RAS 5269 72-22-ISFSI — Applicant Exhibit 85- Rec'd 4/29/02

CALCULATION COVER SHEET

JOB NO. 1101-000
FILE NO.
CALC NO G(PO17)-2
NO OF SHEETS 289

PROJECT Private Fuel Storage Facility (PFSF)
SUBJECT Storage Pad Analysis and Design

RECORD OF ISSUES

NO.	DESCRIPTION	BY	DATE	CHKD	DATE	APPRD	DATE
0	Initial Issue	DH AWM	10/18/99	DH AWM	10/18/99		10/18/99
1	Revision 1 (see notes below)	DH	12/6/99	DH	12/6/99		12/6/99
2	Revision 2 (see notes below)	DH	2/4/00		2/4/00		2/4/00
3	Revision 3 (see notes on Sheet ii)	AWM DH	4/5/01	AWM DH	4/5/01		4/5/01

☒ Nuclear Quality Assurance Category ☐ Non-Nuclear Quality Assurance Category

This set of calculations documents the engineering analyses and detailed calculations required for structural design of the reinforced-concrete spent-fuel cask storage pads to be constructed at the Private Fuel Storage Facility (PFSF) project site.

This set of calculations has been prepared in accordance with CEC's quality assurance procedure for nuclear projects.

Revision 1 was made to correct (1) typographical errors on Pages 5, 29, and A-3 and (2) insert computer output file names and explanation notes on Pages 43 and 51.

Revision 2 was made to correct typographical errors and to include additional clarifications on Pages 17, 21, 28, 236, 298, and 312.

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CALCULATION COVER SHEET

PROJECT Private Fuel Storage Facility (PFSF)
SUBJECT Storage Pad Analysis and Design

JOB NO. 1101-000
FILE NO.
CALC NO. G(PO17)-2
SHEET ii

Revision 3 was made to incorporate the following: (1) PGA of 0.711g and 0.695g for horizontal and vertical components of the new design ground motions, (2) Revised dynamic soil properties for lower-bound, best-estimate, and upper-bound soils provided by Geomatrix, (3) Revised cask force time-histories provided by Holtec, (4) Revised pad size to 30 ft by 67 ft with cask spacing in the long axis of the pad changed to 16 ft and cask spacing in the short axis of the pad remained at 15 ft, (5) Pad founded in soil cement with about 3 ft under the pad and 2 ft thick on its side walls, and (6) Revised transporter weight to 145 kips.

CALCULATION SHEET

ORIGINATOR	KV	DATE 4/3/01	CALC. NO. G(PO17)-2	REV.NO.	3
PROJECT	Private Fuel Storage Facility		CHECKED DH	DATE	4/3/01
SUBJECT	Storage Pad Analysis and Design			JOB NO	1101-000
				SHEET	1

1. OBJECTIVE

The objective of this set of calculations is to present the analyses and detailed calculations required for the design of the reinforced-concrete spent-fuel cask storage pads to be constructed at the PFSF project site.

5.2.1 SASSI Model

The strain-compatible soil properties for the SASSI model were provided by Reference 5. They are listed on the following pages.

Table 1

16-Feb-01

Dynamic Soil Properties for SASSI Model

High Range Properties

Shake Layers	Depth Top (ft)	Depth Bottom (ft)	Wave Velocity Density (pcf)	Vs (fps)	Vp (fps)	Damping Ratio Shear (%)	Compression (%)	Poisson's Ratio
1-2	0	5	100	2120	3380	0 91	0 91	0 176
3-4	5	10	80	557	1385	3 48	3 48	0 403
5	10	12	80	807	1543	2 69	2 69	0 312
6-7	12	18	100	983	1803	1 82	1.82	0 289
8-9	18	26	94	973	1764	2 31	2 31	0.281
10-12	26	35	115	1053	2042	5 07	5 07	0 319
13-15	35	50	115	1488	2949	4 04	4 04	0 329
16-23	50	90	120	2481	4808	1 21	1 21	0 318
24-26	90	125	135	4101	7104	4 28	4 28	0 250
27-35	125	300	145	4101	7104	4 28	4 28	0 250
36-39	300	500	145	5657	9798	3 10	3 10	0 250
40-41	500	700	145	6398	11155	2 53	2 53	0 255
	700		170	6398	11155	2 16	1 00	0 255

Best Estimate Properties

Shake Layers	Depth Top (ft)	Depth Bottom (ft)	Wave Velocity Density (pcf)	Vs (fps)	Vp (fps)	Damping Ratio Shear (%)	Compression (%)	Poisson's Ratio
1-2	0	5	100	1497	2390	0 94	0 94	0 177
3-4	5	10	80	415	1131	4 78	4 78	0 422
5	10	12	80	622	1260	3 60	3 60	0 339
6-7	12	18	100	779	1472	2 29	2 29	0.306
8-9	18	26	94	760	1440	3 01	3 01	0 307
10-12	26	35	115	818	1667	6 21	6 21	0 341
13-15	35	50	115	956	2085	6 13	6 13	0 367
16-23	50	90	120	1716	3400	1 74	1 74	0 329
24-26	90	125	135	2900	5023	4 32	4 32	0 250
27-35	125	300	145	2900	5023	4 32	4 32	0 250
36-39	300	500	145	3450	5975 5	3 67	3 67	0 250
40-41	500	700	145	3950	6841.5	3 33	3 33	0 250
	700		170	6398	11155	1 76	1 00	0 255

CEC JOB NO. 1101-000
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Low Range Properties

Shake Layers	Depth Top (ft)	Depth Bottom (ft)	Density (pcf)	Wave Velocity Vs (fps)	Wave Velocity Vp (fps)	Damping Ratio Shear (%)	Damping Ratio Compression (%)	Poisson's Ratio
1-2	0	5	100	1053	1690	1 08	1.08	0 183
3-4	5	10	80	298	923	6 57	6 57	0 442
5	10	12	80	622	1260	3 60	3 60	0 339
6-7	12	18	100	610	1202	2 97	2 97	0 327
8-9	18	26	94	593	1176	3 73	3 73	0 330
10-12	26	35	115	614	1361	8 09	8 09	0 372
13-15	35	50	115	565	1474	9 82	9 82	0 414
16-23	50	90	120	1191	2404	2 18	2 18	0 337
24-26	90	125	135	2051	3552	3 97	3 97	0 250
27-35	125	300	145	2051	3552	3 97	3 97	0 250
36-39	300	500	145	2051	3552	3 97	3 97	0 250
40-41	500	700	145	2051	3552	3 97	3 97	0 250
	700		170	6398	11155	2 16	1 00	0 255

CALCULATION SHEET

ORIGINATOR DH DATE 4/3/01 CALC. NO. G(PO17)-2 REV. NO. 3
CHECKED [illegible] DATE 4/3/01
PROJECT Private Fuel Storage Facility JOB NO 1101-000
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Low Range Properties

Shake Layers (no)	Depth Top (ft)	Depth Bottom (ft)	Soil Density (pcf)	Wave Vs (fps)	Velocity Vp (fps)	Damping Shear (%)	Ratio Compression (%)	Layer Thick (ft)	Cut-off Freq (cps)
1-2	0	5	100	1053	1690	1.08	1 08	5	42.1
3-4	5	10	80	298	923	6.57	6 57	5	11.9
5	10	12	80	622	1260	3.60	3 60	2	62.2
6-7	12	18	100	610	1202	2 97	2.97	6	20.3
8-9	18	26	94	593	1176	3.73	3 73	8	14.8
10-12	26	35	115	614	1361	8 09	8 09	9	13.6
13-15	35	50	115	565	1474	9 82	9 82	15	7.5
16-23	50	90	120	1191	2404	2.18	2.18	40	6.0
24-26	90	125	135	2051	3552	3 97	3 97	35 01	11.7
27-35	125	300	145	2051	3552	3.97	3 97	174.96	2.3
36-39	300	500	145	2051	3552	3.97	3 97	200	2.1
40-41	500	700	145	2051	3552	3 97	3.97	200	2 1
HS	700	900	170	6398	11155	2 16	1.00	200 03	6 4
							total	699 97	

CALCULATION SHEET

ORIGINATOR DH DATE 4/3/01 CALC NO G(PO17)-2 REV. NO. 3
CHECKED [illegible] DATE 4/3/01
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SUBJECT Storage Pad Analysis and Design SHEET NO 14

Best Estimate Properties

Shake Layers (no)	Depth Top (ft)	Depth Bottom (ft)	Soil Density (pcf)	Wave Vs (fps)	Velocity Vp (fps)	Damping Shear (%)	Ratio Compression (%)	Layer Thick (ft)	Cut-off Freq (cps)
1-2	0	5	100	1497	2390	0.94	0.94	5	59.9
3-4	5	10	80	415	1131	4.78	4.78	5	16 6
5	10	12	80	622	1260	3 60	3 60	2	62.2
6-7	12	18	100	779	1472	2 29	2 29	6	26.0
8-9	18	26	94	760	1440	3 01	3 01	8	19 0
10-12	26	35	115	818	1667	6.21	6 21	9	18.2
13-15	35	50	115	956	2085	6.13	6.13	15	12.7
16-23	50	90	120	1716	3400	1.74	1.74	40	8 6
24-26	90	125	135	2900	5023	4.32	4.32	35 01	16 6
27-35	125	300	145	2900	5023	4 32	4.32	174.96	3.3
36-39	300	500	145	3450	5975.5	3 67	3 67	200	3 5
40-41	500	700	145	3950	6841.5	3.33	3 33	200	4 0
HS	700	900	170	6398	11155	1.76	1.00	200 03	6 4
							total	699.97	

CALCULATION SHEET

ORIGINATOR PH DATE 4/3/01 CALC. NO. G(PO17)-2 REV. NO 3
CHECKED [illegible] DATE 4/3/01
PROJECT Private Fuel Storage Facility JOB NO. 1101-000
SUBJECT Storage Pad Analysis and Design SHEET NO 142

Upper Range Properties

Shake Layers (no)	Depth Top (ft)	Depth Bottom (ft)	Soil Density (pcf)	Wave Vs (fps)	Velocity Vp (fps)	Damping Shear (%)	Ratio Compression (%)	Layer Thick (ft)	Cut-off Freq (cps)
1-2	0	5	100	2120	3380	0.91	0.91	5	84.8
3-4	5	10	80	557	1385	3 48	3 48	5	22.3
5	10	12	80	807	1543	2.69	2.69	2	80.7
6-7	12	18	100	983	1803	1.82	1.82	6	32.8
8-9	18	26	94	973	1764	2.31	2.31	8	24 3
10-12	26	35	115	1053	2042	5.07	5 07	9	23 4
13-15	35	50	115	1488	2949	4 04	4 04	15	19.8
16-23	50	90	120	2481	4808	1.21	1 21	40	12 4
24-26	90	125	135	4101	7104	4 28	4.28	35.01	23.4
27-35	125	300	145	4101	7104	4 28	4 28	174.96	4.7
36-39	300	500	145	5657	9798	3 10	3.10	200	5.7
40-41	500	700	145	6398	11155	2.53	2 53	200	6 4
HS	700	900	170	6398	11155	2.16	1.00	200 03	6 4
							total	699 97	

Dynamic Soil Properties for SASSI Model (from Ref. 5)
Lower Bound Properties

Layer	Thick (ft)	Density (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping Vs	Damping Vp	Top of Layer Elevation (ft)	Poisson's ratio	Approx. Cut-off Freq (cps)
1	5	0 1	1053	1690	1 08	1.08	0	0 1830	42 1
2	1.66	0 08	298	923	6 57	6 57	-5	0 4420	35 8
3	1 67	0 08	298	923	6 57	6 57	-6 66	0 4420	35 6
4	1 67	0 08	298	923	6.57	6.57	-8 33	0 4420	35 6
5	2	0 08	622	1260	3.60	3 60	-10	0.3386	62 2
6	3	0 1	610	1202	2.97	2 97	-12	0 3268	40.6
7	3	0 1	610	1202	2.97	2 97	-15	0.3268	40 6
8	2.66	0.094	593	1176	3 73	3.73	-18	0 3296	44 6
9	2.67	0 094	593	1176	3 73	3 73	-20 66	0 3296	44 4
10	2 67	0 094	593	1176	3 73	3 73	-23 33	0 3296	44 4
11	3	0.115	614	1361	8 09	8 09	-26	0 3724	40 9
12	3	0 115	614	1361	8 09	8 09	-29	0 3724	40 9
13	3	0 115	614	1361	8 09	8 09	-32	0.3724	40 9
14	3	0 115	565	1474	9 82	9 82	-35	0 4140	37.6
15	3	0 115	565	1474	9.82	9 82	-38	0 4140	37 6
16	3	0 115	565	1474	9 82	9 82	-41	0 4140	37 6
17	3	0 115	565	1474	9 82	9 82	-44	0 4140	37 6
18	3	0 115	565	1474	9.82	9 82	-47	0 4140	37 6
19	5	0.12	1191	2404	2.18	2 18	-50	0 3372	47.7
20	5	0 12	1191	2404	2 18	2 18	-55	0.3372	47.7
21	5	0.12	1191	2404	2.18	2.18	-60	0.3372	47.7
22	5	0.12	1191	2404	2.18	2 18	-65	0 3372	47.7
23	5	0 12	1191	2404	2 18	2 18	-70	0 3372	47.7
24	5	0 12	1191	2404	2.18	2 18	-75	0 3372	47.7
25	5	0 12	1191	2404	2 18	2 18	-80	0.3372	47.7
26	5	0 12	1191	2404	2 18	2.18	-85	0 3372	47 7
27	8 75	0 135	2051	3552	3 97	3 97	-90	0 2499	46 9
28	8 75	0 135	2051	3552	3 97	3 97	-98 75	0 2499	46 9
29	8 75	0 135	2051	3552	3 97	3 97	-107.5	0 2499	46 9
30	8 75	0.135	2051	3552	3.97	3 97	-116.25	0 2499	46 9
31	10 9375	0.145	2051	3552	3 97	3 97	-125	0 2499	37 5
32	10.9375	0 145	2051	3552	3.97	3.97	-135 9375	0 2499	37.5
33	10 9375	0 145	2051	3552	3 97	3.97	-146 875	0.2499	37.5
34	10 9375	0 145	2051	3552	3.97	3 97	-157 8125	0 2499	37.5
35	10 9375	0 145	2051	3552	3 97	3 97	-168 75	0 2499	37 5
36	10 9375	0 145	2051	3552	3 97	3 97	-179.6875	0 2499	37 5

Dynamic Soil Properties for SASSI Model (from Ref. 5)
Lower Bound Properties

Layer	Thick (ft)	Density (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping Vs	Damping Vp	Top of Layer Elevation (ft)	Poisson's ratio	Approx Cut-off Freq. (cps)
37	10 9375	0.145	2051	3552	3 97	3 97	-190 625	0 2499	37.5
38	10 9375	0 145	2051	3552	3 97	3 97	-201.5625	0 2499	37.5
39	10 9375	0 145	2051	3552	3 97	3.97	-212.5	0 2499	37 5
40	10 9375	0 145	2051	3552	3 97	3 97	-223 4375	0 2499	37.5
41	10 9375	0 145	2051	3552	3 97	3 97	-234 375	0 2499	37.5
42	10.9375	0 145	2051	3552	3 97	3 97	-245.3125	0 2499	37.5
43	10 9375	0.145	2051	3552	3 97	3 97	-256 25	0 2499	37.5
44	10.9375	0.145	2051	3552	3 97	3 97	-267.1875	0 2499	37 5
45	10 9375	0 145	2051	3552	3 97	3 97	-278 125	0 2499	37.5
46	10 9375	0.145	2051	3552	3 97	3 97	-289 0625	0.2499	37.5
47	11.111	0 145	2051	3552	3 97	3 97	-300	0.2499	36 9
48	11 111	0 145	2051	3552	3 97	3.97	-311 111	0 2499	36 9
49	11.111	0 145	2051	3552	3 97	3 97	-322 222	0 2499	36 9
50	11.111	0 145	2051	3552	3 97	3 97	-333 333	0 2499	36 9
51	11 111	0 145	2051	3552	3 97	3 97	-344 444	0.2499	36 9
52	11.111	0 145	2051	3552	3 97	3 97	-355 555	0.2499	36 9
53	11.111	0 145	2051	3552	3 97	3 97	-366 666	0 2499	36.9
54	11 111	0 145	2051	3552	3 97	3 97	-377 777	0 2499	36.9
55	11.111	0 145	2051	3552	3 97	3 97	-388 888	0 2499	36 9
56	11 111	0 145	2051	3552	3 97	3 97	-399 999	0 2499	36 9
57	11.111	0 145	2051	3552	3 97	3 97	-411.11	0 2499	36 9
58	11 111	0 145	2051	3552	3 97	3.97	-422 221	0 2499	36.9
59	11 111	0 145	2051	3552	3.97	3 97	-433.332	0 2499	36 9
60	11.111	0 145	2051	3552	3 97	3 97	-444 443	0 2499	36 9
61	11 111	0 145	2051	3552	3 97	3 97	-455 554	0.2499	36.9
62	11.111	0.145	2051	3552	3 97	3 97	-466 665	0 2499	36.9
63	11 112	0 145	2051	3552	3 97	3 97	-477 776	0 2499	36.9
64	11 112	0 145	2051	3552	3 97	3 97	-488.888	0 2499	36 9
65	11.111	0 145	2051	3552	3 97	3 97	-500	0.2499	36 9
66	11.111	0.145	2051	3552	3 97	3 97	-511.111	0 2499	36 9
67	11.111	0.145	2051	3552	3 97	3 97	-522 222	0 2499	36 9
68	11 111	0 145	2051	3552	3.97	3 97	-533 333	0.2499	36.9
69	11 111	0 145	2051	3552	3 97	3 97	-544 444	0.2499	36.9
70	11 111	0 145	2051	3552	3 97	3 97	-555 555	0 2499	36 9
71	11 111	0 145	2051	3552	3 97	3 97	-566 666	0 2499	36.9
72	11.111	0 145	2051	3552	3.97	3 97	-577.777	0.2499	36 9
73	11.111	0 145	2051	3552	3 97	3 97	-588 888	0 2499	36 9
74	11 111	0 145	2051	3552	3 97	3 97	-599 999	0.2499	36.9
75	11 111	0 145	2051	3552	3 97	3 97	-611.11	0.2499	36 9

Dynamic Soil Properties for SASSI Model (from Ref 5)
Lower Bound Properties

Layer	Thick (ft)	Density (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping Vs	Damping Vp	Top of Layer Elevation (ft)	Poisson's ratio	Approx Cut-off Freq. (cps)
76	11 111	0.145	2051	3552	3 97	3 97	-622 221	0 2499	36 9
77	11.111	0.145	2051	3552	3 97	3 97	-633 332	0 2499	36 9
78	11.111	0.145	2051	3552	3 97	3 97	-644 443	0 2499	36.9
79	11.111	0 145	2051	3552	3 97	3 97	-655 554	0 2499	36 9
80	11.111	0 145	2051	3552	3 97	3 97	-666 665	0 2499	36 9
81	11 112	0 145	2051	3552	3 97	3 97	-677 776	0 2499	36 9
82	11 112	0 145	2051	3552	3 97	3 97	-688 888	0 2499	36.9
HS		0 17	6398	11155	2 16	1 00	-700	0 2549	
Total	700							Minimum	35 6

Dynamic Soil Properties for SASSI Model (from Ref 5)
Best Estimate Bound Properties

Layer	Thick (ft)	Density (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping Vs	Damping Vp	Top of Layer Elevation (ft)	Poisson's ratio	Approx. Cut-off Freq (cps)
1	5	0 1	1497	2390	0 0094	0.0094	0	0 1772	59.9
2	1 66	0 08	415	1131	0 0478	0 0478	-5	0 4223	50.0
3	1.67	0 08	415	1131	0 0478	0 0478	-6 66	0 4223	49 7
4	1 67	0.08	415	1131	0 0478	0 0478	-8.33	0 4223	49.7
5	2	0 08	622	1260	0 0360	0 0360	-10	0 3386	62 2
6	3	0 1	779	1472	0 0229	0 0229	-12	0 3056	51.9
7	3	0 1	779	1472	0 0229	0.0229	-15	0 3056	51.9
8	2.66	0 094	760	1440	0 0301	0 0301	-18	0.3068	57.2
9	2.67	0.094	760	1440	0 0301	0 0301	-20 66	0.3068	56 9
10	2 67	0.094	760	1440	0 0301	0.0301	-23 33	0 3068	56 9
11	3	0 115	818	1667	0 0621	0 0621	-26	0 3413	54 6
12	3	0 115	818	1667	0 0621	0 0621	-29	0 3413	54 6
13	3	0 115	818	1667	0 0621	0 0621	-32	0 3413	54 6
14	3	0 115	956	2085	0 0613	0 0613	-35	0 3670	63 7
15	3	0 115	956	2085	0 0613	0 0613	-38	0 3670	63 7
16	3	0.115	956	2085	0 0613	0 0613	-41	0 3670	63 7
17	3	0 115	956	2085	0 0613	0 0613	-44	0 3670	63 7
18	3	0 115	956	2085	0 0613	0 0613	-47	0 3670	63.7
19	5	0 12	1716	3400	0 0174	0 0174	-50	0 3291	68 6
20	5	0 12	1716	3400	0 0174	0 0174	-55	0 3291	68 6
21	5	0 12	1716	3400	0 0174	0 0174	-60	0.3291	68 6
22	5	0.12	1716	3400	0 0174	0 0174	-65	0 3291	68 6
23	5	0 12	1716	3400	0 0174	0 0174	-70	0 3291	68 6
24	5	0.12	1716	3400	0 0174	0 0174	-75	0 3291	68.6
25	5	0 12	1716	3400	0 0174	0 0174	-80	0 3291	68 6
26	5	0 12	1716	3400	0 0174	0 0174	-85	0.3291	68 6
27	8 75	0 135	2900	5023	0 0432	0 0432	-90	0 2500	66 3
28	8 75	0 135	2900	5023	0 0432	0 0432	-98 75	0 2500	66 3
29	8 75	0 135	2900	5023	0.0432	0 0432	-107 5	0.2500	66 3
30	8.75	0.135	2900	5023	0 0432	0 0432	-116 25	0 2500	66 3
31	10 9375	0 145	2900	5023	0 0432	0 0432	-125	0 2500	53 0
32	10 9375	0 145	2900	5023	0 0432	0 0432	-135 9375	0.2500	53 0
33	10.9375	0 145	2900	5023	0 0432	0 0432	-146 875	0 2500	53 0
34	10 9375	0.145	2900	5023	0.0432	0 0432	-157.8125	0.2500	53 0
35	10 9375	0 145	2900	5023	0 0432	0 0432	-168 75	0 2500	53 0
36	10 9375	0 145	2900	5023	0 0432	0 0432	-179 6875	0 2500	53 0

Dynamic Soil Properties for SASSI Model (from Ref 5)
Best Estimate Bound Properties

Layer	Thick (ft)	Density (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping Vs	Damping Vp	Top of Layer Elevation (ft)	Poisson's ratio	Approx Cut-off Freq (cps)
37	10 9375	0 145	2900	5023	0 0432	0 0432	-190 625	0.2500	53 0
38	10 9375	0 145	2900	5023	0 0432	0 0432	-201.5625	0 2500	53.0
39	10 9375	0.145	2900	5023	0.0432	0 0432	-212 5	0 2500	53.0
40	10 9375	0 145	2900	5023	0 0432	0 0432	-223 4375	0 2500	53.0
41	10 9375	0 145	2900	5023	0 0432	0 0432	-234 375	0.2500	53 0
42	10.9375	0 145	2900	5023	0 0432	0 0432	-245 3125	0 2500	53 0
43	10 9375	0 145	2900	5023	0 0432	0 0432	-256 25	0 2500	53 0
44	10.9375	0 145	2900	5023	0 0432	0.0432	-267.1875	0 2500	53 0
45	10.9375	0 145	2900	5023	0.0432	0 0432	-278 125	0 2500	53 0
46	10.9375	0 145	2900	5023	0 0432	0 0432	-289 0625	0 2500	53 0
47	11 111	0 145	3450	5976	0.0367	0 0367	-300	0 2500	62 1
48	11 111	0 145	3450	5976	0 0367	0 0367	-311 111	0 2500	62 1
49	11 111	0 145	3450	5976	0 0367	0 0367	-322 222	0 2500	62.1
50	11.111	0 145	3450	5976	0 0367	0 0367	-333 333	0 2500	62 1
51	11 111	0 145	3450	5976	0 0367	0 0367	-344 444	0 2500	62 1
52	11 111	0 145	3450	5976	0 0367	0 0367	-355 555	0.2500	62 1
53	11.111	0.145	3450	5976	0.0367	0 0367	-366 666	0 2500	62.1
54	11.111	0 145	3450	5976	0.0367	0 0367	-377.777	0 2500	62.1
55	11 111	0 145	3450	5976	0 0367	0 0367	-388 888	0 2500	62 1
56	11 111	0 145	3450	5976	0 0367	0.0367	-399.999	0 2500	62 1
57	11 111	0 145	3450	5976	0 0367	0 0367	-411.11	0 2500	62.1
58	11.111	0 145	3450	5976	0.0367	0 0367	-422.221	0 2500	62.1
59	11.111	0 145	3450	5976	0 0367	0 0367	-433 332	0.2500	62 1
60	11.111	0 145	3450	5976	0 0367	0 0367	-444 443	0 2500	62.1
61	11.111	0.145	3450	5976	0 0367	0 0367	-455 554	0 2500	62 1
62	11.111	0 145	3450	5976	0 0367	0.0367	-466 665	0.2500	62 1
63	11 112	0 145	3450	5976	0 0367	0 0367	-477.776	0 2500	62 1
64	11 112	0 145	3450	5976	0 0367	0 0367	-488 888	0 2500	62.1
65	11.111	0 145	3950	6842	0 0333	0 0333	-500	0.2500	71 1
66	11 111	0 145	3950	6842	0 0333	0.0333	-511 111	0.2500	71.1
67	11.111	0 145	3950	6842	0 0333	0 0333	-522.222	0 2500	71 1
68	11.111	0 145	3950	6842	0 0333	0 0333	-533.333	0 2500	71 1
69	11.111	0 145	3950	6842	0 0333	0 0333	-544 444	0 2500	71 1
70	11.111	0 145	3950	6842	0 0333	0 0333	-555 555	0.2500	71 1
71	11 111	0 145	3950	6842	0 0333	0 0333	-566 666	0 2500	71.1
72	11.111	0 145	3950	6842	0 0333	0 0333	-577.777	0 2500	71.1
73	11.111	0.145	3950	6842	0.0333	0 0333	-588 888	0 2500	71 1
74	11.111	0 145	3950	6842	0 0333	0 0333	-599 999	0.2500	71 1
75	11.111	0.145	3950	6842	0 0333	0 0333	-611.11	0.2500	71.1

Dynamic Soil Properties for SASSI Model (from Ref. 5)
Best Estimate Bound Properties

Layer	Thick (ft)	Density (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping Vs	Damping Vp	Top of Layer Elevation (ft)	Poisson's ratio	Approx Cut-off Freq (cps)
76	11 111	0 145	3950	6842	0 0333	0 0333	-622.221	0 2500	71 1
77	11 111	0 145	3950	6842	0 0333	0 0333	-633 332	0 2500	71.1
78	11 111	0 145	3950	6842	0 0333	0 0333	-644 443	0 2500	71 1
79	11 111	0 145	3950	6842	0 0333	0 0333	-655 554	0 2500	71.1
80	11 111	0 145	3950	6842	0 0333	0 0333	-666 665	0 2500	71.1
81	11 112	0 145	3950	6842	0 0333	0 0333	-677.776	0 2500	71.1
82	11 112	0 145	3950	6842	0 0333	0 0333	-688.888	0 2500	71.1
HS		0 17	6398	11155	0 0176	0 01	-700	0 2549	
Total.	700							Minimum:	49 7

