and as Noted		EW		N/A		
10	7-29-81	Revised Para. 7.12.4, 7.12.8 & App'x S&T	RC	EW		N/A		
.1	9-25-81	Updated Appendix H.4	DPK	wm		N/A		
12	11-5-81	Revised Para. 7.9.3, 7.9.4	CET	EW		N/A		
13	12-23-81	Revised Appendix H.4	WCM	EW		N/A	FSD	

LATEST SPECIFICATION REVISION NO. 13

INDIVIDUAL PAGE REVISION INDEX SHEET

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NUCLEAR PIPING SYSTEMS
FOR
MISSISSIPPI POWER & LIGHT COMPANY
GRAND GULF NUCLEAR STATION UNITS 1 AND 2
GRAND GULF, MISSISSIPPI

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APPENDICES

SUPPORTING APPENDICES

SPECIFICATION CHECK LIST
BECHTEL JOB 9645
GRAND GULF NUCLEAR STATION
SPECIFICATION NUMBER 9645-M-220.0

1 Document Reference (PSAR Section, Question, etc.)	2 LCTS Locator	3 Incorporated in Specification Paragraph/Subparagraph	4 SAR Change Notice (if applicable)
4 3.7.3.7.1, 3.7.27, 3.7.1.1.2 (FSAR)	7200 A 30, 3350 B 10	7.12.3, 7.6.1	
3.7.3.8.1.4, 3.7.1.3.1 & TABLE 3.7.3 (FSAR)	6950 Z 38 7200 A 10, 7200 A 20	7.12.4	
3.7.2.1.1 (FSAR)	1350 Z 37	7.12.3	
3.7.2.1.6.4	1350 B 06	7.12.3	
6 3.7.3.3.1.2 (FSAR) 3.7.2.1	7200 A 37	7.12.3	

Remarks: *Reference - PSAR, unless otherwise noted
SAR C.N. - SAR change notice

REV. NO.	DATE	BY	SUPERV.	PQE
1	4-16-76	E Warfield	Smith	Abaya
2	7-15-76	E Warfield		Abaya
3	5-3-77	E Warfield	Smith	Abaya
4	12-29-78	F. F. Dange	EW	Abaya
5	3-16-79	HB Shepherd	EW	
6	8-1-79	J. J. Dangi	EW	Al Martin
7	2-25-80	C Featherwood	EW	Abaya
8	7-31-80	C Featherwood	EW	Stanchfield
9	10-17-80		EW	Stanchfield
10	7-29-81	RC	EW	Stanchfield
11	9-25-81	D Kaelber		

1 Page Added
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2-23-76

Specification No. 9645-M-220.0

SPECIFICATION CHECK LIST
BECHTEL JOB 9645
GRAND GULF NUCLEAR STATION
SPECIFICATION NUMBER 9645-M-220.0

1 Document Reference (PSAR Section, Question, etc.)	2 LCTS Locator	3 Incorporated in Specification Paragraph/Subparagraph	SAR Change Notice (if applicable)

Remarks:

REV. NO.	DATE	BY	SUPERV.	PQE
12	11-5-81	C.E THOMAS	Ew/	
13	12-23-81	WC moore	Ew/	

△12 Page Added

SPECIFICATION CHECK LIST
BECHTEL JOB 9645
GRAND GULF NUCLEAR STATION
SPECIFICATION NUMBER 9645-M-220.0

1 Document Reference (PSAR Section, Question, etc.)	2 LCTS Locator	3 Incorporated in Specification Paragraph/Subparagraph	△4 SAR Change Notice (if applicable)
△4 3.7.3.3.1.5 (FSAR)	7200 A 39	7.12.5	
3.7.2.7 (FSAR)	7200 A 30	7.12.6	
3.7.3.8.1.2.2 (FSAR)	1350 Z 39	7.12.2	
3.7.3.11 (FSAR)	1100 A 34	7.10.3, 7.12.3	
△6 3.7.3.13 (FSAR)	7200 A 41	7.12.7	
3.7.3.8.1.4 (FSAR)	6950 Z 38	7.12.4	
3.7.3.2 (FSAR)	1100 A 37	7.9.4	
3.7.3.2	6950 Z 25	7.12.1	
FSAR Table 3.9-17	1100 A 15	7.6.1	
AM 18, ITEM 4	1100 A 01	7.6.2	
Table 3.9.2/ SAR C.N. #30, 38, 47, 55, 57, 62	1150 Z 10	3.0	
△1 △4 FSAR Table 3.9-22	1150 A 10	7.1.1, 7.7.1, 7.8.1, 7.8.2	
FSAR Table 5.2-4, FSAR 5,22,7	6400 A 32	4.0/8.0	
5.5.7.3	1850 J 06	3.0, 8.0	
5.5.9.1	6300 H 01	7.6	
5.5.9.1	6300 H 05	7.1.1	
-△4 5.4.3.8	6400 H 35	7.10.3	

