Complete Report

No. 826892

TENNESSEE VALLEY AUTHORITY

DESIGN SPECIFICATION

WBNP-DS-1935-4443-RO

NOVEMBER 27, 1979

WATTS BAR NUCLEAR PLANTS UNITS 1 AND 2

FLEXIBLE METAL HOSE ASSEMBLIES FOR STEEL CONTAINMENT VESSEL PENETRATION

I certify that this design specification is correct and complete and is in compliance with Paragraph NCA-3252 of the ASME Boiler and Pressure Vessel Code, Section III, Nuclear Power Plant Components. This design specification consists of the following:

		Revision No. or Date
1.	Schedule 1	RO
2.	Attachment C, Quality Assurance Requirements for ASME Section III Components (Excluding Pumps, Valves, and Automatic Backwash Filters), Component Supports, and Piping Subassemblies	October 10, 1979
3.	Attachment M, Marking and Certification Requirements for Pipe, Fittings, Flanges, and Bolting for Use in ASME Section III Nuclear Class 2 or 3 Systems	September 20, 1979
4.	Attachment Q, Pipe, Fittings, Tubing, and Miscellaneous Components Austenitic Stainless Steel Heat Treatment Welding Materials, Packaging, and Marking	December 26, 1978
5.	Appendix A - Response Spectra Curves for Accident	November 14, 1979
6.	Appendix B - Response Spectra Curves for Seismic	November 14, 1979
7.	Appendix C - Allowable Nozzle Loads	November 14, 1979
8.	47B450-1	R1
9.	47B450-1A	R1

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DESIGN SPECIFICATION (Continued)

	Revision No. or Date
10. 47B450-2	R1
11. 47B450-2A	R1
12. Contract Document Requirements List	-

IVAN LEE BELTZ

Ivan L. Beltz 12/3/79

Ivan L. Beltz, PE
Registered Professional Engineer

Prepared	Date	Correlated	Date	Submitted	Date	Approved	Date
T.R. Watson	12/3/79	[illegible]	12/3/79	[illegible]	12/3/79	C.A. Chandley	12-4-79

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TENNESSEE VALLEY AUTHORITY

ASME SECTION III

CLASS 2 FLEXIBLE HOSE ASSEMBLIES

DESIGN SPECIFICATION CRITERIA LOCATOR

INFORMATION REQUIRED BY NCA-3252 AND ITS LOCATION IN THIS SPECIFICATION

1. Function of the component including any dimensions upon which the functional performance depends.	Schedule of prices
2. The design requirements, i.e., the mechanical and operational loadings.	Schedule of prices
3. The environmental conditions, including radiation.	Schedule of prices
4. The code classification of the component.	Schedule of prices
5. The definition of the component.	Schedule of prices
6. Material requirements.	Schedule of prices
7. Certification of the design specification.	Cover sheet
8. Operability requirements.	Schedule of prices

No. 826892

TENNESSEE VALLEY AUTHORITY

DESIGN SPECIFICATION

WBNP-DS-1935-4443-RO

NOVEMBER 27, 1979

WATTS BAR NUCLEAR PLANTS UNITS 1 AND 2

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8.	47B450-1	R1
9.	47B450-1A	R1

DESIGN SPECIFICATION (Continued)

	Revision No. or Date
10. 47B450-2	R1
11. 47B450-2A	R1
12. Contract Document Requirements List	-

IVAN LEE BELTZ

Ivan L. Beltz 12/3/79

Ivan L. Beltz, PE
Registered Professional Engineer

Prepared	Date	Correlated	Date	Submitted	Date	Approved	Date
T.R. Watson	12/3/79	[illegible]	12/3/79	[illegible]	12/3/79	C.A. Chandley	12-4-79

ITEM NO	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT

External environment

Penetration numbers with an "I" suffix will be located in the reactor building which has the following environment:

	Normal	Accident
Ambient temperature	140° F max	250° F
Ambient pressure	± 0.3 lb/in^{2}g	15 lb/in^{2}g
Radiation	2 Rad/hr	10^8 Rads

Penetration numbers with an "O" suffix will be located in the auxiliary building which has the following environment:

Pressure: Atmospheric
Temperature: 60 to 104° Normal, 114 F° max
Relative Humidity: 30 to 98% Normal, 100% max
Radiation: 5×10^2 Rad (40-year dose)

Cyclic Life Requirements

General

These hose assemblies shall be designed for a total service life of 40 years while undergoing the conditions specified below. Cyclic design shall be based on analytical and test results. A certified design report, including cyclic life and nozzle load considerations, shall be submitted for permanent retention by TVA. Satisfaction of the current requirements of ASME Section III, Class 2, criteria shall also be documented.

Installation

TVA will install the hose assemblies in the orientations indicated by TVA drawings 47B450-1R1, -1AR1, -2R1, and -2AR1. No external support will be applied except for the end connections to piping and SCV penetration nozzle at points A and B, respectively. No significant torsional load will be applied to the hose at installation and the bellows will not be plastically deformed. A nominal offset misalignment of each braided hose section of $\Delta^* = 0.059\ L/\sqrt{D}$

ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
	shall be assumed in the design calculations as a result of installation, where: L = Live length of hose section, inches. D = Nominal inside diameter of hose, inches. Δ^* = Offset misalignment, inches (upper limit = 1.0 inches). Installation temperature is assumed to be 70 degrees F. Internal pressure and temperature fluctuations The internal pressure and temperature varies from installation values (0 lb/in^{2}g, 70 degress F) to the nominal operating values; evaluate for 10,000 cycles. Internal pressure varies ±10 percent from operating pressure; evaluate for 1 million cycles. Pressure varies from zero to hydrostatic test pressure; evaluate for 50 cycles. End points A and B remain fixed, as installed, for these conditions. Mechanical and flow induced vibration End point B is subjected to continuous sine wave input motion (no rotation) of 0.5 g acceleration in any direction at frequencies of 15, 30, and 60 Hz, while end point B remains fixed. Fluid flow is as specified above at operating pressure and temperature. Evaluate for continuous service under these conditions, with mechanical input motion in the most critical direction. Relative end point movements during accident and seismic conditions End point B is deflected (without rotation) to the Δx, Δy, and Δz values specified in TVA drawings 47B450-1R1, 1AR1, -2R1, and -2AR1, while point A remains fixed. Evaluate for 500 cycles assuming these deflections to be quasi-static alternating displacements which are measured from the as-installed position. Dynamic inertial effect of accident and seismic conditions End point B is subjected to input motion (without rotation) as defined by the response spectra curves of appendixes A and B for accident and seismic conditions, respectively. End point A remains fixed.				

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ITEM No.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE	AMOUNT
				(Quote unit price and compute extension)	
	The horizontal accident response spectra is given in north-south and east-west directions. Orientation and location of each hose assembly are defined by reference to the sketches of TVA drawings 47B450-1R1, 1AR1, -2R1, and -2AR1, and table 1 from appendix A. (Note that the azimuth angle is measured counter-clockwise from south.)				
	The seismic response spectra in appendix B are for 1/2 SSE; these accelerations must be doubled to obtain the SSE accelerations. The horizontal SSE response spectra are applicable in both north-south and east-west directions. (Elevations of each hose assembly are given in table 1 of appendix A; use the response spectra curve for that elevation or the nearest available higher elevation.)				
	Accident and SSE seismic condition responses shall be combined absolutely. Evaluate for 500 cycles of the maximum resultant stresses.				
	The capability of each hose assembly to withstand these motions, while performing its intended functions, shall be demonstrated by tests of prototypical assemblies. Tests shall be performed with the assembly at operating and zero internal fluid pressures. Test reports shall be included in the submitted documentation. Submittal of proposed test procedures is also recommended.				
	Nozzle Load Requirements				
	For combined loadings from installation misalignment, operating pressure and temperature, mechanical and flow induced vibration, relative end point movements during accident and seismic conditions, and dynamic inertial effects of accident and seismic conditions, the nozzle loads at points A and B shall not exceed the allowable values determined from appendix C. The various loadings are described above.				
	In determining the allowable nozzle loads assume attached schedule 40 pipe of the same nominal diameter as the hose and with a yield strength of 30,000 lb/in^2.				
	Satisfaction of these requirements shall be demonstrated in the certified design report.				
	Contractor shall provide handling, storage, and installation instructions.				
	ASME Section III, Class 2				
	For additional requirements see attachments C, M, and Q.				

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BIDDER

Schedule of Prices

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Item No.	ARTICLES OR SERVICES (Give description or catalog no.) Size	WBNP Unit No.	Mk No.	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
1	3/4"	1	47W450-1001	1	EA		
2	3/4"	1	47W450-1002	1	EA		
3	1"	1	47W450-1003	1	EA		
4	1"	1	47W450-1004	1	EA		
5	1-1/2"	1	47W450-1005	1	EA		
6	1-1/2"	1	47W450-1006	1	EA		
7	1-1/2"	1	47W450-1007	1	EA		
8	1-1/2"	1	47W450-1008	1	EA		
9	1-1/2"	1	47W450-1009	1	EA		
10	1-1/2"	1	47W450-1010	1	EA		
11	2"	1	47W450-1011	1	EA		
12	2"	1	47W450-1012	1	EA		
13	2"	1	47W450-1013	1	EA		
14	2"	1	47W450-1014	1	EA		
15	2"	1	47W450-1015	1	EA		
16	2"	1	47W450-1016	1	EA		
17	2"	1	47W450-1017	1	EA		
18	2"	1	47W450-1018	1	EA		
19	2"	1	47W450-1019	1	EA		
20	2"	1	47W450-1020	1	EA		
21	2"	1	47W450-1021	1	EA		
22	2"	1	47W450-1022	1	EA		
23	2"	1	47W450-1023	1	EA		
24	2"	1	47W450-1024	1	EA		
25	2"	1	47W450-1025	1	EA		
26	2"	1	47W450-1026	1	EA		
27	2"	1	47W450-1027	1	EA		
28	2"	1	47W450-1028	1	EA		
29	2"	1	47W450-1029	1	EA		
30	2"	1	47W450-1030	1	EA		
31	2"	1	47W450-1031	1	EA		
32	2"	1	47W450-1032	1	EA		
33	2"	1	47W450-1033	1	EA		
34	2"	1	47W450-1034	1	EA		
35	2"	1	47W450-1035	1	EA		
36	2"	1	47W450-1036	1	EA		
37	2"	1	47W450-1037	1	EA		
38	2"	1	47W450-1038	1	EA		
39	2"	1	47W450-1039	1	EA		
40	2"	1	47W450-1040	1	EA		
41	2"	1	47W450-1043	1	EA		
42	2"	1	47W450-1044	1	EA		
43	2"	1	47W450-1045	1	EA		
44	2"	1	47W450-1046	1	EA		
45	1"	1	47W450-1047	1	EA		
46	1"	1	47W450-1048	1	EA		

TVA 5551 (DF 9-73)

BIDDER _____

Schedule of Prices

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ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)			QUANTITY	UNIT	UNIT PRICE	AMOUNT
	Size	WB&P Unit No.	Mk No.			(Quote unit price and compute estimated)	
47	3/4"	2	47W450-1001	1	EA		
48	3/4"	2	47W450-1002	1	EA		
49	1"	2	47W450-1003	1	EA		
50	1"	2	47W450-1004	1	EA		
51	1-1/2"	2	47W450-1005	1	EA		
52	1-1/2"	2	47W450-1006	1	EA		
53	1-1/2"	2	47W450-1007	1	EA		
54	1-1/2"	2	47W450-1008	1	EA		
55	1-1/2"	2	47W450-1009	1	EA		
56	1-1/2"	2	47W450-1010	1	EA		
57	2"	2	47W450-1011	1	EA		
58	2"	2	47W450-1012	1	EA		
59	2"	2	47W450-1013	1	EA		
60	2"	2	47W450-1014	1	EA		
61	2"	2	47W450-1015	1	EA		
62	2"	2	47W450-1016	1	EA		
63	2"	2	47W450-1017	1	EA		
64	2"	2	47W450-1018	1	EA		
65	2"	2	47W450-1019	1	EA		
66	2"	2	47W450-1020	1	EA		
67	2"	2	47W450-1021	1	EA		
68	2"	2	47W450-1022	1	EA		
69	2"	2	47W450-1023	1	EA		
70	2"	2	47W450-1024	1	EA		
71	2"	2	47W450-1025	1	EA		
72	2"	2	47W450-1026	1	EA		
73	2"	2	47W450-1027	1	EA		
74	2"	2	47W450-1028	1	EA		
75	2"	2	47W450-1029	1	EA		
76	2"	2	47W450-1030	1	EA		
77	2"	2	47W450-1031	1	EA		
78	2"	2	47W450-1032	1	EA		
79	2"	2	47W450-1033	1	EA		
80	2"	2	47W450-1034	1	EA		
81	2"	2	47W450-1035	1	EA		
82	2"	2	47W450-1036	1	EA		
83	2"	2	47W450-1037	1	EA		
84	2"	2	47W450-1038	1	EA		
85	2"	2	47W450-1039	1	EA		
86	2"	2	47W450-1040	1	EA		
87	2"	2	47W450-1043	1	EA		
88	2"	2	47W450-1044	1	EA		
89	2"	2	47W450-1045	1	EA		
90	2"	2	47W450-1046	1	EA		
91	1"	2	47W450-1047	1	EA		
92	1"	2	47W450-1048	1	EA		

TVA 5051 (DF-9-73)

BIDDER _____

Schedule of Prices

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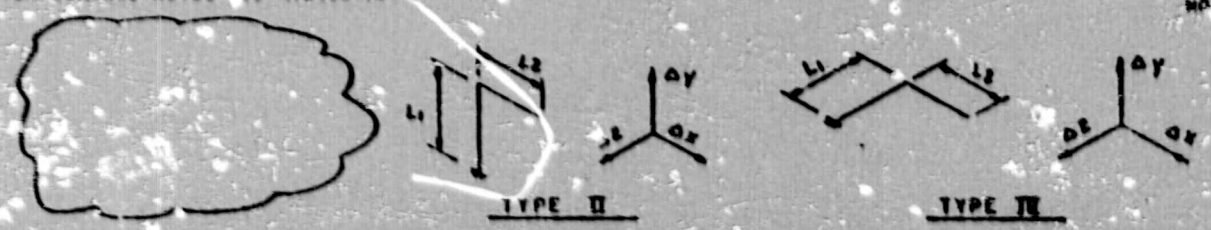
ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE	AMOUNT
				(Quote unit price and compute extension)	
93	Engineering charges				
94	Testing charges				
	Brand name & figure no. _____				
	Manufacturer _____				
	Point of manufacture _____				
	Has the supplier's, manufacturer's, or bidder's Quality System Certificate or Quality Assurance Program been approved on a previous TVA contract? Yes _____ No _____				
	If not, please refer to attachment G and ensure that your bid complies with the submittal requirements therein.				
	If yes, identify in the following space the previous TVA contract number on which approval was obtained: _____				
	Noncompliance with the above may result in your bid being ruled nonresponsive.				
	Documentation submittal after award (days) _____				
	Drawing submittal after award (days) _____				
	Total Items 1 through 94				

TVA 5051 (OP 9-73)

BIDDER _____

MARK NUMBER	PEN NUMBER	NOM DIA	SYSTEM	DESIGN PRESSURE	DESIGN TEMP	OPERATING PRESSURE	OPERATING TEMP	FLUID	TYPE	MAXIMUM L_1	MAXIMUM L_2	MAXIMUM DEFLECTIONS ΔX	ΔY	ΔZ
47W450-1001	X-39B-I	3/4"	WD-077	150 PSIG	150° F	3 PSIG	100° F	N_2	II	22"	16"	.85	.17	.15
47W450-1002	X-39B-0	3/4"		150	150°	3	100°						.17	
47W450-1003	X-39A-I	1"		900	150°	650	100°							
47A450-1004	X-39A-0	1"		900	150°	650	100°							
47W450-1005	X-34-I	2"	INSTR	120	150°			AIR				.89		.19
47A450-1006	X-34-0													
47A450-1007	X-[illegible]-I											.91	.41	.23
47A450-1008	X-50-0													
47A450-1009	X-51-I											.88	.22	.18
47A450-1010	X-51-0													
47W450-1011	X-41-I	2"	FD-040	150	200°	100	150°	WATER	III			.89	.16	
47A450-1012	X-41-0													
47A450-1013	X-64-I		CW-031	65	110°	26	48° to 58°		II			.85	.41	.2
47A450-1014	X-64-0													
47A450-1015	X-65-I												.42	
47A450-1016	X-65-0													
47W450-1017	X-66-I											.86	.31	.25
47W450-1018	X-66-0													
47W450-1019	X-67-I												.42	
47W450-1020	X-67-0													
47W450-1021	X-68-I		ERCW-067	160	130°	50 to 120	35° to 100°		III			0.53	.77	.74
47W450-1022	X-68-0													
47W450-1023	X-69-I												.79	
47A450-1024	X-69-0													
47A450-1025	X-70-I												.81	
47A450-1026	X-70-0													
47W450-1027	X-71-I												.83	
47W450-1028	X-71-0													
47W450-1029	X-72-I												.76	
47W450-1030	X-72-0													
47A450-1031	X-73-I												.78	
47W450-1032	X-73-0													

FOR GENERAL NOTES SEE 47B450-1A



NOTE: ΔX IS RADIAL UNLESS OTHERWISE NOTED.
ΔY IS VERTICAL UNLESS OTHERWISE NOTED

COMPANION DWG: 47B450-1A

ECN 2104

REMOVED TYPE I PER ECN

REACTOR BLDG

MECHANICAL, UNIT 1
FLEX HOSE ASSEMBLIES
FOR RCV PENETRATIONS

WATTS BAR NUCLEAR PLANT

MARK NUMBER	PEN NUMBER	NOM DIA	SYSTEM	DESIGN PRESSURE	DESIGN TEMP	OPERATING PRESSURE	OPERATING TEMP	FLUID	TYPE	MAXIMUM L_1	MAXIMUM L_2	MAXIMUM DEFLECTIONS ΔX	ΔY	ΔZ
47W450-1033	X-74-I	2"	ERCW-067	100 PS	130°F	50 to 120 PSIG	35° to 100°	WATER	III	22"	16"	.53	80°	.74
47W450-1034	X-74-O													
47W450-1035	X-75-I												82	
47W450-1036	X-75-O													
47W450-1037	X-76-I		SA-033	100	100°	100	100°	AIR	II			86	08	
47W450-1038	X-76-O													
47W450-1039	X-77-I		DW-059		150°			WATER					.06	
47W450-1040	X-77-O													
47W450-1043	X-114-I		IC-061	150	120°	150	110°	50% GLY. 50% H_2O	IV			.42	67°	.77
47W450-1044	X-114-O													
47W450-1045	X-115-I												65	75
47W450-1046	X-115-O													
47W450-1047	X-408-I	1"	SEC CHEMFD-36	1025	70°	1025	70°	[illegible]				.74		
47W450-1048	X-408-I											(?)		