Dynamic Soil Properties for SASSI Model (from Ref 5)
Upper Bound Properties

Layer	Thick (ft)	Density (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping Vs	Damping Vp	Top of Layer Elevation (ft)	Poisson's ratio	Approx Cut-off Freq (cps)
1	5	0.1	2120	3380	0 0091	0 0091	0	0 1757	84 8
2	1 66	0 08	557	1385	0 0348	0 0348	-5	0 4033	67 2
3	1 67	0 08	557	1385	0 0348	0 0348	-6 66	0 4033	66 8
4	1.67	0 08	557	1385	0.0348	0.0348	-8 33	0 4033	66 8
5	2	0 08	807	1543	0 0269	0 0269	-10	0 3116	80 7
6	3	0 1	983	1803	0 0182	0 0182	-12	0 2886	65 5
7	3	0 1	983	1803	0 0182	0 0182	-15	0.2886	65 5
8	2 66	0 094	973	1764	0 0231	0 0231	-18	0 2814	73.2
9	2 67	0 094	973	1764	0 0231	0 0231	-20 66	0.2814	72.9
10	2.67	0 094	973	1764	0 0231	0 0231	-23 33	0 2814	72 9
11	3	0 115	1053	2042	0 0507	0 0507	-26	0 3191	70 2
12	3	0 115	1053	2042	0 0507	0 0507	-29	0 3191	70 2
13	3	0 115	1053	2042	0 0507	0.0507	-32	0 3191	70 2
14	3	0 115	1488	2949	0 0404	0 0404	-35	0 3292	99 2
15	3	0 115	1488	2949	0 0404	0 0404	-38	0 3292	99 2
16	3	0 115	1488	2949	0 0404	0 0404	-41	0 3292	99 2
17	3	0 115	1488	2949	0 0404	0 0404	-44	0 3292	99 2
18	3	0 115	1488	2949	0 0404	0 0404	-47	0 3292	99 2
19	5	0 12	2481	4808	0 0121	0 0121	-50	0 3185	99.3
20	5	0 12	2481	4808	0 0121	0 0121	-55	0 3185	99 3
21	5	0.12	2481	4808	0 0121	0 0121	-60	0.3185	99 3
22	5	0.12	2481	4808	0 0121	0 0121	-65	0.3185	99.3
23	5	0 12	2481	4808	0 0121	0 0121	-70	0 3185	99 3
24	5	0 12	2481	4808	0 0121	0.0121	-75	0 3185	99 3
25	5	0 12	2481	4808	0 0121	0.0121	-80	0 3185	99 3
26	5	0 12	2481	4808	0.0121	0.0121	-85	0 3185	99 3
27	8 75	0 135	4101	7104	0 0428	0 0428	-90	0 2501	93 7
28	8 75	0 135	4101	7104	0 0428	0 0428	-98 75	0 2501	93 7
29	8 75	0 135	4101	7104	0 0428	0 0428	-107.5	0.2501	93 7
30	8 75	0 135	4101	7104	0 0428	0 0428	-116.25	0.2501	93 7
31	10.9375	0 145	4101	7104	0 0428	0 0428	-125	0 2501	75 0
32	10 9375	0 145	4101	7104	0 0428	0 0428	-135.9375	0 2501	75 0
33	10 9375	0 145	4101	7104	0 0428	0 0428	-146.875	0 2501	75 0
34	10 9375	0 145	4101	7104	0 0428	0 0428	-157.8125	0 2501	75 0
35	10 9375	0 145	4101	7104	0 0428	0 0428	-168.75	0 2501	75 0
36	10 9375	0 145	4101	7104	0 0428	0 0428	-179 6875	0 2501	75.0

Dynamic Soil Properties for SASSI Model (from Ref. 5)
Upper Bound Properties

Layer	Thick (ft)	Density (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping Vs	Damping Vp	Top of Layer Elevation (ft)	Poisson's ratio	Approx. Cut-off Freq (cps)
37	10 9375	0 145	4101	7104	0 0428	0 0428	-190 625	0.2501	75 0
38	10 9375	0 145	4101	7104	0 0428	0 0428	-201 5625	0 2501	75 0
39	10 9375	0 145	4101	7104	0 0428	0 0428	-212.5	0 2501	75 0
40	10 9375	0 145	4101	7104	0 0428	0 0428	-223 4375	0 2501	75 0
41	10.9375	0 145	4101	7104	0 0428	0 0428	-234 375	0 2501	75 0
42	10.9375	0.145	4101	7104	0 0428	0 0428	-245 3125	0 2501	75 0
43	10.9375	0 145	4101	7104	0 0428	0 0428	-256.25	0 2501	75 0
44	10 9375	0.145	4101	7104	0 0428	0 0428	-267.1875	0 2501	75.0
45	10 9375	0 145	4101	7104	0.0428	0 0428	-278.125	0 2501	75.0
46	10 9375	0 145	4101	7104	0 0428	0 0428	-289.0625	0.2501	75 0
47	11 111	0 145	5657	9798	0 0310	0 0310	-300	0 2500	101 8
48	11.111	0.145	5657	9798	0 0310	0 0310	-311.111	0.2500	101 8
49	11.111	0 145	5657	9798	0 0310	0 0310	-322 222	0 2500	101 8
50	11.111	0.145	5657	9798	0 0310	0 0310	-333 333	0.2500	101 8
51	11.111	0 145	5657	9798	0 0310	0.0310	-344 444	0 2500	101 8
52	11 111	0 145	5657	9798	0 0310	0 0310	-355 555	0 2500	101.8
53	11 111	0 145	5657	9798	0 0310	0 0310	-366 666	0 2500	101.8
54	11.111	0 145	5657	9798	0 0310	0 0310	-377.777	0.2500	101.8
55	11.111	0 145	5657	9798	0 0310	0 0310	-388 888	0 2500	101.8
56	11.111	0 145	5657	9798	0.0310	0 0310	-399.999	0.2500	101.8
57	11.111	0 145	5657	9798	0 0310	0 0310	-411.11	0.2500	101.8
58	11.111	0 145	5657	9798	0.0310	0 0310	-422.221	0 2500	101.8
59	11.111	0 145	5657	9798	0 0310	0 0310	-433 332	0 2500	101.8
60	11 111	0 145	5657	9798	0 0310	0.0310	-444 443	0 2500	101.8
61	11 111	0 145	5657	9798	0 0310	0 0310	-455 554	0 2500	101.8
62	11 111	0 145	5657	9798	0 0310	0 0310	-466 665	0 2500	101.8
63	11.112	0 145	5657	9798	0 0310	0 0310	-477 776	0 2500	101 8
64	11.112	0.145	5657	9798	0.0310	0 0310	-488 888	0.2500	101.8
65	11.111	0.145	6398	11155	0 0253	0 0253	-500	0 2549	115 2
66	11.111	0 145	6398	11155	0 0253	0 0253	-511 111	0 2549	115 2
67	11.111	0 145	6398	11155	0 0253	0 0253	-522.222	0 2549	115 2
68	11.111	0 145	6398	11155	0 0253	0 0253	-533 333	0 2549	115.2
69	11 111	0 145	6398	11155	0 0253	0 0253	-544 444	0 2549	115 2
70	11.111	0 145	6398	11155	0 0253	0.0253	-555.555	0.2549	115 2
71	11 111	0 145	6398	11155	0 0253	0 0253	-566.666	0 2549	115 2
72	11 111	0.145	6398	11155	0.0253	0 0253	-577.777	0.2549	115 2
73	11 111	0 145	6398	11155	0 0253	0 0253	-588 888	0.2549	115 2
74	11 111	0 145	6398	11155	0 0253	0.0253	-599 999	0.2549	115 2
75	11.111	0.145	6398	11155	0 0253	0 0253	-611.11	0 2549	115.2

Dynamic Soil Properties for SASSI Model (from Ref 5)
Upper Bound Properties

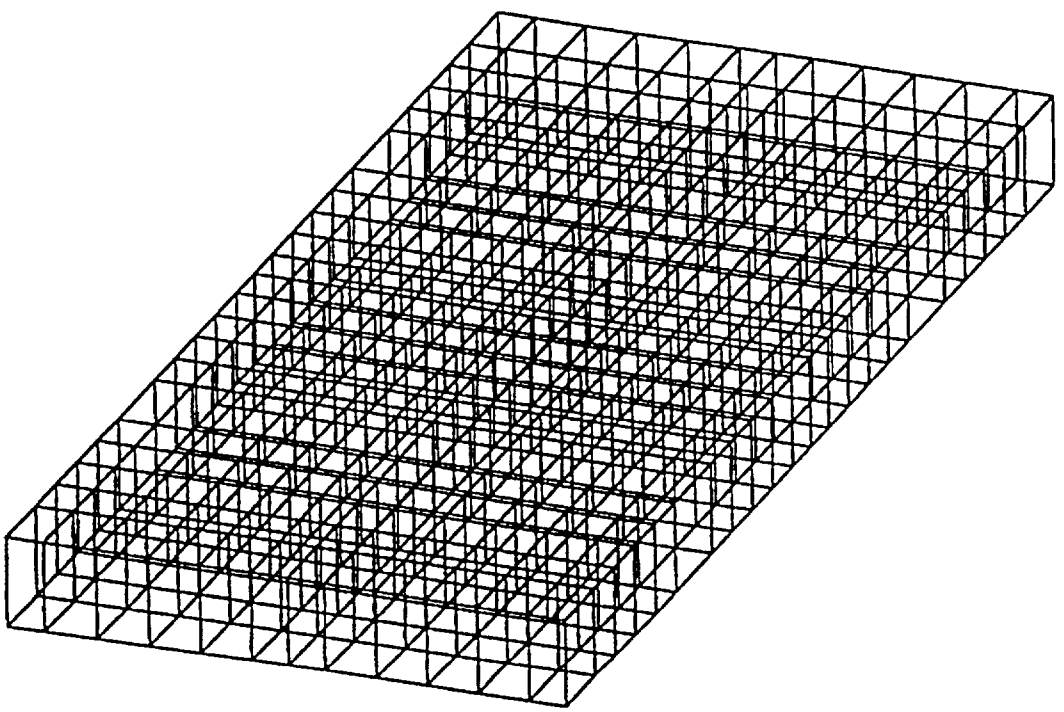
Layer	Thick (ft)	Density (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping Vs	Damping Vp	Top of Layer Elevation (ft)	Poisson's ratio	Approx. Cut-off Freq (cps)
76	11 111	0 145	6398	11155	0 0253	0 0253	-622.221	0 2549	115 2
77	11 111	0 145	6398	11155	0 0253	0 0253	-633 332	0 2549	115 2
78	11.111	0 145	6398	11155	0 0253	0 0253	-644 443	0 2549	115 2
79	11.111	0 145	6398	11155	0 0253	0 0253	-655 554	0 2549	115 2
80	11 111	0 145	6398	11155	0 0253	0 0253	-666 665	0 2549	115 2
81	11 112	0 145	6398	11155	0 0253	0 0253	-677.776	0 2549	115.2
82	11 112	0 145	6398	11155	0 0253	0 0253	-688 888	0 2549	115 2
HS		0 17	6398	11155	0.0216	0 01	-700	0 2549	
Total	700							Minimum	65 5

CALCULATION SHEET

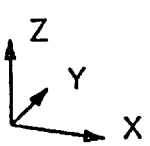
ORIGINATOR	DH	DATE 4/2/01	CALC. NO. G(PO17)-2	REV. NO.	3
			CHECKED [illegible]	DATE	4/3/01
PROJECT	Private Fuel Storage Facility			JOB NO.	1101-000
SUBJECT	Storage Pad Analysis and Design			SHEET NO.	152

The following pages show the finite element mesh of the SASSI model.

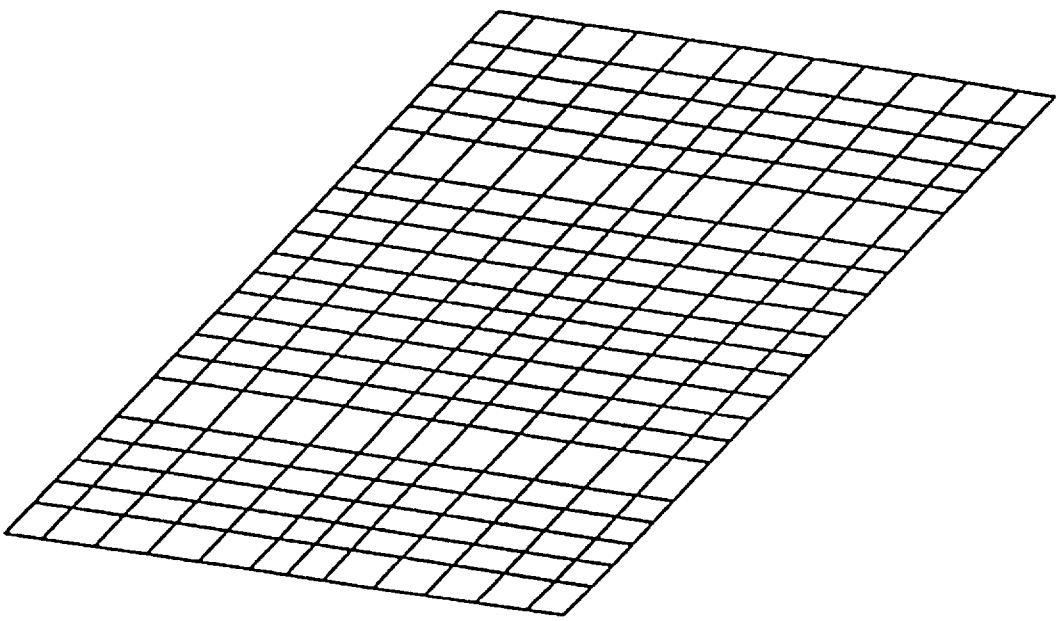
CEC JOB NO. 1101-000
BY DH DATE 4/2/01
CHECK auon DATE 4/3/01
CALC. NO. G(0017)-2 REV. NO 3
SHEET NO. 153



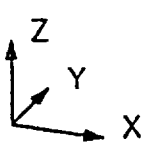
PFSF, REV. 3, Groups 1-3



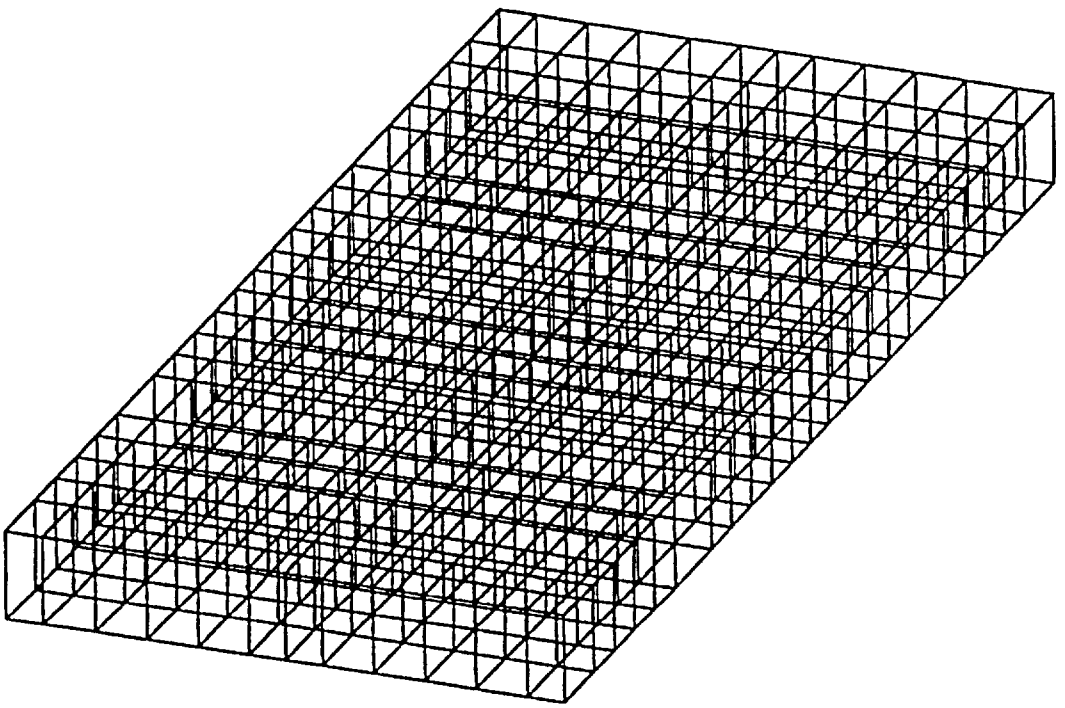
CEC JOB NO. 1101-000
BY DH DATE 4/2/01
CHECK aum DATE 4/3/01
CALC. NO. SQ(P012)-Z REV. NO. 3
SHEET NO. 154



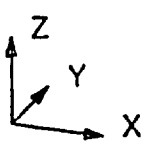
PFSF SASSI MODEL, GROUP 1 (PLATE ELEMENTS)

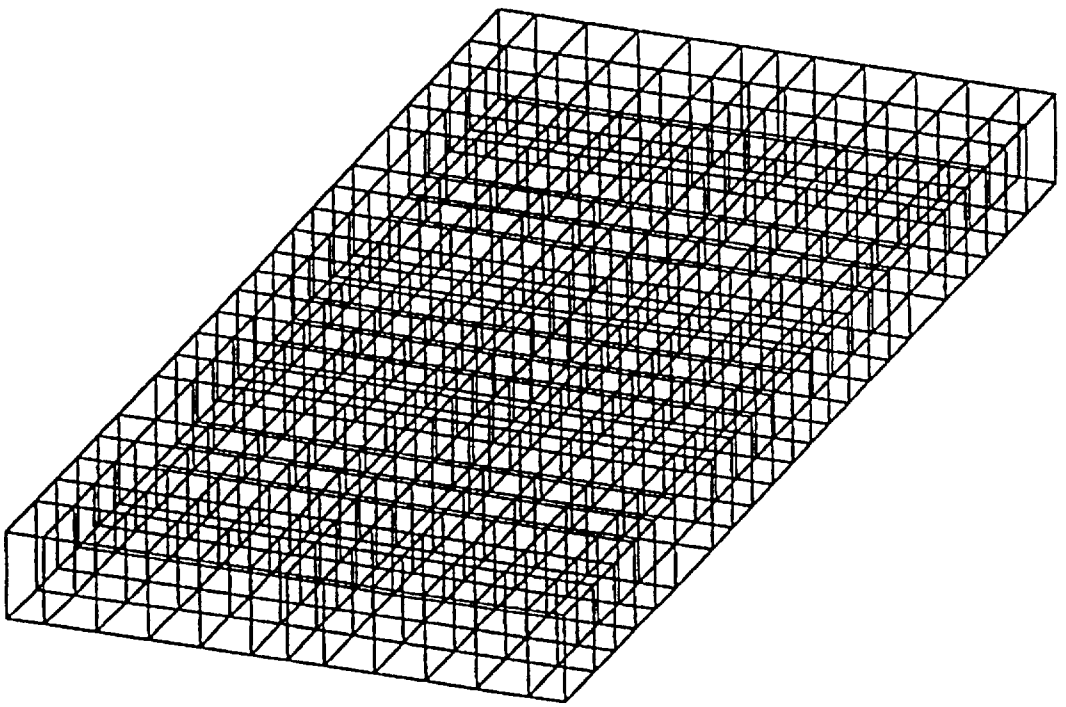


CEC JOB NO. 1101-000
BY DH DATE 4/2/01
CHECK AWM DATE 4/3/01
CALC. NO. G(A97)-2 REV. NO. 3
SHEET NO. 155

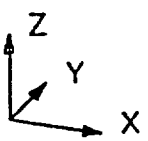


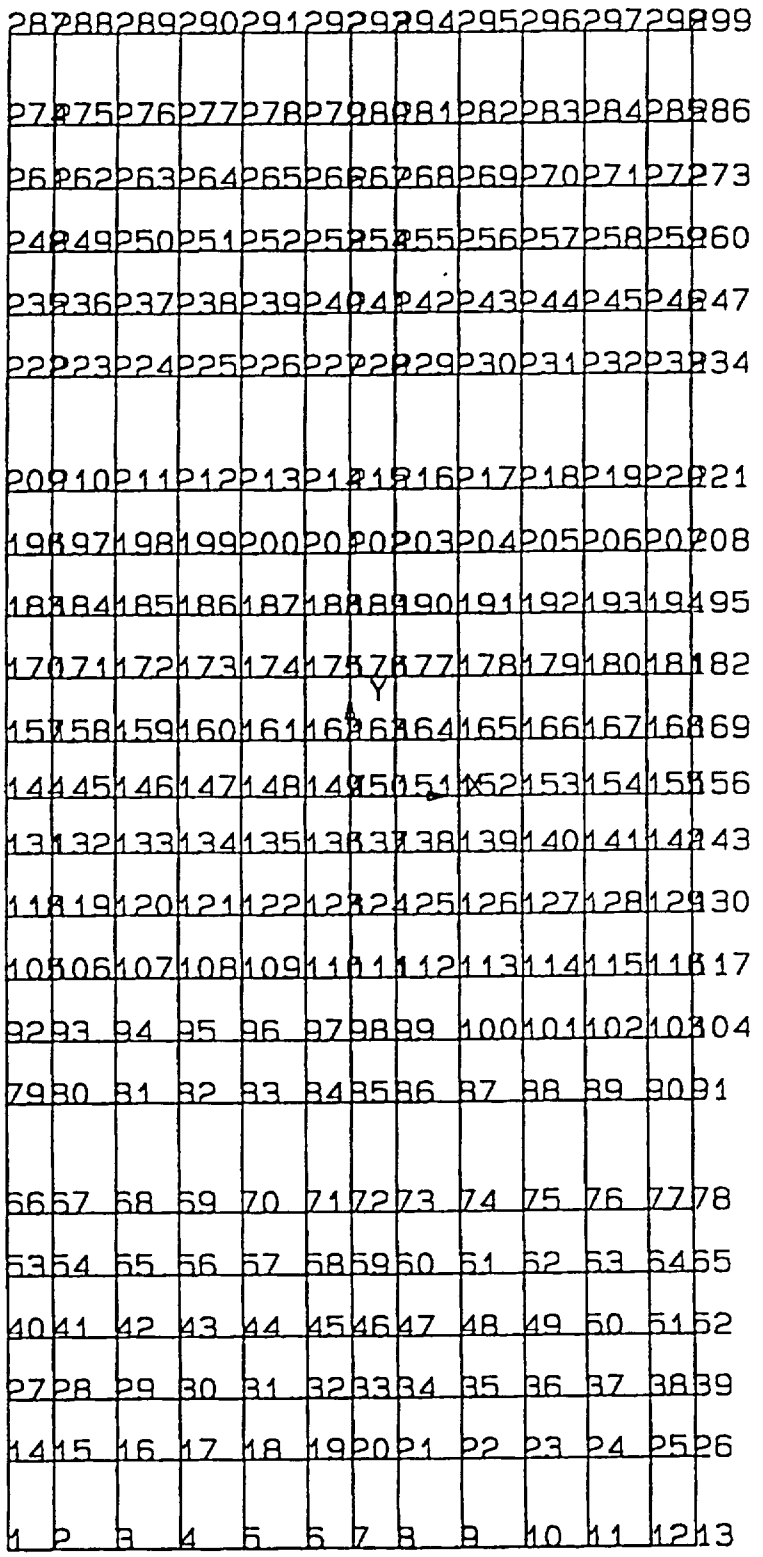
PFSF SASSI MODEL, GROUP 2 (EXCAVATED SOIL)





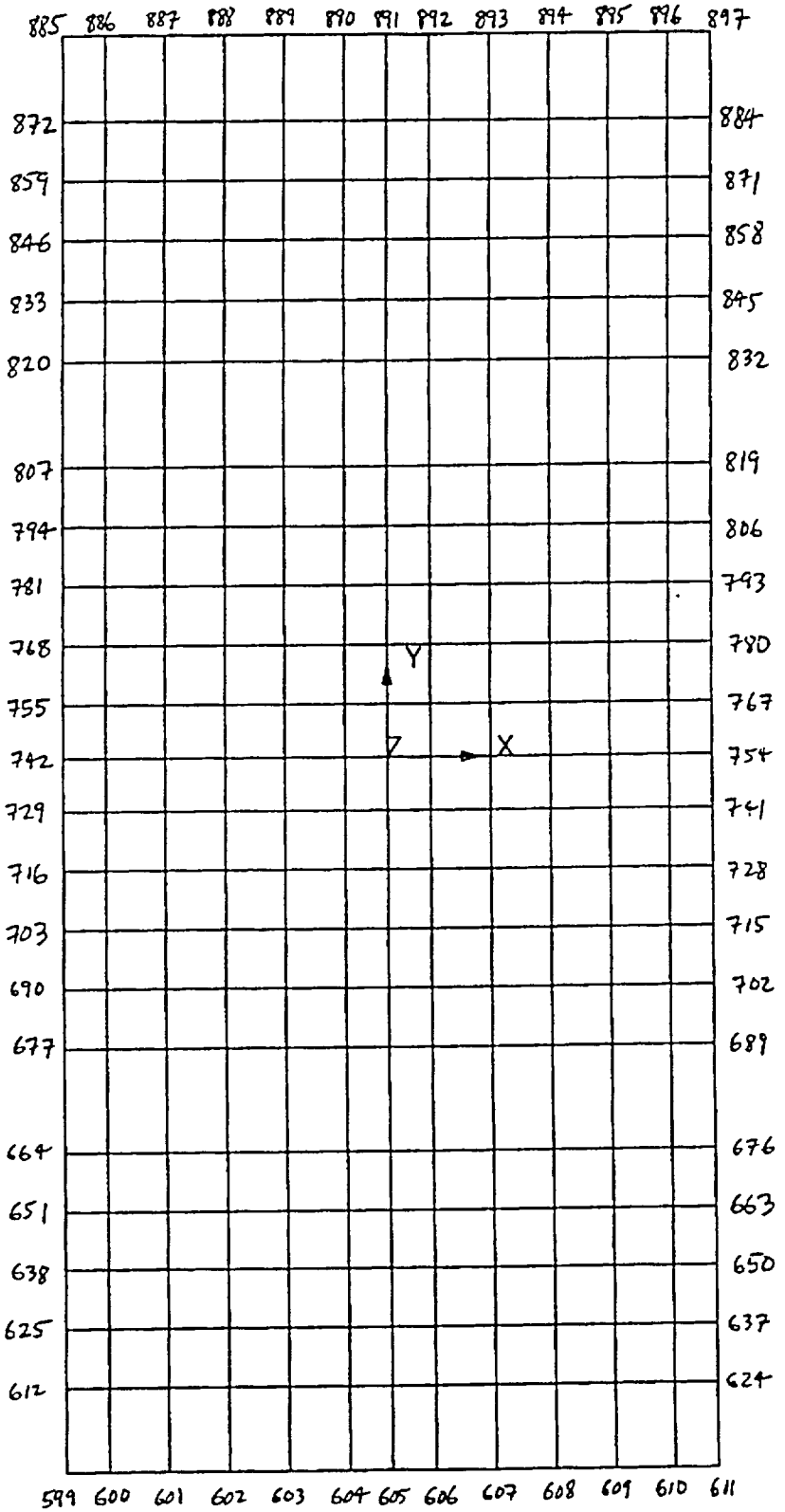
PFSF SASSI MODEL, GROUP 3 (SOIL ELEMENTS)





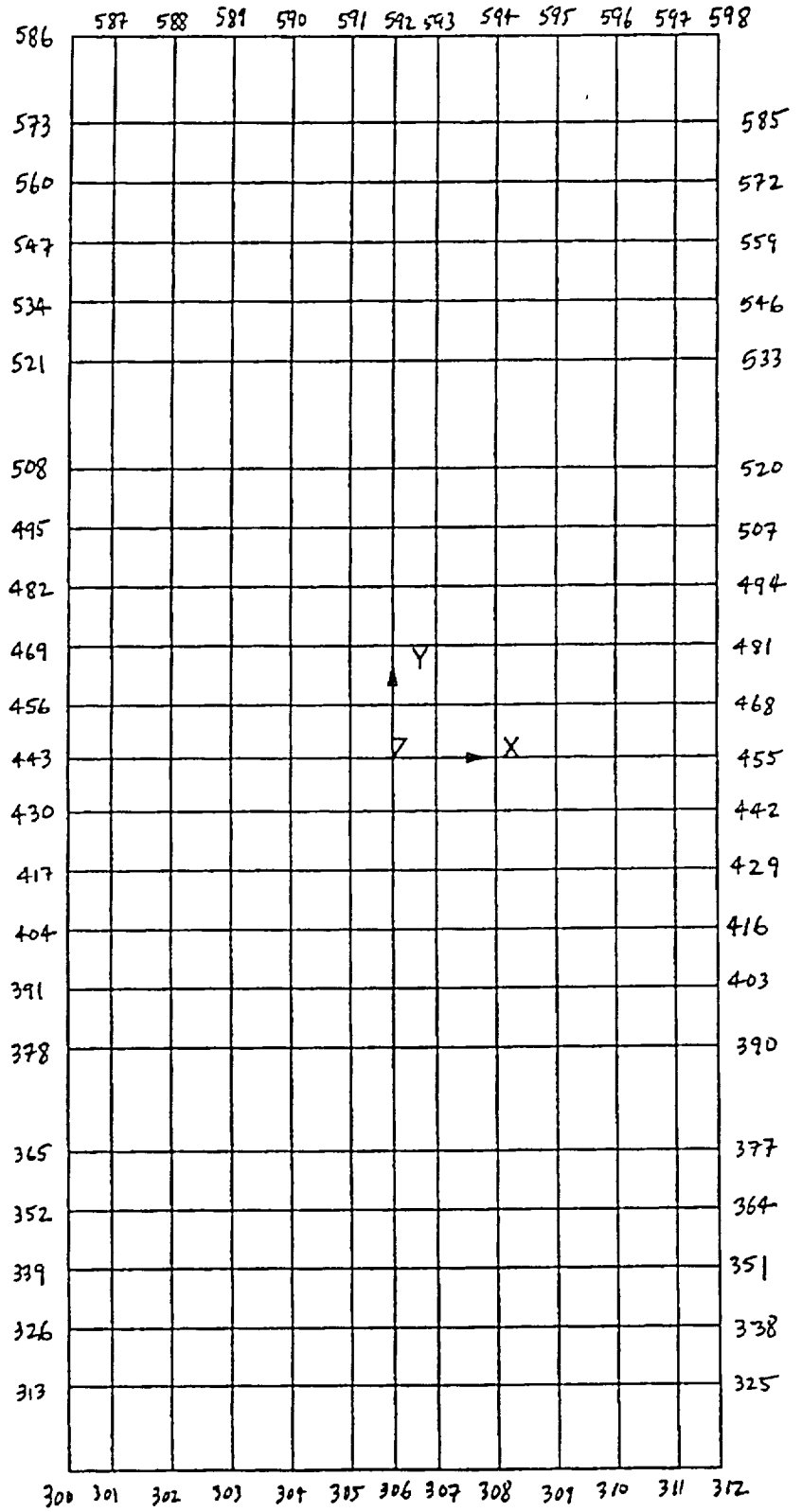
CEC JOB NO. 1101-000
BY DH DATE 4/2/01
CHECK Quinn DATE 4/3/01
CALC. NO SL2013-2 REV NO 3
SHEET NO 153

PFSF. REV. 3 SASSI MODEL PLATE ELEMENT NODES



CEC JOB NO. 1101-000
BY DH DATE 4/2/01
CHECK [illegible] DATE 4/3/01
CALC. NO. S-(P017)-2 REV. NO. 3
SHEET NO. 158

PFSF SASSI MODEL BRICK ELEMENT NODES (EL. 0.0')

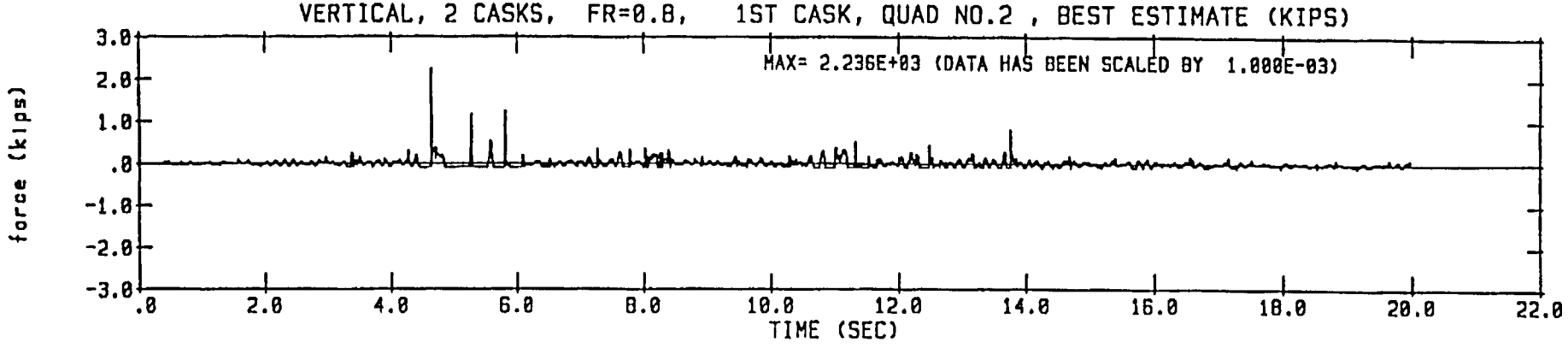


CEC JOB NO. 1101-000
BY DH DATE 4/2/01
CHECK Cam DATE 4/3/01
CALC. NO. G(PSF)-2 REV. NO 2
SHEET NO. 15

PFSF SASSI MODEL BRICK ELEMENT NODES (EL. -5.0')

5.2.2 Dynamic Loading

The following page shows the vertical load which was applied to node 249 of the SASSI model.