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SPECIFICATION CHECK LIST
BECHTEL JOB 9645
GRAND GULF NUCLEAR STATION
SPECIFICATION NUMBER 9645-M-220.0

1 Document Reference (PSAR Section, Question, etc.)	2 LCTS Locator	3 Incorporated in Specification Paragraph/Subparagraph	SAR Change Notice (if applicable)
6.3.3.5/SAR C.N. #65	3450 G 20	7.1.1	
✓ 5.2.1.2.1	6400 A 05	3.0	
✓ 10.3.2	4850 A 20	7.6	
FSAR Table 5.2-1	1150 Z 36	3.1a	
△6 △8 FSAR 3.6A.2.4.3	2050 B 15	Appendix 5, Para. 3.7	
FSAR 3.6A.2.4.2	2050 B 30	Appendix 5, Para. 2.0	
FSAR 3.6A.2.4.3c	2050 B 60	Appendix 5, Para. 3.3	
FSAR 3.6A.2.4.3	2050 B 70	Appendix 5, Para. 3.5	
FSAR 3.6A.2.4.3	2050 B 96	Appendix 5, Para. 3.2	
FSAR 3.6A.2.4.3	2050 B 50	Appendix 5, Para. 3.2	
FSAR 3.6A.2.1.C.2	2050 B 72	Para. 7.8.4	
△4 FSAR 3A/1.057	2050 B 97	Appendix 5, Table 1	
▲ FSAR 3.6A.2.4.30	5150 A 42	Appendix S, Table 1	
FSAR Table 3.9-18	1100 A 20	7.8.1	
FSAR 3.6A.2.4.3(f)	2050 B 80	Appendix 5, 3.6	
FSAR 3.6A.2.4.3(c)	2050 B 65	Appendix 5, 3.3	
AECM 76/18	3450 E 11	7.7.1	

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BECHTEL JOB 9645
GRAND GULF NUCLEAR STATION
SPECIFICATION NUMBER 9645-M-220.0

1 Document Reference (PSAR Section, Question, etc.)	2 LCTS Locator	3 Incorporated in Specification Paragraph/Subparagraph	SAR Change Notice (if applicable)
AECM 76/40	2050 C 43	7.7.1	
AECM 76/18	2050 C 89	7.6.1, 5.3.1	
Appendix 3A/1.48	1100 A 30	7.6, 7.7	
△8 03.06A.2.1C (FSAR)	5150 A 32	7.8.4	
△6 T3.9-19 (FSAR)	1100 A 25	7.9	
03.09-22T (FSAR)	1150 A 16	7.8.2	
03.09-24T (FSAR)	1150 A 20	7.8.1	
03.07.3.07.1 (FSAR)	7200 A 30	7.12.3, 7.6.1, 7.12.6	
03.9.1.1.2 (FSAR)	1100 A 10	△9 7.9.3	
08.3.1.9.1.1.F (PSAR)	3550 B 10	7.12.3, 7.6.1	
06.07.02.09 (FSAR)	3650 D 10	1.0, 9.1	
△4			

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Specification No. 9645-M-220.0

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2-23-76

TECHNICAL SPECIFICATION

FOR

NUCLEAR PIPING SYSTEM

1.0 SCOPE

1.1 The purpose of this Design Specification is to provide the information, including administrative directions, for the design, analysis, construction, examination and testing of Nuclear Class 1, 2, and 3 piping systems for Grand Gulf Nuclear Power Station Units 1 and 2 in accordance with the requirements of Paragraph NA-3250 of the ASME Boiler and Pressure Vessel Code, Section III.