GENERAL NOTES

1. THIS DRAWING PROVIDES INFORMATION FOR ORDERING AND DESIGNING FLEX HOSES FOR ISOLATING 2" & UNDER PIPING FROM SCV MOVEMENT.
2. THE L_1 AND L_2 VALUES ARE TO BE CONSIDERED MAXIMUM VALUES FOR DETERMINING FLEX HOSE LENGTHS. SMALLER FLEX HOSE LENGTHS ARE ACCEPTABLE.
3. THIS DRAWING IS AN ATTACHMENT TO 478M450-19.

ECN 2104

COMPANION DWG: 478450-1

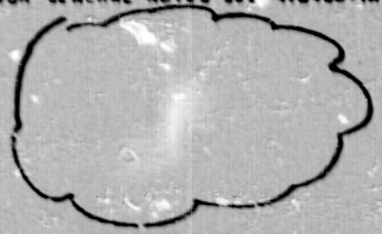
ADDED MK 1047 & 1048 PER ECN

REACTOR BLDG

MECHANICAL, UNIT 1
FLEX HOSE ASSEMBLIES
FOR SCV PENETRATIONS

MARK NUMBER	PEN NUMBER	NOM DIA	SYSTEM	DESIGN PRESSURE	DESIGN TEMP	OPERATING PRESSURE	OPERATING TEMP	FLUID	TYPE	MAXIMUM L_1	MAXIMUM L_2	MAXIMUM DEFLECTIONS Δx	Δy	Δz
47W450-1001	X-39B-I	3/4"	WD-077	150 PSIG	150° F	3 PSIG	100° F	N_2	II	22"	16"	85	17	15
47W450-1002	X-39B-O	3/4"		150	150°	3	100°						17"	
47W450-1003	X-39A-I	1"		900	150°	650	100°							
47W450-1004	X-39A-O	1"		500	150°	650	100°							
47W450-1005	X-34 [illegible]	[illegible]	INSTR	120	150°			AIR				89		19
47W450-1006	X-34 -O													
47W450-1007	X-90 -I											91	31	23
47W450-1008	X-90 -O													
47W450-1009	X-91 -I											88	22	18
47W450-1010	X-91 -O													
47W450-1011	X-41 -I	2"	FD-040	150	200°	100	150°	WATER	III			89	16	
47W450-1012	X-41 -O													
47W450-1013	X-64 -I		CW-031	65	110°	26	48° to 58°		II			85	41"	2
47W450-1014	X-64 -O													
47W450-1015	X-65 -I												42"	
47W450-1016	X-65 -O													
47W450-1017	X-66 -I											86	41"	25
47W450-1018	X-66 -O													
47W450-1019	X-67 -I												42"	
47W450-1020	X-67 -O								III					
47W450-1021	X-68 -I		ERCW-067	160	130°	50 to 120	35° to 100°					53	77"	74
47W450-1022	X-68 -O													
47W450-1023	X-69 -I												79	
47W450-1024	X-69 -O													
47W450-1025	X-70 -I												81	
47W450-1026	X-70 -O													
47W450-1027	X-71 -I												83	
47W450-1028	X-71 -O													
47W450-1029	X-72 -I												76"	
47W450-1030	X-72 -O													
47W450-1031	X-73 -I												78	
47W450-1032	X-73 -O													

FOR GENERAL NOTES SEE 478450-1A



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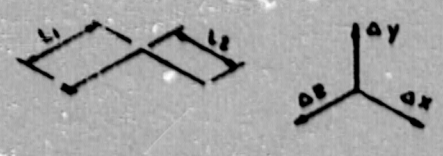


TYPE III

NOTE: ΔX IS RADIAL UNLESS OTHERWISE NOTED.
ΔY IS VERTICAL UNLESS OTHERWISE NOTED

COMPANION DWG: 479450-2A

ECN 2105

REMOVED TYPE I PER ECN

REACTOR BLDG

MECHANICAL, UNIT 2
FLEX HOSE ASSEMBLIES
FOR SCV PENETRATIONS

MARK NUMBER	PEN NUMBER	NOM DIA	SYSTEM	DESIGN PRESSURE	DESIGN TEMP	OPERATING PRESSURE	OPERATING TEMP	FLUID	TYPE	MAXIMUM L_1	MAXIMUM L_2	MAXIMUM DEFLECTIONS ΔX	ΔY	ΔZ
47W450-1033	X-74-I	2"	ERCW-067	160 PSIG	[illegible]0° F	50 to 120 PSIG	35° to 100° F	WATER	III	22"	16"	[illegible]	.80"	.74
47W450-1034	X-74-O													
47W450-1035	X-75-I												.82	
47W450-1036	X-75-O													
47W450-1037	X-76-I		SA-033	100	100°	100	100°	AIR	II			.86	.08	.1
47W450-1038	X-76-O													
47W450-1039	X-77-I		DW-059		150°			WATER					.06	
47W450-1040	X-77-O													
47W450-1043	X-114-I		ICS-061	150	-20°	150	-10°	50% GLY. 50% H_2O	III			.42	.67"	.77
47W450-1044	X-114-O													
47W450-1045	X-115-I												.65	.76
47W450-1046	X-115-O													
47W450-1047	X-408-I	1"	SFC CHEM FD-36	1025	70°	1025	70°	[illegible]				.74		
47W450-1048	X-408-I											.69		

GENERAL NOTES

1. THIS DRAWING PROVIDES INFORMATION FOR ORDERING AND DESIGNING FLEX HOSES FOR ISOLATING 2" & UNDER PIPING FROM SCV MOVEMENT.
2. THE L_1 AND L_2 VALUES ARE TO BE CONSIDERED MAXIMUM VALUES FOR DETERMINING FLEX HOSE LENGTHS. SMALLER FLEX HOSE LENGTHS ARE ACCEPTABLE.
3. THIS DRAWING IS AN ATTACHMENT TO 47BM450-10.

ECN 2106

COMPANION DWG: 47B450-2

ADDED MK 1047 & 1048 PER ECN

REACTOR BLDG

MECHANICAL, UNIT 2
FLEX HOSE ASSEMBLIES
FOR SCV PENETRATIONS

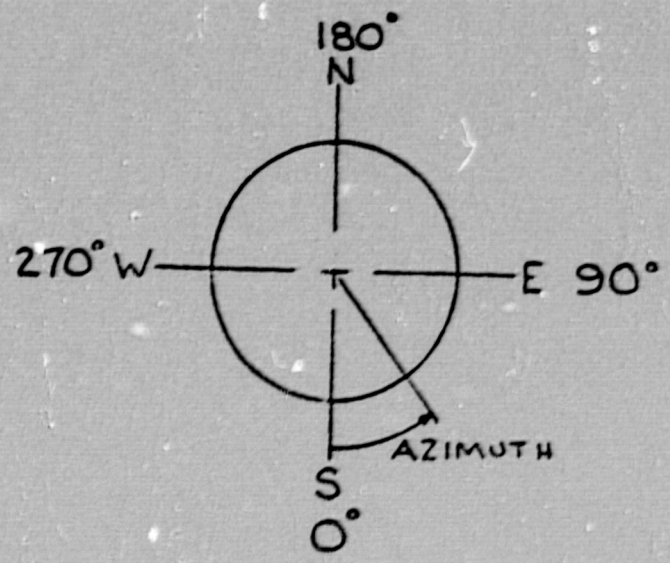
WALTS [illegible] NUCLEAR PLANT

APPENDIX A

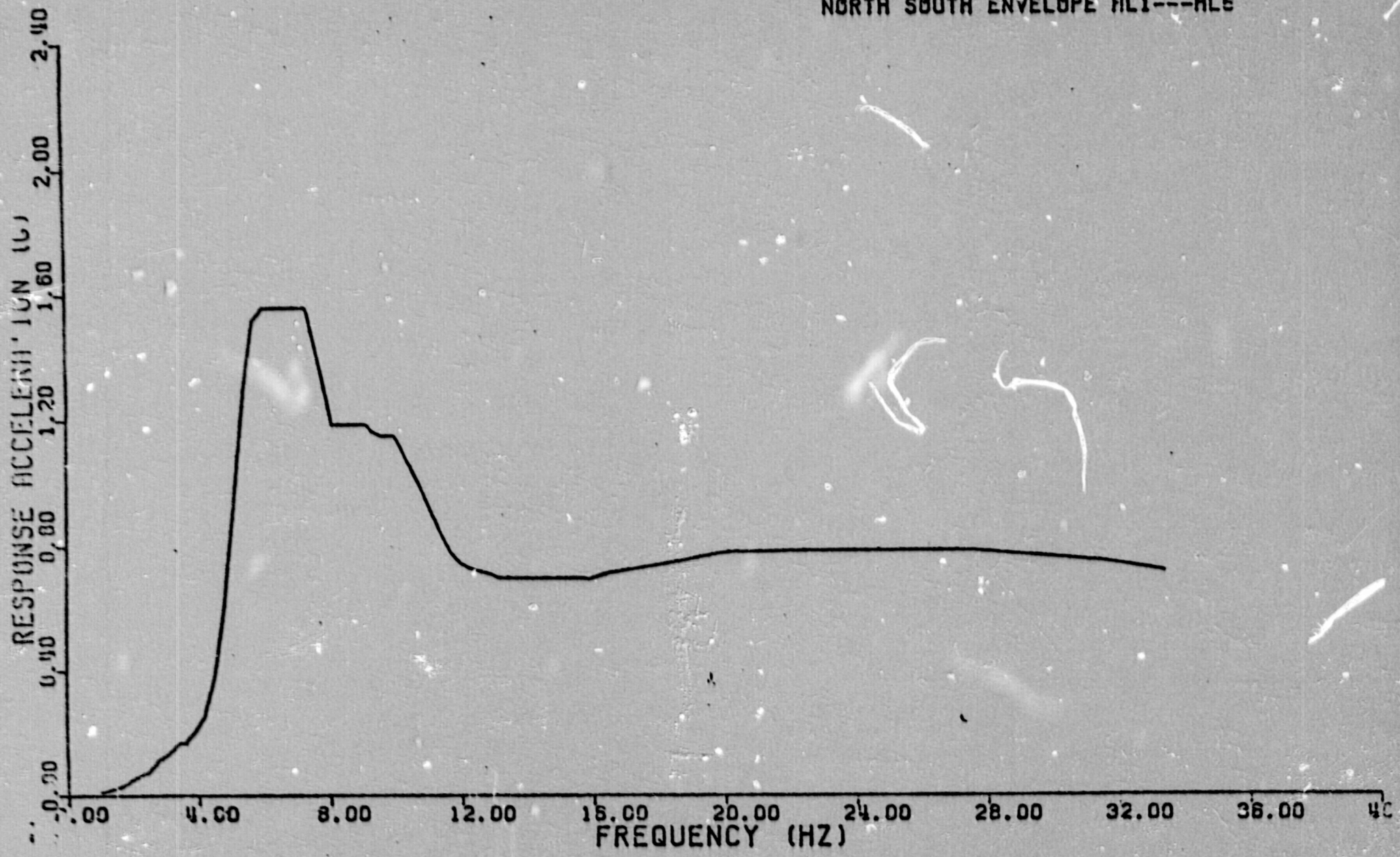
11-14-79

TABLE 1

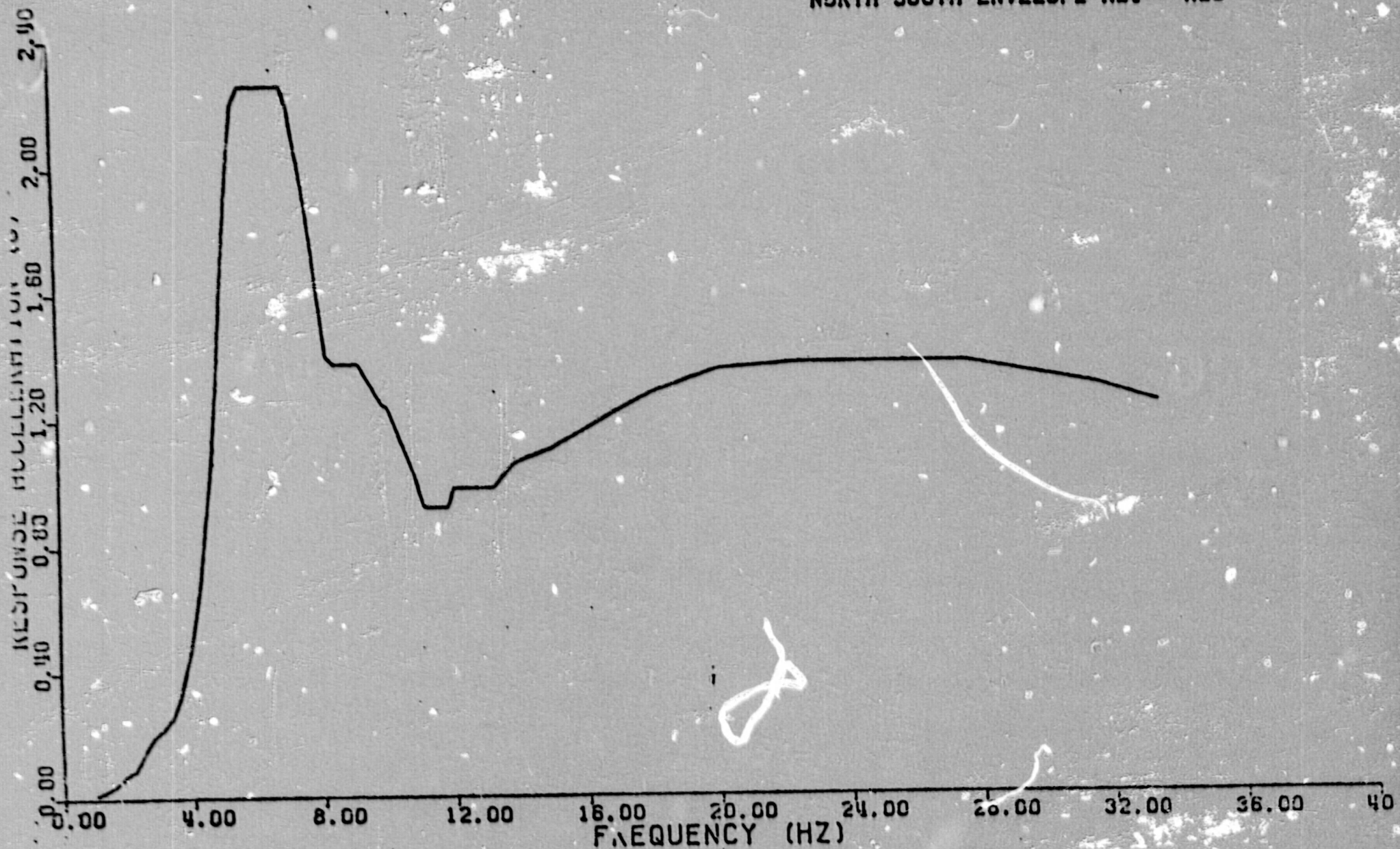
PENETRATION NUMBER	USE RESPONSE SPECTRA LOCATED AT: ELEVATION (FT)	AZIMUTH (DEG)
39, 91	716.5	285
34, 41, 76, 77	716.5	300
90	733.5	285
64, 65	733.5	60
66, 67	733.5	90
75, 68, 69, 70, 71, 72, 73, 74	792.0	300
114, 115	773.0	300
40	754.0	300