SASSI INPUT

CEC JOB NO. 1101-000
BY PH DATE 4/2/01
CHECK [illegible] DATE 4/3/01
CALC. NO. C-000-Z REV. NO. 2
SHEET NO. 161

TIME HISTORY FILE = v2beq2.ths

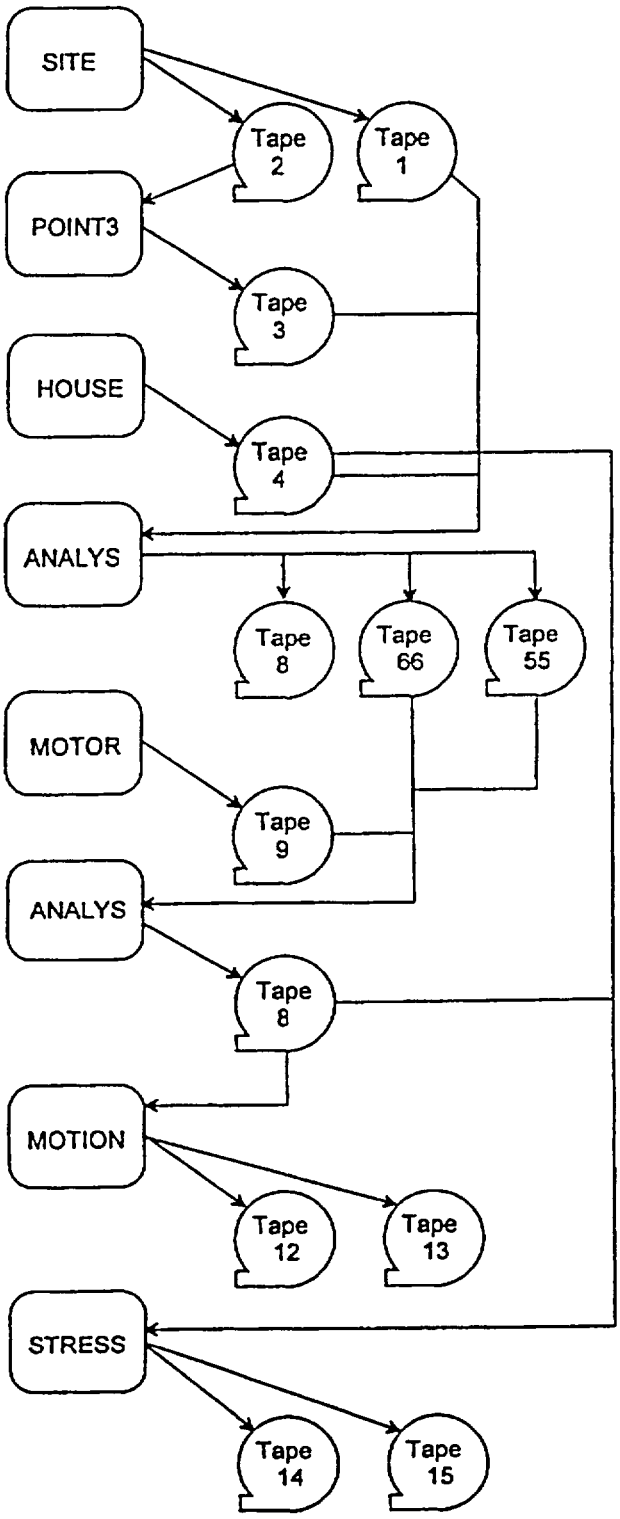
5.2.3 SASSI Analysis Procedure

The following pages show the SASSI analysis procedure.

CALCULATION SHEET

ORIGINATOR pH DATE 4/2/01 CALC. NO G(PO17)-2 REV. NO 3
CHECKED [illegible] DATE 4/3/01
PROJECT Private Fuel Storage Facility JOB NO. 1101-000
SUBJECT Storage Pad Analysis and Design SHEET NO. 163

SASSI Analysis Procedure - Lower Bound Soil



Step 1. Run the SITE module.
Input = lb3sd

Step 2. Run the POINT3 module.
Input = lb3pd

Step 3. Run the HOUSE module.
Input = lb3hd

Step 4. Run the ANALYS module.
Input = lb3ad

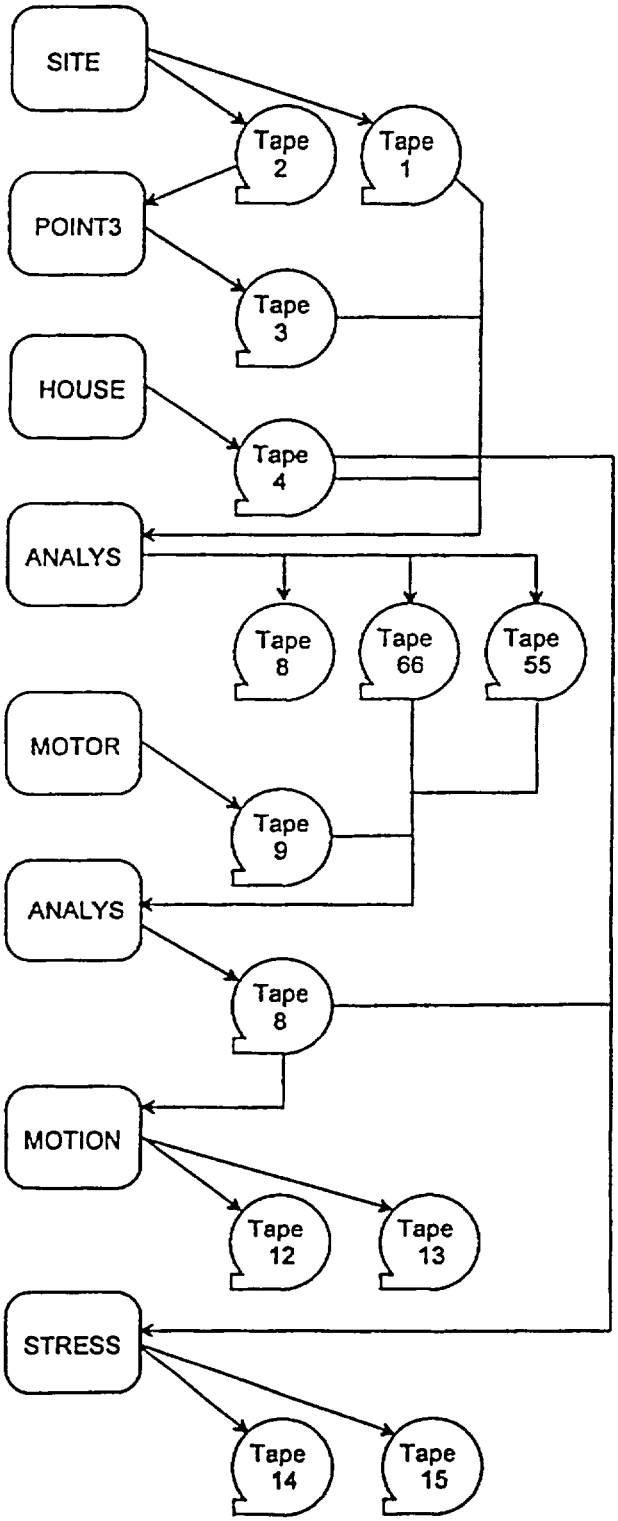
Step 5. Run the MOTOR module.
Input = l3249zmd

Step 6. Run the ANALYS module.
Input = l3249zad

Step 7. Run the MOTION module.
Input = l3249zod

Step 8. Run the STRESS module.
Input = l3249ztd

SASSI Analysis Procedure - Best Estimate Soil



Step 1. Run the SITE module.
Input = be3sd

Step 2. Run the POINT3 module.
Input = be3pd

Step 3. Run the HOUSE module.
Input = be3hd

Step 4. Run the ANALYS module.
Input = be3ad

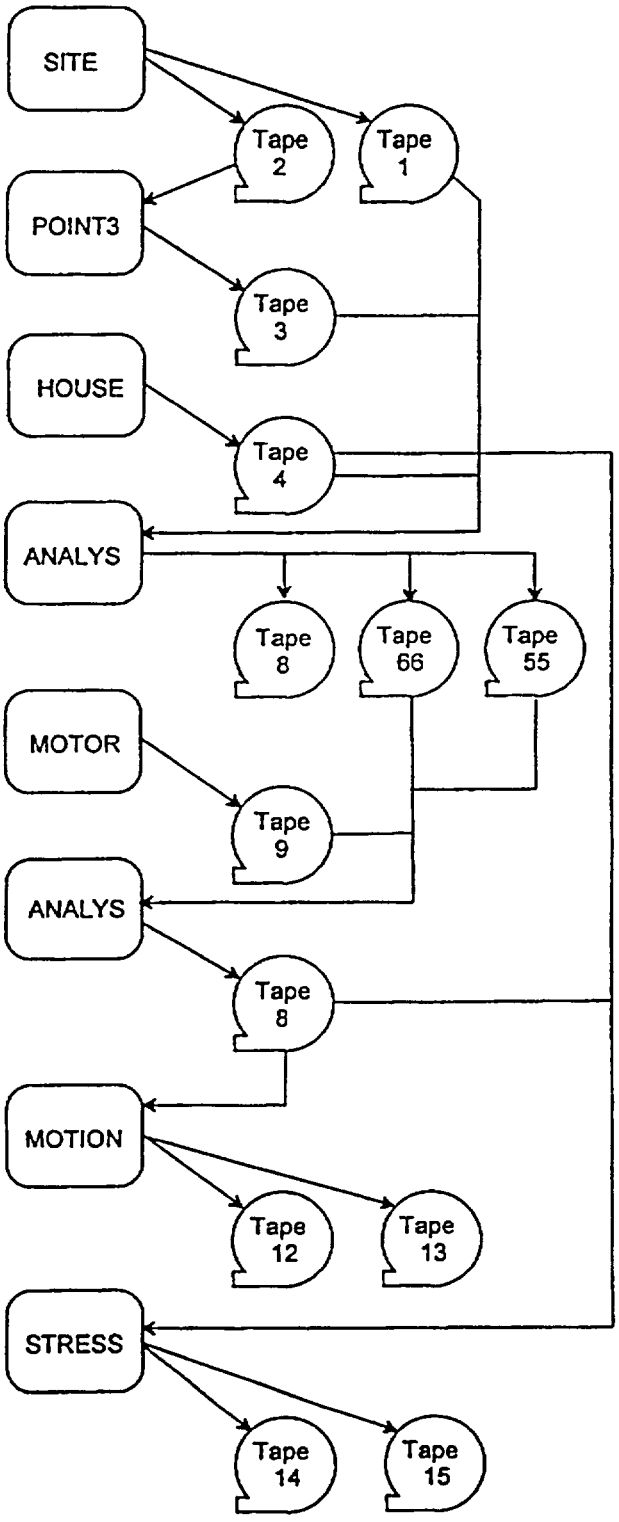
Step 5. Run the MOTOR module.
Input = b3249zmd

Step 6. Run the ANALYS module.
Input = b3249zad

Step 7. Run the MOTION module.
Input = b3249zod

Step 8. Run the STRESS module.
Input = b3249ztd

SASSI Analysis Procedure - Upper Bound Soil



Step 1. Run the SITE module.
Input = ub3sd

Step 2. Run the POINT3 module.
Input = ub3pd

Step 3. Run the HOUSE module.
Input = ub3hd

Step 4. Run the ANALYS module.
Input = ub3ad

Step 5. Run the MOTOR module.
Input = u3249zmd

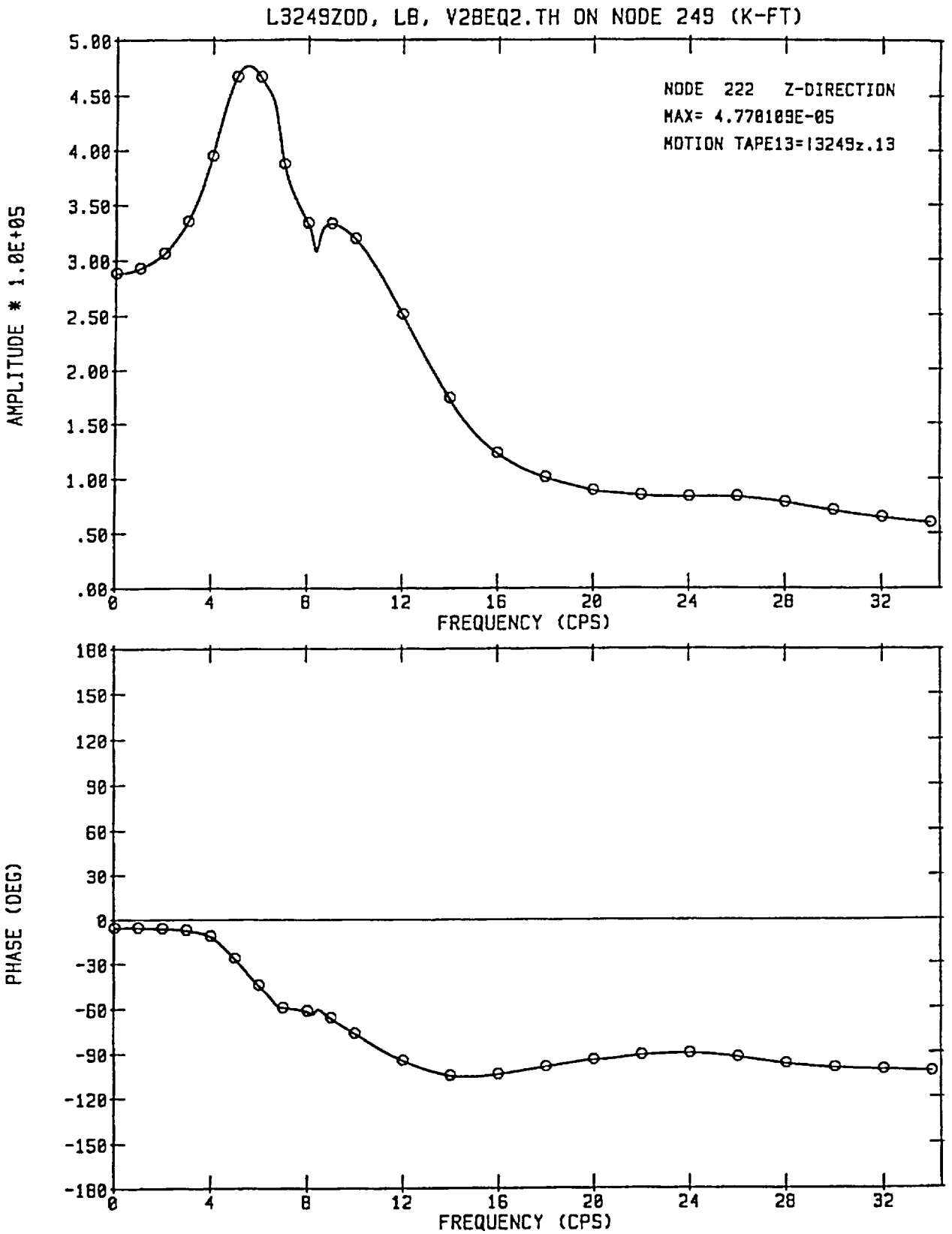
Step 6. Run the ANALYS module.
Input = u3249zad

Step 7. Run the MOTION module.
Input = u3249zod

Step 8. Run the STRESS module.
Input = u3249ztd

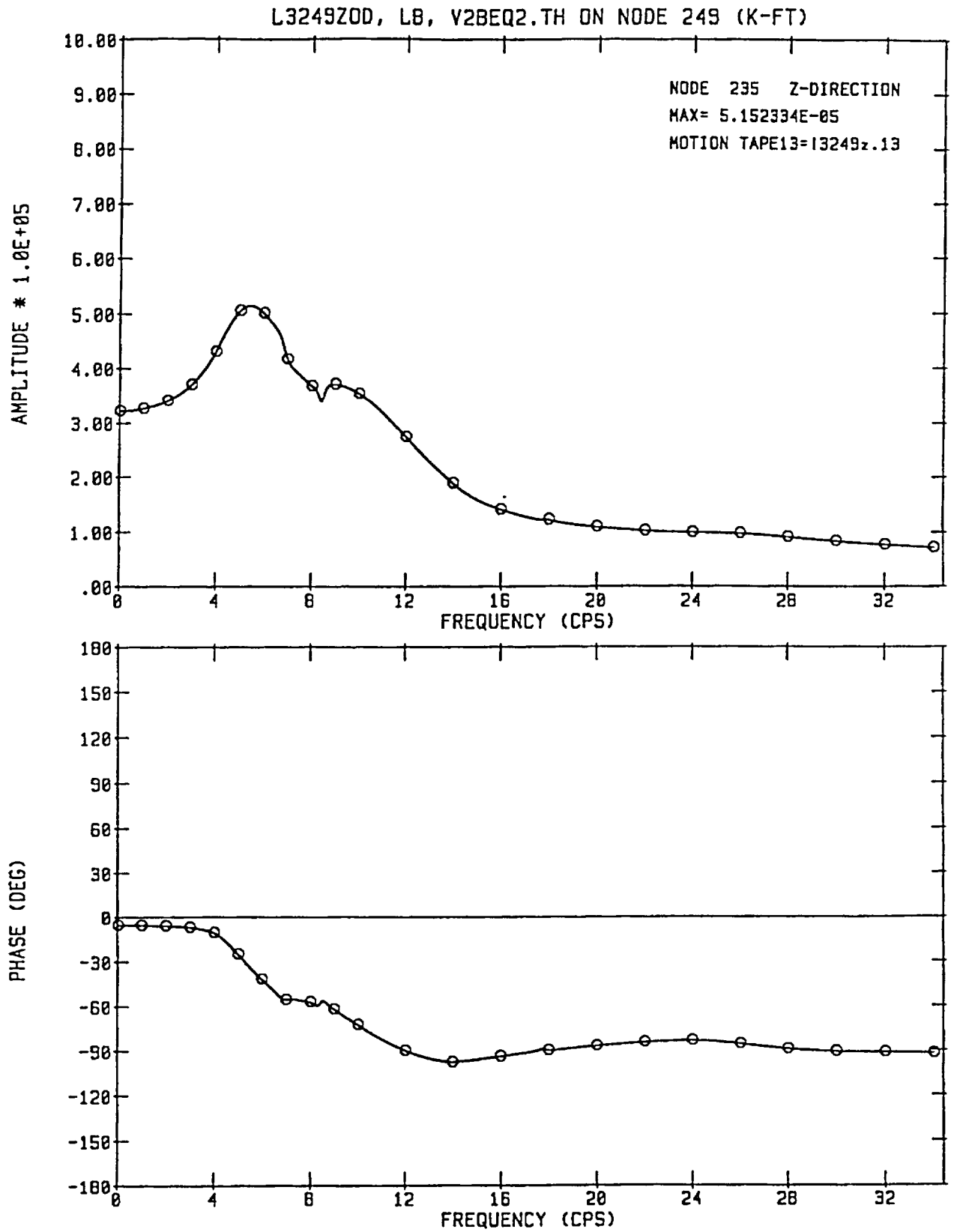
5.2.4 SASSI Analysis Results

The following pages show the SASSI analysis results. Force-to-displacement transfer functions are shown for selected nodes. Force-to-moment transfer functions are shown for selected elements.



CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK Qun DATE 4/3/01
CALC. NO. G(P97)-2 REV. NO. 3
SHEET NO. 167