1.2 The nuclear piping systems shall be installed at Grand Gulf Nuclear Station Units 1 and 2 which are located at Grand Gulf, Mississippi and owned by Middle South Energy, Incorporated and Mississippi Power & Light Company, hereinafter referred to as "Owner."

The Owner's address is:

Mississippi Power & Light Company
P. O. Box 1640
Jackson, Mississippi 39205

1.3 General Electric Company, hereinafter referred to as "General Electric" will provide the nuclear steam supply system (NSSS) and will act as the engineering organization for the NSSS. Bechtel Power Corporation, hereinafter referred to as "Bechtel" will act as the engineering organization for support systems, and as installer of all systems. Either General Electric or Bechtel will act as Owner's Agent as appropriate.

△4 1.4 The function of the piping systems, as a minimum, is to transmit fluid and provide a pressure retaining boundary to effect the overall intended operation of the Mechanical Systems and their individual components as described in the System Descriptions and Piping and Instrument Diagrams (P&IDs). The design, construction, examination, and testing requirements of these individual components connected by piping (such as vessels, pumps, valves, etc) are delineated in separate Design Specifications.

△3 1.5 All Nuclear Class 1, 2 and 3 piping shown on the P&IDs, except for portions identified as "Vendor Supplied", is within the scope of this Design Specification. Refer to the latest revision of P&ID No. 9645-M-0030A for a complete list of all P&IDs.

△3 Deleted

△3 1.6 Deleted

2.0 ABBREVIATIONS

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
MSS	Manufacturers Standardization Society
PFI	Pipe Fabricators Institute

3.0 CODES AND STANDARDS

3.1 Design, materials, manufacture, examination, testing, inspection, stamping, certification, and documentation shall conform to applicable portions of the following adopted or tentative specifications, standards, codes, and addenda, as applicable.

a. ASME Boiler and Pressure Vessel Code:

Section II	Material Specifications
Section III	Nuclear Power Plant Components (hereinafter referred to as the "Code"). The applicable code editions, addenda, and Code Cases are delineated in this Design Specification, Paragraph 4.2, except for piping design and stress analysis which shall be performed in accordance with the 1974 Edition, Addenda through Summer 1975 and Code Case 1606-1. In addition, Code Case 1580-1 is referenced in 9645-MS-06. △4
Section IX	Welding Qualifications
Section XI	Rules for Inservice Inspection of Nuclear Power Plant Components

b. ANSI standards, including:

N45.2	Quality Assurance Requirements for Nuclear Power Plants
N45.2.2	Packaging, Shipping, Receiving Storage, and Handling of Items for Nuclear Power Plants

4.0 ENGINEERING DESIGN DOCUMENTS

4.1 In addition to the codes and standards listed in Paragraph 3.0 and the Appendices attached to this Design Specification, the design shall be in accordance with the latest revisions of the following engineering documents. Subject documents are available in the Gaithersburg office and at the Grand Gulf jobsite.

a. General

Piping and Instrument Diagrams (P&IDs)
System Flow Diagrams (SFDs)
System Descriptions
Piping Isometric Drawings
Building Response Spectra Curves

b. Technical Specifications

9645-C-151.0	Technical Specification for Liner Plate and Accessories for Containment, Drywell and Suppression Pool
9645-M-160.0	Technical Specification for Plant Insulation
9645-M-163.0	Technical Specification for Reflective Insulation
9645-M-189.0	Technical Specification for In-Service Inspection Services
9645-M-195.0	Technical Specification for Protection Against Dynamic Effects Associated with the Postulated Rupture of Piping
9645-M-207.0	Technical Specification for Field Purchase of Piping 2½ Inches and Larger for Nuclear Service
9645-M-300.0	Hangers and Supports
9645-M-205.0	Technical Specification for Piping 2 Inches and Smaller for Nuclear Service (Procurement of Materials only)
9645-M-205.2	Technical Specification for Carbon and Stainless Steel Piping 2 Inches and Smaller - Nuclear Service
9645-M-302.0	Technical Specification for ASME III and ANSI B31.1 Hangers and Supports

c. Design Specifications

9645-M-201.0	Shop Fabricated Piping - Nuclear Service 2½ Inches and Larger
9645-M-204.0	Field Fabrication and Installation of Nuclear Service Piping and Instrumentation
9645-M-300.2	Design Specification for Hangers and Supports, Nuclear Service
9645-M-300.6	Fabrication of Structural Steel for Pipe Supports, Restraints and Anchors - Nuclear Service
9645-M-312.0	Flued Heads