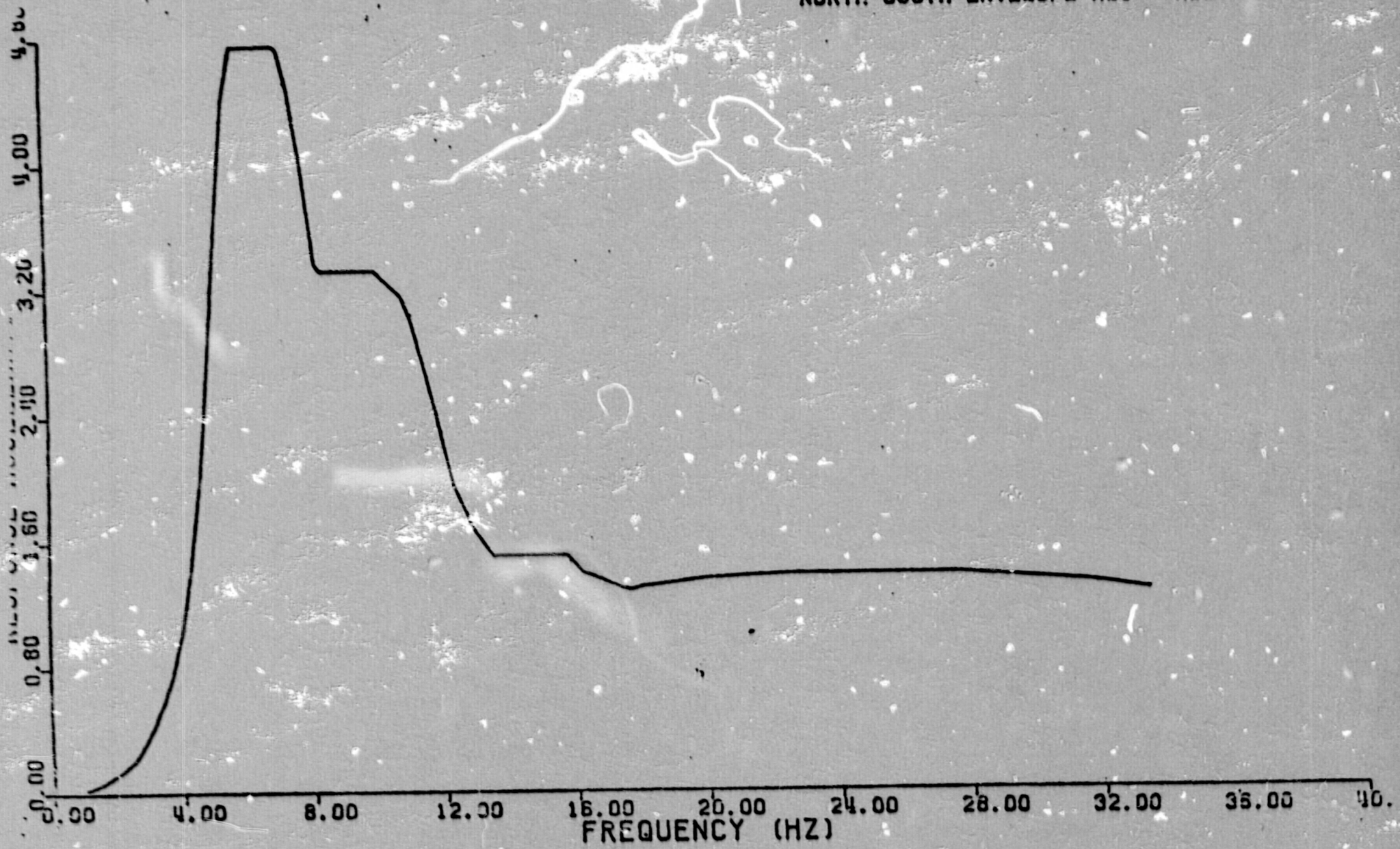
TENNESSEE VALLEY AUTHORITY 09/08/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 716.5,AZ265.DEG.
DAMPING RATIO 0.020
NORTH SOUTH ENVELOPE HL1---HL8



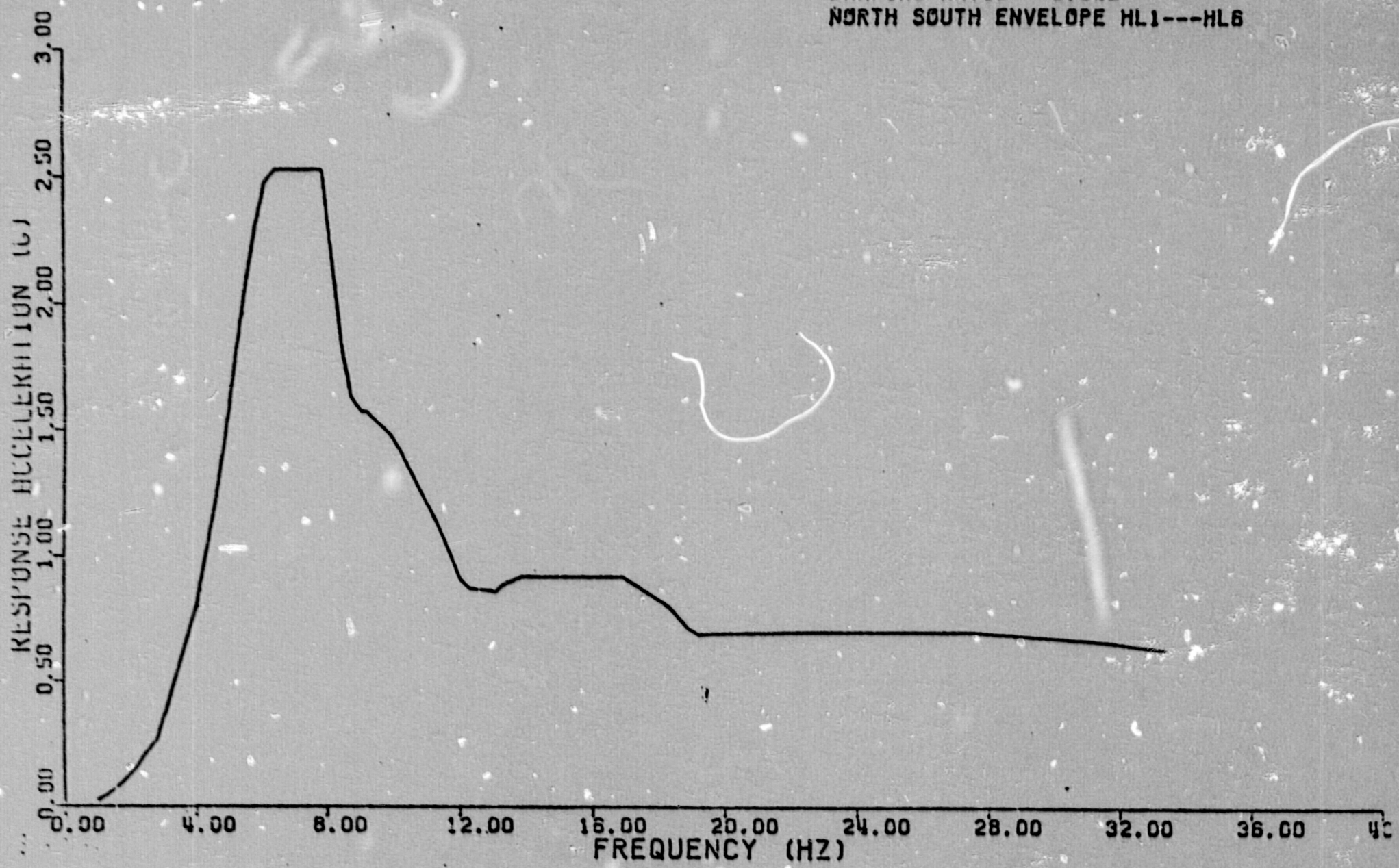
TENNESSEE VALLEY AUTHORITY 09/06/79
RESPONSE ACCELERATION SPECTRUM
USNP CONTAINMENT EL 716.5,AZ300.DEC.
DAMPING RATIO 0.020
NORTH SOUTH ENVELOPE HL1---HL6



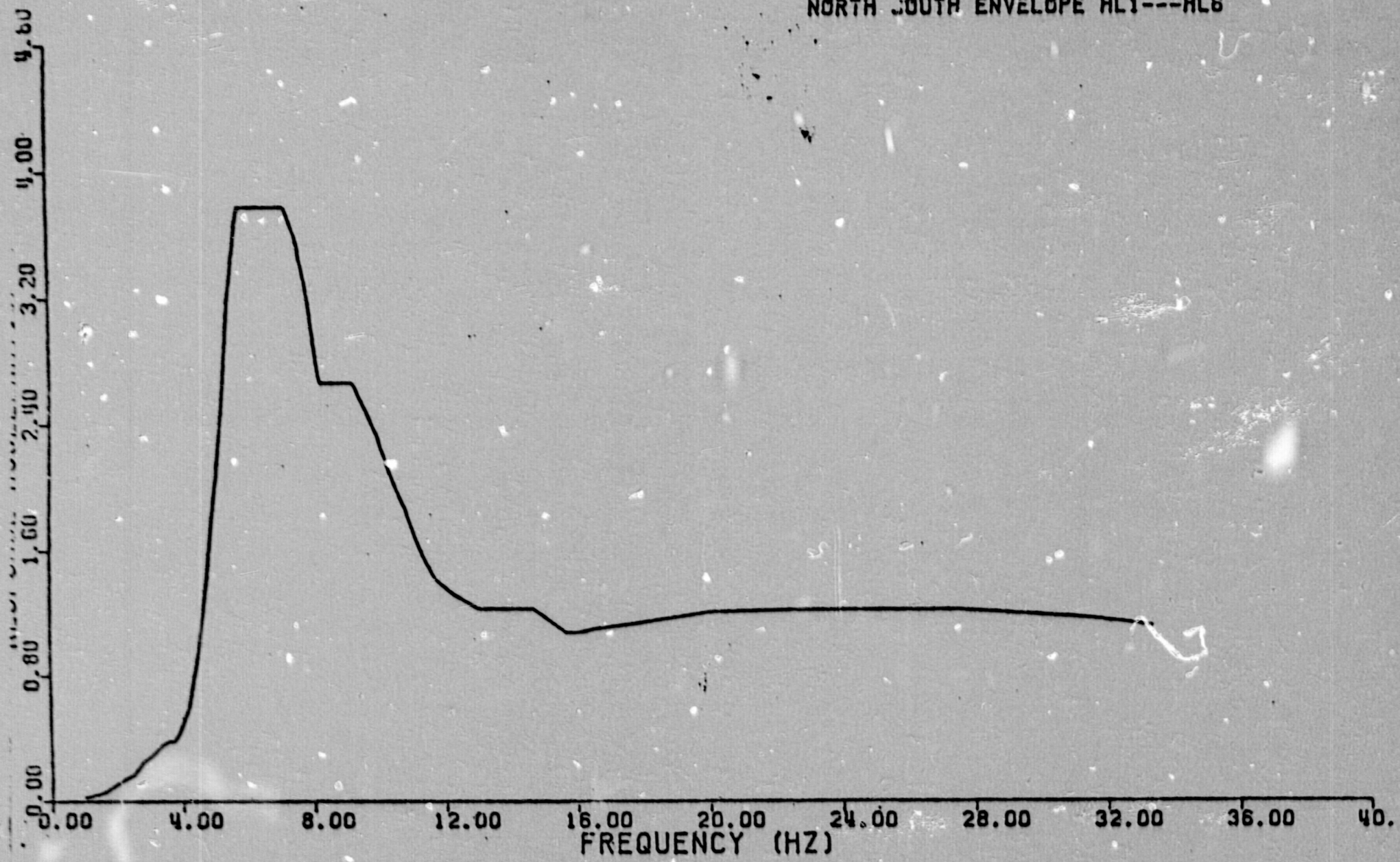
TENNESSEE VALLEY AUTHORITY 09/06/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 733.5,AZ 60.DEG.
DAMPING RATIO 0.020
NORTH SOUTH ENVELOPE HL1---HL6



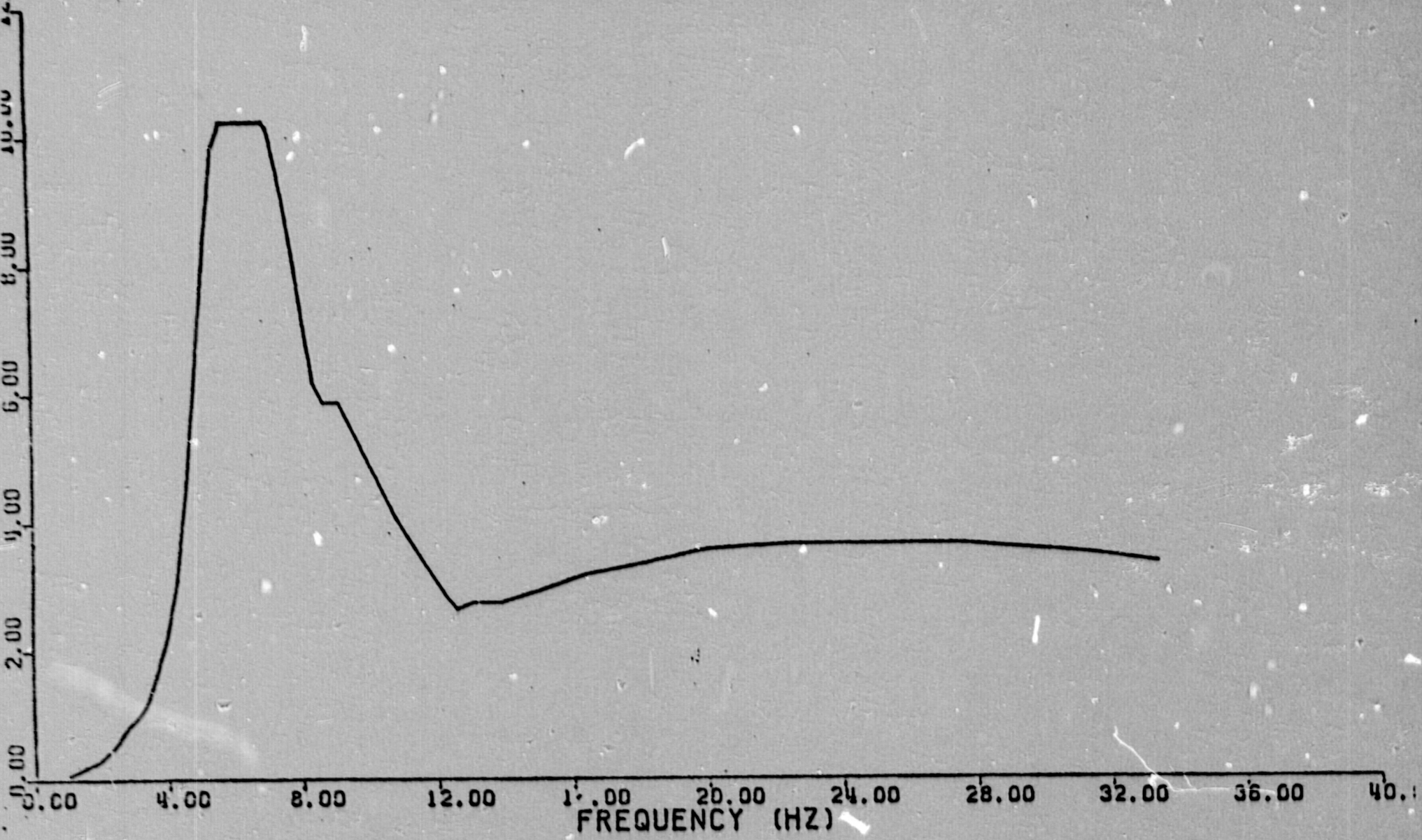
TENNESSEE VALLEY AUTHORITY 09/03/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 733.5,AZ 90.DEG.
DAMPING RATIO 0.020
NORTH SOUTH ENVELOPE HL1---HL6



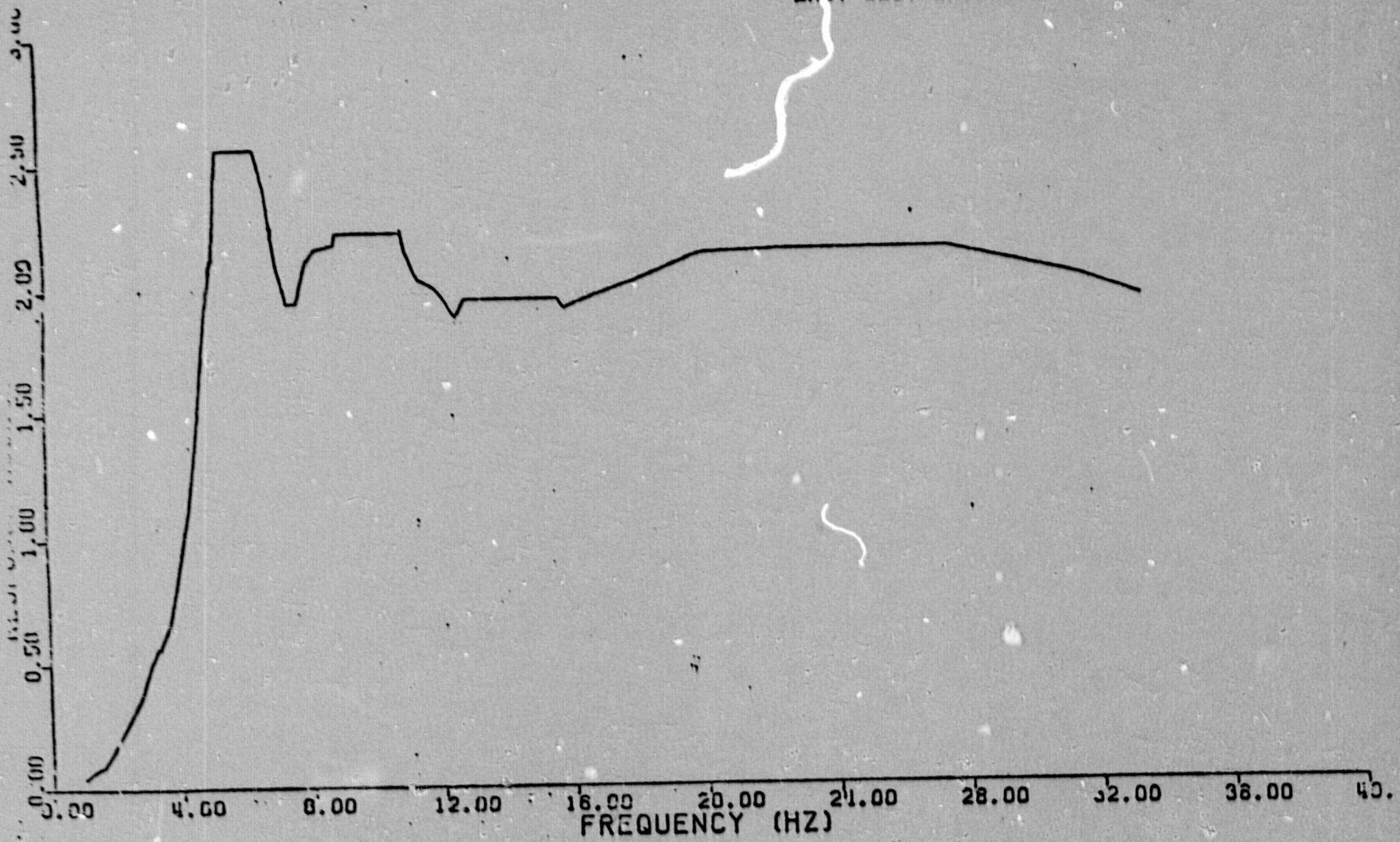
TENNESSEE VALLEY AUTHORITY 09/08/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 733.5,AZ265.DEG.
DAMPING RATIO 0.020
NORTH SOUTH ENVELOPE HL1---HL6