v8\Gfx222Z.INP 1 4/ 3/ 1



CEC JOB NO. 1101-000

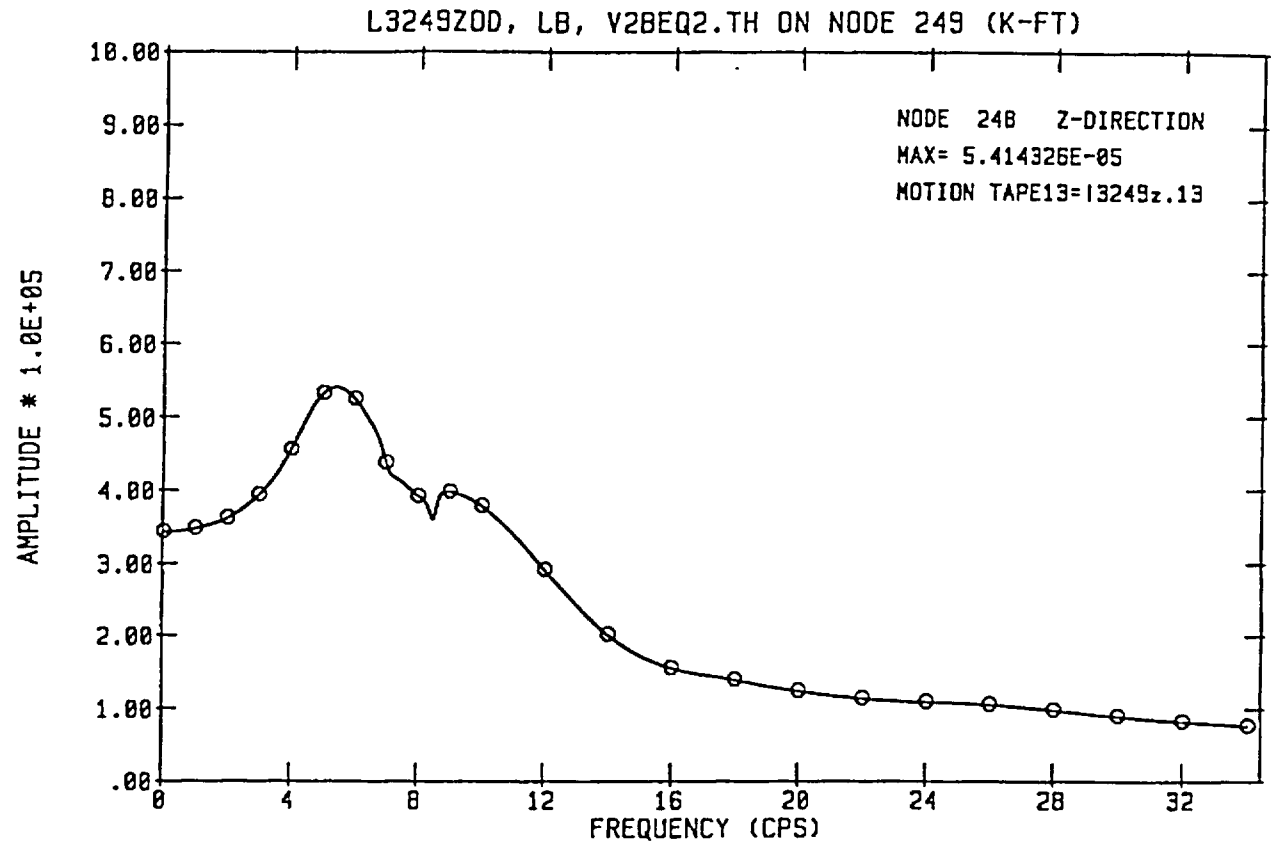
BY DH DATE 4/3/01

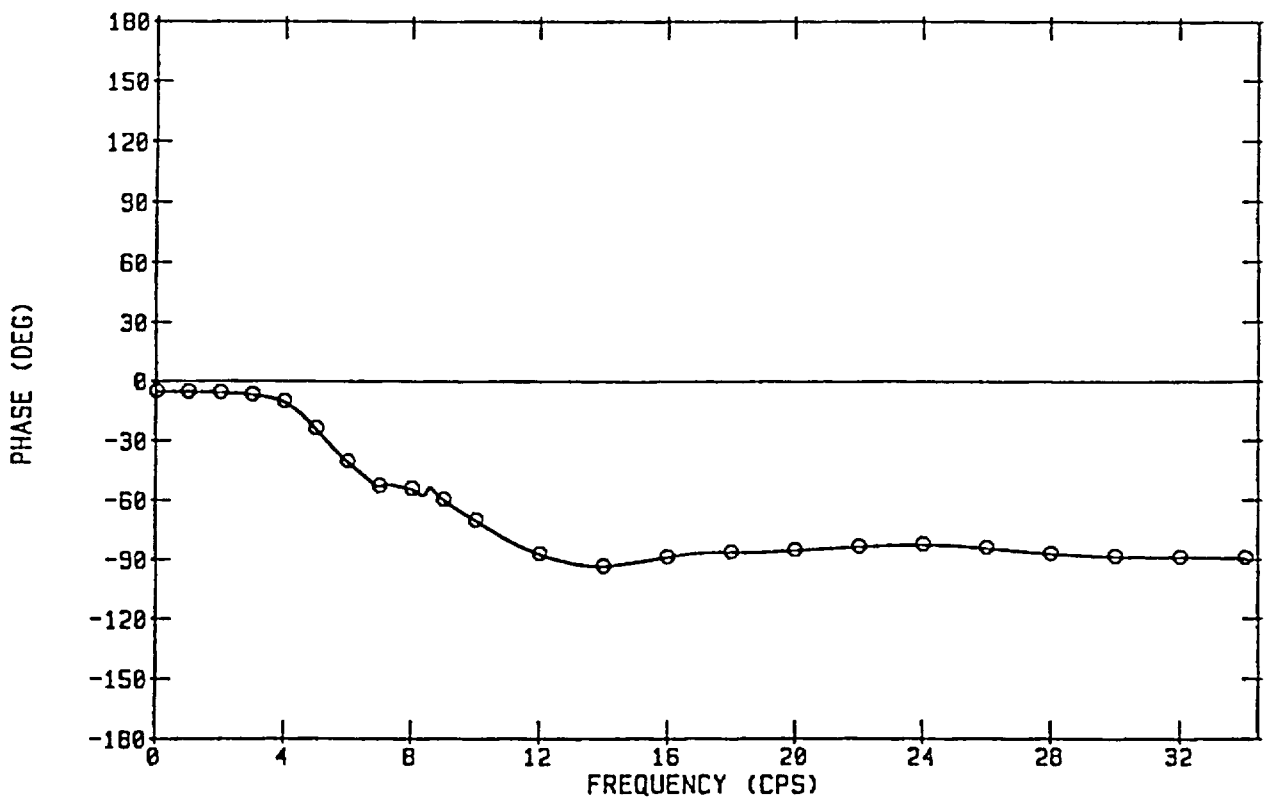
CHECK Avm DATE 4/3/01

CALC. NO. G1P017)-Z REV. NO. 3

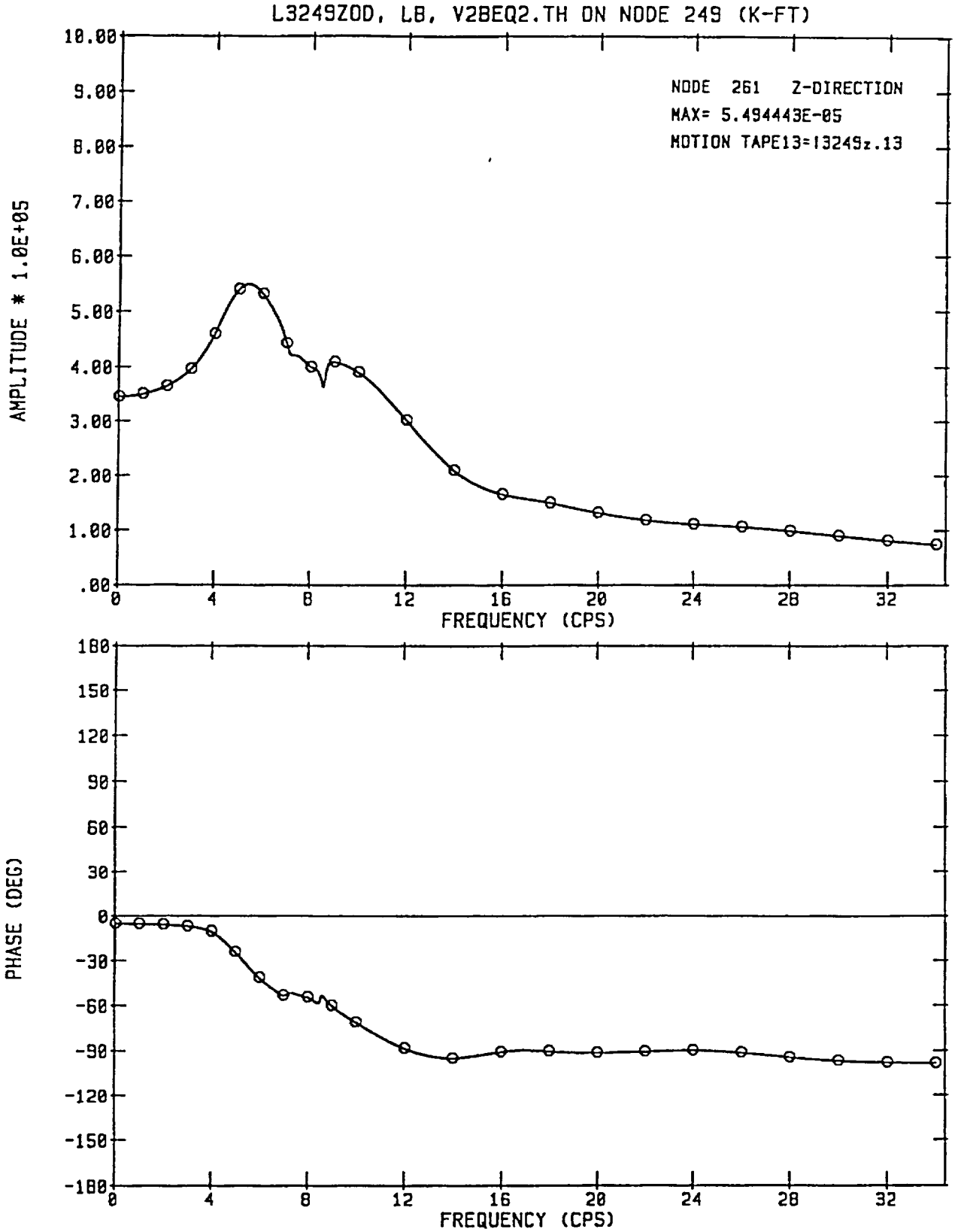
SHEET NO. 168

ve\Gfz235Z.INP 1 4/ 3/ 1





CEC JOB NO. 1101-001
BY DH DATE 4/3/01
CHECK Qum DATE 4/3/01
CALC. NO. G(P017)-2 REV. NO. 3
SHEET NO. 169



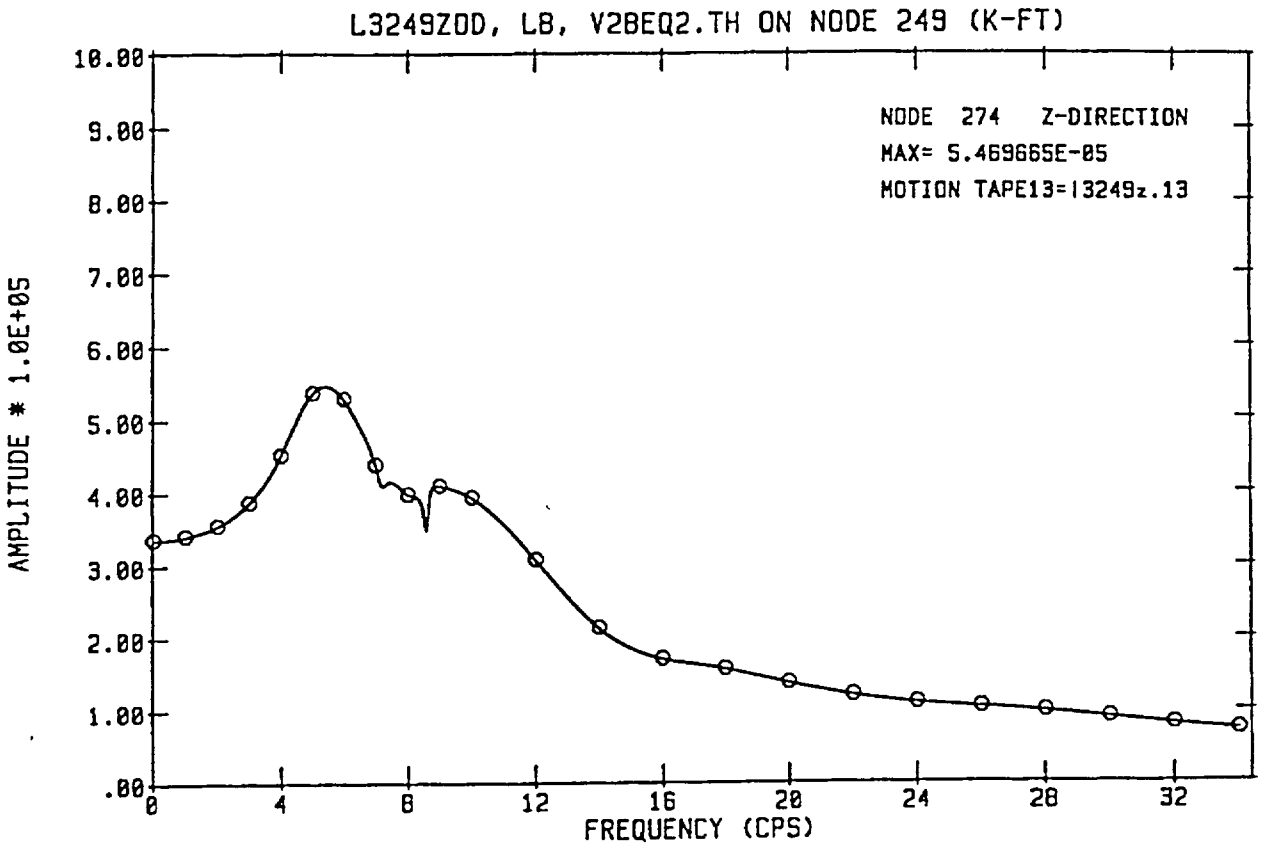
CEC JOB NO. 1101-004

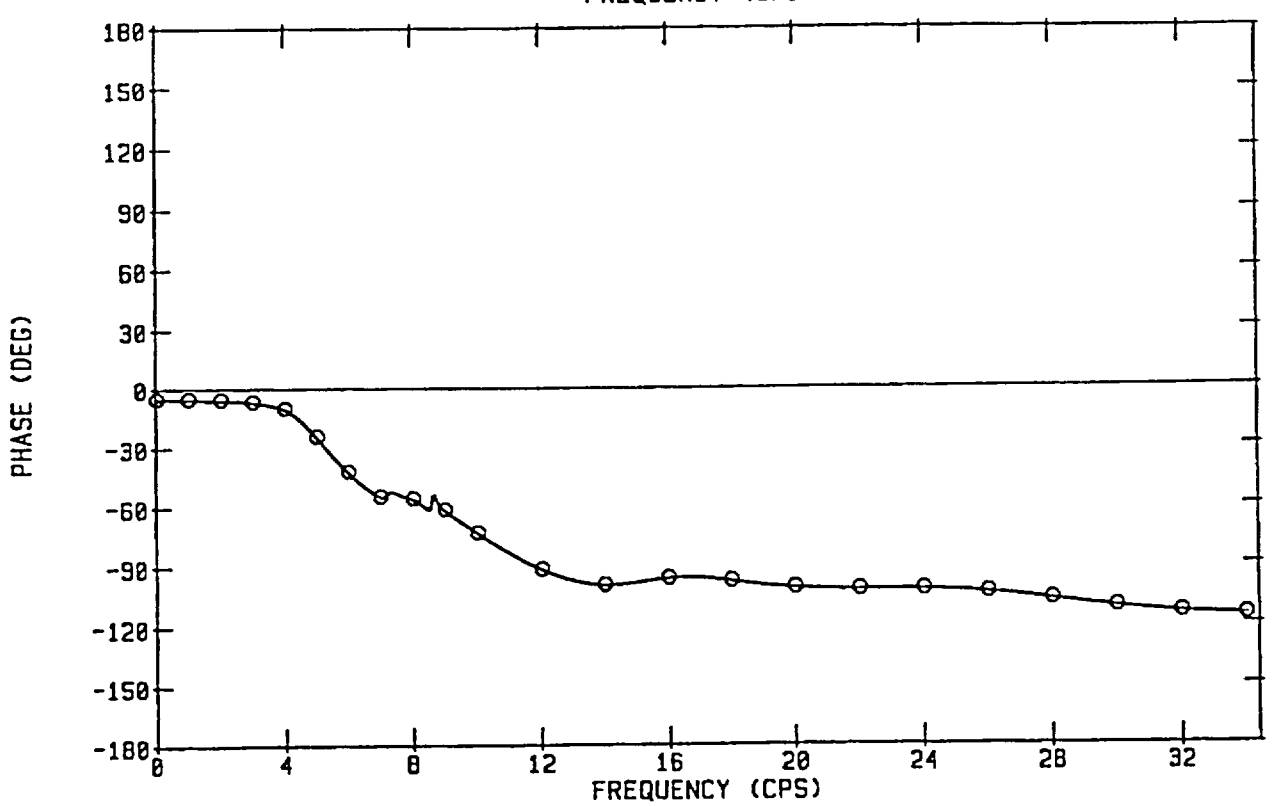
BY DH DATE 4/3/01

CHECK Qum DATE 4/3/01

CALC. NO. G(A017)-2 REV. NO. 3

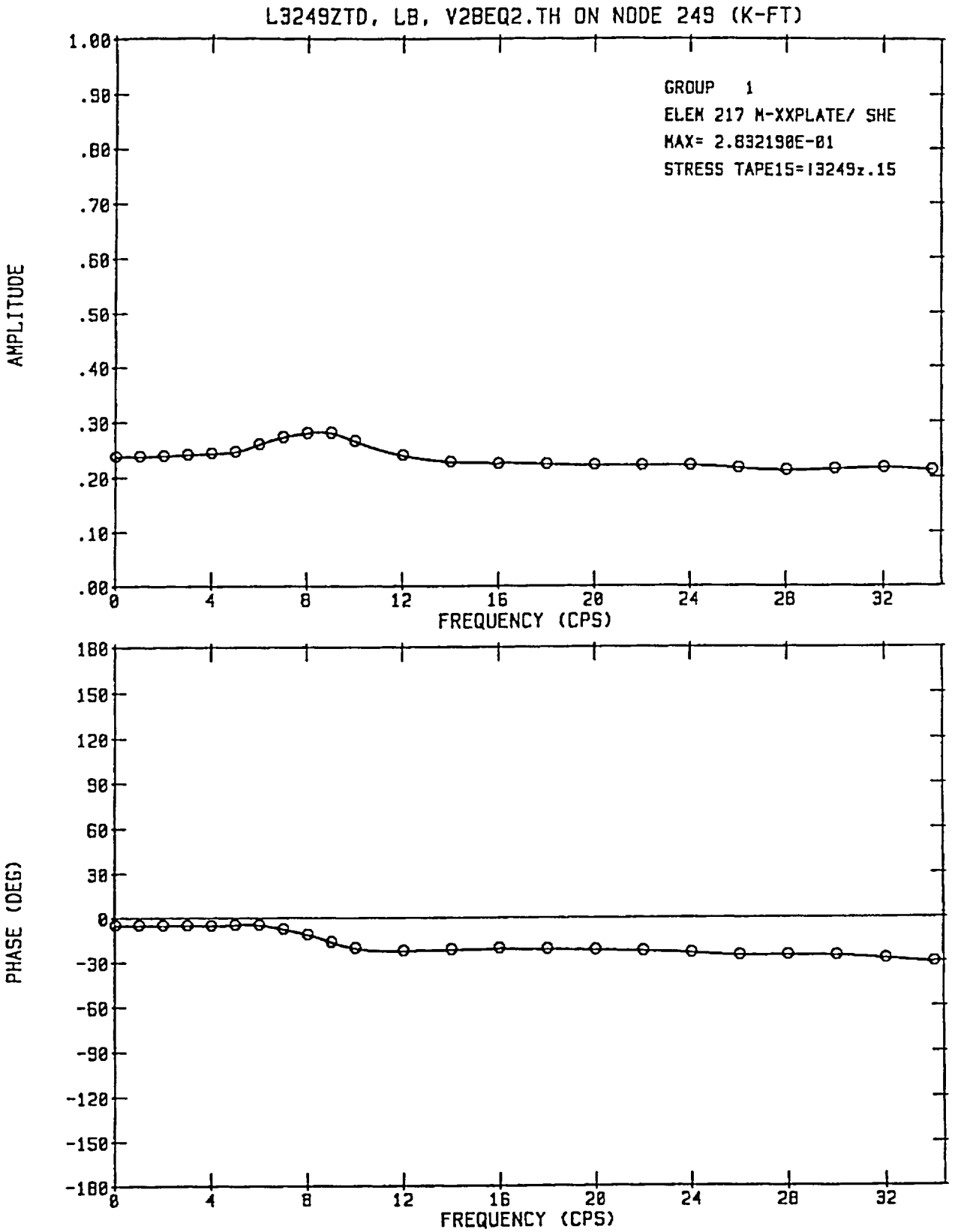
SHEET NO. 170



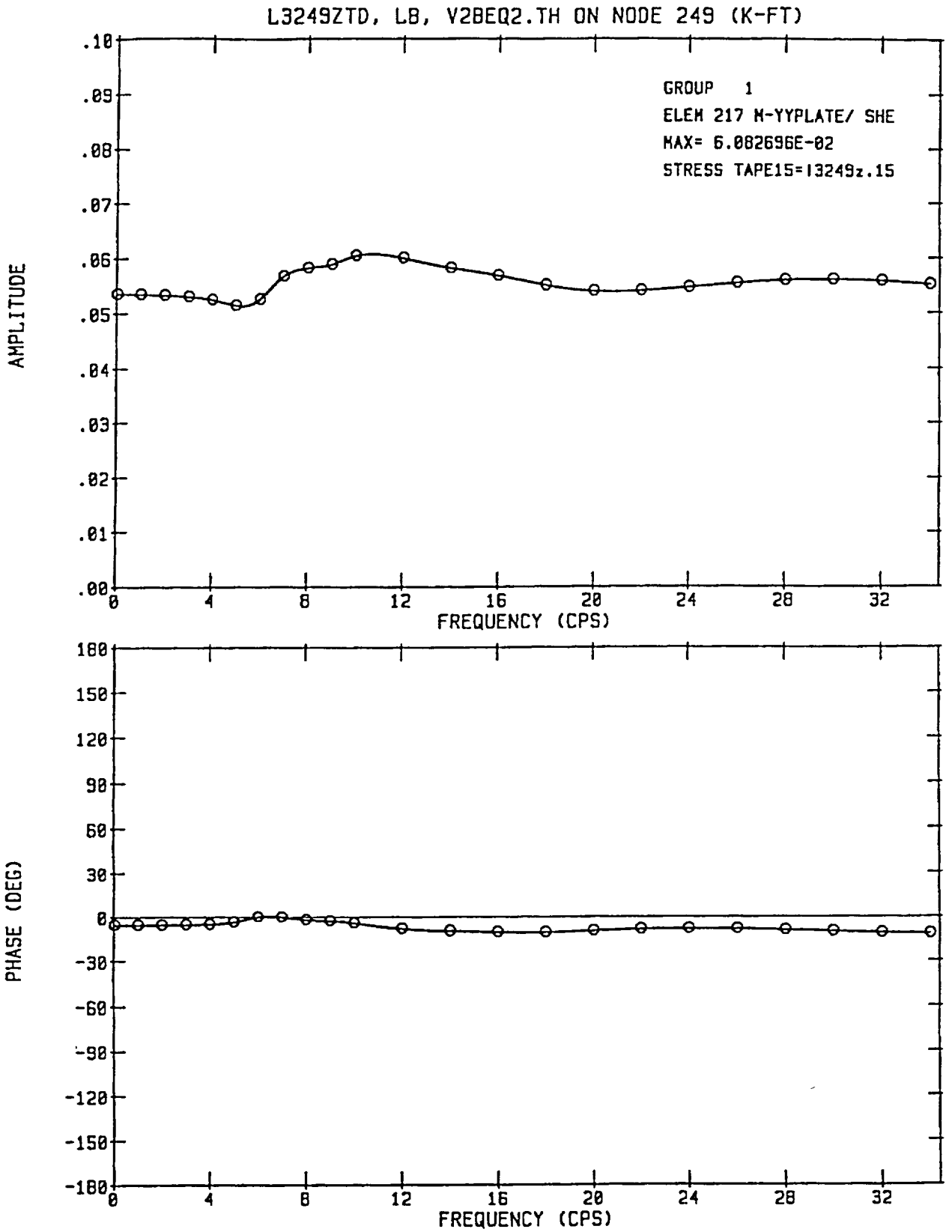


CEC JOB NO. 1101-000
BY PH DATE 4/3/01
CHECK Qum DATE 4/3/01
CALC. NO. G(P017)-2 REV. NO. 3
SHEET NO. 171

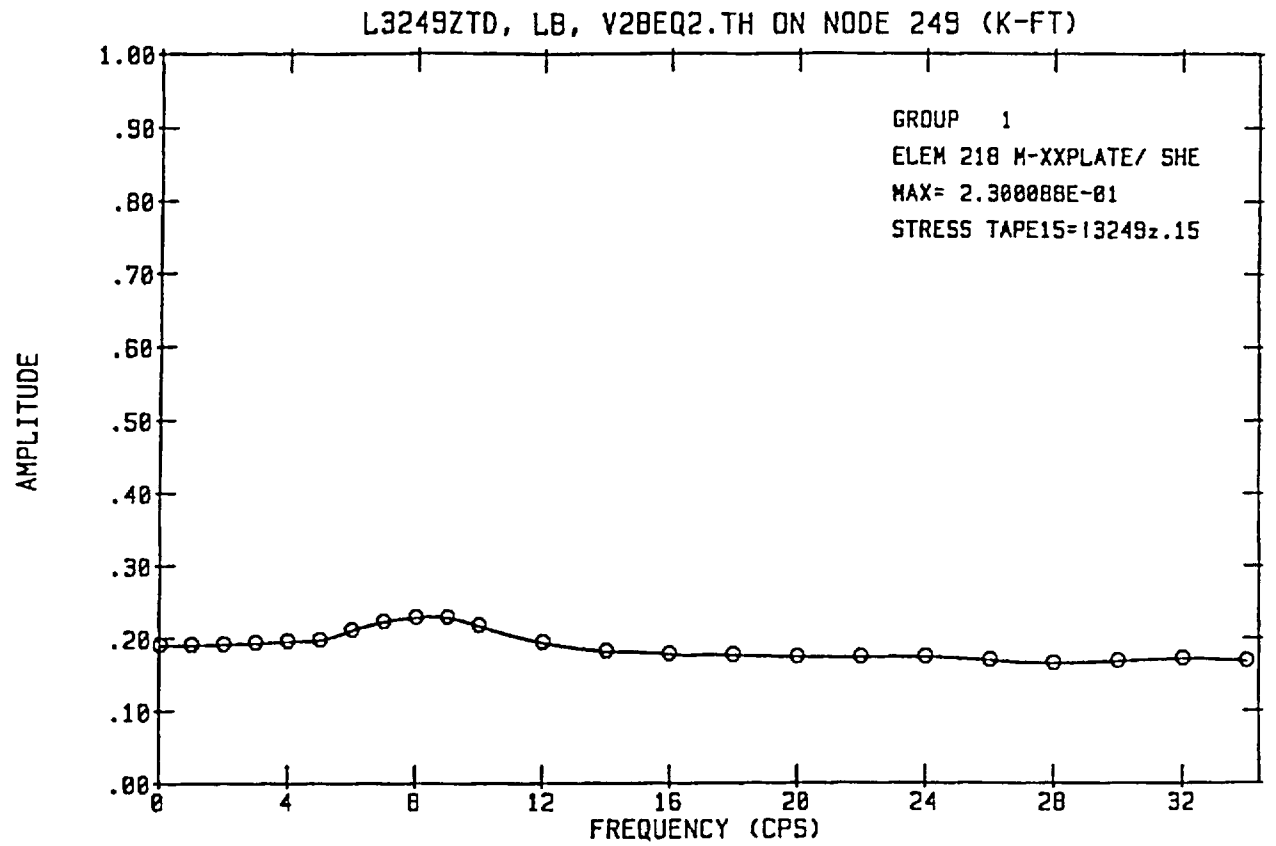
va\Gfx274Z.INP 1 4/ 3/ 1

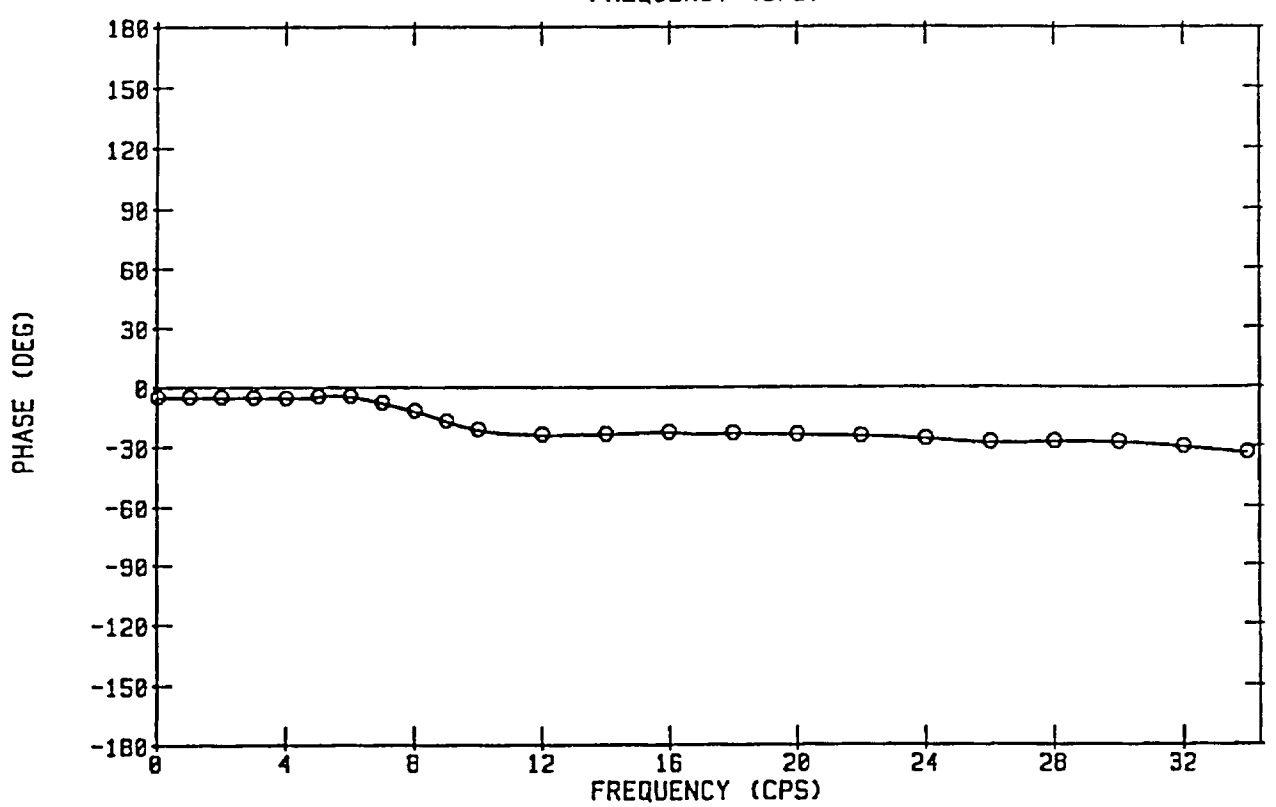


CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK Qum DATE 4/3/01
CALC. NO. G(P017)-2 REV. NO. 3
SHEET NO. 172



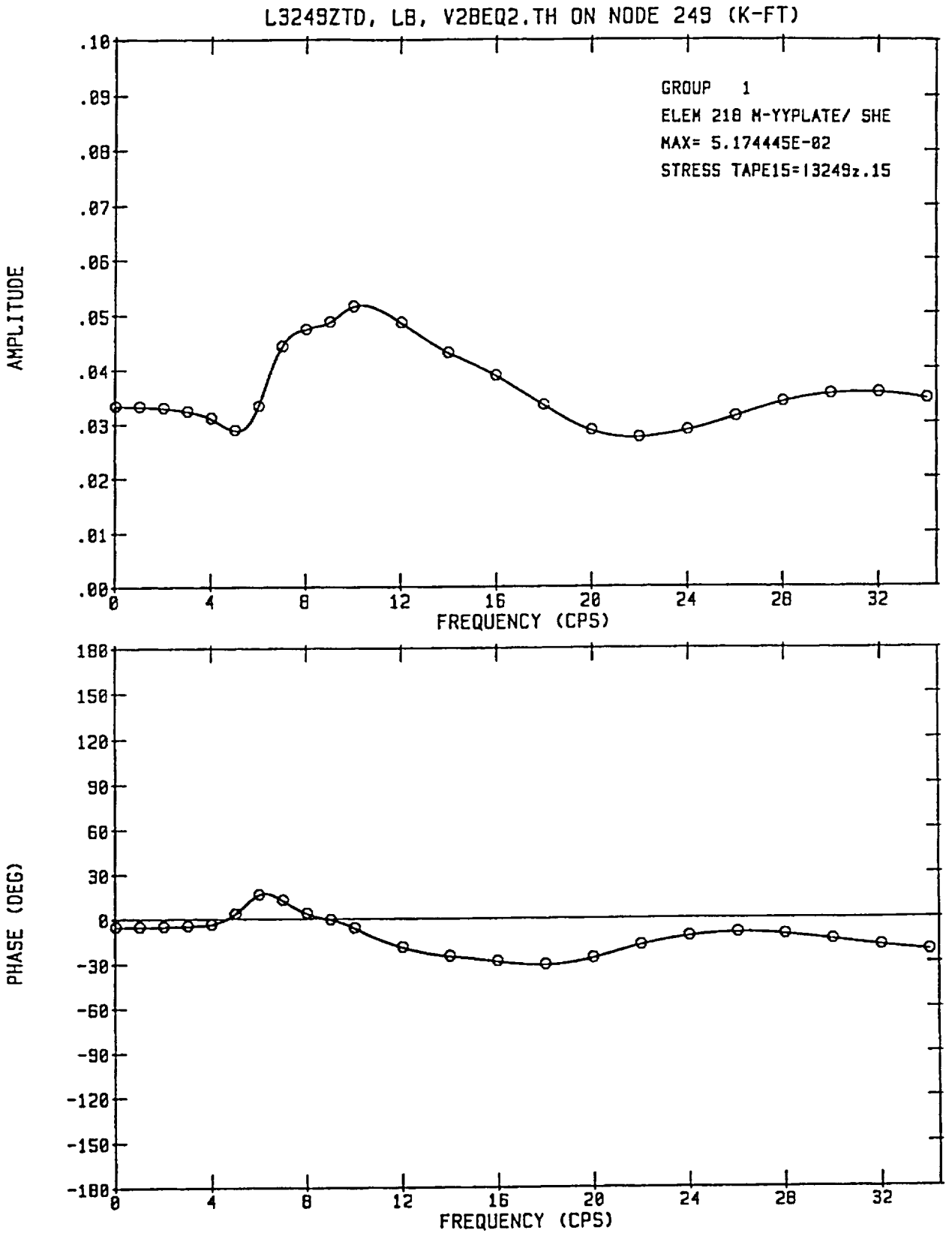
CEC JOB NO. 1161-000
BY DH DATE 4/3/01
CHECK aym DATE 4/3/01
CALC. NO. G(1017)-Z REV. NO. 3
SHEET NO. 173