△4 Page Revised
△3 Page Revised
△1 Page Revised

9645-M-318.0	Penetration Bellows Assemblies
Deleted	
9645-C-153.0	Personnel Locks, Equipment Hatch, Drywell Penetrations and Drywell Head

d. Mechanical Standards

9645-MS-01	Valve Identification Sheets
9645-MS-02	Piping Class Summary Sheets
9645-MS-03	Piping Class Sheets
9645-MS-04	Typical Branch Connection Requirements
9645-MS-05	Line Vent & Drain Details
9645-MS-06	Field Buttweld Transition Details for Valves, Fittings & Equipment
9645-MS-07	Buttweld End Preparation Details
9645-MS-08	Weld End Preparation, Non-Critical Service with Backing Ring
9645-MS-09	Weld End Preparation for Non-Critical Service Without Backing Ring
9645-MS-10	Instrument Connections
9645-MS-11	Welding & Non-Destructive Testing Requirements for Field Erected Piping
9645-MS-12	Piping Insulation Thickness
9645-MS-13	Criteria for Support of Non-Seismic Pipe & Duct Work Over Essential Equipment
9645-MS-14	Bolt Tensioning
9645-MS-15	Field Design of 2" & Smaller Piping
9645-MS-16	Criteria for Hanger Installation
9645-MS-17	Start-up Strainers
9645-MS-19	Schedule of Leak Test Pressure
9645-MS-20	Weld Crown Preparation for Volumetric Examination
9645-MS-21	Compensation Allowances for Piping Misalignment
9645-MS-22	Jack Screw Details
9645-MS-23	Miscellaneous Valves for Field Procurement
9645-MS-24	Design and Installation Guide for Penetration Closures
9645-MS-25	Criteria for MOV Torque Switch Settings and Closure Times

e. Drawings

9645-M-1398	Requirements for Implementation of Design Guide M-18 on the Grand Gulf Project

4.2 The applicable ASME Section III edition, addenda, and Code cases are defined in the specifications listed in Paragraph 4.1.

5.0 PROCEDURAL REQUIREMENTS

5.1 The authorized inspection agency at the Grand Gulf plant site for nuclear piping systems is Lumbermens Mutual Casualty Company.

5.2 There is no enforcement authority in the State of Mississippi having jurisdiction over the installation of ASME Section III piping systems. The Nuclear Regulatory Commission has Federal jurisdiction over the construction of nuclear power plants.

△ Page Revised

5.3 Overpressure Protection Analysis and Reports

Overpressure protection for all Classes 1, 2, and 3 piping systems shall be provided for by safety and relief devices as shown on the P&IDs.

5.3.1 Stress analysis of the main steam relief valve discharge piping for the blowdown transient shall utilize a dynamic analysis approach.

5.3.2 Overpressure Protection Report

An Overpressure Protection Report will be prepared in accordance with the requirements of Paragraph NB-7300 of the Code.

The report will be certified by a registered professional engineer and filed at the plant site.

5.4 Data Reports

5.4.1 Shop Fabricators

Shop fabricators of piping subassemblies shall submit Data Reports to the installer at the jobsite, as prescribed by Paragraph NA-8415 of the Code, on or before the arrival of the hardware at the jobsite.

5.4.2 Installer

The installer of piping subassemblies shall prepare Form N-5, as directed by Paragraph NA-8416 of the Code, and forward copies to the Owner or the Owner's Agents for inclusion in the data package accompanying Form N-3.

5.4.3 Owner

The Owner or Owner's Agent shall complete Form N-3, which shall be filed at the plant site after being signed by the Authorized Inspector.

5.5 Stress Reports

The stress reports shall be certified by a Registered Professional Engineer competent in the area of piping design and stress analysis. Bechtel will supply two copies of each Class 1 stress report to the Owner for transmittal to the inspection agency as required by Paragraphs NA-3358 and NA-3260 of the Code. These stress reports will be reviewed and the review certified by the Owner's Agent in accordance with Paragraph NA-3260 of the Code.

6.0 ENVIRONMENTAL CONDITIONS OF SERVICE

6.1 Depending on plant operating conditions and on physical location in the plant, piping systems will be exposed to various environmental conditions as tabulated below. Piping system design shall accommodate the conditions listed.