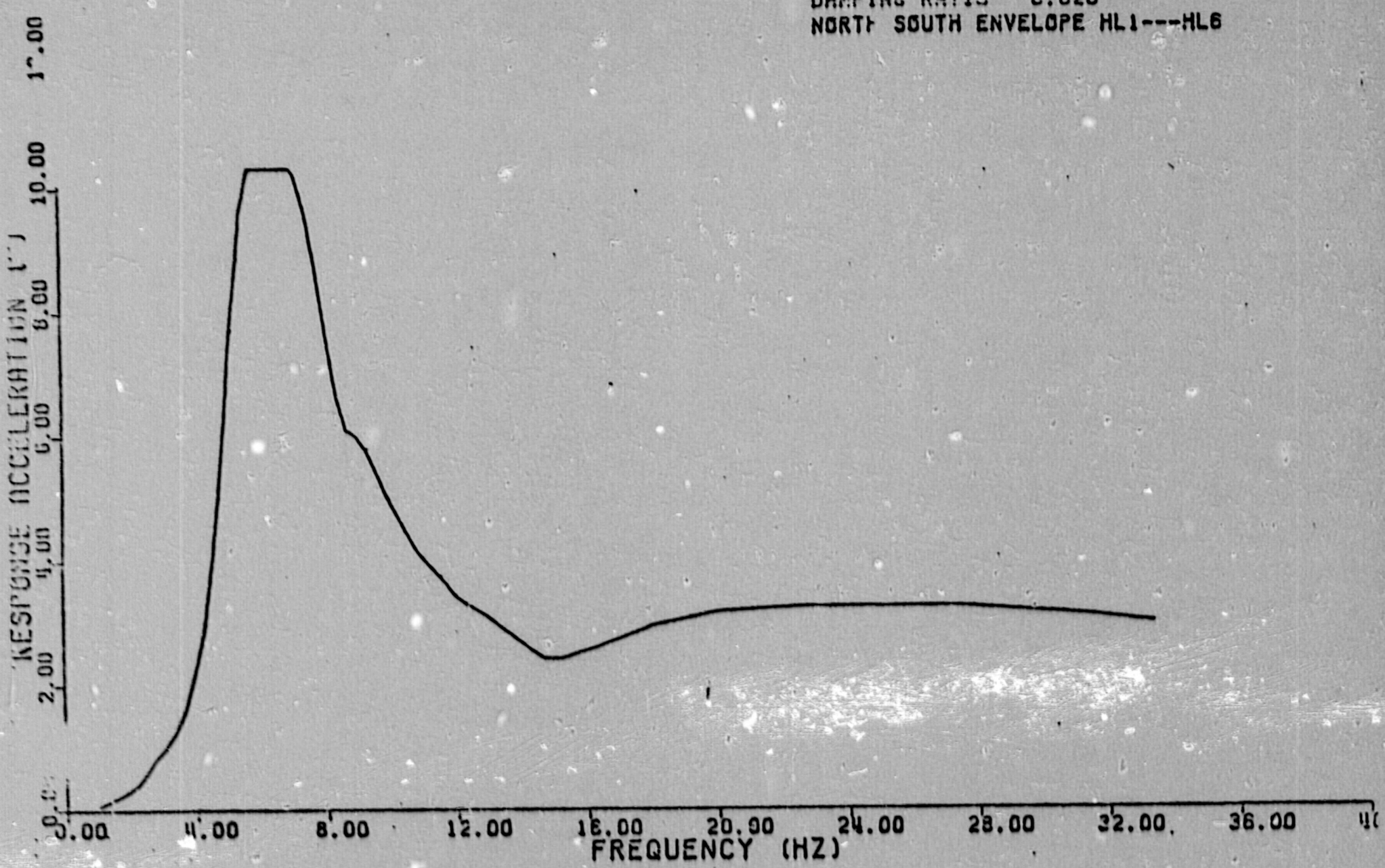
TENNESSEE VALLEY AUTHORITY 09/06/79
RESPONSE ACCELERATION SPECTRUM
UBNP CONTAINMENT EL 773.0,AZ300.DEG.
DAMPING RATIO 0.020
NORTH SOUTH ENVELOPE HL1---HL6



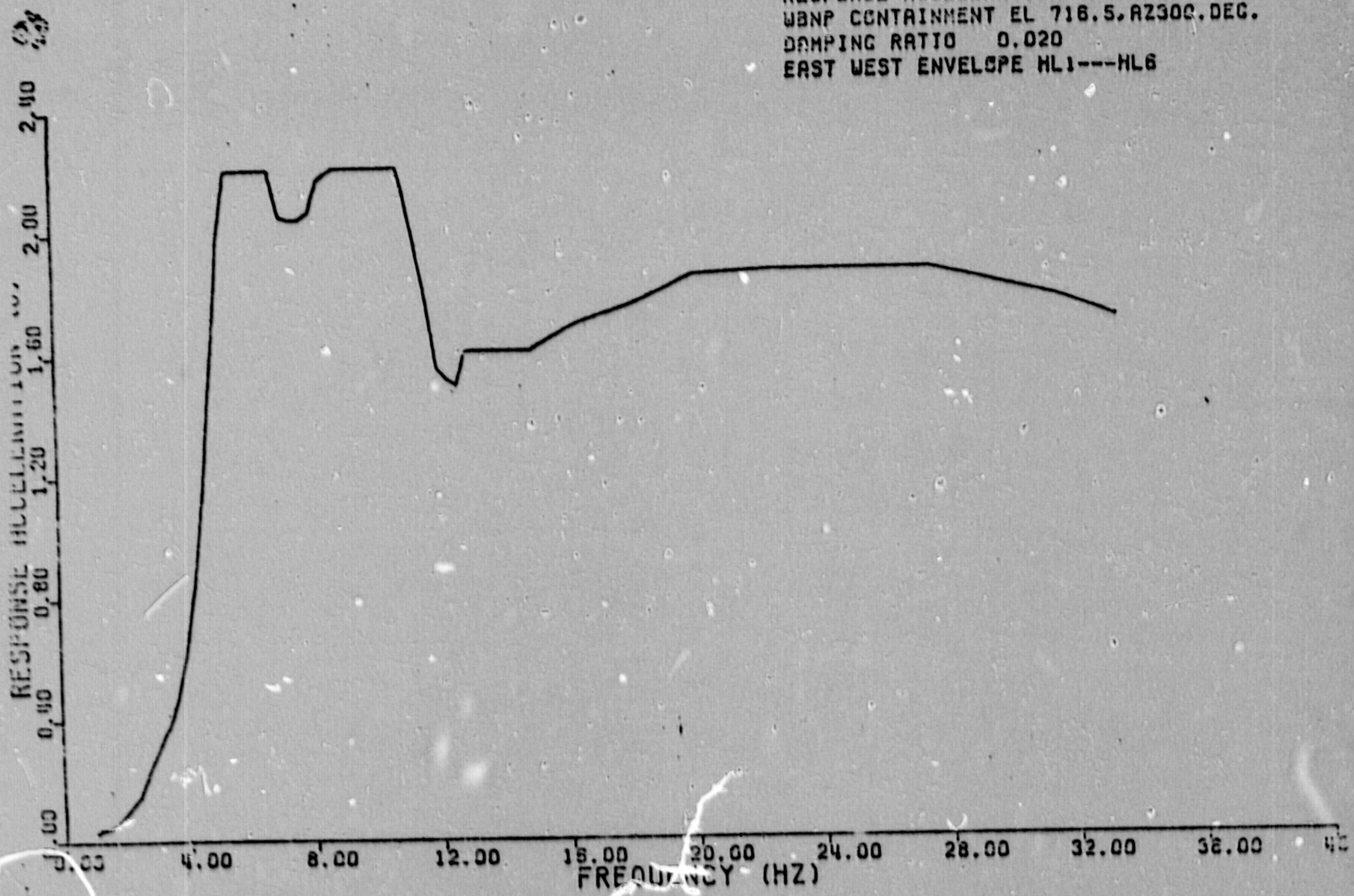
TENNESSEE VALLEY AUTHORITY 09/06/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 716.5,AZ285.DEG.
DAMPING RATIO 0.020
EAST WEST ENVELOPE HL1---HL6



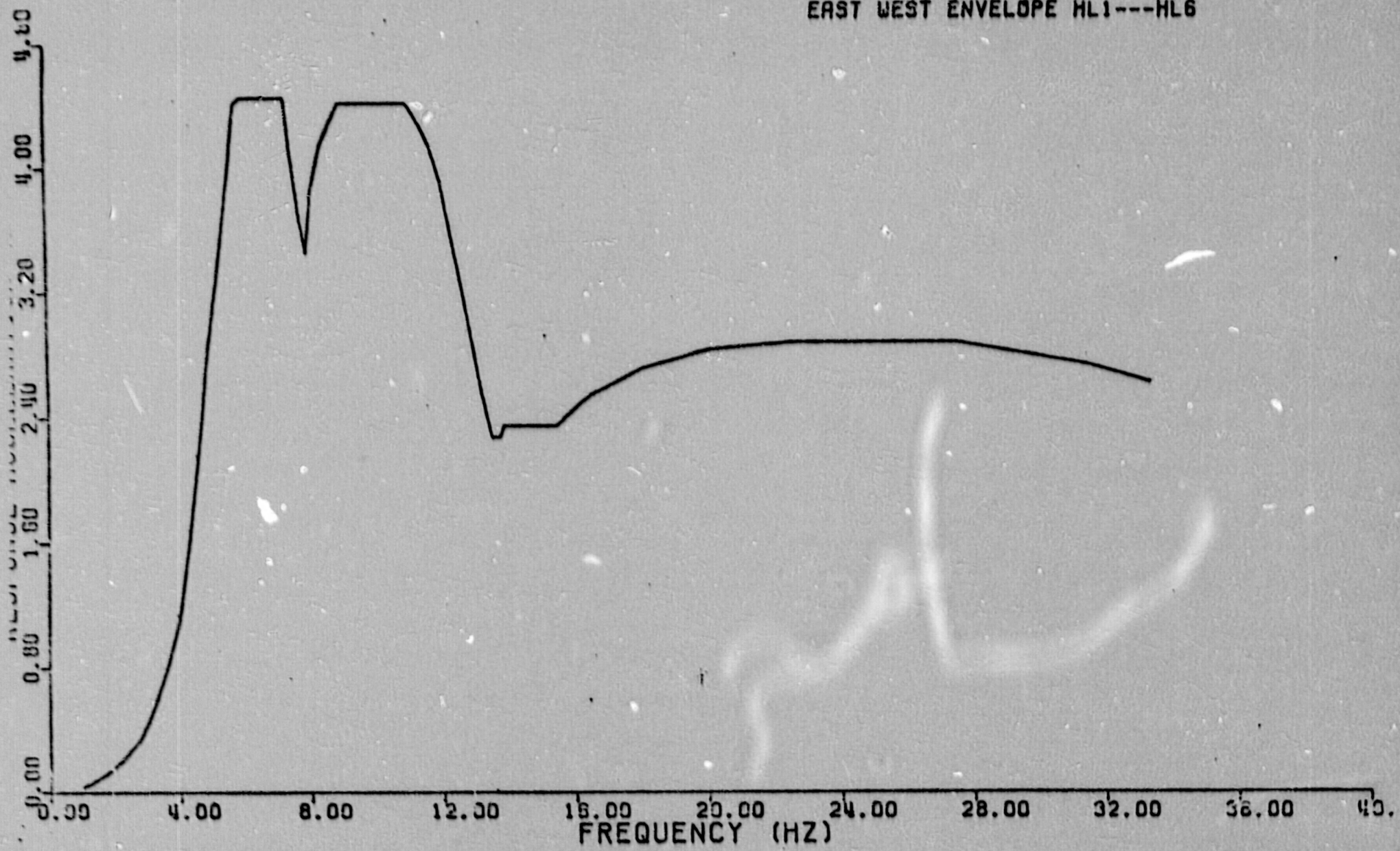
TENNESSEE VALLEY AUTHORITY 09.06.79
RESPONSE ACCELERATION SPECTRUM
UBNP CONTAINMENT EL 792.1,A2300.DEG.
DAMPING RATIO 0.020
NORTH SOUTH ENVELOPE HL1---HL6



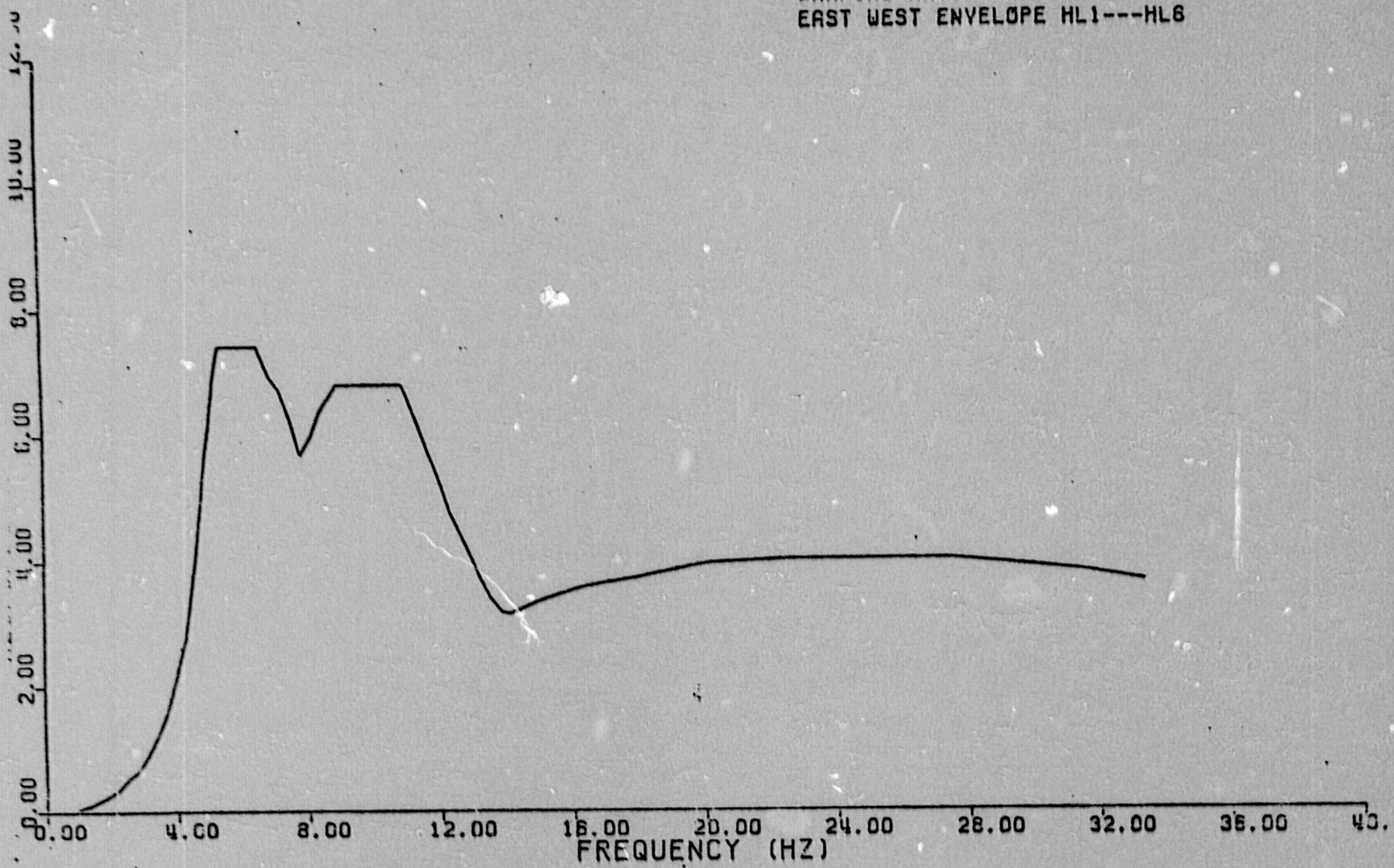
TENNESSEE VALLEY AUTHORITY 09/06/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 716.5,AZ300,DEG.
DAMPING RATIO 0.020
EAST WEST ENVELOPE HL1---HL6