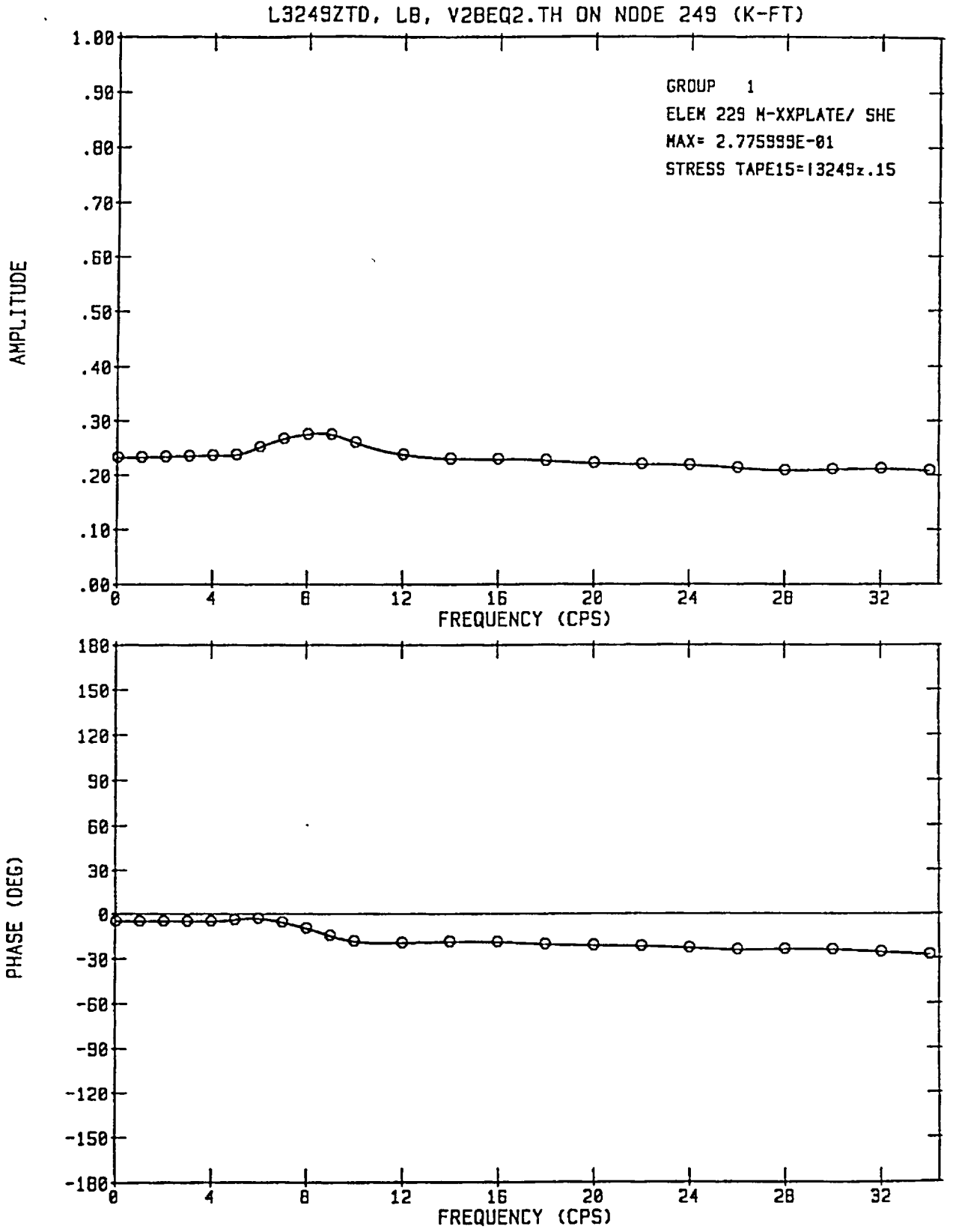
CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK [illegible] DATE 4/3/01
CALC. NO. G1(017)-2 REV. NO. 3
SHEET NO. 174

ve\G1218M-XX.INP1 4/ 3/ 1



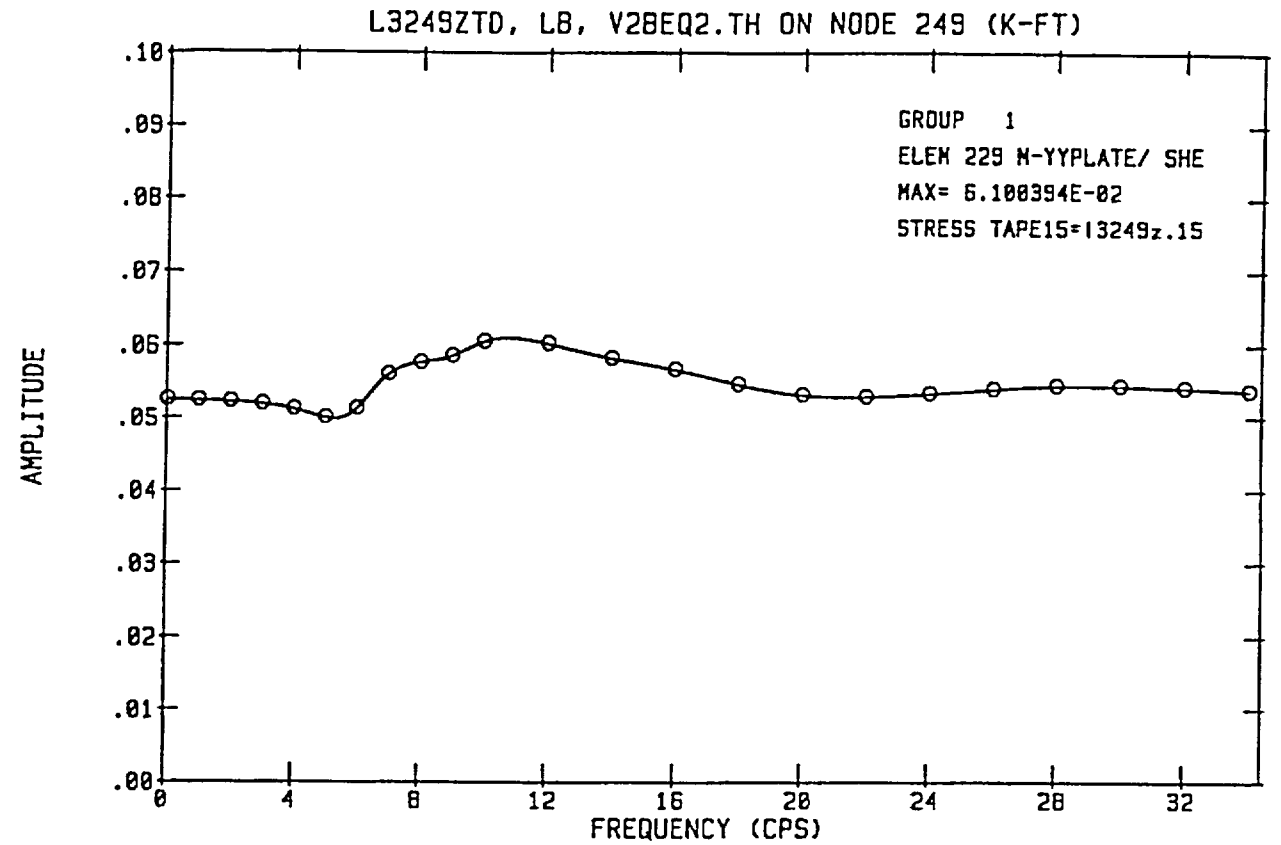
CEC JOB NO 1101.000
BY DH DATE 4/3/01
CHECK Amm DATE 4/3/01
CALC NO. G1A017-2 REV. NO 3
SHEET NO. 125

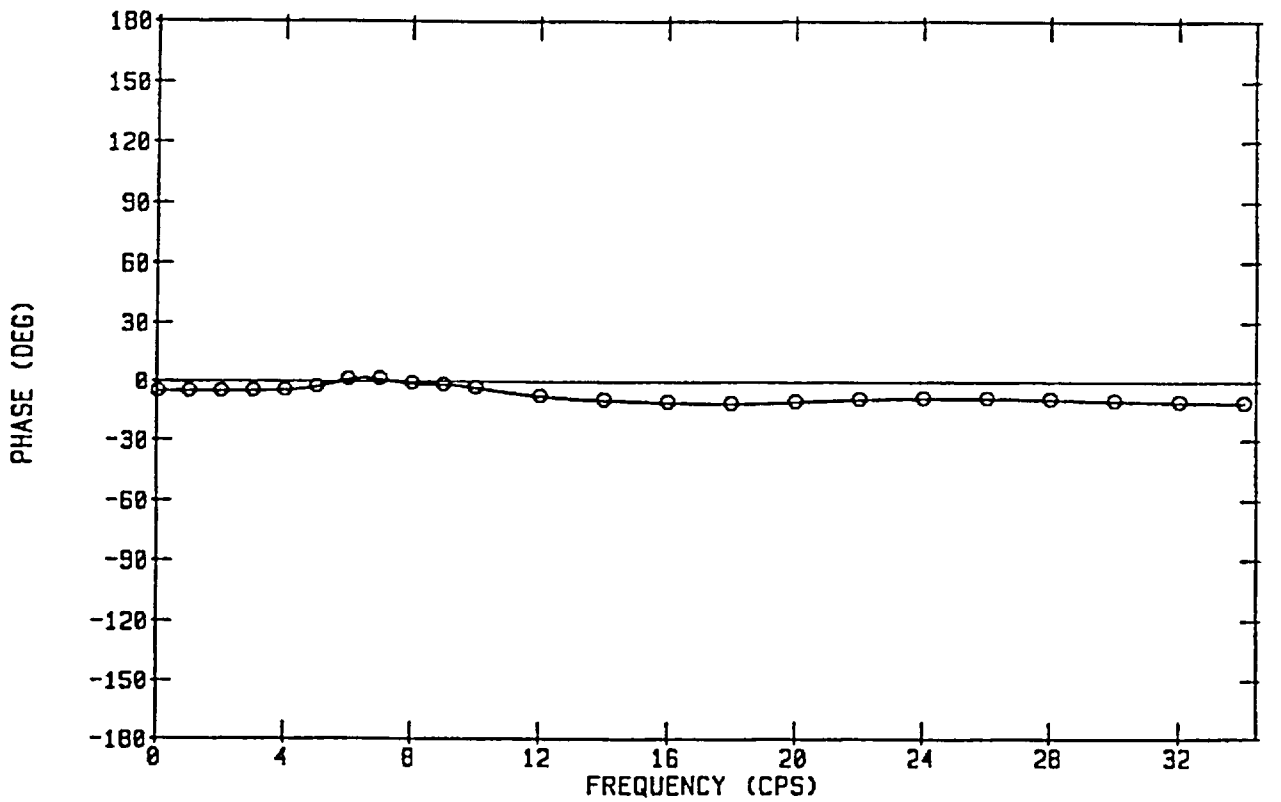
ve\G1218K-YY.INP1 4/ 3/ 1



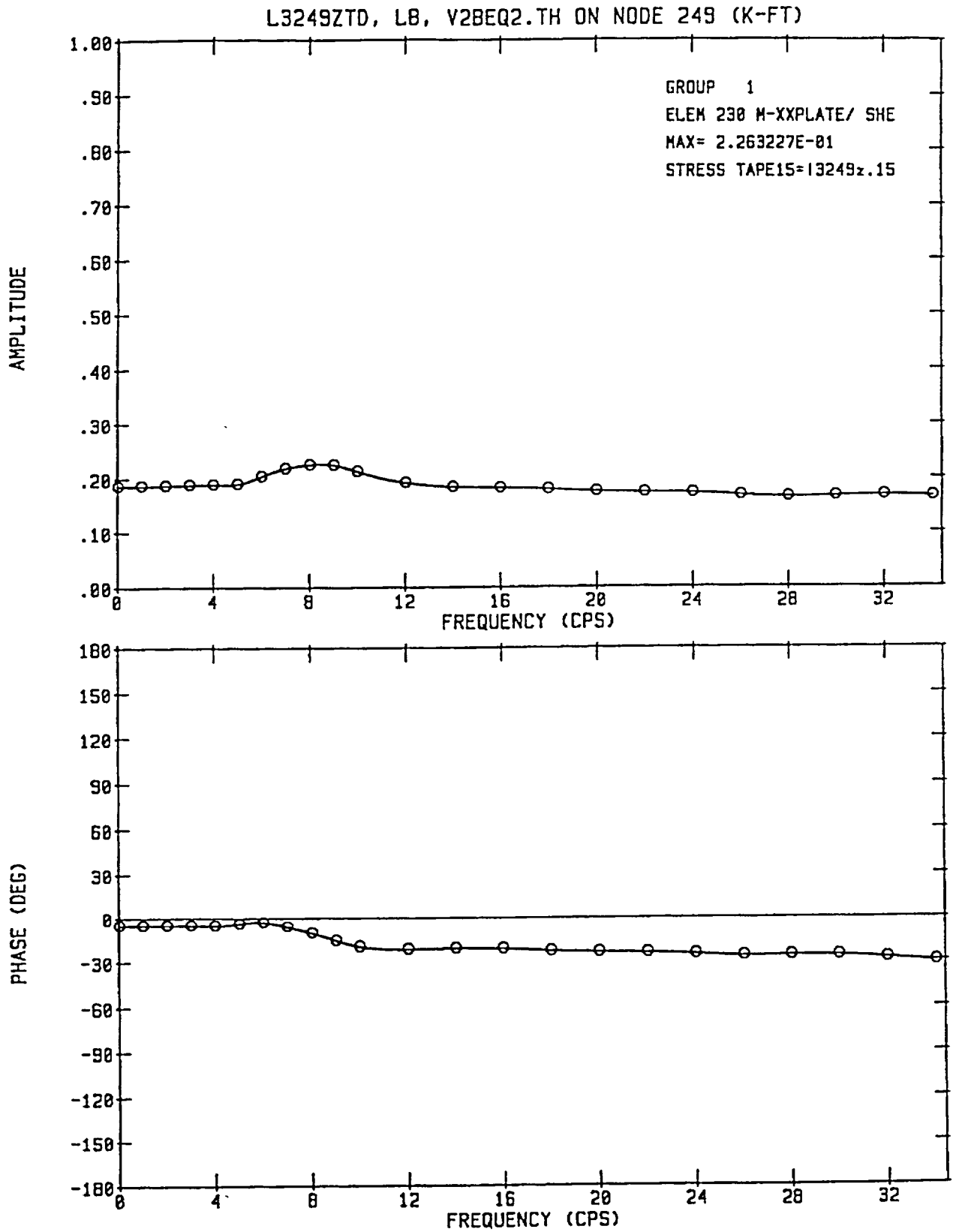
CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK Qum DATE 4/3/01
CALC. NO. G(A17)-2 REV NO. 3
SHEET NO. 176

ve\G1229M-XX.INP1 4/ 3/ 1

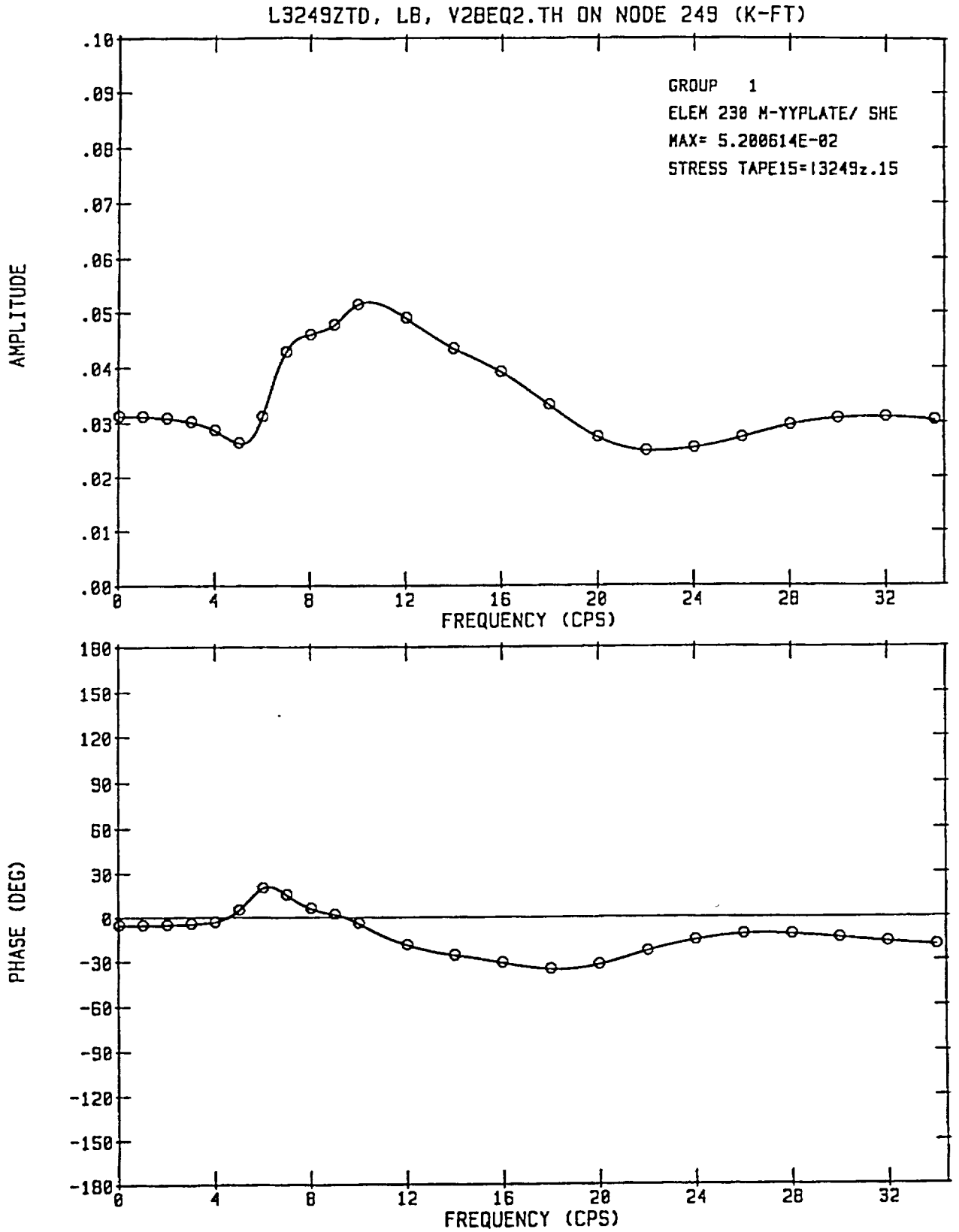




CEC JOB NO 1101-000
BY DH DATE 4/3/01
CHECK aum DATE 4/3/01
CALC. NO. G1207)-2 REV. NO. 3
SHEET NO. 177

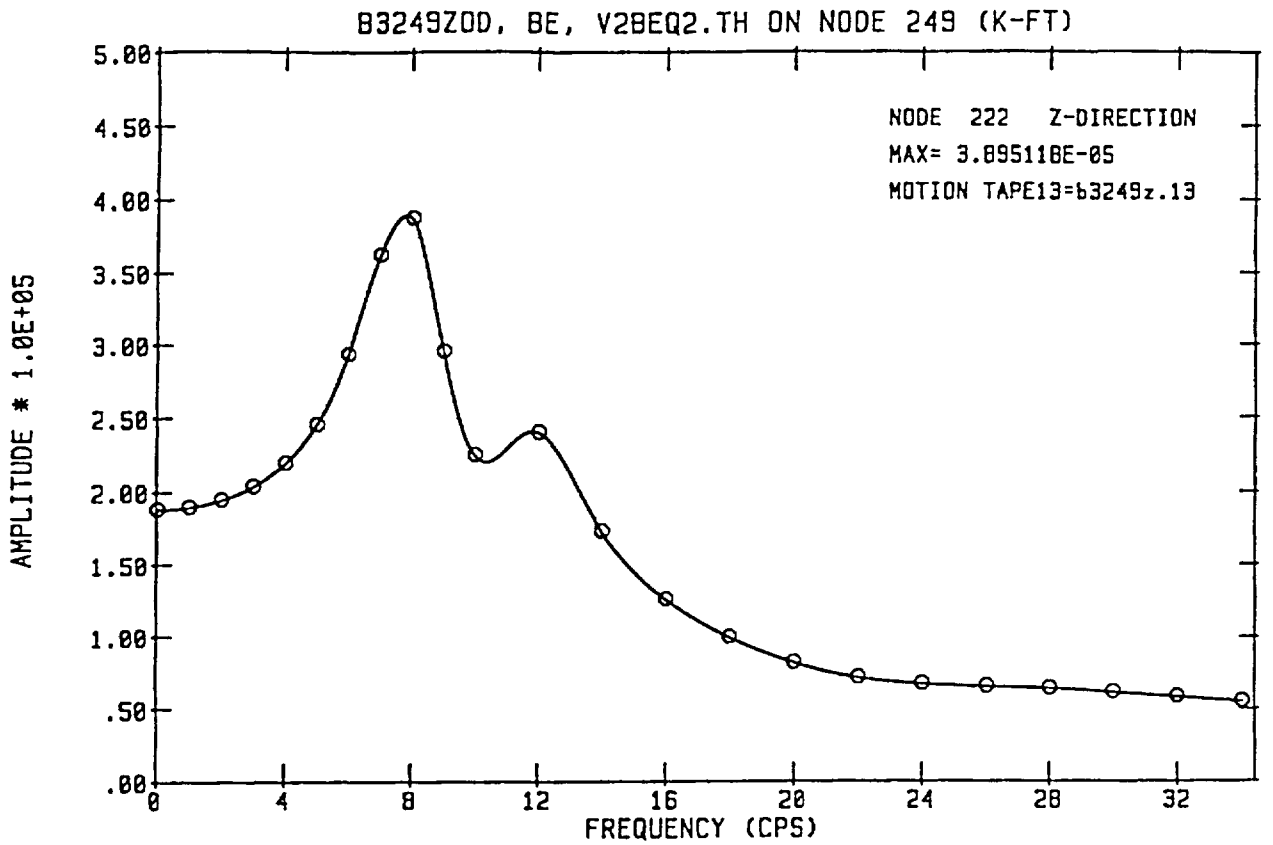


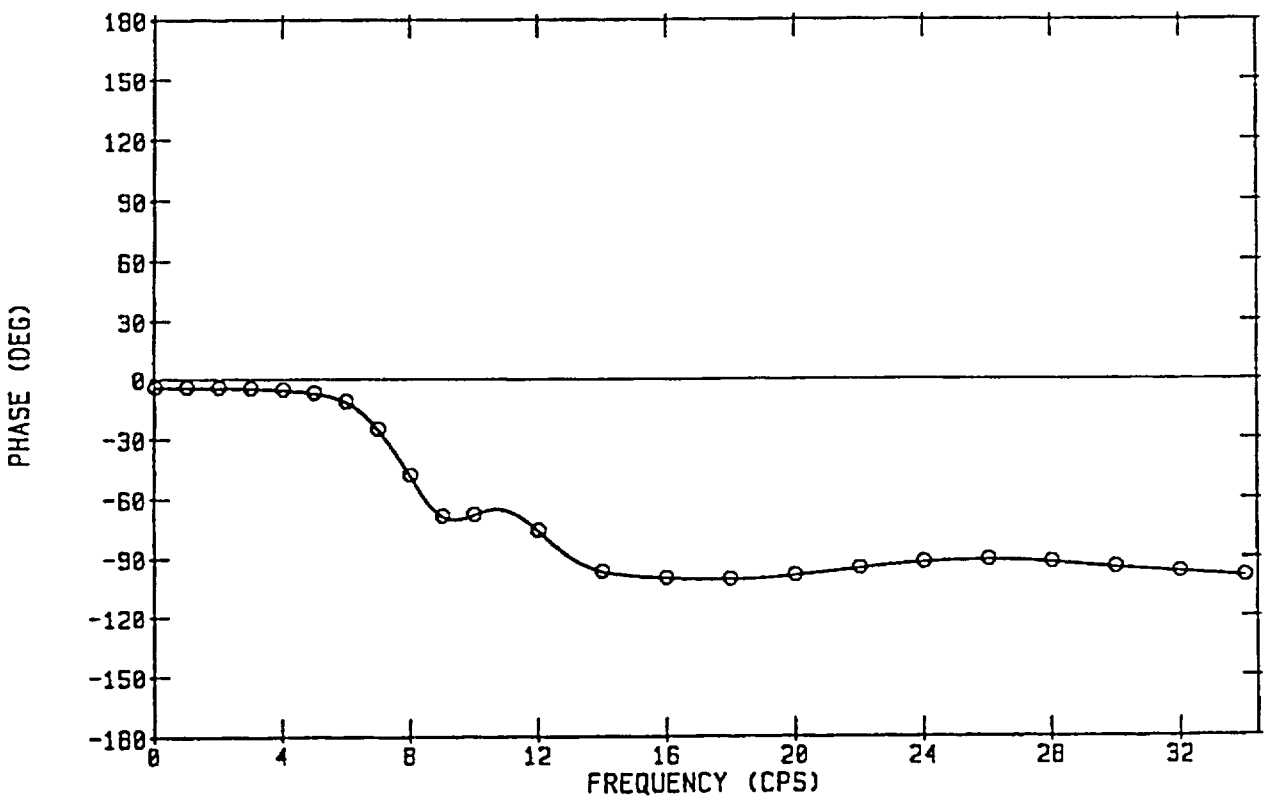
CEC JOB NO 1101-000
BY DH DATE 4/3/01
CHECK AUM DATE 4/3/01
CALC. NO. G(A07)-2 REV. NO 3
SHEET NO. 178



CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK [illegible] DATE 4/3/01
CALC. NO. G(P012)-2 REV. NO. 3
SHEET NO. 179

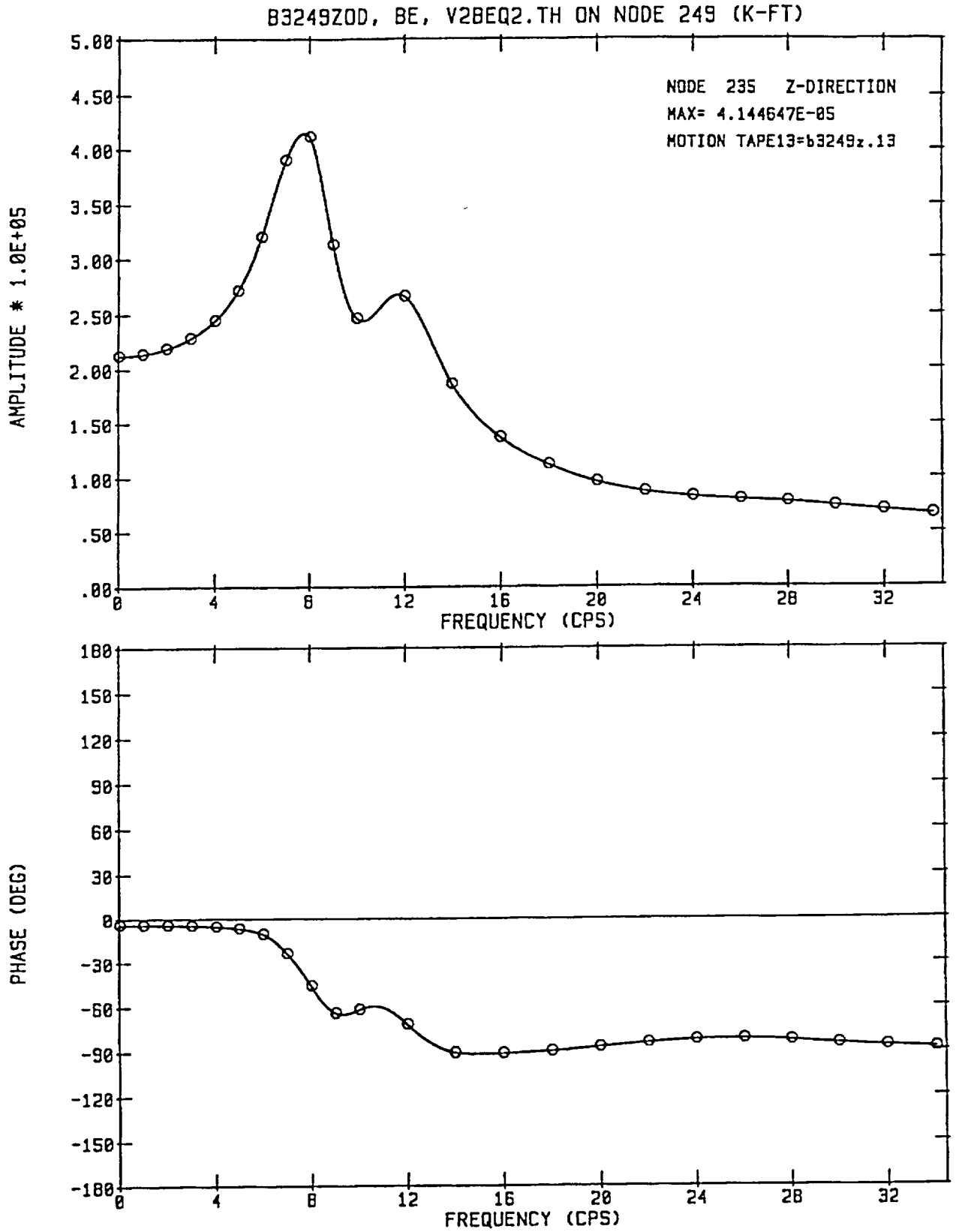
v:\G1230M-YY.INP1 4/ 3/ 1





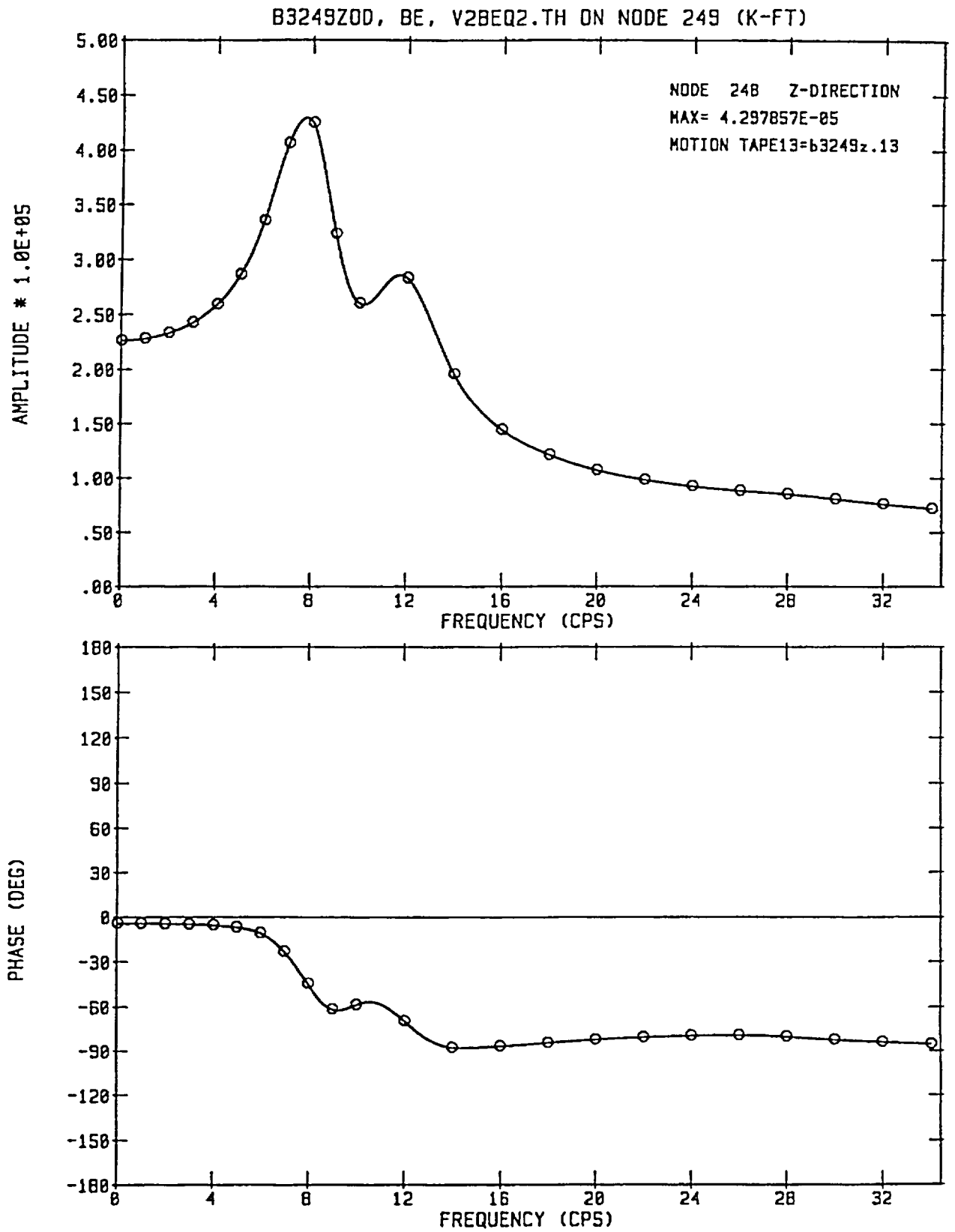
CEC JOB NO 1101-000
BY DH DATE 4/3/01
CHECK AUM DATE 4/3/01
CALC. NO. G(P017)-2 REV. NO. 3
SHEET NO. 180