6.1.1 Environmental Conditions for All Plant Operating Conditions Except Design Basis Accident (DBA):

	Location				
		Containment Building		Other Building	Outdoors
	Inside Sacrificial Shield	Inside Drywell	Outside Drywell		
Temperature, F	100 to 185	135 ave	40 to 140	40 to 120	0 to 100
Pressure, psig	-0.5 to 2.0	-0.5 to 2.0	(2)	(3)	Atm.
Relative humidity, %	40 to 60	40 to 60	30 to 98	30 to 90	20 to 100
Gamma Dose (1) Rads	2.3×10^{10}	1.8×10^{7}	8.76×10^{6}	1.8×10^{6}	NONE
Neutron Fluence, Neutrons/cm^2	7.9×10^{16}	1.8×10^{14}	NONE	NONE	NONE

(1) 40 year integrated radiation exposure
(2) -0.10 to-1.0 inches water gauge
(3) -0.25 inches water gauge to atmospheric

6.1.2 Environmental Conditions for Design Basis Accident (DBA):

	Location				
		Containment Building		Other Building	Outdoors
	Inside Sacrificial Shield	Inside Drywell	Outside Drywell		
Temperature, F	See inside drywell	330 (6) 310 (7) 250 (8) 250 to 110 (11)	330 (9) 212 (10) 185 (8) 185 to 110 (11)	330 (9) 212 (10) 150 (8) 150 to 40 (11)	0 to 100
Pressure, psig		20 max.	15 max.	0 to 2	Atmospheric
Relative Humidity, %		(4)	(4)	(4)	20 to 100
Gamma Dose (1) Rads		2.6×10^{7}	2.6×10^{7}	4.5×10^{4}	NONE

(1) 6 month integrated radiation exposure
(2) -1.0 to -0.10 in. wg
(3) Atmos. ± 1.0 in. wg
(4) Zero to six hours after DBA: All steam
6 hours to 100 days after DBA: 100 percent R.H.

△2 Page Revised

(5) Deleted
(6) Zero to three hours after DBA
(7) Three to six hours after DBA
(8) Six hours to one day after DBA
(9) Zero to one hour after DBA
(10) One to six hours after DBA
(11) One to 100 days after DBA

7.0 DESIGN

7.1 General

7.1.1 All piping systems within the scope of this Design Specification shall be designed in accordance with the requirements of the Code as stipulated in Subarticle NB-3200 and NB-3600 for Nuclear Class 1 and NC-3600 and ND-3600 for Nuclear Class 2 and 3, respectively.

7.1.2 All nuclear piping systems shall be designed for a 40-year service life.

7.1.3 Piping systems within the scope of this Design Specification shall be designed in accordance with the in-service inspection requirements of Specification 9645-M-189.0 and the pipe break protection requirements of Specification 9645-M-195.0.

7.1.4 At the time of final Code stamping (NA) of the system, the "as-built" piping shall conform to the latest issue of the P&IDs. In case of a conflict, project engineering shall be advised.

7.1.5 Guard pipe assemblies shall be provided and designed in accordance with the requirements of Appendix 5.

7.2 Classification of Piping Systems

7.2.1 Nuclear classification of the piping systems are shown on the P&IDs in accordance with the nomenclature specified in the Piping Class Sheets (9645-MS-03).

7.2.2 Seismic classification of the piping systems are specified in the Piping Class Summary Sheets (9645-MS-02) and are also shown on the P&IDs. Refer to Paragraph 7.12 for seismic analysis requirements.

7.3 Boundaries

7.3.1 Piping system boundaries are designated on the P&IDs for Nuclear Class 1, 2, and 3 piping.

7.3.2 The dimensional location of each such boundary is shown on the Piping Isometric Drawings.

7.4 Pipe Sizing

Nominal pipe sizes shall be selected in accordance with standard power plant practices. Pipe sizes are shown on the P&IDs.