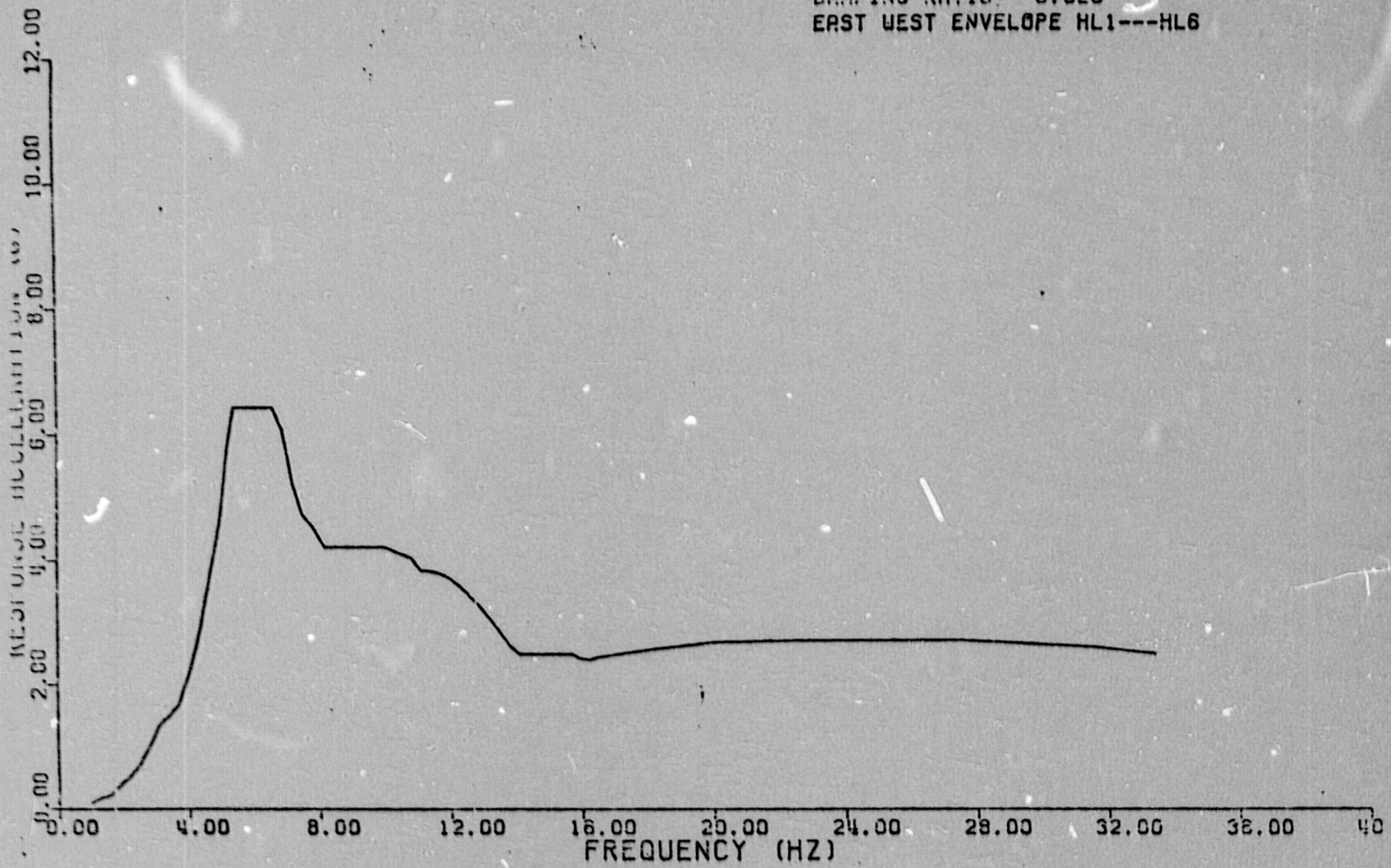
TENNESSEE VALLEY AUTHORITY 09/06/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 733.5,AZ 60.DEG.
DAMPING RATIO 0.020
EAST WEST ENVELOPE HL1---HL6



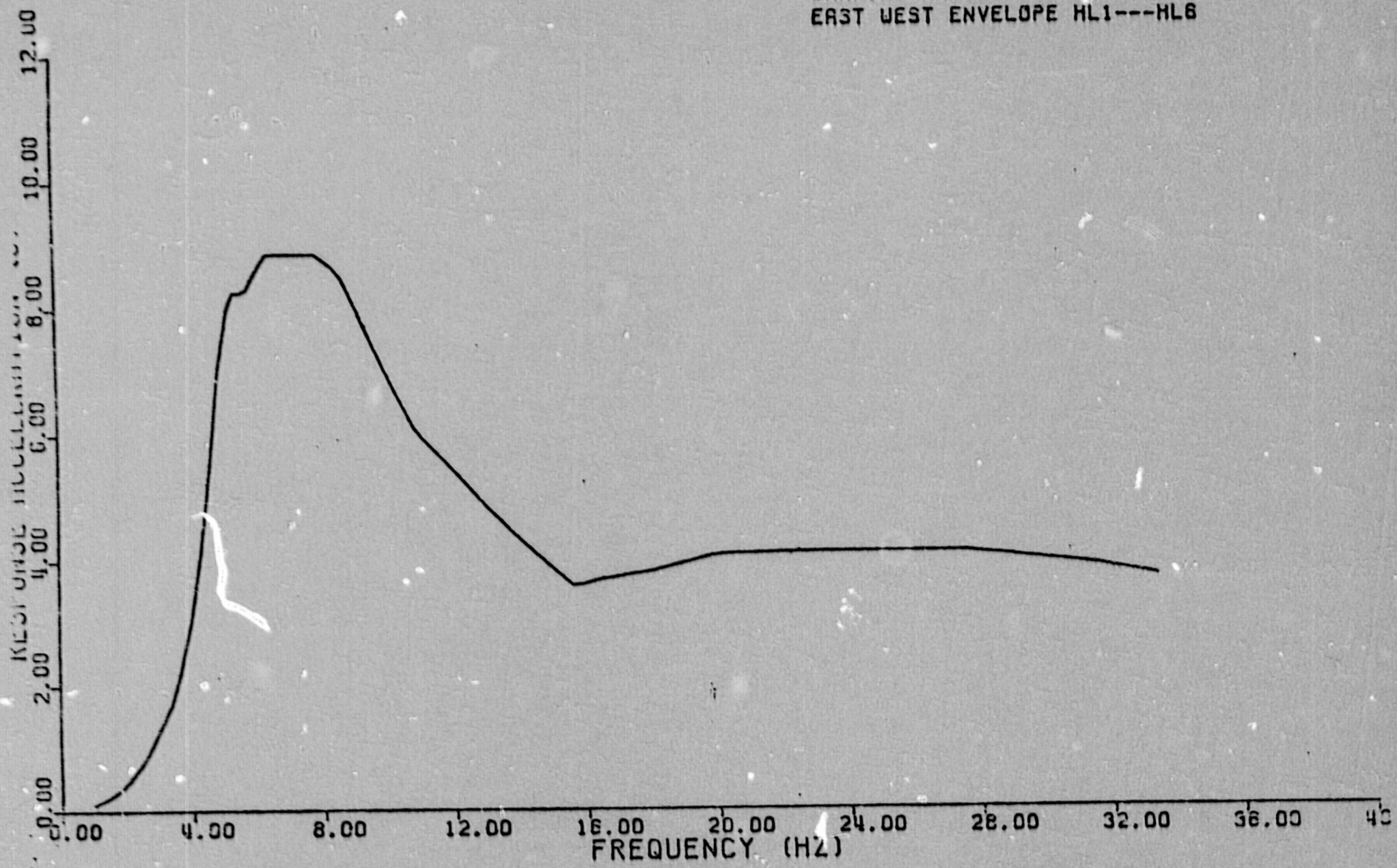
TENNESSEE VALLEY AUTHORITY 09/06/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 733.5,AZ 90.DEG.
DAMPING RATIO 0.020
EAST WEST ENVELOPE HL1---HL6



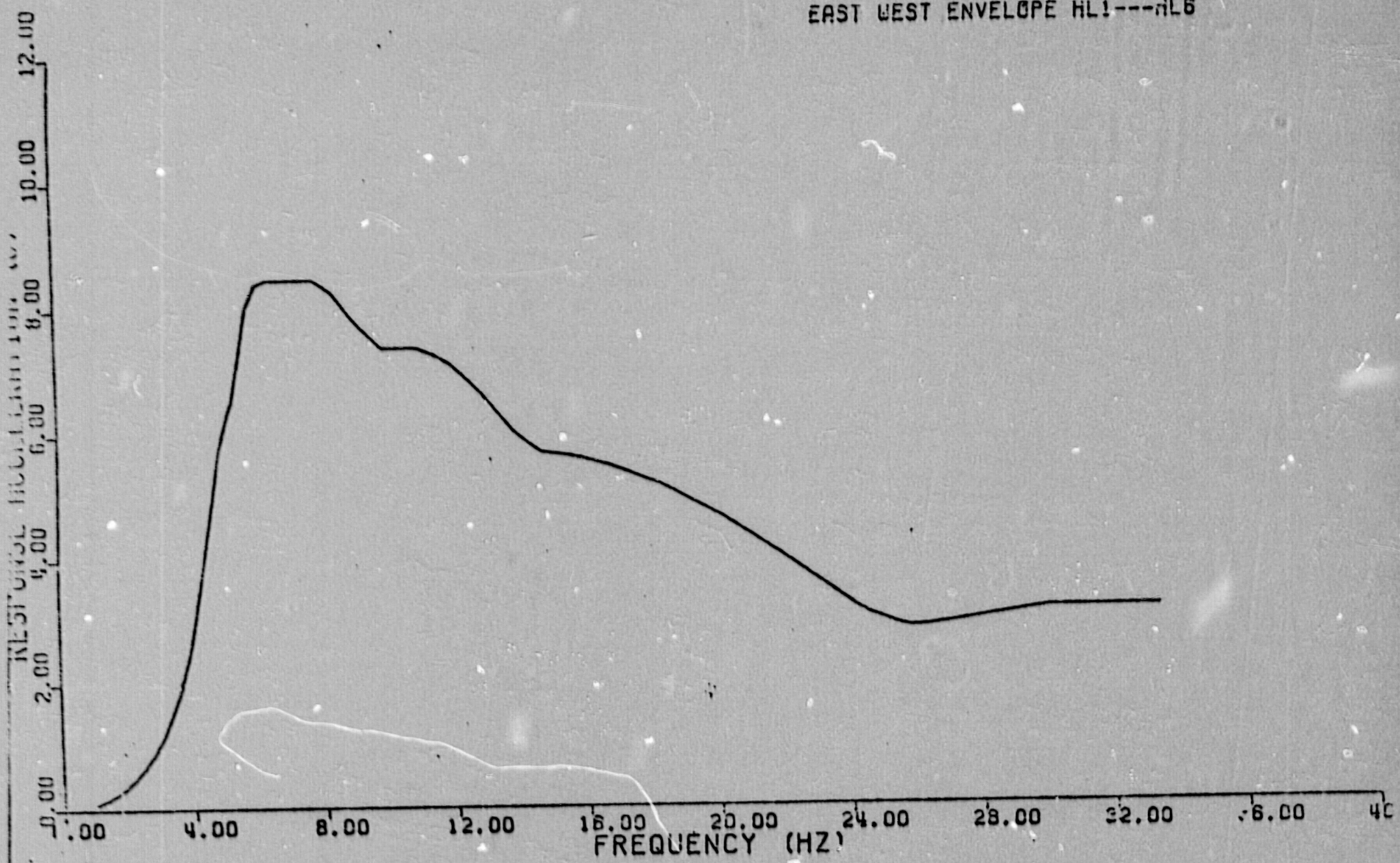
TENNESSEE VALLEY AUTHORITY 06/08/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 733.5,AZ285.DEG.
DAMPING RATIO 0.020
EAST WEST ENVELOPE HL1---HL6



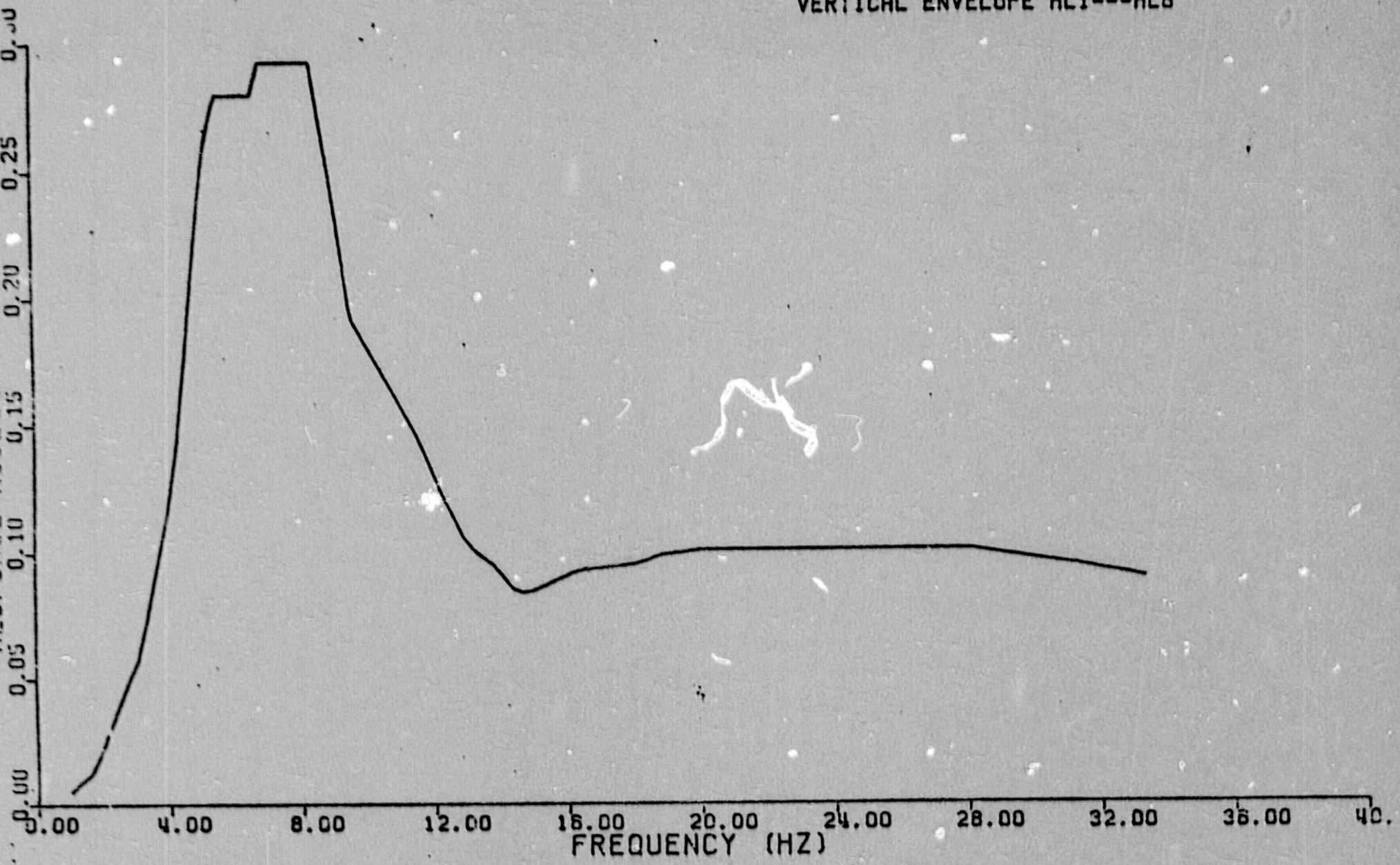
TENNESSEE VALLEY AUTHORITY 09/06/79
RESPONSE ACCELERATION SPECTRUM
UBNP CONTAINMENT EL 773.0,AZ300.DEG.
DAMPING RATIO 0.020
EAST WEST ENVELOPE HL1---HL6



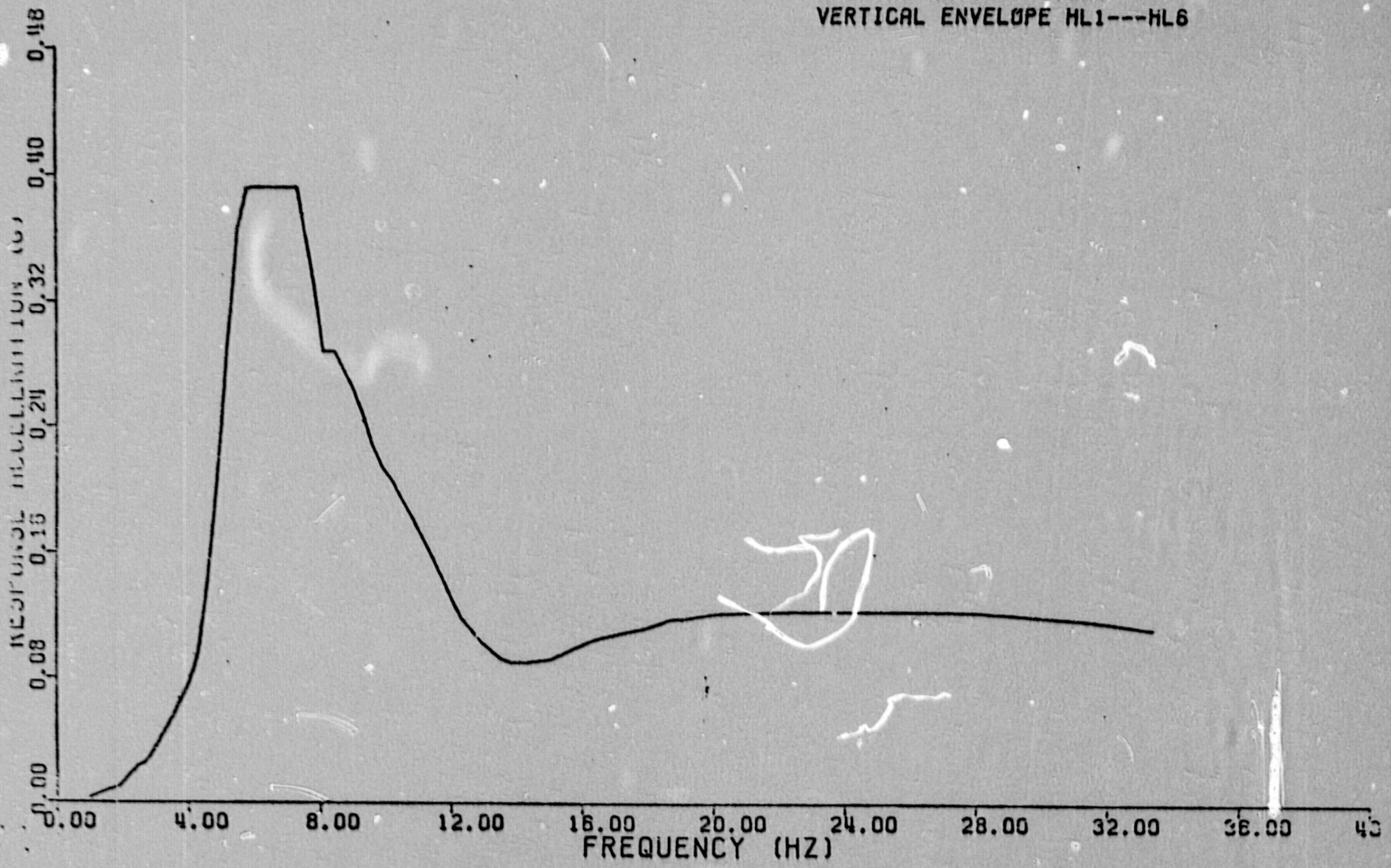
TENNESSEE VALLEY AUTHORITY 09/08/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 792.0,AZ300.DEG.
DAMPING RATIO 0.020
EAST WEST ENVELOPE HL1---HL6