ve\Gfz222Z.INP 1 4/ 3/ 1



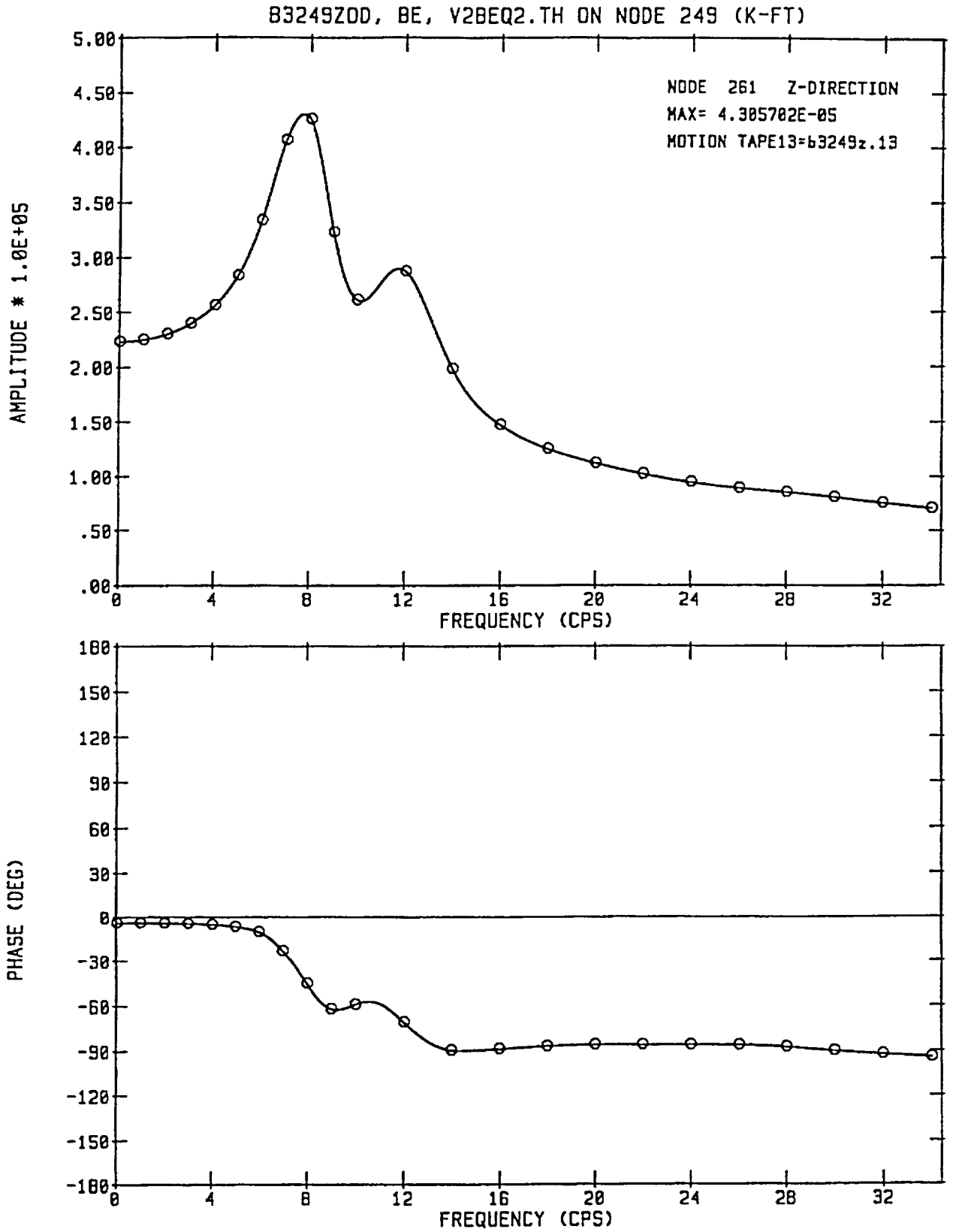
CEC JOB NO 1101-000
BY DH DATE 4/3/01
CHECK [illegible] DATE 4/3/01
CALC. NO. G(P617)-2 REV. NO 3
SHEET NO. 181

ve\Gfx235Z.INP 1 4/ 3/ 1

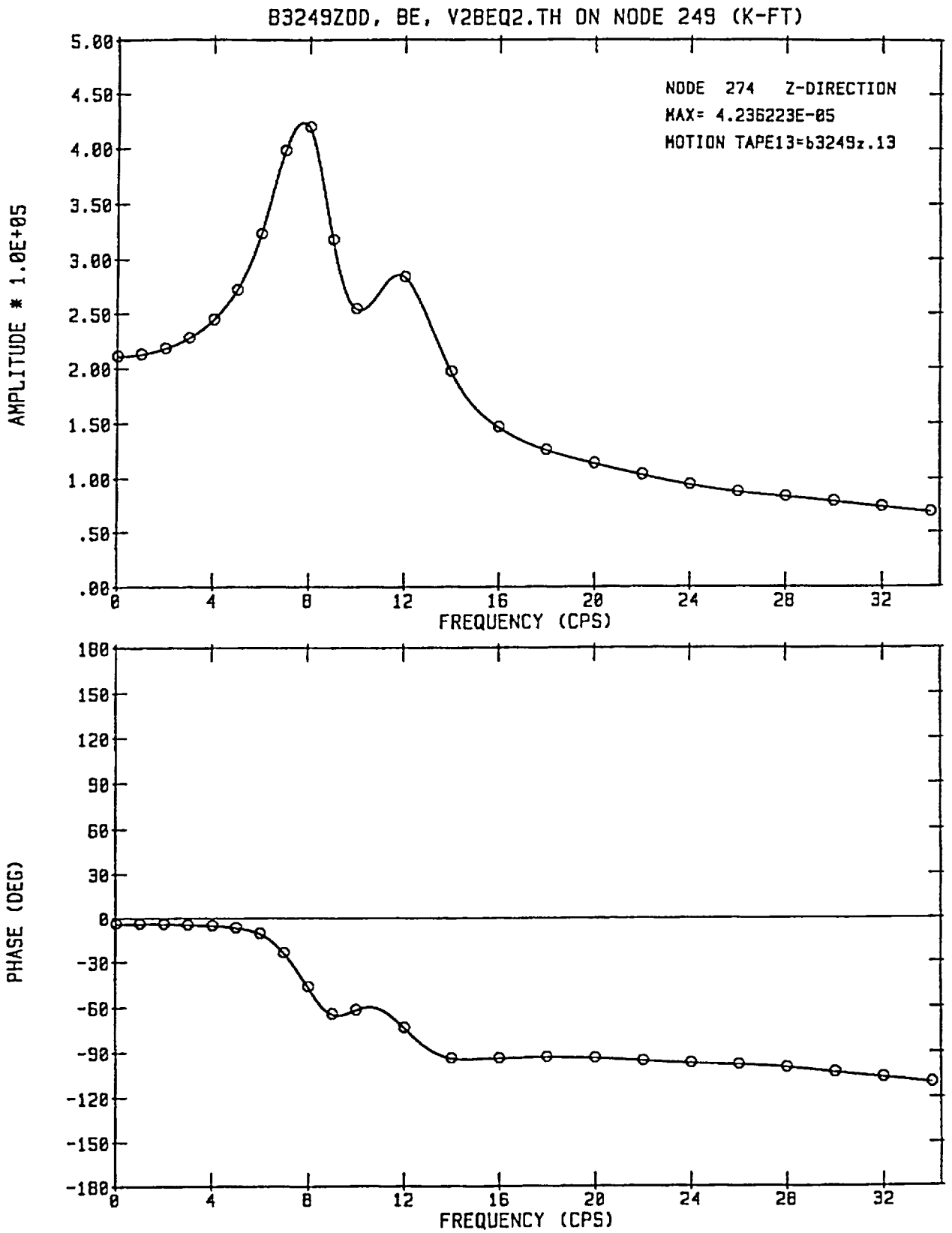


CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK [illegible] DATE 4/3/01
CALC NO G(P017)-2 REV. NO. 3
SHEET NO. 162

ve\Gfx248Z.INP 1 4/ 3/ 1

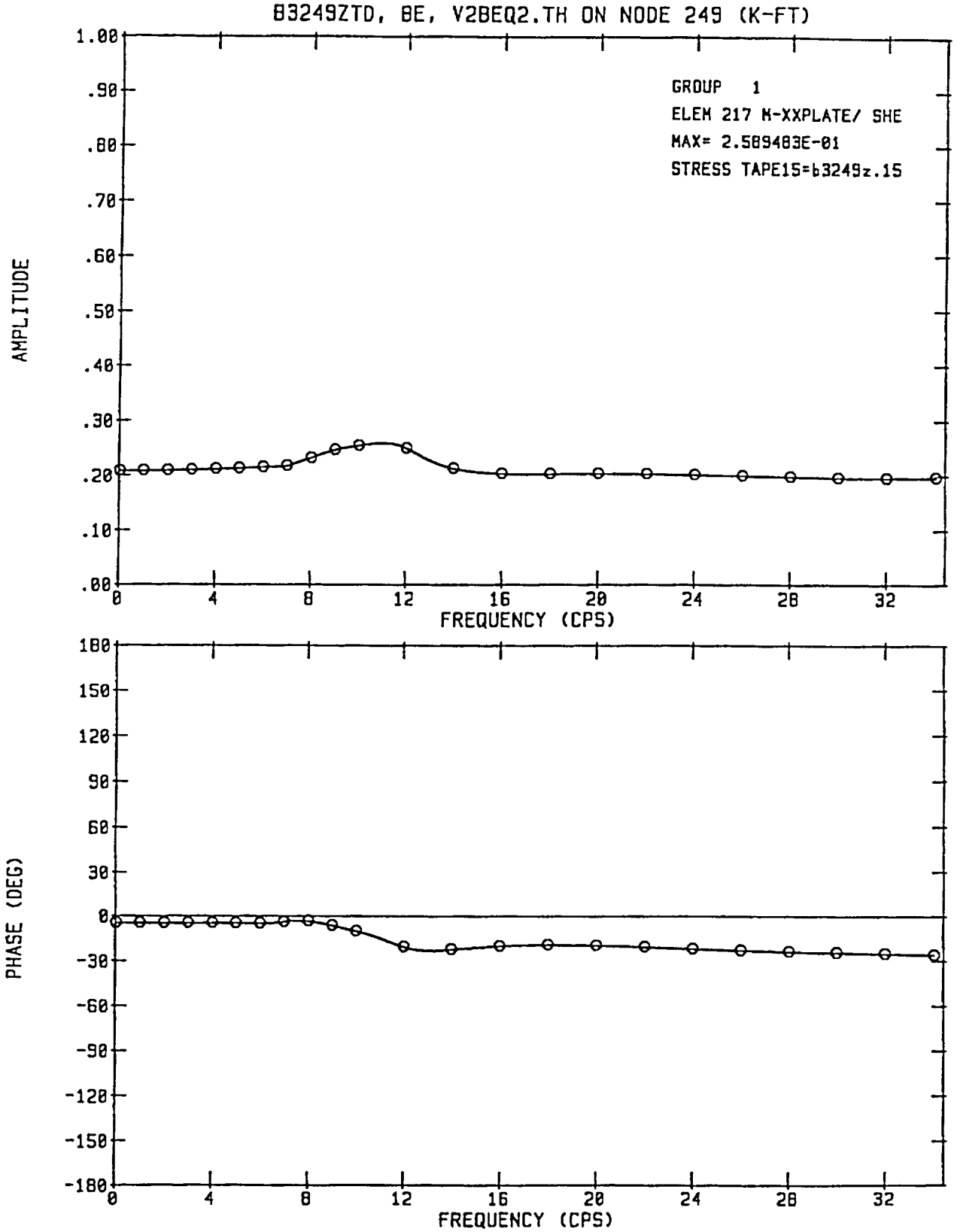


CEC JOB NO 1101-000
BY DH DATE 4/3/01
CHECK AUM DATE 4/3/01
CALC. NO. GI P617-2 REV. NO. 3
SHEET NO. 183

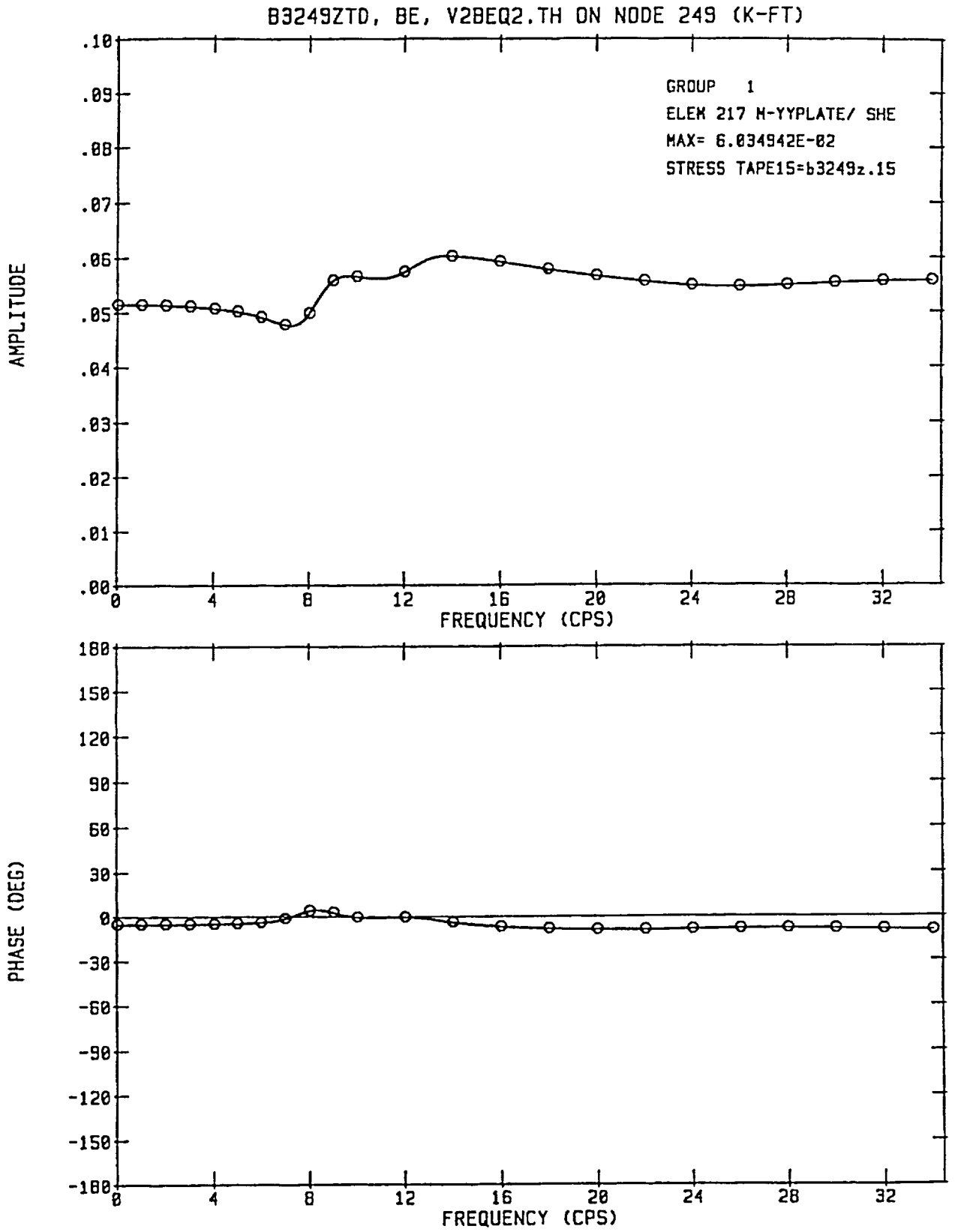


CEC JOB NO 1101-000
BY DH DATE 4/3/01
CHECK [illegible] DATE 4/3/01
CALC. NO. G(P017)-2 REV. NO. 3
SHEET NO. 184

ve\Gfz274Z.INP 1 4/ 3/ 1

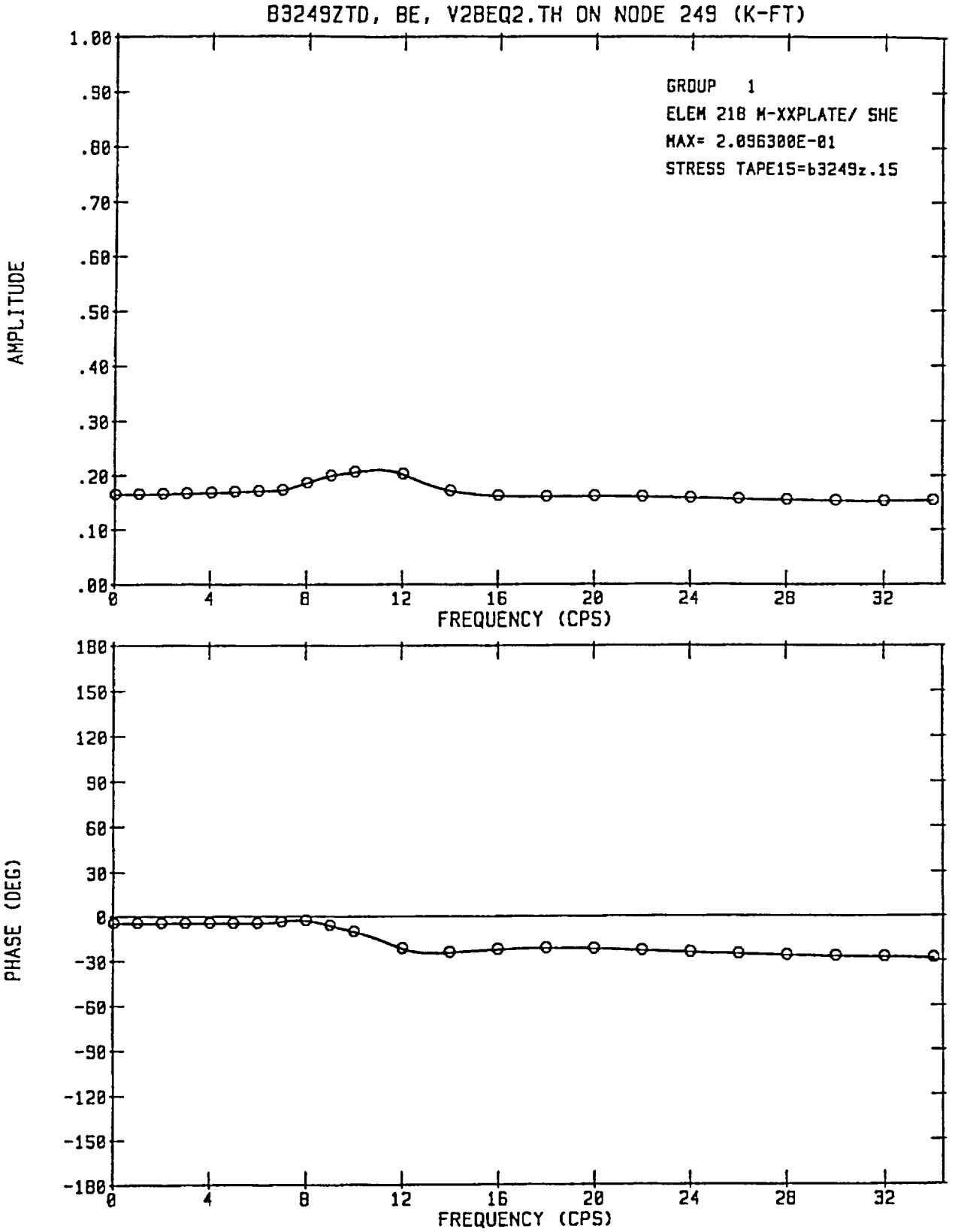


CEC JOB NO 1101-000
BY DH DATE 4/3/01
CHECK Qum DATE 4/3/01
CALC NO. G(1017)-2 REV. NO. 3
SHEET NO. 185

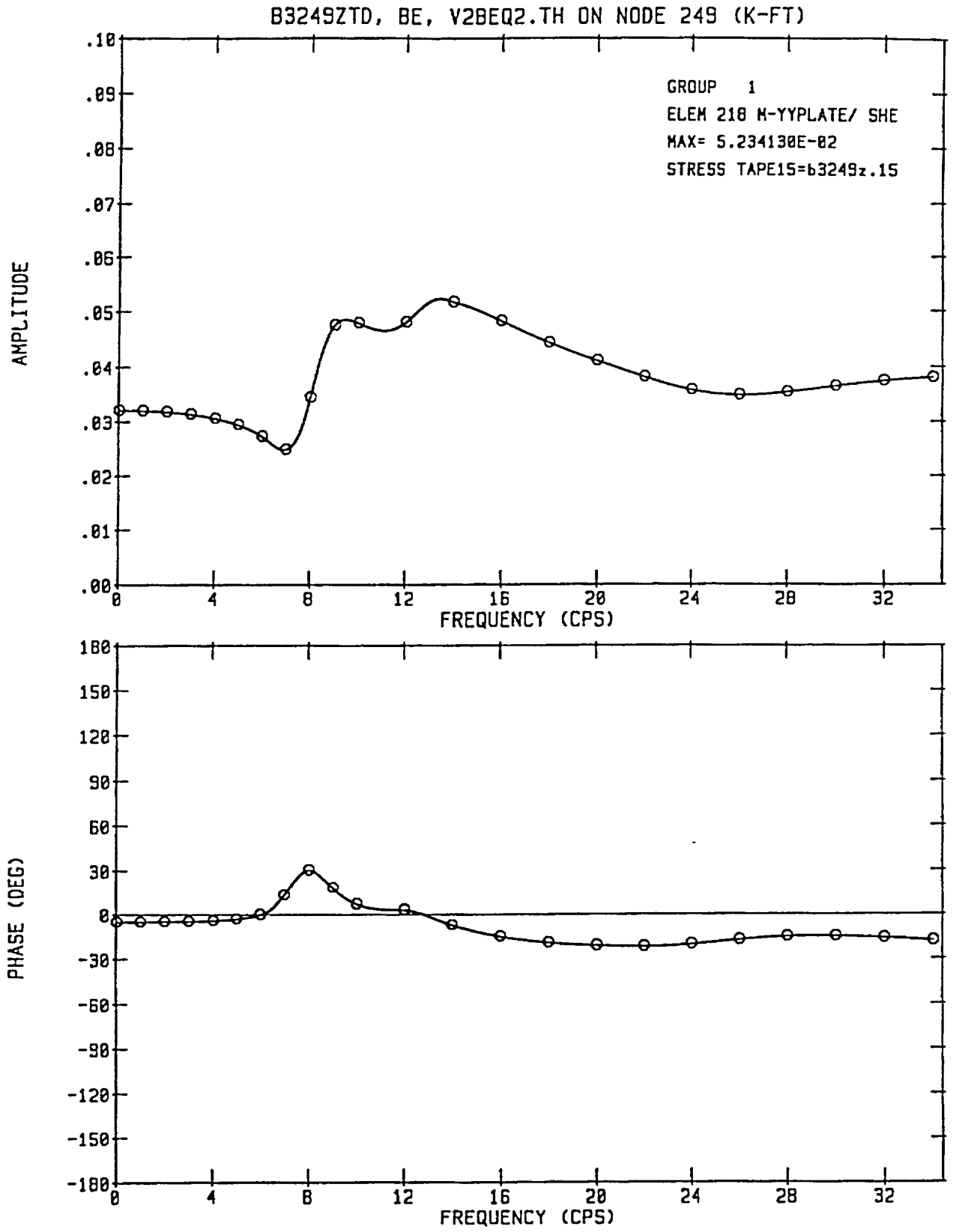


CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK [illegible] DATE 4/3/01
CALC. NO. G(P017)-7 REV. NO. 3
SHEET NO. 186

ve\G1217M-YY.INP1 4/ 3/ 1

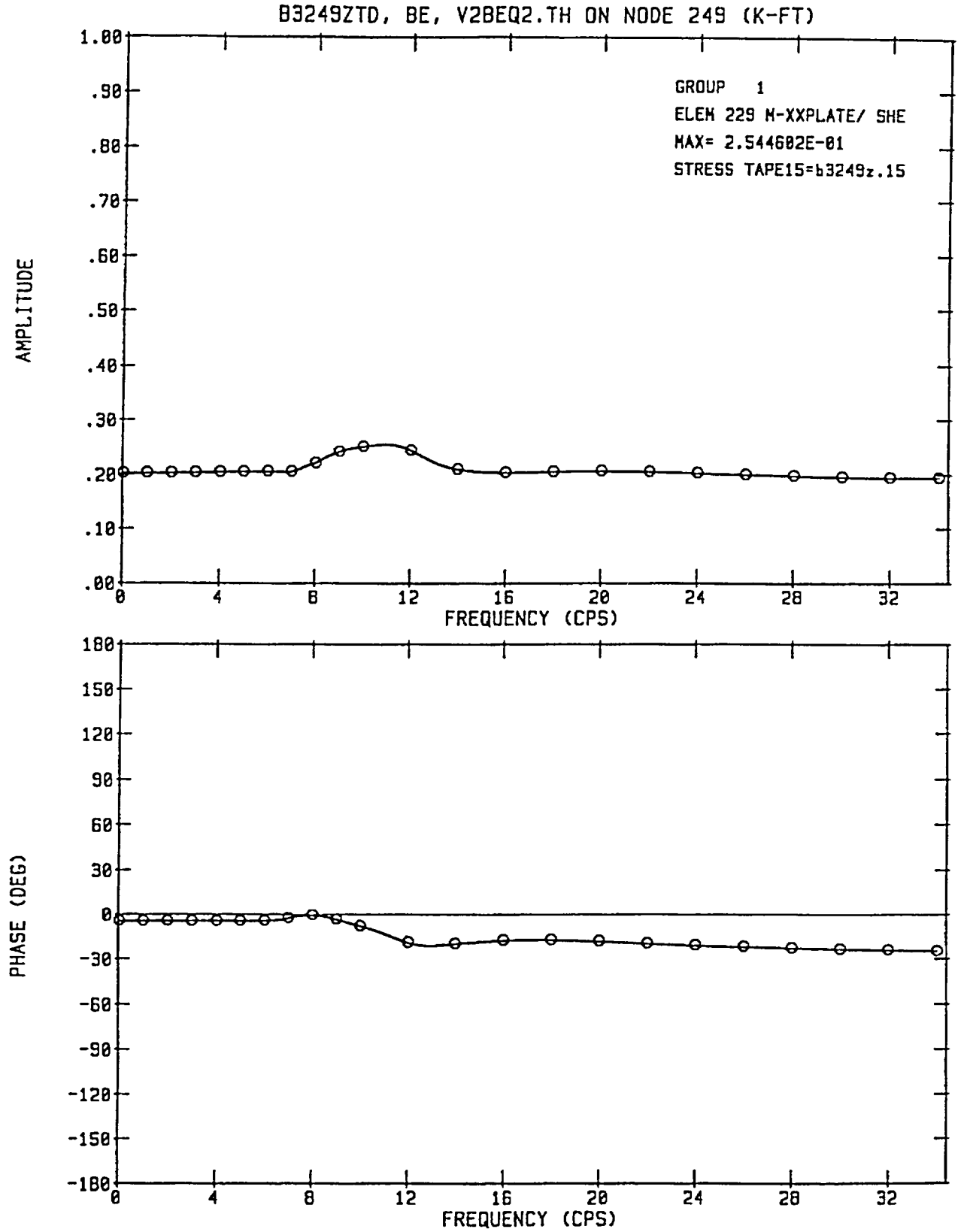


CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK Qum DATE 4/3/01
CALC. NO. G(P017)-2 REV NO. 3
SHEET NO 187