7.5 Pipe Wall Thickness

7.5.1 Calculations of piping wall thicknesses shall be in accordance with the Code; however, the following minimum wall thicknesses shall be used:

a. Carbon Steel

N.P.S.	SCHEDULE
2 inches and smaller	80
2-1/2 inches through 10 inches	40
12 inches and larger	0.375 inch nominal wall

b. Austenitic Steel

N.P.S.	SCHEDULE
3/4 inch and smaller	80 S
1 inch through 2 inch	40 S
2-1/2 inches through 10 inches	10 S
12 inches through 24 inches	0.250 inch nominal wall
26 inches and larger	0.375 inch nominal wall

7.5.2 A corrosion/erosion allowance for piping shall be selected in accordance with the following, unless otherwise dictated by specific mechanical system requirements:

a. Carbon Steel Pipe -

High velocity steam lines (100 fps and greater)	0.120 inch
All other lines	0.080 inch

b. Stainless Steel Pipe -

All Lines	0.003 inch

4 7.5.3 Pipe wall thicknesses shall be specified on the Piping Class Sheets (9645-MS-03) except as otherwise indicated on the P&IDs or piping isometric drawings.

7.5.4 When standard pipe schedules or a nominal wall thickness is specified, the thickness shall be sufficient to compensate for manufacturing tolerances on wall thickness to exclude infringing on the minimum wall.

7.6 Loading Combinations

7.6.1 The combination of design loadings for the piping, categorized with respect to plant operating conditions identified as normal, upset, emergency, and faulted, are presented in Appendix S:

7.6.2 The OBE shall be combined with the most adverse conditions for the upset condition. For Grand Gulf the OBE has been combined with Event 10, "Turbine Generator Trip, Feedwater On." The safe shutdown earthquake is combined with Event 10 and is analyzed as faulted event.

7.6.3 In addition to the primary loads listed in Paragraph 7.6.1, secondary loads, such as thermal and seismic anchor movements, shall be considered in the normal and upset condition.

7.7 Condition Categories

7.7.1 Deleted

7.7.2 ASME Class 1, 2, and 3 piping systems required to function for safe shutdown under load cases 3, 6, 7, 8 and 9 of Appendix S are listed in Appendix T.

7.8 Stress Limits

7.8.1 Stress limits for Class 1 piping shall be in accordance with the Code. In addition, Appendix F of the Code shall be used for the analysis of piping in the faulted condition. Elastic or inelastic methods are acceptable.

7.8.2 Stress limits for Class 2 and 3 piping shall be in accordance with the Code. However, for piping in the faulted condition, the rules of ASME Code Case 1606-1 apply.

7.8.3 In addition, stresses for guard pipes shall also meet NE-3131(c) using loadings associated with design pressure and temperature in combination with the SSE. Allowable stress values shall be per ASME Section III, Appendix I - Table I-7.1 in lieu of Table I-10.0.

7.8.4 Refer to Specification 9645-M-195.0 for the definition of high energy piping and associated special stress limits. In particular, stresses shall be within the limits for "Break Exclusion Zones" (No Break Zones).

7.9 Loading Valves

7.9.1 The design pressures and temperatures for all Class 1, 2, and 3 piping systems are tabulated in the Piping Class Summary Sheets (9645-MS-02).

7.9.2 Operating pressures, temperatures, and flows are tabulated on the SFDs for Class 1, 2, and 3 piping.

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7.9.3 For Class 1 piping, the pressure, temperature and flow transients, including cycles, duration, and description of subsystem boundaries are provided by GE. Refer to the following latest Bechtel-approved GE documents:

System	GE Document No.	MPL No.
Nuclear Boiler	794E708 794E709	B21-3000
Reactor Recirc	794E703	B33-3000
RHR	794E858	E12-3000
LPCS	794E705	E21-3000
HPCS	794E707	E22-3000
RCIC	137C6117	E51-3000
*	762E458	B13-3040

*Applicable for 2-inch and smaller piping connected to the reactor nozzles.

7.9.4 Earthquake cycles for Nuclear Class 1 piping shall be as follows:

△2 △9 Expected number of equivalent OBE in life of pipe system - 1

Maximum number of peak seismic load cycles of pipe system-10

7.9.5 Values for the Safe Shutdown Earthquake (SSE) shall be obtained from the applicable Building Response Spectrum Curves.

7.9.6 Weight of the pipe, fittings, flanges, fluid, insulation, valves (including actuators) and any other in-line components shall be considered.

7.9.7 Valve weights and centers of gravity shall be as specified on the applicable Valve Assembly Drawings furnished by the respective suppliers.