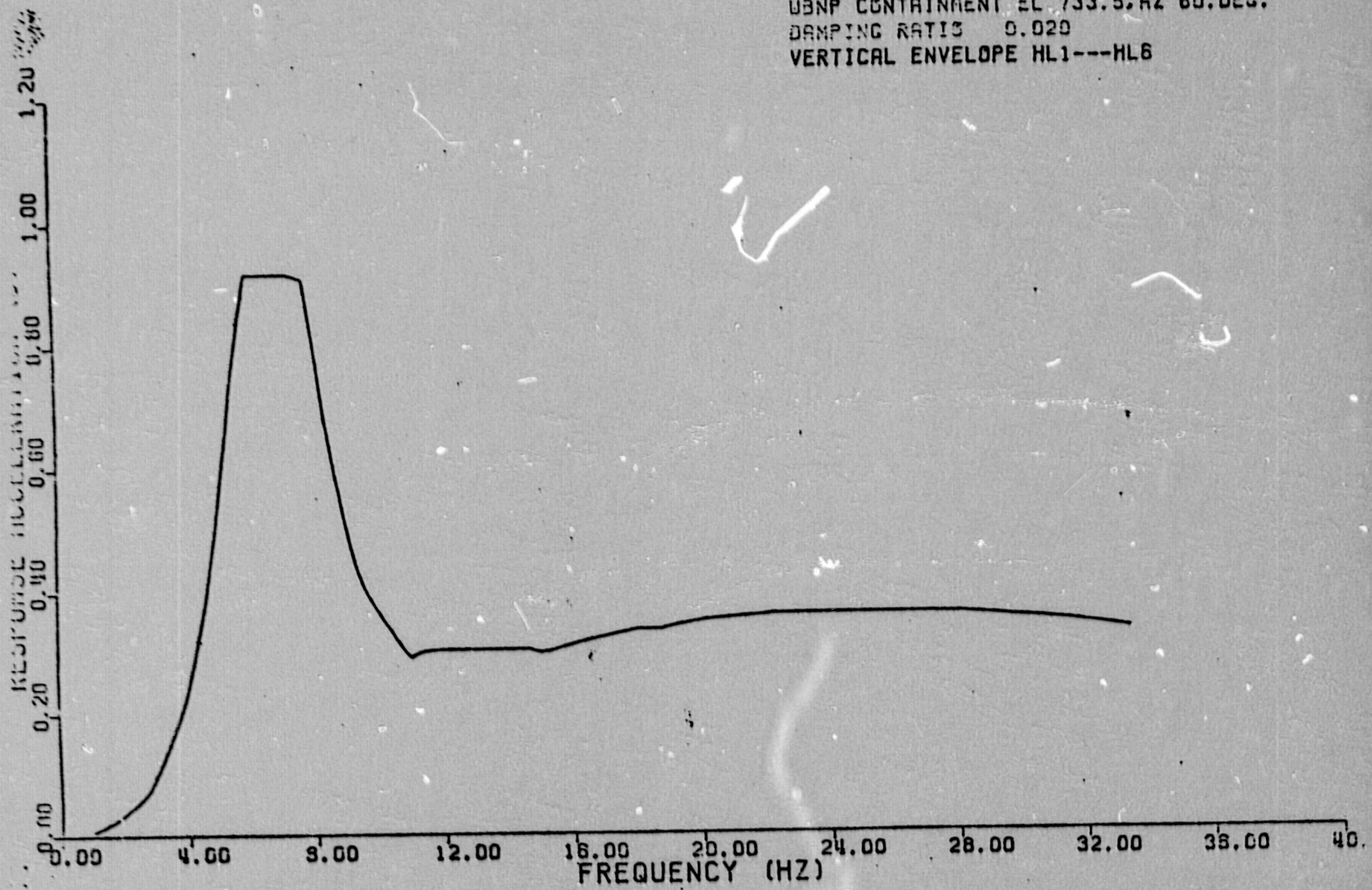
TENNESSEE VALLEY AUTHORITY 09/05/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 716.5,AZ285.DEG.
DAMPING RATIO 0.020
VERTICAL ENVELOPE HL1---HL6



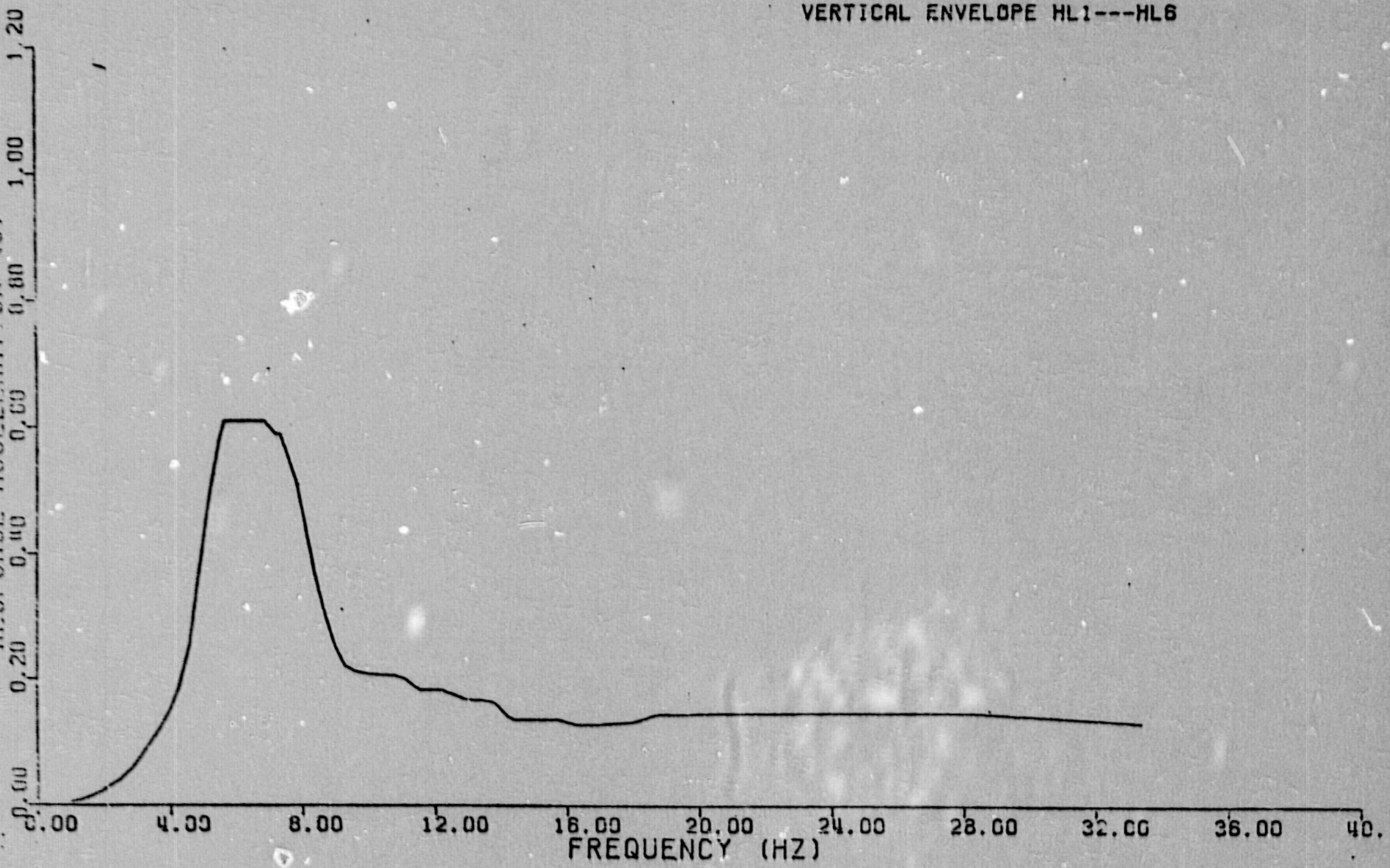
TENNESSEE VALLEY AUTHORITY 09/05/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 716.5.RZ300.DEC.
DAMPING RATIO 0.020
VERTICAL ENVELOPE HL1---HL6



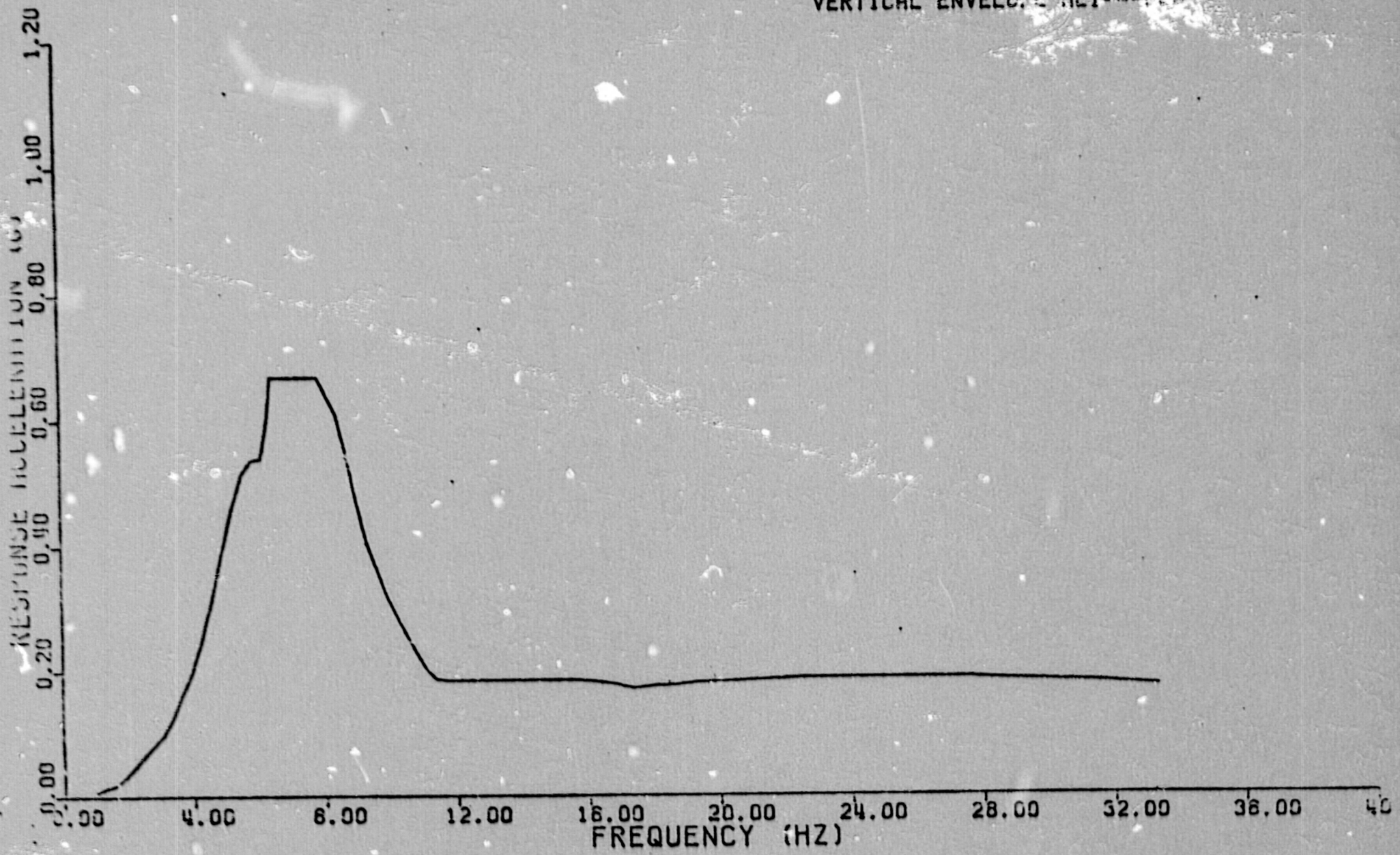
TENNESSEE VALLEY AUTHORITY 09/05/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 733.5, AZ 60.DEG.
DAMPING RATIO 0.020
VERTICAL ENVELOPE HL1---HL6



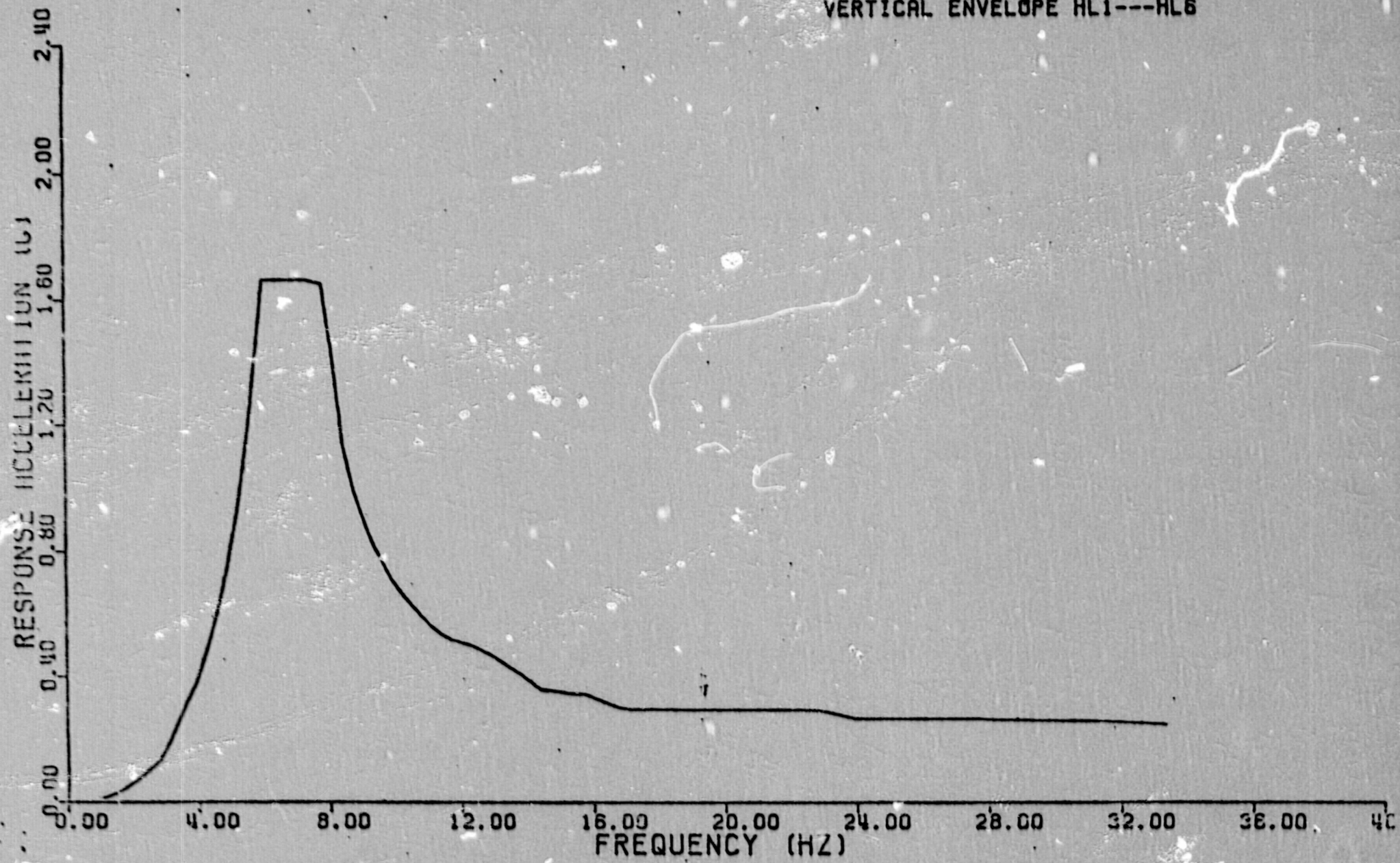
TENNESSEE VALLEY AUTHORITY 09/05/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 733.5,AZ 90.DEG.
DAMPING RATIO 0.0[illegible]
VERTICAL ENVELOPE HL1---HL6