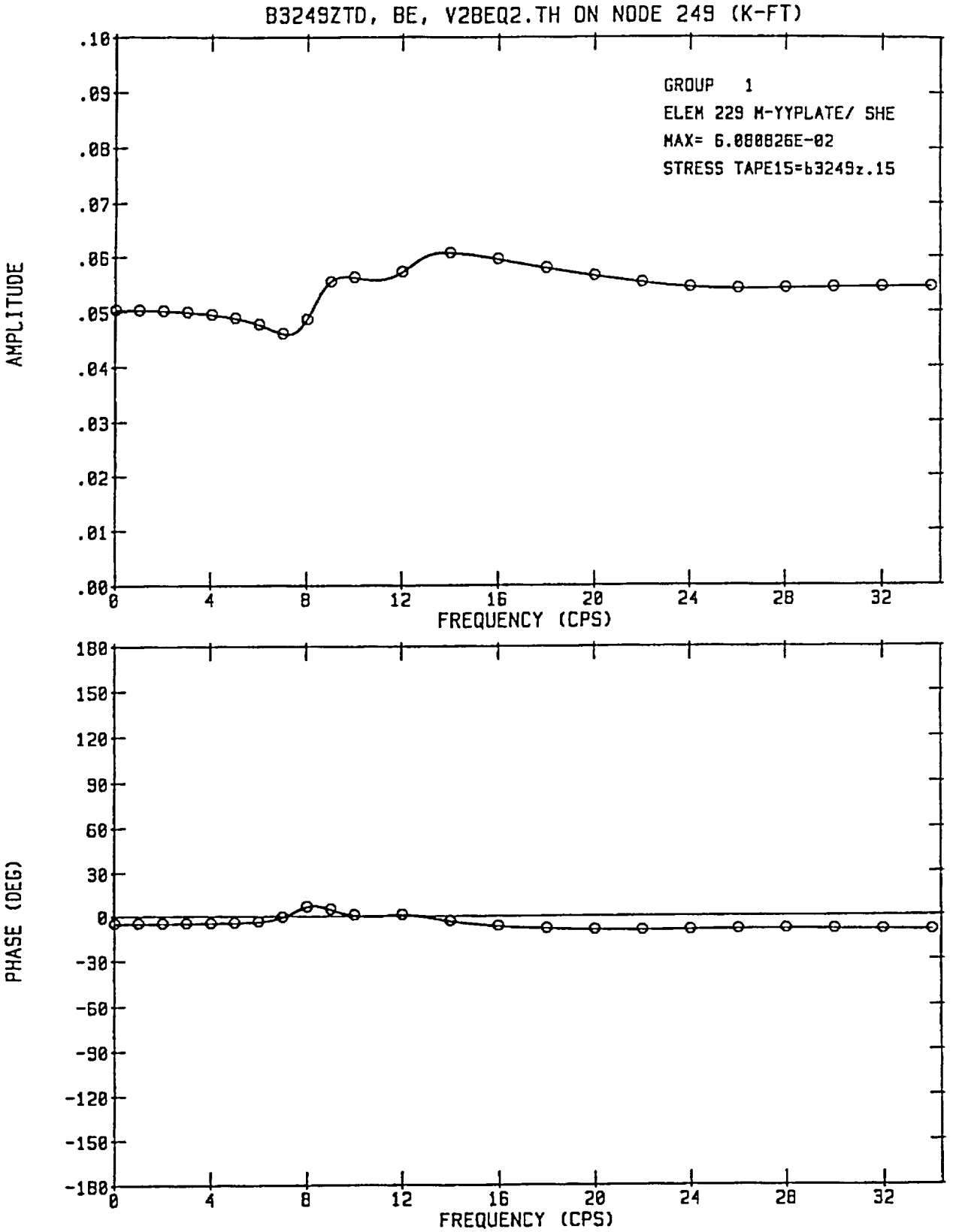
CEC JOB NO. 1101-001
BY DH DATE 4/3/01
CHECK AHM DATE 4/3/01
CALC. NO. G(P07)-2 REV. NO. 3
SHEET NO. 188

ve\G1218H-YY.INP1 4/ 3/ 1



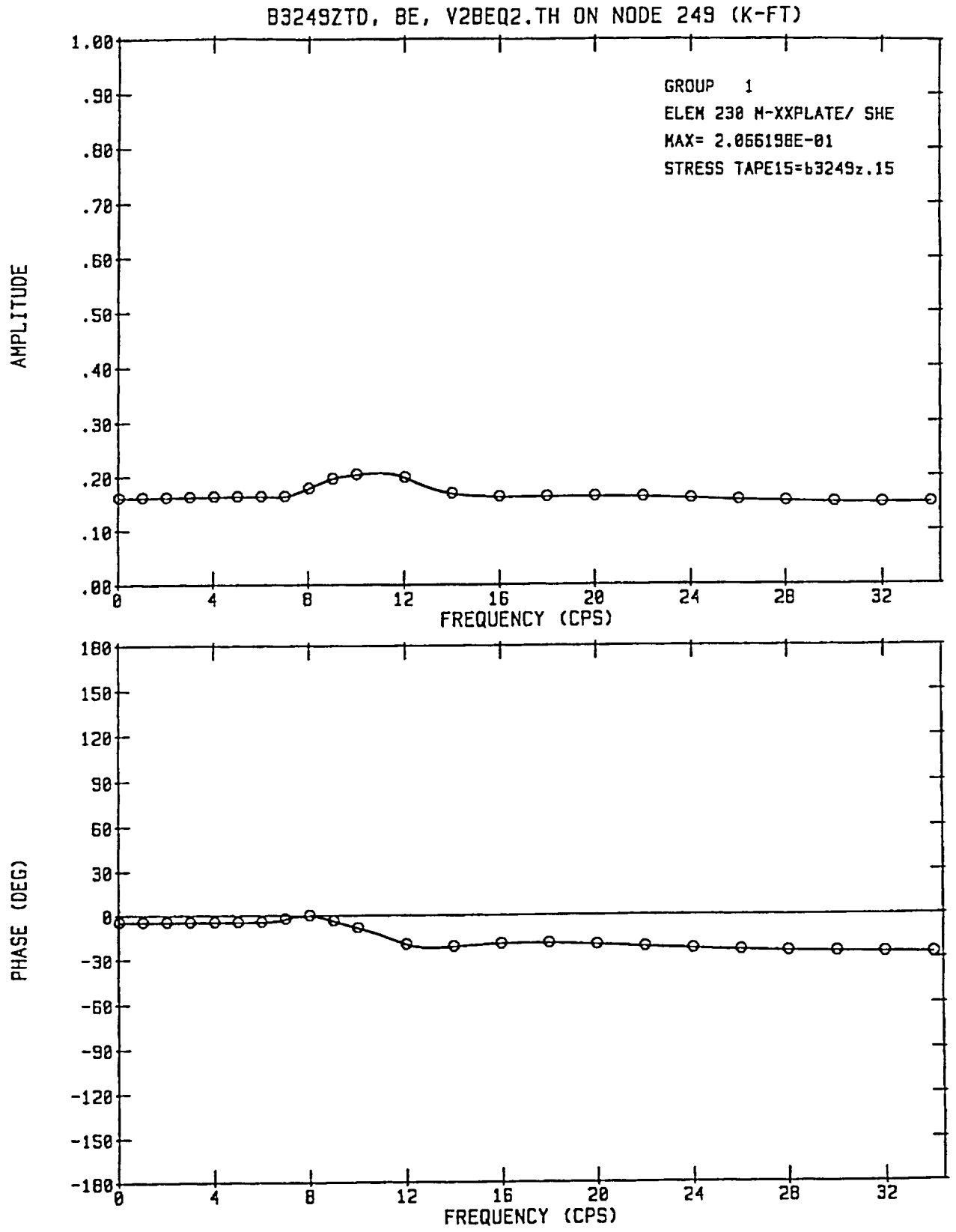
CEC JOB NO 1101-000
BY DH DATE 4/3/01
CHECK Aum DATE 4/3/01
CALC. NO. G(P017)-2 REV. NO. 3
SHEET NO. 189

v8\G1229M-XX.INP1 4/ 3/ 1

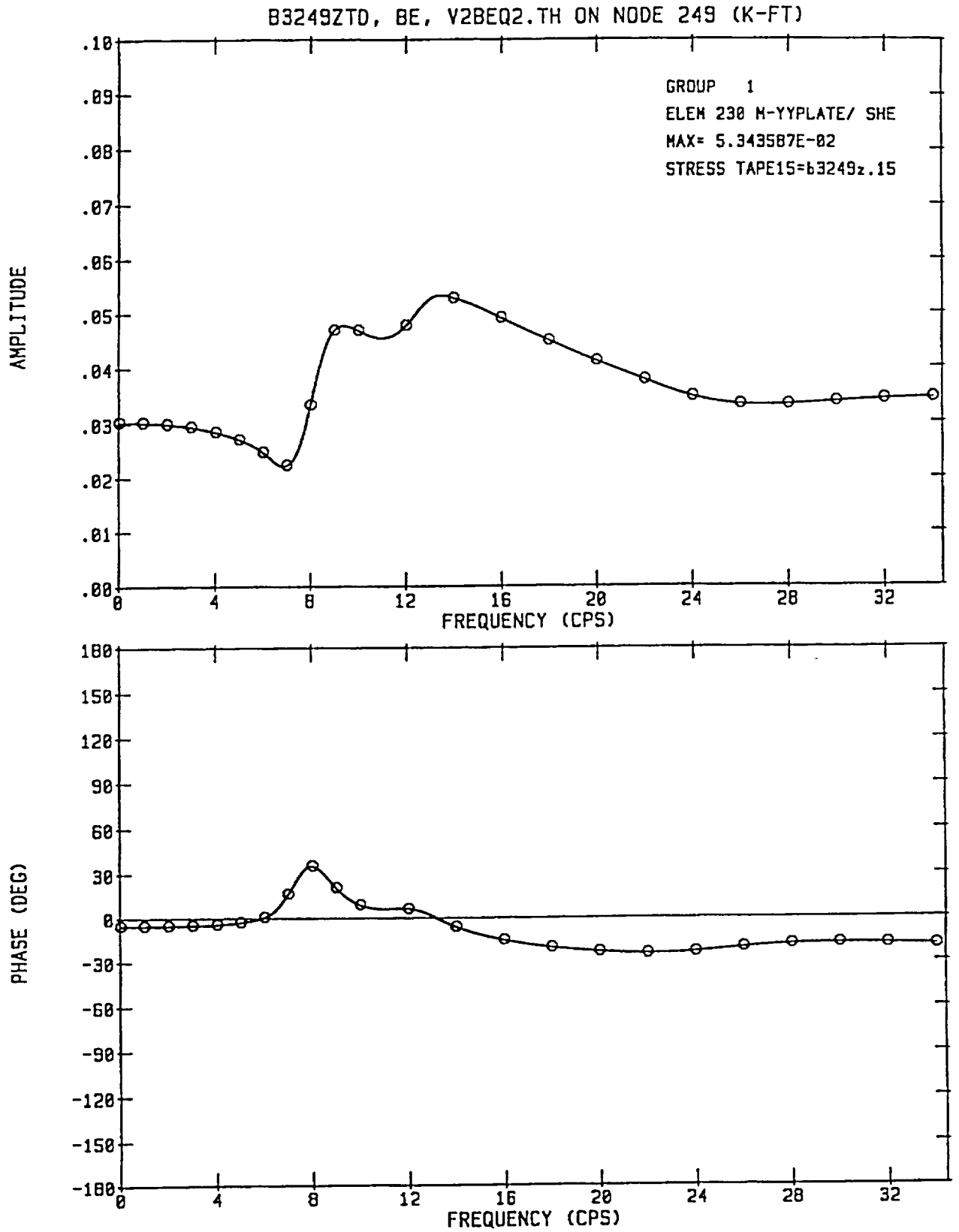


CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK QUM DATE 4/3/01
CALC NO. G(P017)-2 REV. NO. 3
SHEET NO. 190

ve\G1229M-YY.INP1 4/ 3/ 1

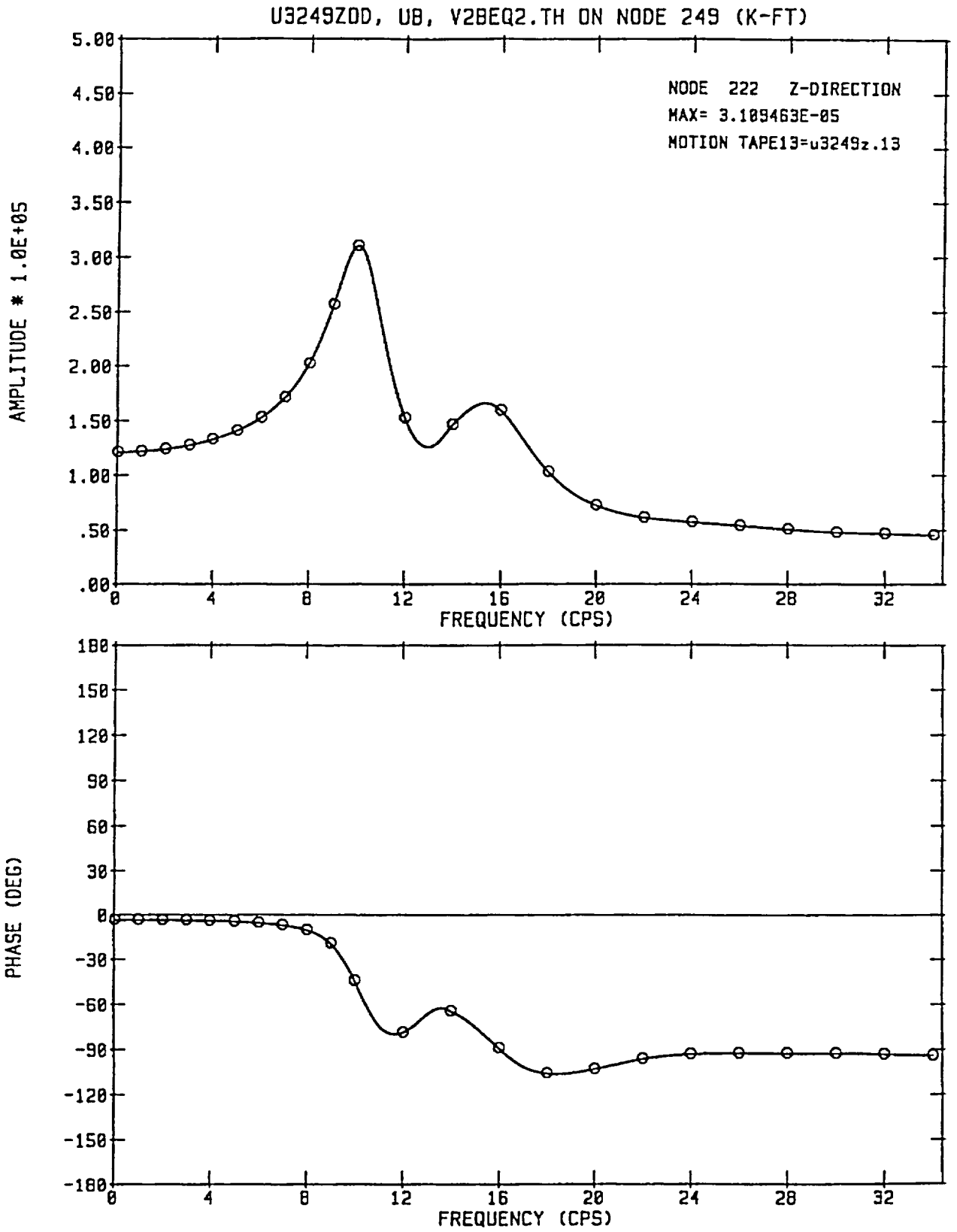


CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK AMM DATE 4/3/01
CALC. NO. G1P017)-2 REV. NO. 3
SHEET NO. 191



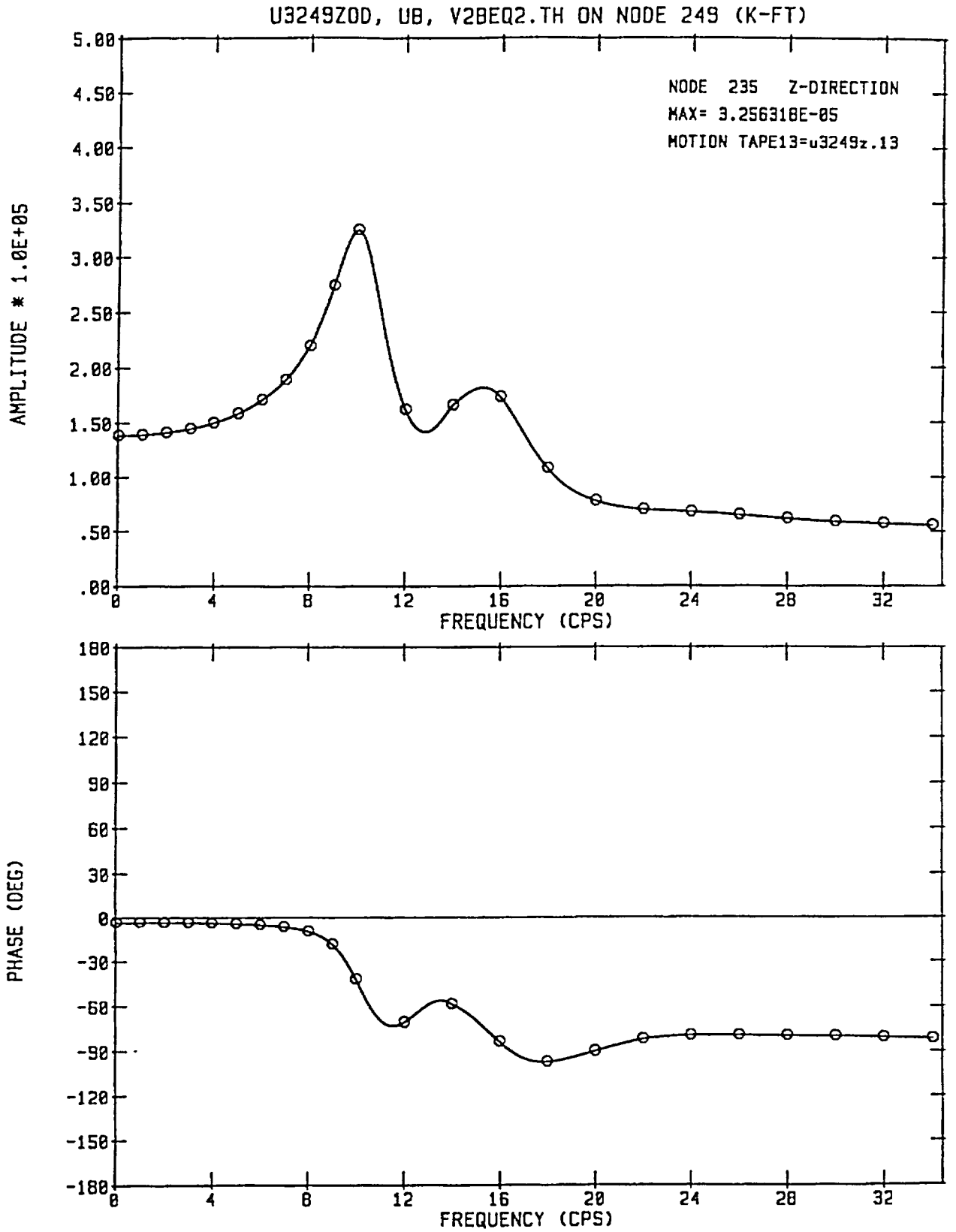
CEC JOB NO 1101-000
BY DH DATE 4/3/01
CHECK AWM DATE 4/3/01
CALC NO. G(P017)-2 REV. NO. 3
SHEET NO 192

va\G1230M-YY.INP1 4/ 3/ 1



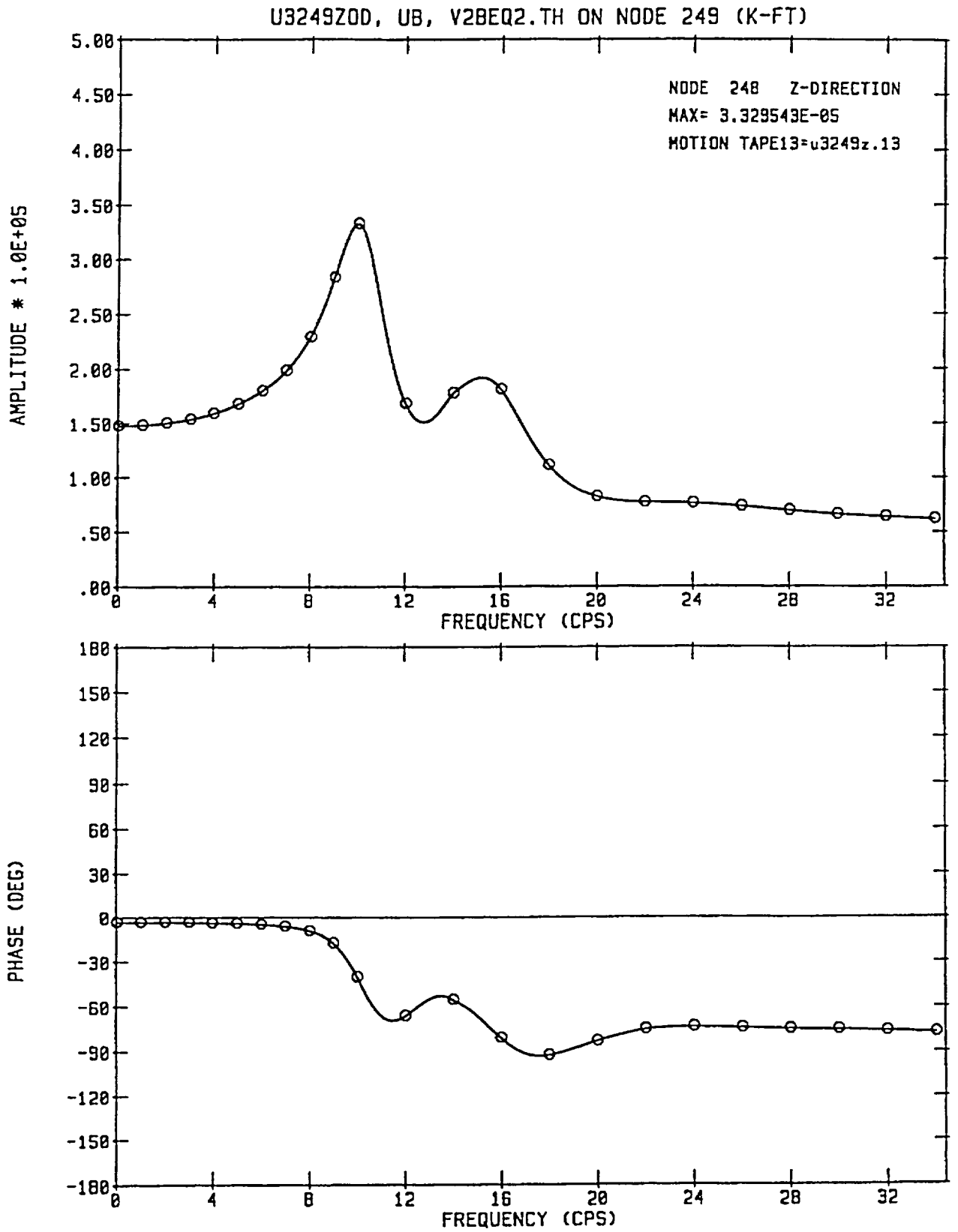
CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK amw DATE 4/3/01
CALC. NO G(P07)-2 REV. NO 3
SHEET NO. 193