7.9.8 The weight of thermal insulation shall be in accordance with the density and thickness as specified in the Insulation Thickness (9645-MS-12). The insulation class shall be obtained from the Piping Class Summary Sheets (9645-MS-02).

△4 7.9.9 Any significant flow-induced vibration during startup or preoperational testing shall be reported to the piping designers for evaluation.

7.10 Additional Considerations

7.10.1 Reactions of attached piping 2 inches and smaller for all nuclear classes shall be considered when significant.

7.10.2 The total number of transient cycles for each Class 2 and 3 piping system shall be evaluated. Transient cycles exceeding 7000, if any such cases exist, will be tabulated in Appendix 4.

7.10.3 The allowable loads (including torsional and thermal movements of interfacing component nozzles) shall not be exceeded unless otherwise agreed to by the respective component supplier.

7.10.4 In addition to the requirements specified herein, piping subjected to suppression pool dynamics shall meet the requirements of Appendix H.4.

7.10.5 For piping systems connected to components (such as the RPV), the safe end to piping weld (including the weld) shall be considered as part of the piping analysis.

7.11 Flued heads and portions of penetration assemblies which comprise process piping shall be constructed in accordance with the Code requirements for Nuclear Class 1 or 2 as applicable and shall meet all of the requirements stipulated herein for nuclear piping systems. Flued heads and penetration bellows assemblies shall be fabricated in accordance with Specifications 9645-M-312.0 and 9645-M-318.0, respectively. Embedded containment penetrations and flat plate penetration assemblies that fall within the scope of this paragraph shall meet the requirements stipulated above and shall be fabricated in accordance with Specifications 9645-C-151.0 and 9645-C-153.0.

7.12 Seismic Analysis

7.12.1 Piping may be generally classified according to the dynamic response of the system. Systems are considered rigid if they are supported and restrained so as to cause the first mode of vibration to occur in the rigid range of the response spectrum curve. All other piping is considered flexible. Natural frequencies up to 33 Hz or up to rigid range will be considered in all piping analysis.

7.12.2 Rigid Piping Systems

Rigid piping systems may be analyzed with static equivalent loads corresponding to the acceleration in the rigid range of the response spectrum curves for the applicable floor elevations.

Both horizontal and vertical static equivalent loads shall be applied to the rigid piping systems and the responses of the component for two horizontal and one vertical direction combined by the square-root-of-the-sum-of-the-squares (SRSS) basis.

Classification of a specific piping system as rigid may be made in either of the following ways:

a. Restraints may be located so that no span between rigid restraints exceeds the length of a simply supported beam with a rigid range frequency. In addition, restraints are located at changes in direction, concentrated masses, and extended masses.

b. A dynamic analysis may be run to obtain the mode shapes of the piping system. If the first mode frequency is found to be in the rigid range, the system can be assumed rigid.

7.12.3 Flexible Piping Systems

All piping from the reactor to the first isolation valve and other piping that cannot be classified as rigid are assumed to be flexible, and the analytical technique incorporates consideration of pipe natural frequencies in addition to the fundamental frequency.

The dynamic analysis of flexible piping systems shall be performed using the response spectrum method. The piping system shall be idealized as a mathematical model consisting of lumped masses connected by massless elastic members. The lumped masses shall be located so as to adequately represent the dynamic and elastic properties of the piping system. The eccentric masses of valve actuators and other in-line components shall also be considered and modeled as a cantilevered member with a lumped mass at the free end.

The seismic response in terms of displacements, member forces, and support reactions (including torsion) is calculated for each mode in each of the three directions. The method of combining the modal responses is the square root of the sum of the squares, except for safety-related piping. All safety-related piping systems required to safely shut down the plant during an earthquake shall be analyzed by the closely spaced modes method (grouping method).

Closely spaced modes are those where the frequency is less than 10 percent that of the adjacent lower mode. If the modes are closely spaced, the responses of these modes are combined in an absolute manner; the resulting total is treated as a pseudo-mode and then combined with the remainder of the modal responses in an SRSS fashion.

7.12.4 Damping Values

The damping ratio percentage of critical damping of piping systems will be that delineated in Regulatory Guide 1.61. The damping ratio is assumed to be the same for all the modes and is as follows:

	Damping Ratio (Percentage)	
Pipe size	Upset	Faulted
Pipe diameter greater than twelve inches	2	3
Pipe diameter less than or equal to twelve inches	1	2

7.12.5 A static analysis of the piping will be performed to find the effects of seismic displacements on the piping system. The analysis will consist of moving the supporting points a relative distance determined by the vessel and building seismic analysis. The shock suppressors are to be acting during this analysis.