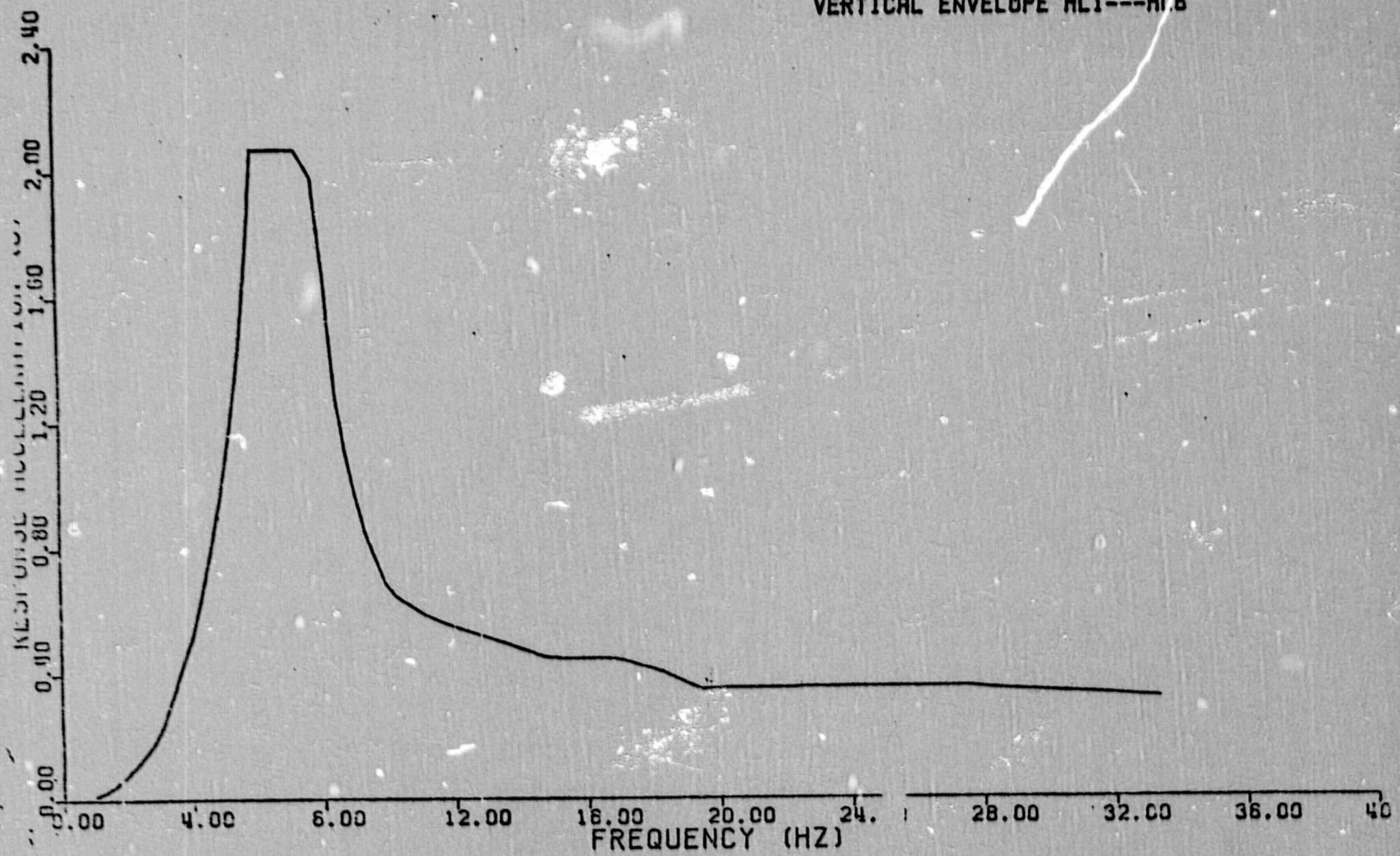
TENNESSEE VALLEY AUTHORITY 08/05/78
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 733.5,AZ285.DEG.
DAMPING RATIO 0.020
VERTICAL ENVELOPE HL1---1.8



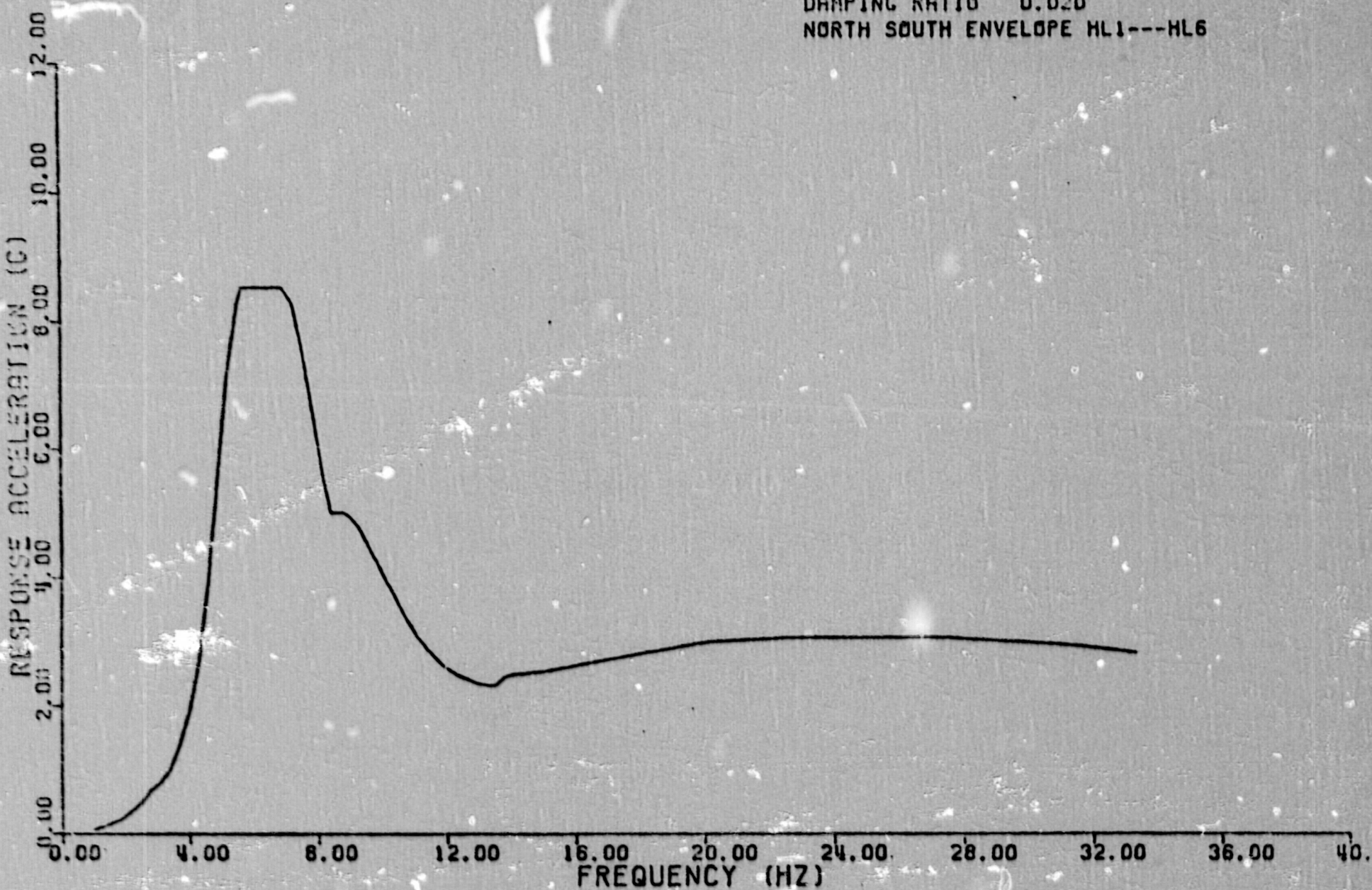
TENNESSEE VALLEY AUTHORITY 09/05/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 773.0,AZ300.DEG.
DAMPING RATIO 0.020
VERTICAL ENVELOPE HL1---HL6

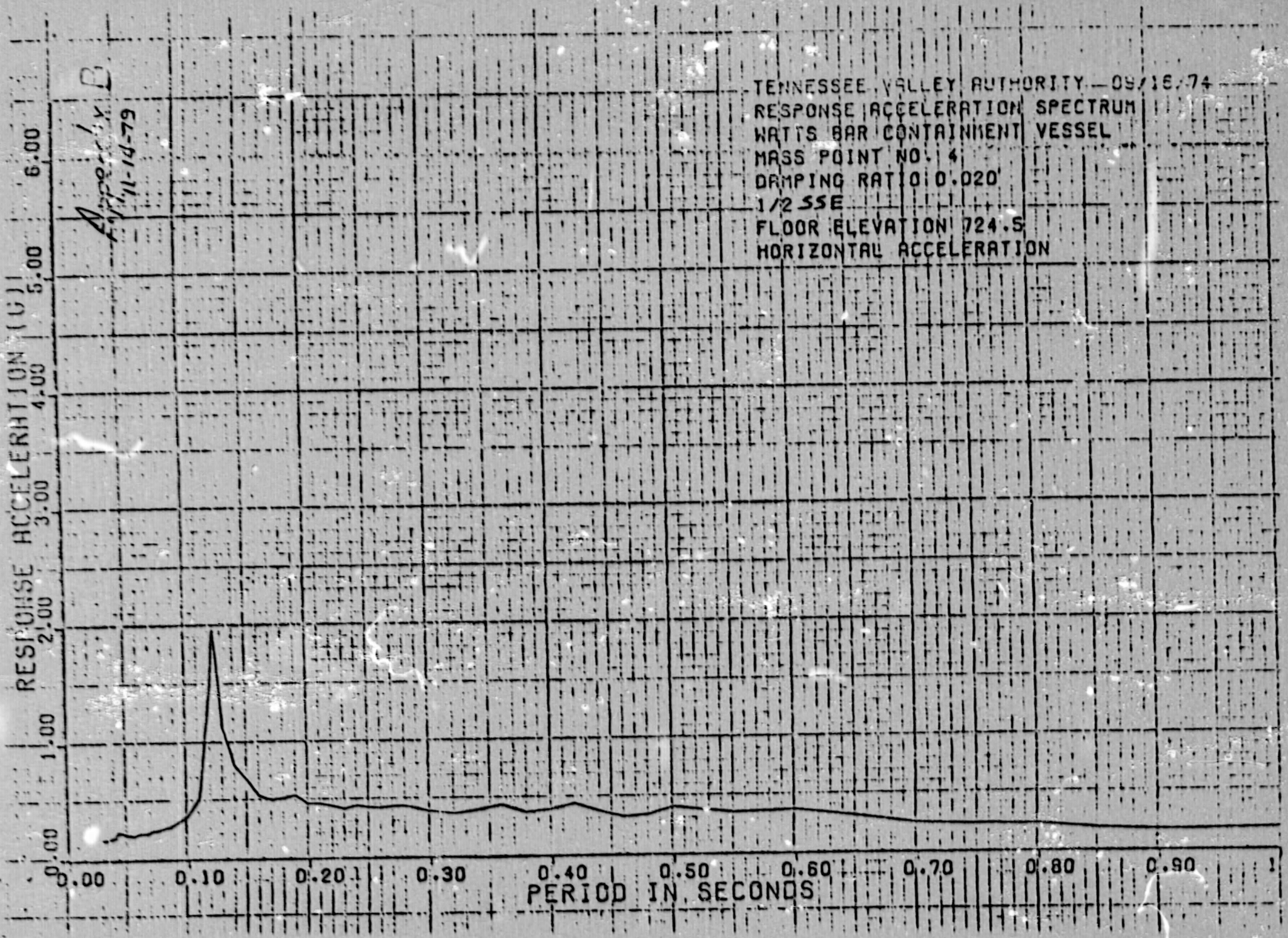


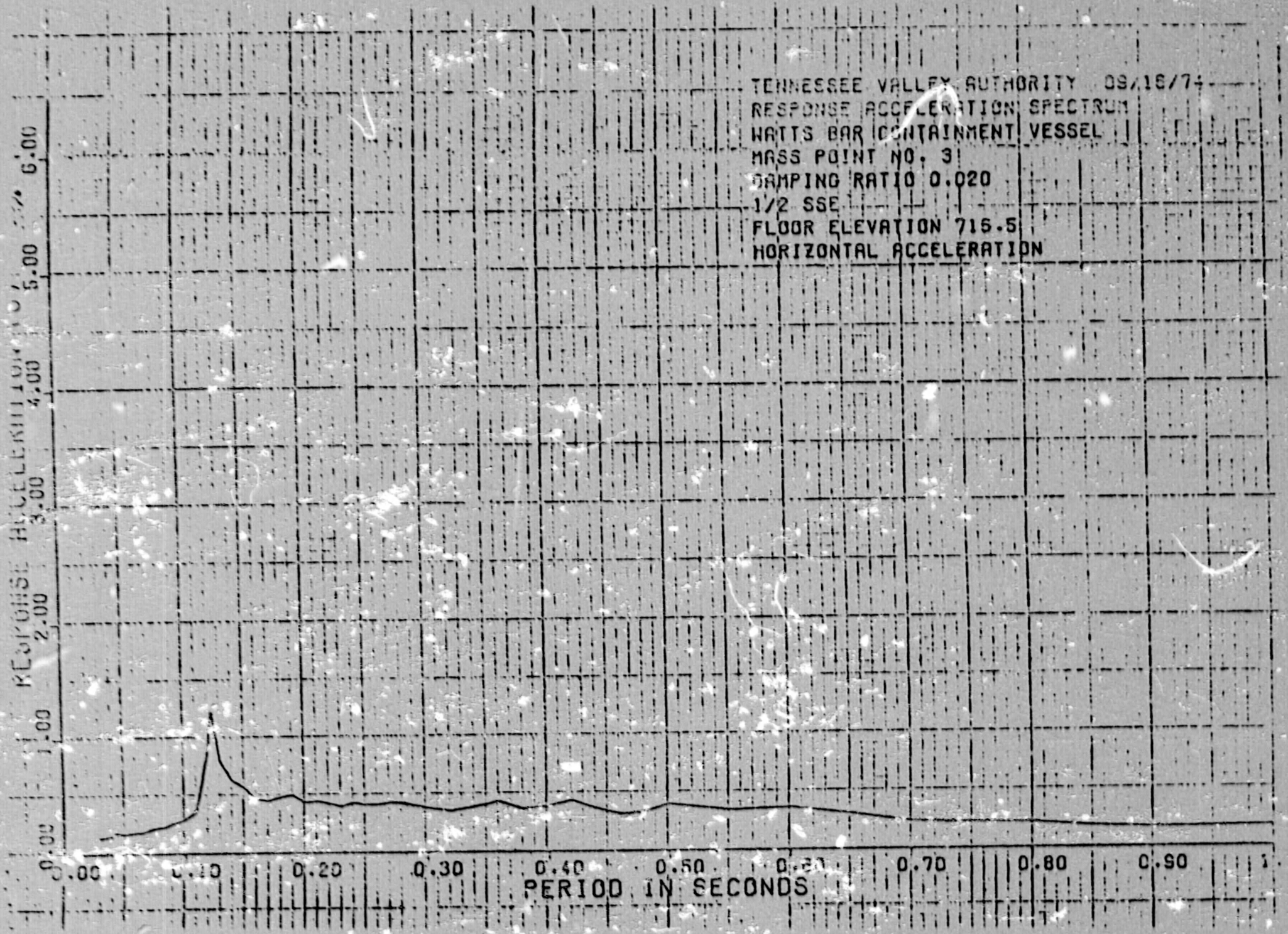
TENNESSEE VALLEY AUTHORITY 09/05/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 792 0.AZ300.DEG.
DAMPING RATIO 0.02
VERTICAL ENVELOPE HL1---HL6

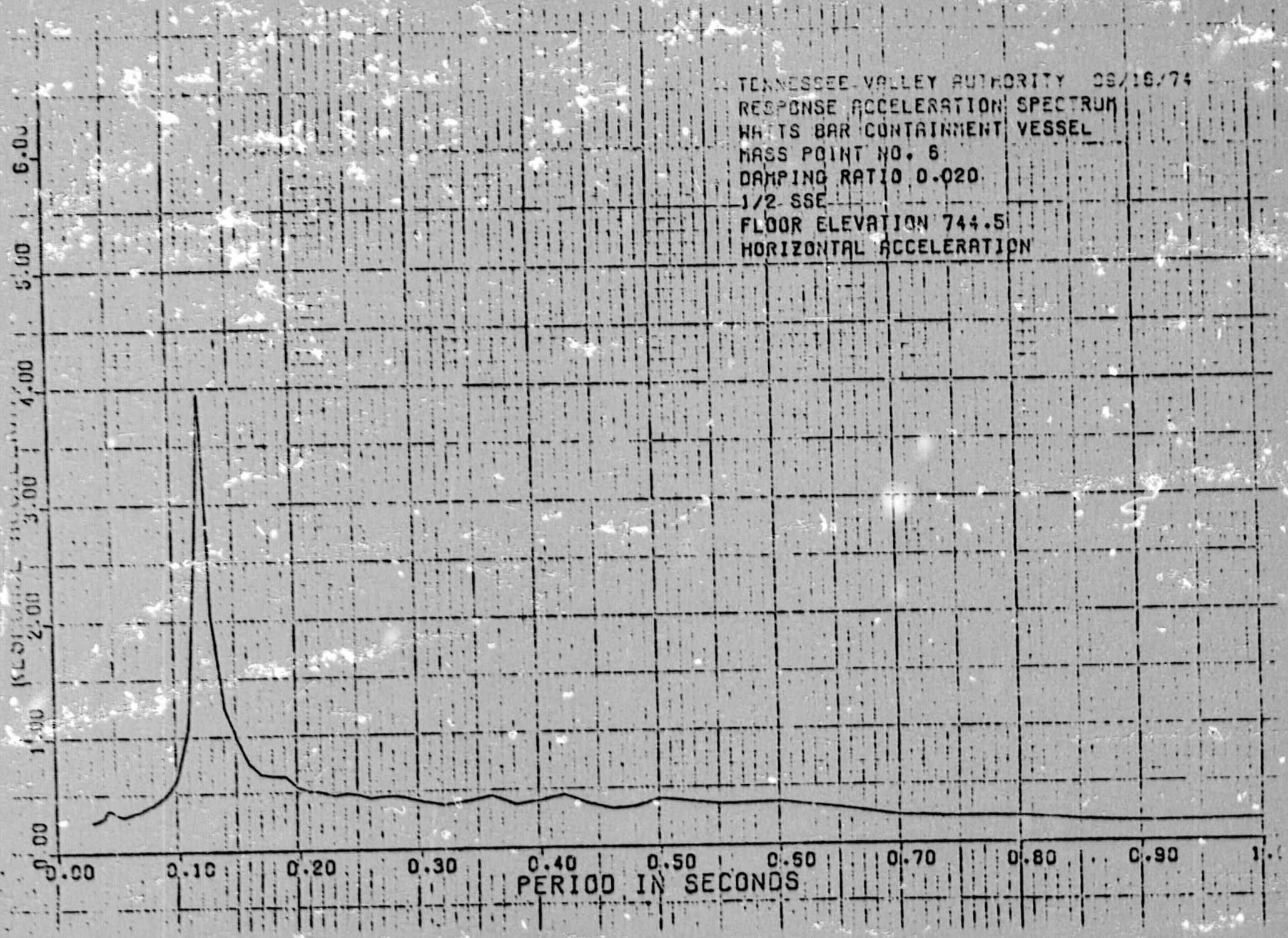


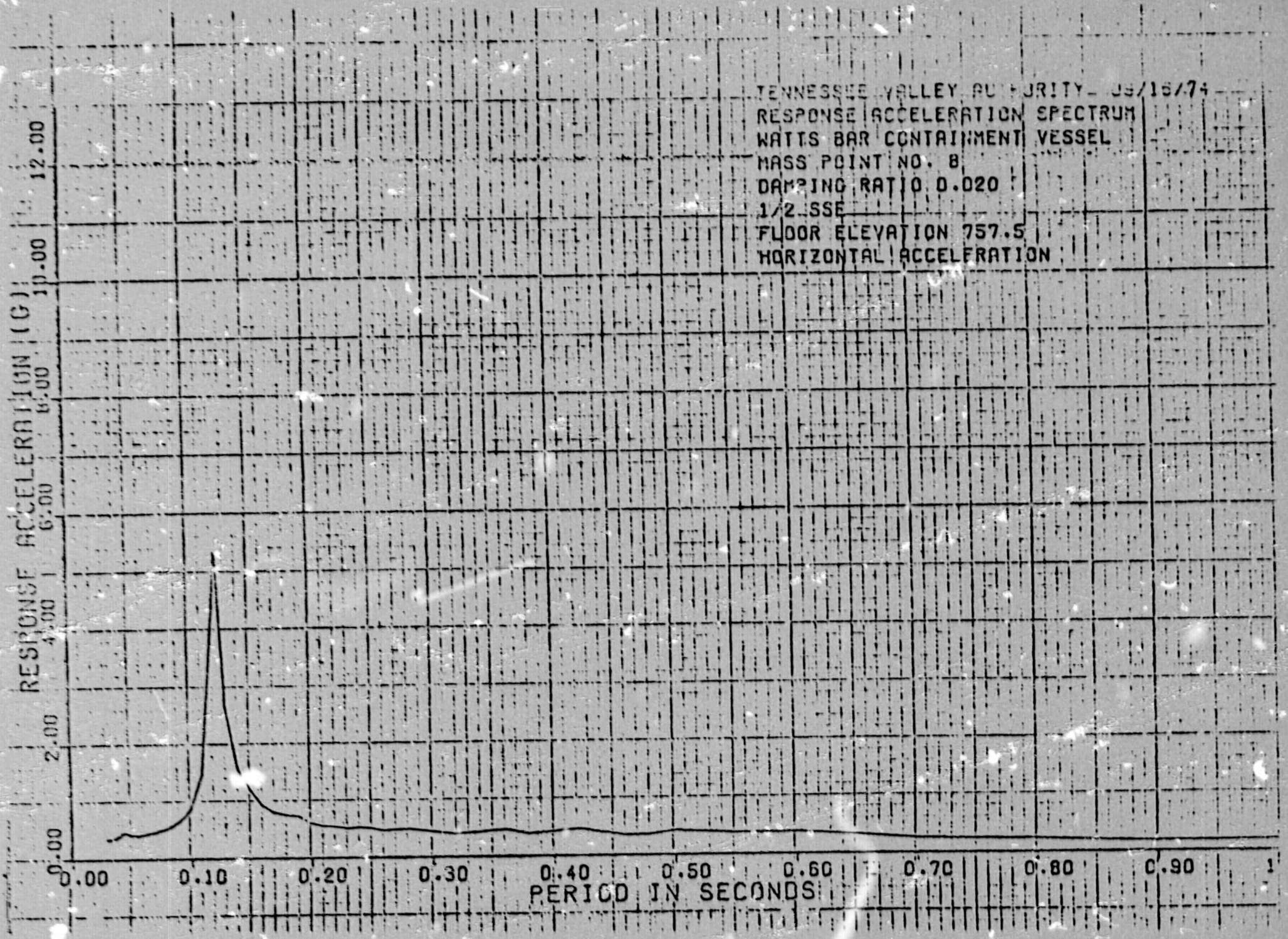
TENNESSEE VALLEY AUTHORITY 09/06/79
RESPONSE ACCELERATION SPECTRUM
WBNP CONTAINMENT EL 754.0,AZ300.DEG.
DAMPING RATIO 0.020
NORTH SOUTH ENVELOPE HL1---HL6

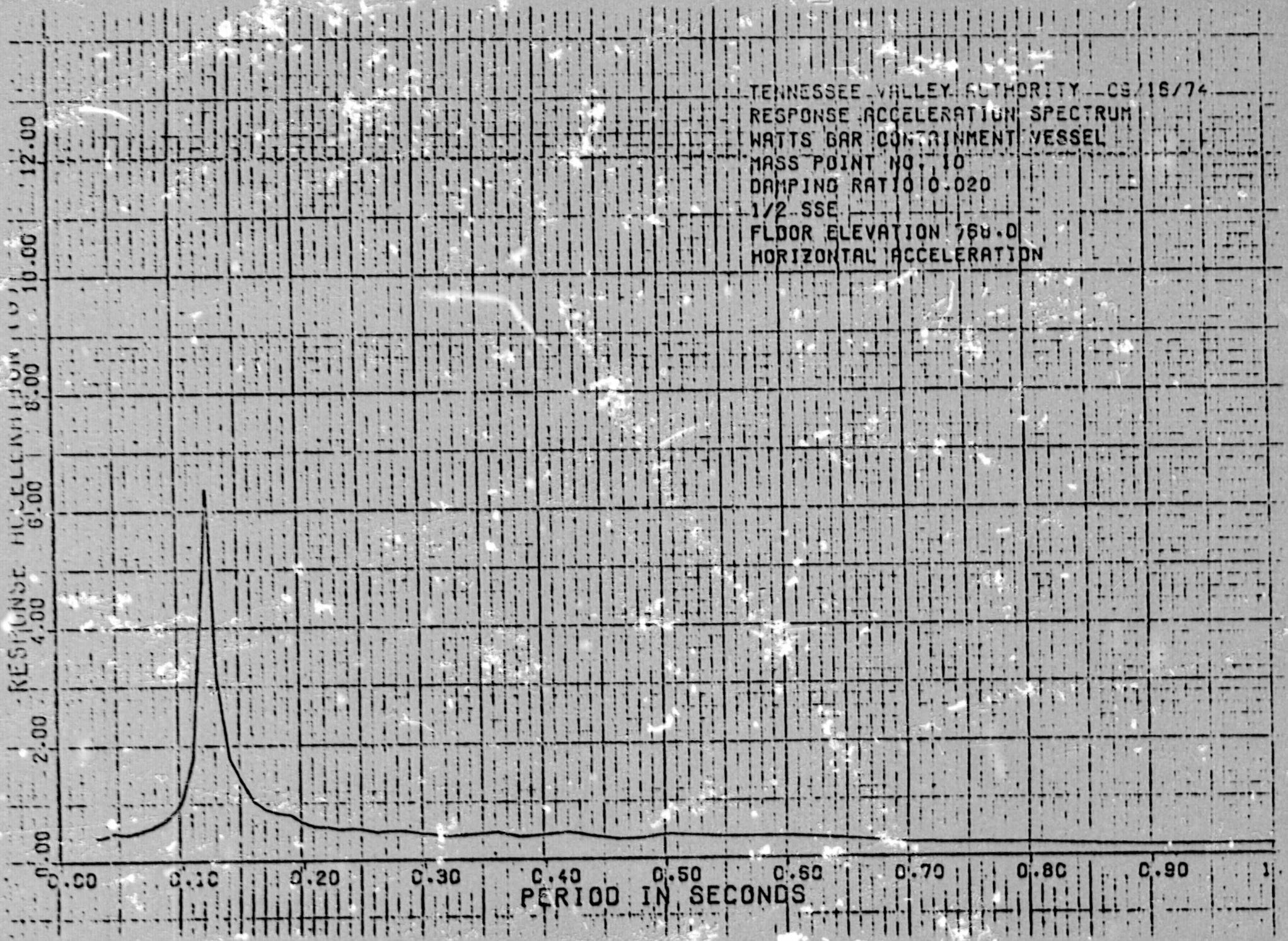


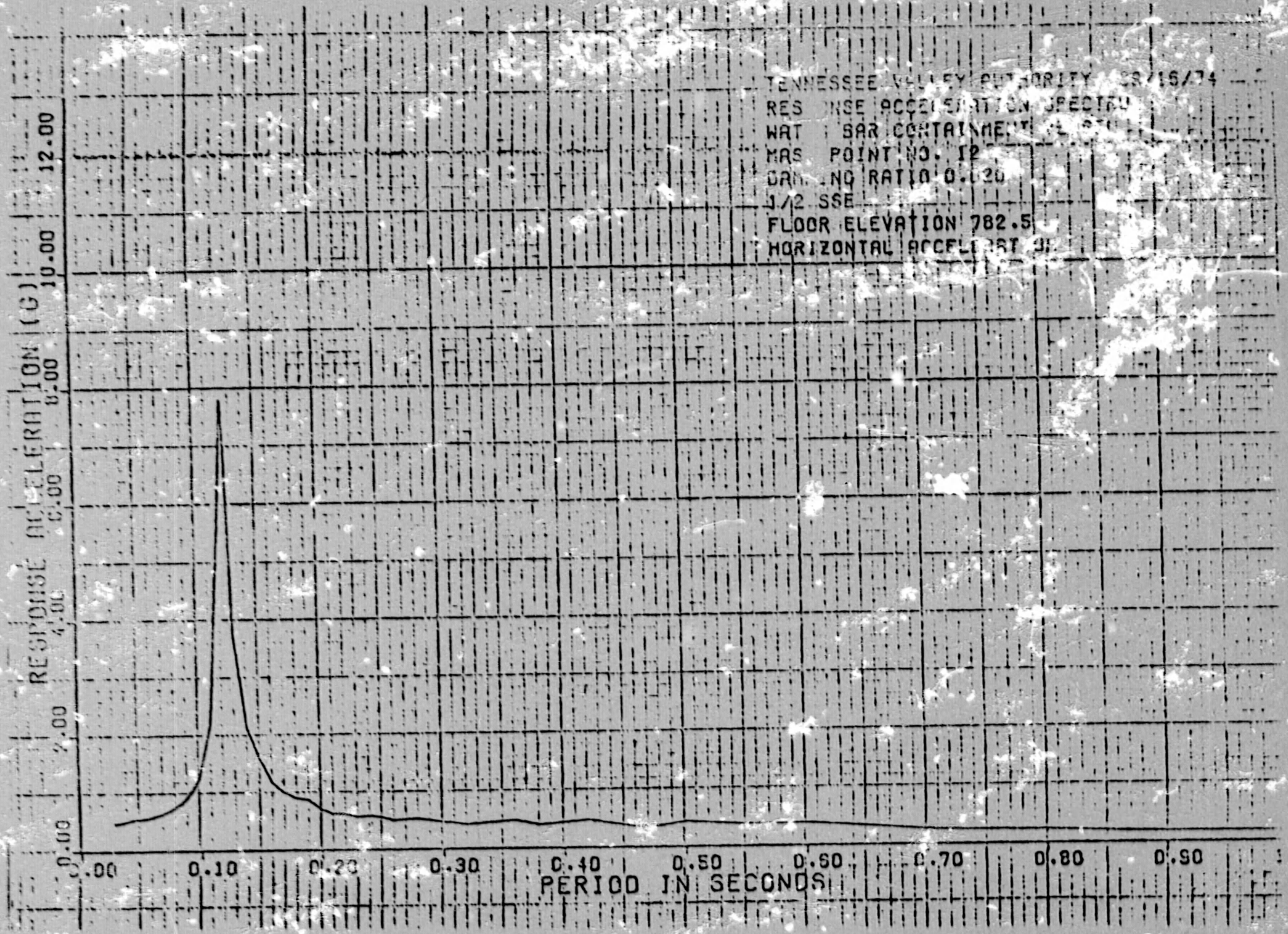

TENNESSEE VALLEY AUTHORITY — 09/16/74
RESPONSE ACCELERATION SPECTRUM
WATTS BAR CONTAINMENT VESSEL
MASS POINT NO. 4
DAMPING RATIO 0.020
1/2 SSE
FLOOR ELEVATION 724.5
HORIZONTAL ACCELERATION
RESPONSE ACCELERATION (G)
0.00
1.00
2.00
3.00
4.00
5.00
6.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1
PERIOD IN SECONDS
Approved
11-14-79
B


TENNESSEE VALLEY AUTHORITY 09/18/74
RESPONSE ACCELERATION SPECTRUM
WATTS BAR CONTAINMENT VESSEL
MASS POINT NO. 3
DAMPING RATIO 0.020
1/2 SSE
FLOOR ELEVATION 715.5
HORIZONTAL ACCELERATION
RESPONSE ACCELERATION
0.00
1.00
2.00
3.00
4.00
5.00
6.00
0.00
0.10
0.20
0.30
0.40
0.50
0.70
0.80
0.90
1
PERIOD IN SECONDS

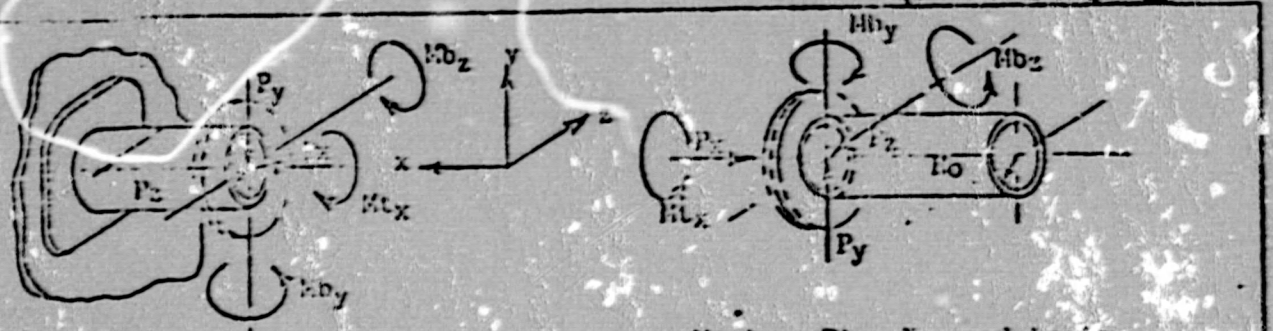

TENNESSEE VALLEY AUTHORITY 09/16/74
RESPONSE ACCELERATION SPECTRUM
WATTS BAR CONTAINMENT VESSEL
MASS POINT NO. 6
DAMPING RATIO 0.020
1/2 SSE
FLOOR ELEVATION 744.5
HORIZONTAL ACCELERATION
0.00
1.00
2.00
3.00
4.00
5.00
6.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
PERIOD IN SECONDS


TENNESSEE VALLEY AUTHORITY- 05/16/74
RESPONSE ACCELERATION SPECTRUM
WATTS BAR CONTAINMENT VESSEL
MASS POINT NO. 8
DAMPING RATIO 0.020
1/2 SSE
FLOOR ELEVATION 757.5
HORIZONTAL ACCELERATION
RESPONSE ACCELERATION (G)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1
PERIOD IN SECONDS


TENNESSEE VALLEY AUTHORITY 05/16/74
RESPONSE ACCELERATION SPECTRUM
WATTS BAR CONTAINMENT VESSEL
MASS POINT NO. 10
DAMPING RATIO 0.020
1/2 SSE
FLOOR ELEVATION 760.0
HORIZONTAL ACCELERATION
RESPONSE ACCELERATION
0.00
2.00
4.00
6.00
8.00
10.00
12.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1
PERIOD IN SECONDS


TENNESSEE VALLEY AUTHORITY
RES NSE ACCELERATION SPECTRU
WAT SAR CONTAINMENT
MAS POINT NO. 12
DAMPING RATIO 0.020
1/2 SSE
FLOOR ELEVATION 782.5
HORIZONTAL ACCELERATION
RESPONSE ACCELERATION (G)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
PERIOD IN SECONDS

APPENDIX C 11-14-79



Minimum Nozzle Loads | Maximum Pipe Imposed Loads

The Axial or Lateral Forces $P_{x,y,z}$ shall be .01 times the force at yield in the pipe.	$P^*_{x,y,z} = 0.01\ \sigma_y$
The Bending Moment $M_{by,z}$ shall be 0.0707 times the moment at yield in the pipe.	$M_{by,z} = 0.0707\ \sigma_y Z$
The Torsional Moment (M_{tx}) shall be 0.1 times the torsional moment at yield in the pipe.	$M_{tx} = 0.1\ \frac{\sigma_y J}{R_o} = .2\ \sigma_y Z$

Definitions

$P_{x,y,z}$ = Minimum design force on nozzle*/penetration.

= Maximum allowable pipe imposed load.

$M_{by,z}$ = Minimum design bending moment on nozzle*/penetration.

= Maximum allowable pipe imposed bending moment.

M_{tx} = Minimum design torsional moment on nozzle/penetration.

= Maximum allowable pipe imposed torsional moment.

A = Metal cross sectional area of pipe.

Ao = Cross sectional area of pipe.

J = Polar moment of inertia of pipe cross section = $\frac{\pi}{32}\ (d_o^4 - d_i^4)$

P = Internal design pressure.

R_o = Outer pipe radius.

Z = Pipe section modulus = I/c

σ_y = Yield stress in pipe at operating temperature.

*The load given for P_x shall be in addition to the internally induced pressure load PA_o, when evaluating the minimum design axial nozzle load.

FIGURE 1
[illegible] LOADS