7.12.6 The piping seismic design shall be in accordance with BP-TOP-1, Rev. 3 except as modified in Section 3.7 of the Grand Gulf Safety Analysis Report, for closely spaced modes.

7.12.7 The effects of non-nuclear piping beyond the nuclear piping boundaries up to the first anchor shall be included in the nuclear piping system seismic analysis where applicable.

7.12.8 Piping shall be designed and supported such that the acceleration of the valves does not exceed 6.0g in any direction or lower g values as required by the respective manufacturers.

8.0 MATERIALS

8.1 Materials to be used in each piping system are stipulated in the Piping Class Sheets (9645-MS-03), except as otherwise indicated on the P&IDs or Piping Isometric Drawings.

8.2 Materials for Nuclear Class 1 piping shall be impact tested in accordance with Article NB-2300 of the Code. Materials for Nuclear Class 2 systems which perform an extension of the containment function shall be impact tested in accordance with Article NC-2300 of the Code. The lowest service metal temperature to be used in calculating the impact test temperature is specified on the Piping Class Sheets (9645-MS-03) for each pipe class involved.

9.0 FABRICATION, ERECTION, SUPPORTS, EXAMINATION, AND TESTING

9.1 Piping

9.1.1 Fabrication, examination, testing, and erection of piping systems within the scope of this Design Specification shall be in full compliance with the Code, and shall be performed in accordance with Specifications 9645-M-201.0, 9645-M-204.0, 9645-M-205.0, 9645-M-205.2, and 9645-M-207.0

9.2 Supports

9.2.1 Pipe supports and anchors shall be provided where required as determined by stress analysis. Physical design and fabrication of hangers and supports shall be as stipulated in Specifications 9645-M-300.0, 9645-M-300.2, and 9645-M-300.6. Inspection, stamping, and data reports are not required. Installation shall be in accordance with Paragraph 9.1.1.

10.0 HANDLING, SHIPPING AND STORAGE

10.1 Handling, storage, and shipping requirements shall be as stipulated in Specifications 9645-M-201.0, 9645-M-204.0, 9645-M-205.0, 9645-M-205.2, and 9645-M-207.0. Storage of material and piping subassemblies shall also be in accordance with 9645-M-184.0.

11.0 QUALITY ASSURANCE PROGRAM REQUIREMENTS

11.1 Piping systems designed and constructed in accordance with this Specification perform safety-related functions in a nuclear power station to be licensed under regulations of the U.S. Nuclear Regulatory Commission. To ensure licensability of the station and system integrity for the life of the plant, Quality Assurance Program requirements applicable to these piping systems shall meet the intent of ANSI N45.2 and Section NA-4000 of the Code by complying with Bechtel's NQAM and BQAM.

ATTACHMENT NO. 8

Miscellaneous Information

The following items will be discussed and information will be provided during the June 2, 1982, meeting between MP&L and the NRC Equipment Qualification Branch:

1. Main Steam Isolation Valve (MSIV)

   Further discussion of the MSIV nozzle loads will be provided during the June 2, 1982, meeting.

2. RHR Heat Exchanger

   The RHR stress calculations will be available at the June 2, 1982, meeting. Also, the RHR nozzle loads will be discussed in regard to the stress values not being addressed in the stress summary.

3. CRD Solenoid Valve

   The CRD solenoid valve "g" loads will be available at the June 2, 1982, meeting. Also, the use of these "g" loads will be discussed at the June 2, 1982, meeting.

4. HPCS Diesel Generator System

   The questions asked by EG&G relative to how loads for critical items were determined will be addressed at the June 2, 1982, meeting. Also, the test reports for the HPCS diesel generator will be available and reviewed at the June 2, 1982, meeting.

5. Conductivity Cell

   The questions of why the stress analysis did not consider the threads in the nipple will be addressed at the June 2, 1982, meeting.

6. Safety Relief Valves (M-141.1)

   The questions of the nozzle loads not being considered and the need for verification that the 6.0 g loads used in testing will not be exceeded will be addressed at the June 2, 1982, meeting.