ve\Gfz222Z.INP 1 4/ 3/ 1



CEC JOB NO 1101-002
BY DH DATE 4/3/01
CHECK AMM DATE 4/2/01
CALC NO. G(P0/7)-2 REV. NO. 3
SHEET NO. 194

ve\Gfz23SZ.INP 1 4/ 3/ 1



CEC JOB NO 1101-002

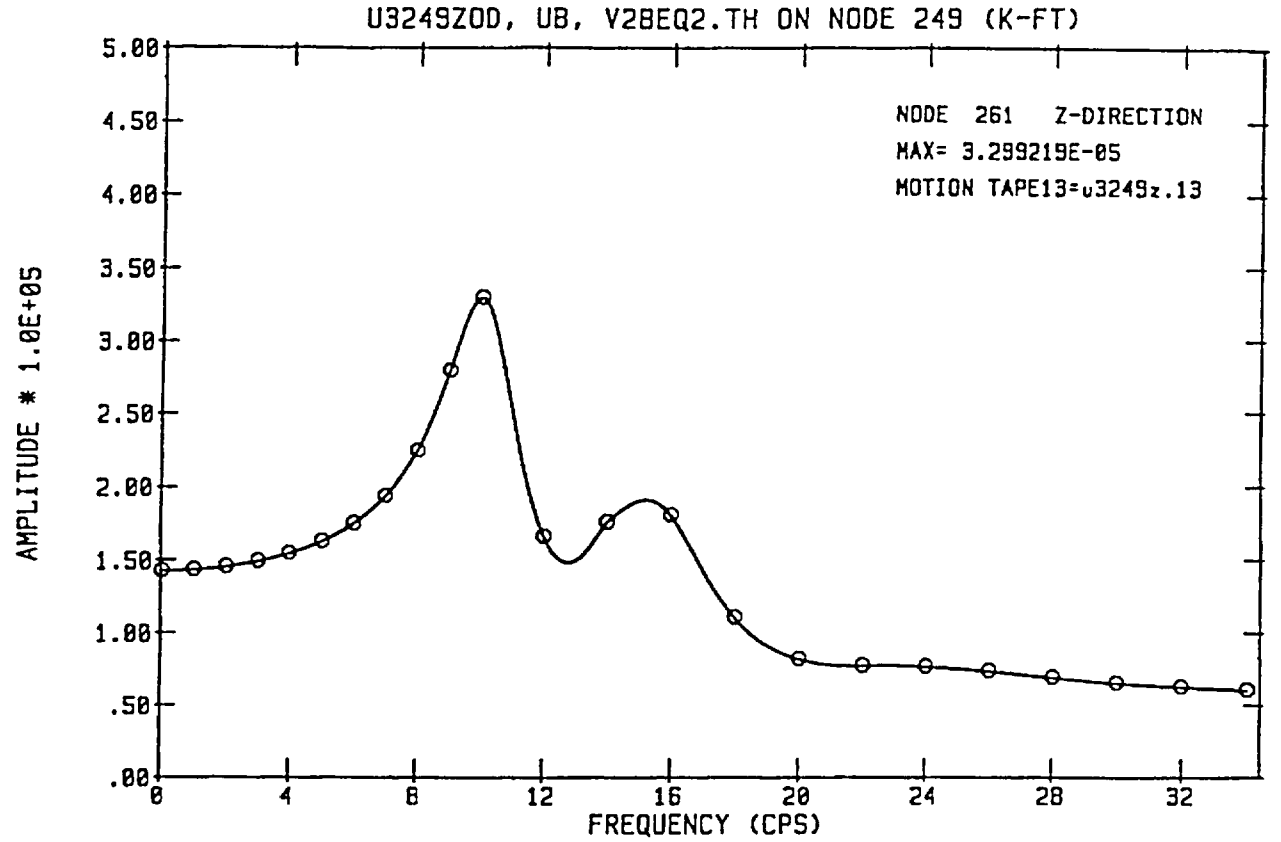
BY DH DATE 4/3/01

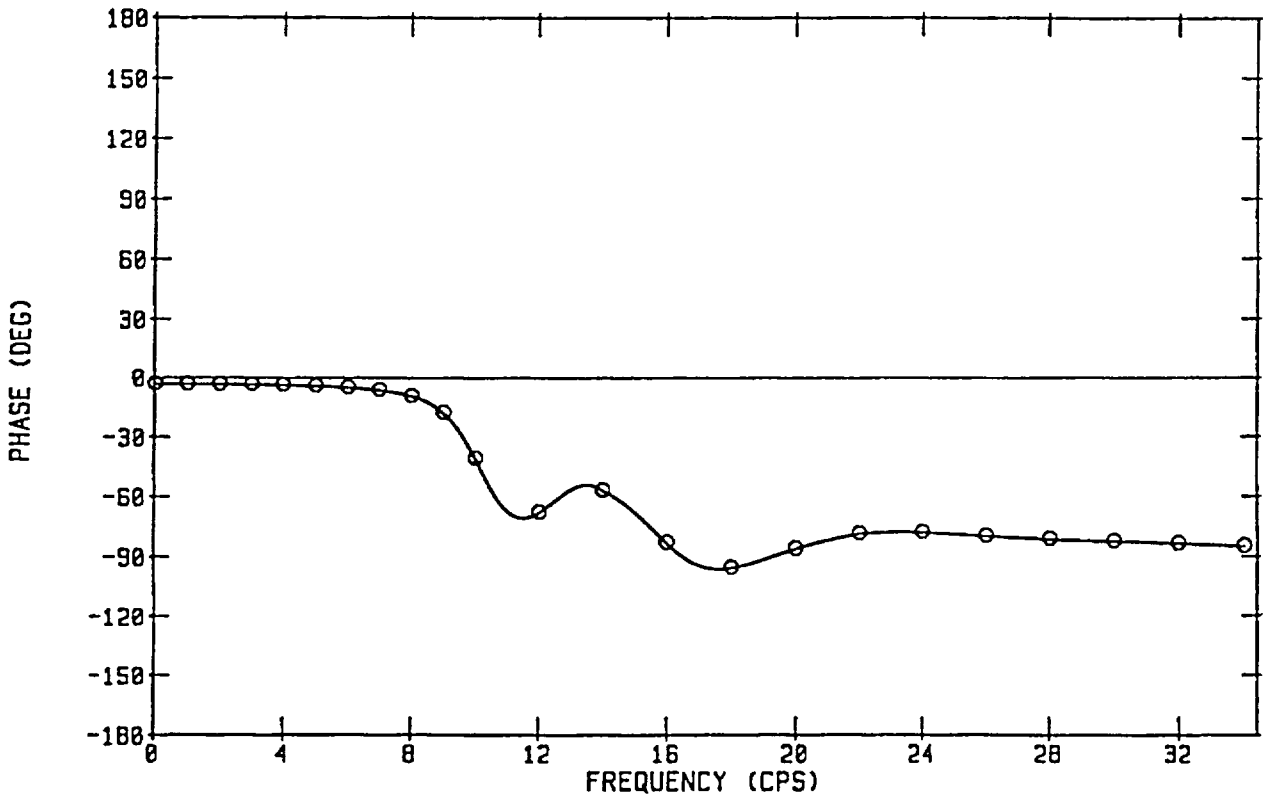
CHECK Quim DATE 4/3/01

CALC. NO G(P017-2) REV. NO. 3

SHEET NO 195

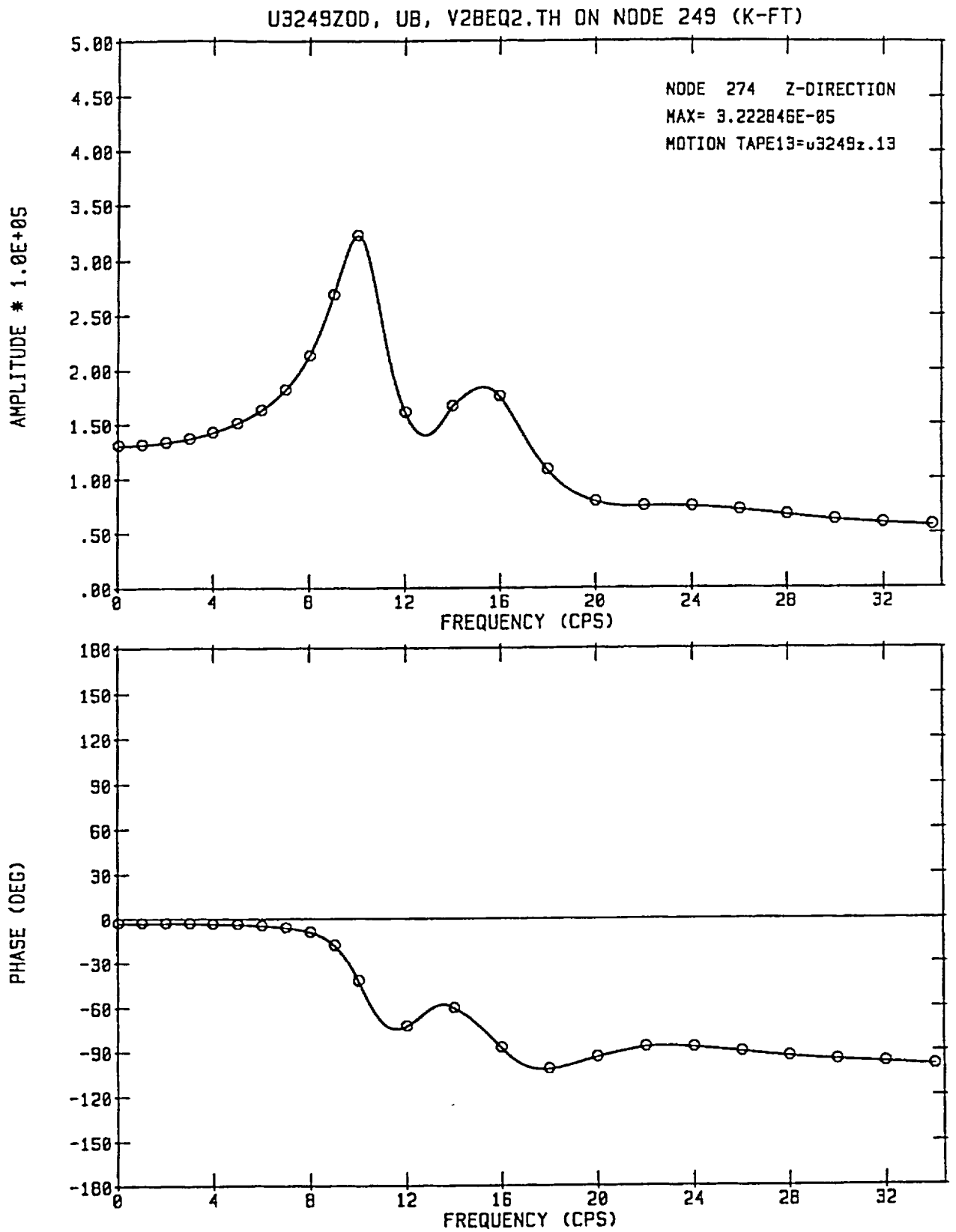
ve\G1z248Z.INP 1 4/ 3/ 1





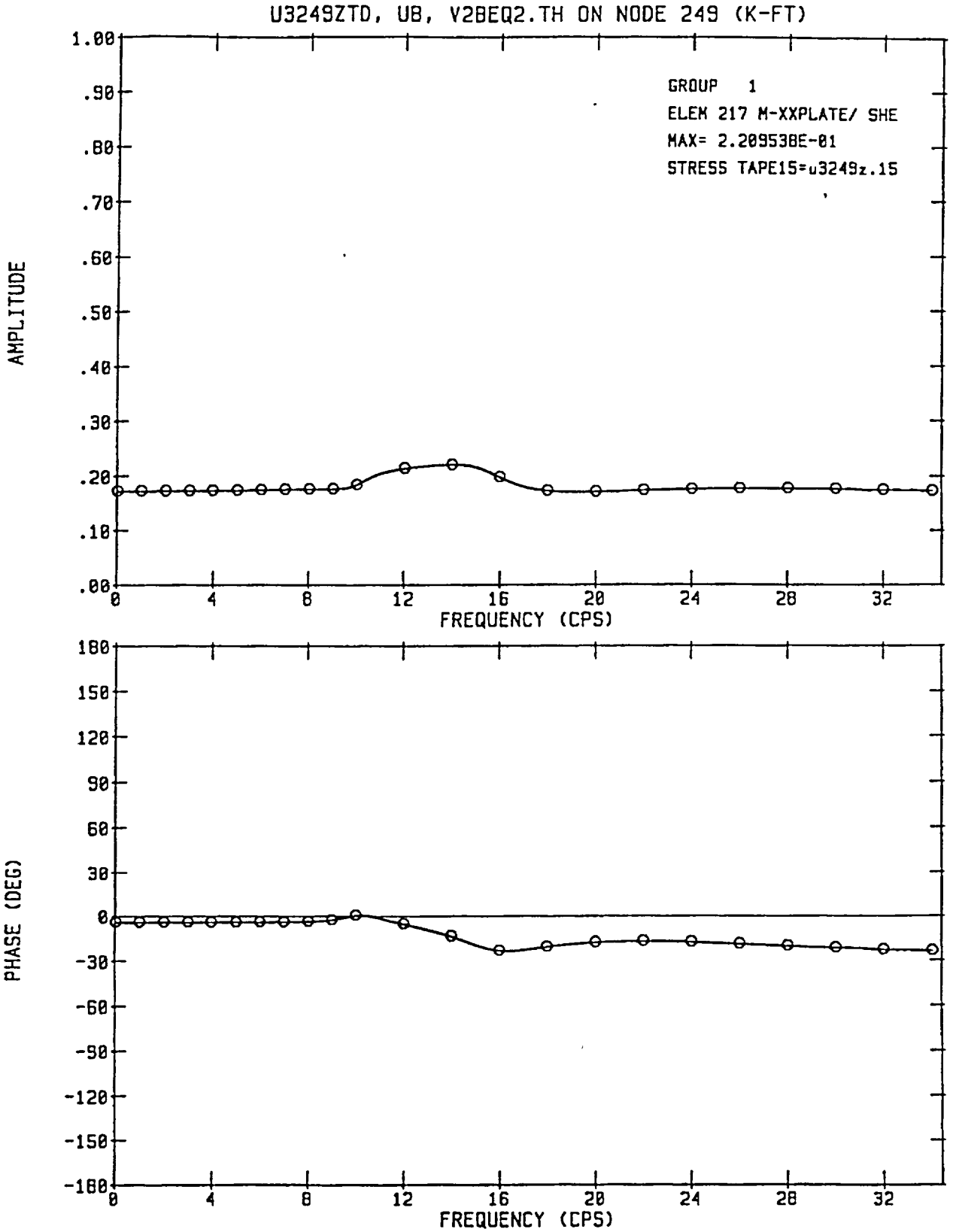
CEC JOB NO 1101-000
BY DH DATE 4/3/01
CHECK aum DATE 4/3/01
CALC NO. G(8017)-2 REV. NO 3
SHEET NO. 196

ve\Gfs261Z.INP 1 4/ 3/ 1



CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK AWM DATE 4/3/01
CALC NO. G(P017)-2 REV. NO 3
SHEET NO 197

ve\Gfz274Z.INP 1 4/ 3/ 1



CEC JOB NO 1101-000

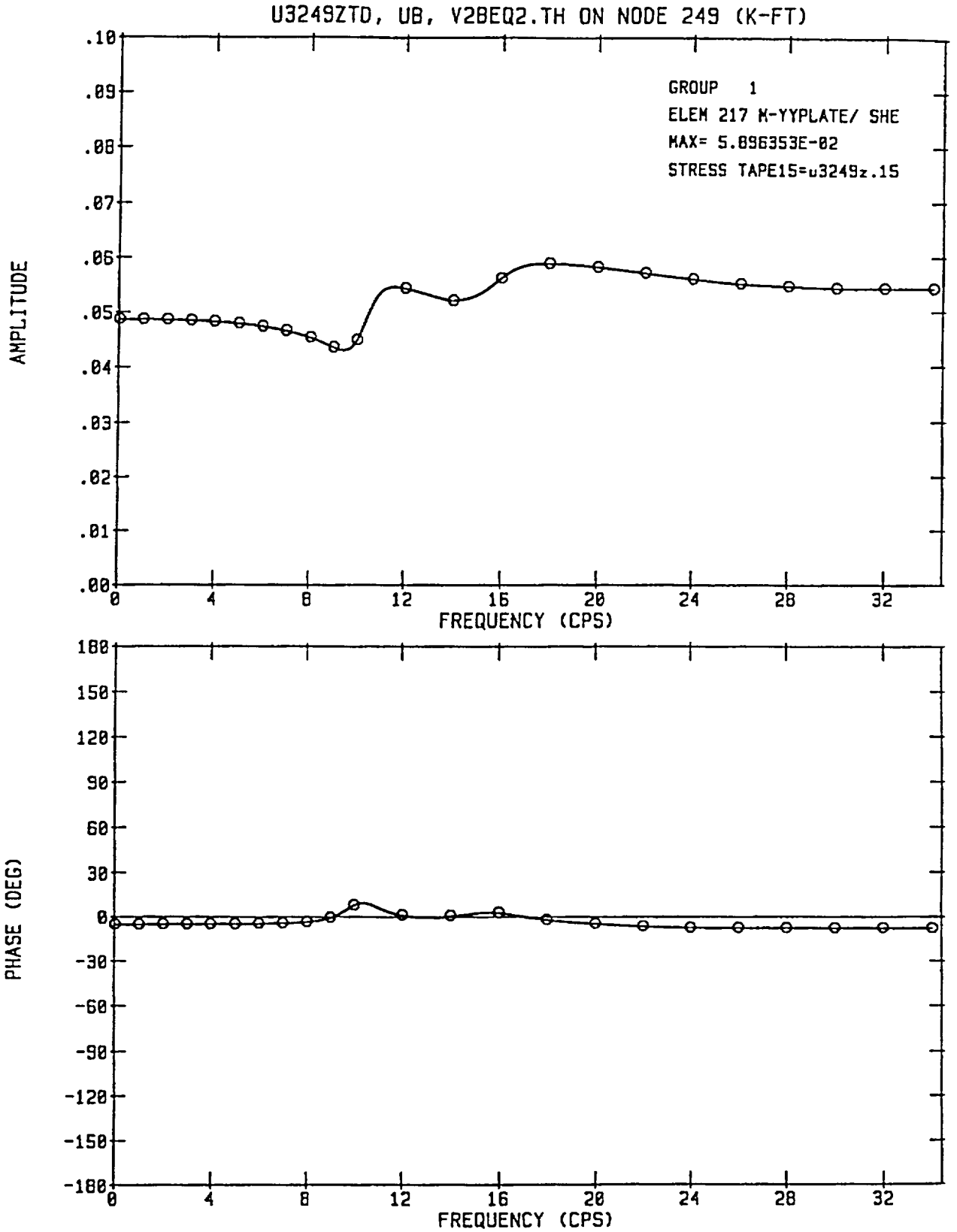
BY DH DATE 4/3/01

CHECK AMM DATE 4/3/01

CALC. NO. G1(Poly)-2 REV. NO. 3

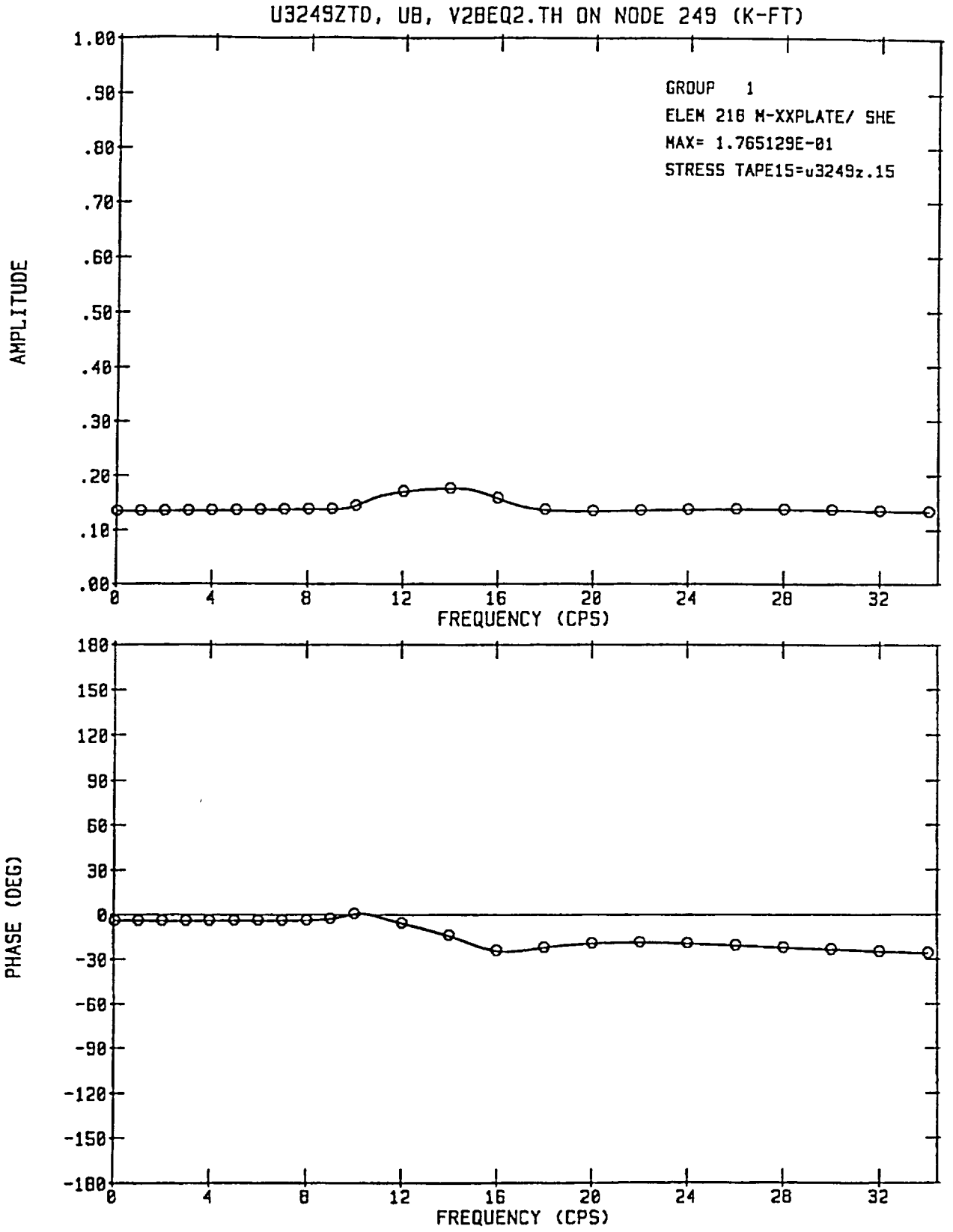
SHEET NO. 198

ve\G1217H-XX.INP1 4/ 3/ 1



CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK AWM DATE 4/3/01
CALC. NO. G(P017)-2 REV. NO 3
SHEET NO. 199

ve\G1217M-YY.INP1 4/ 3/ 1



CEC JOB NO. 1101-000
BY DH DATE 4/3/01
CHECK aum DATE 4/3/01
CALC. NO. C(P017)-2 REV. NO 3
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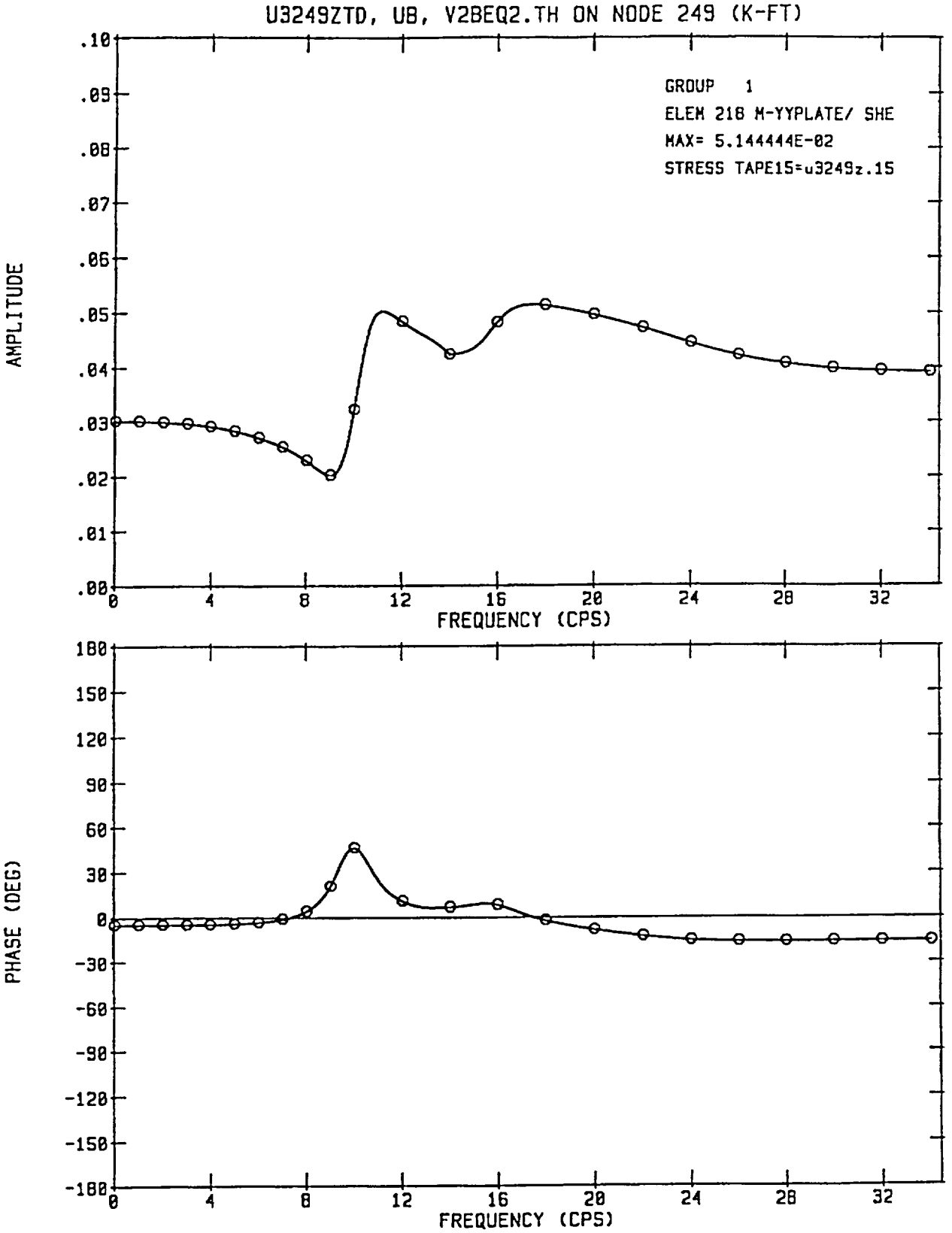
ve\G1218M-XX.INP1 4/ 3/ 1



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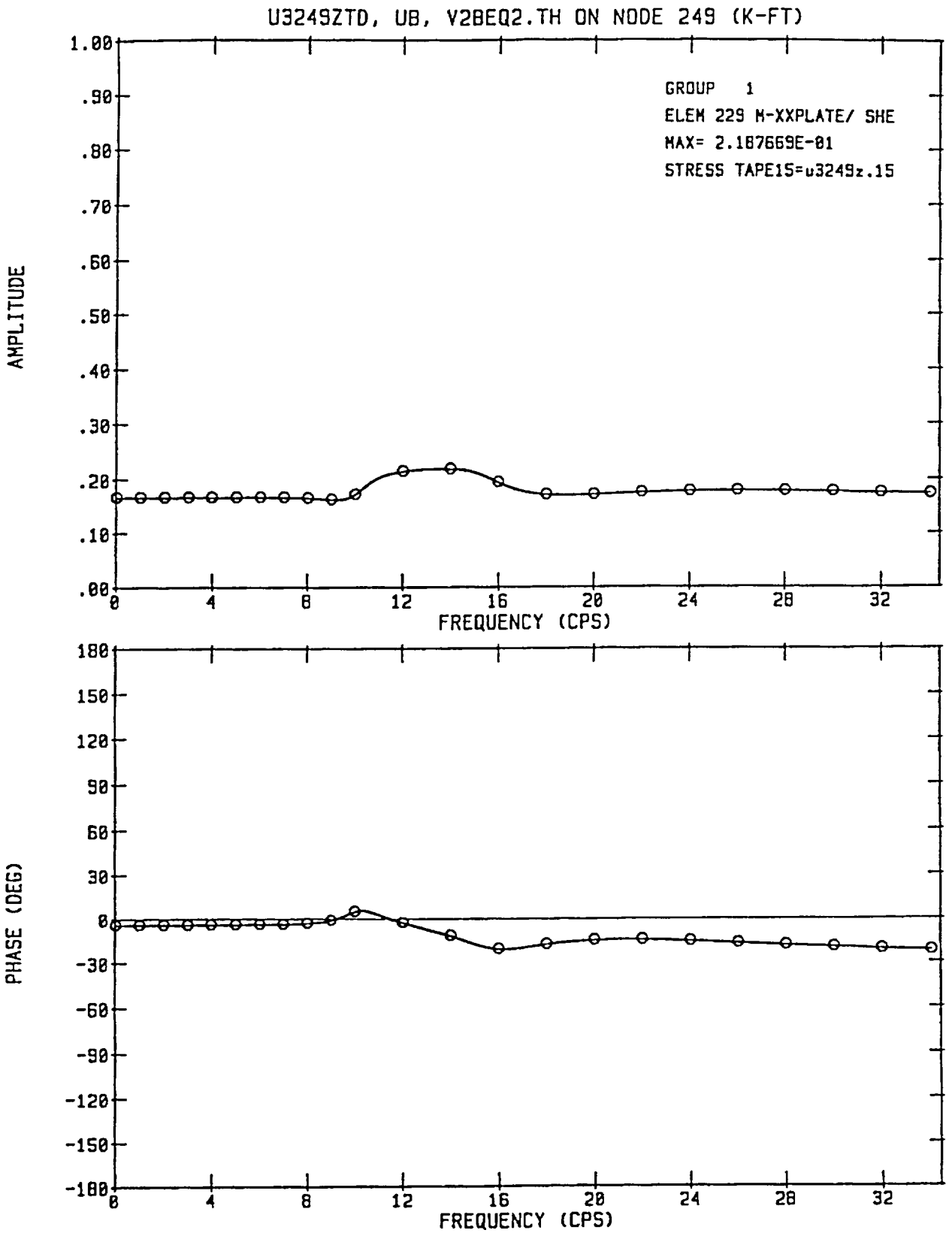

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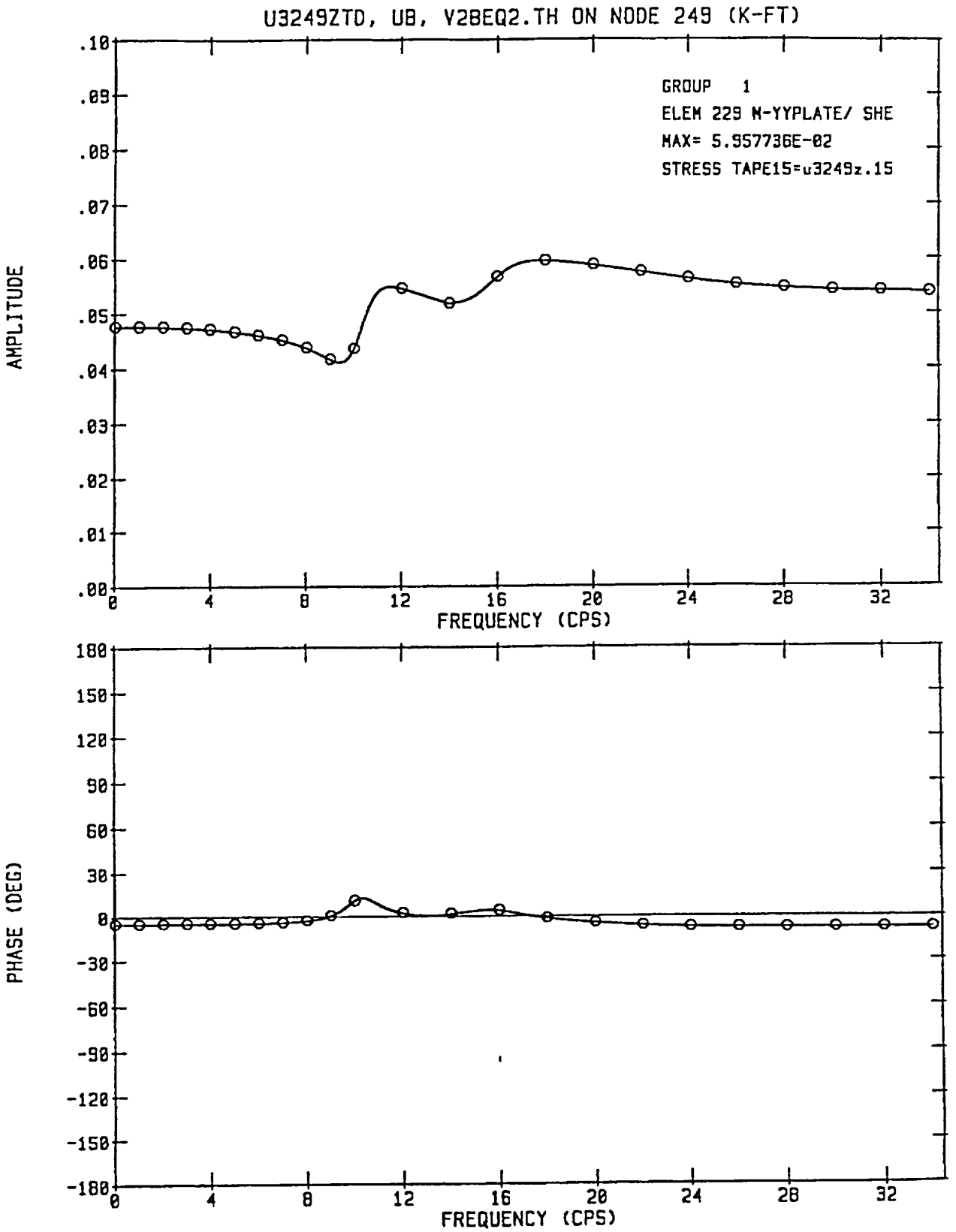

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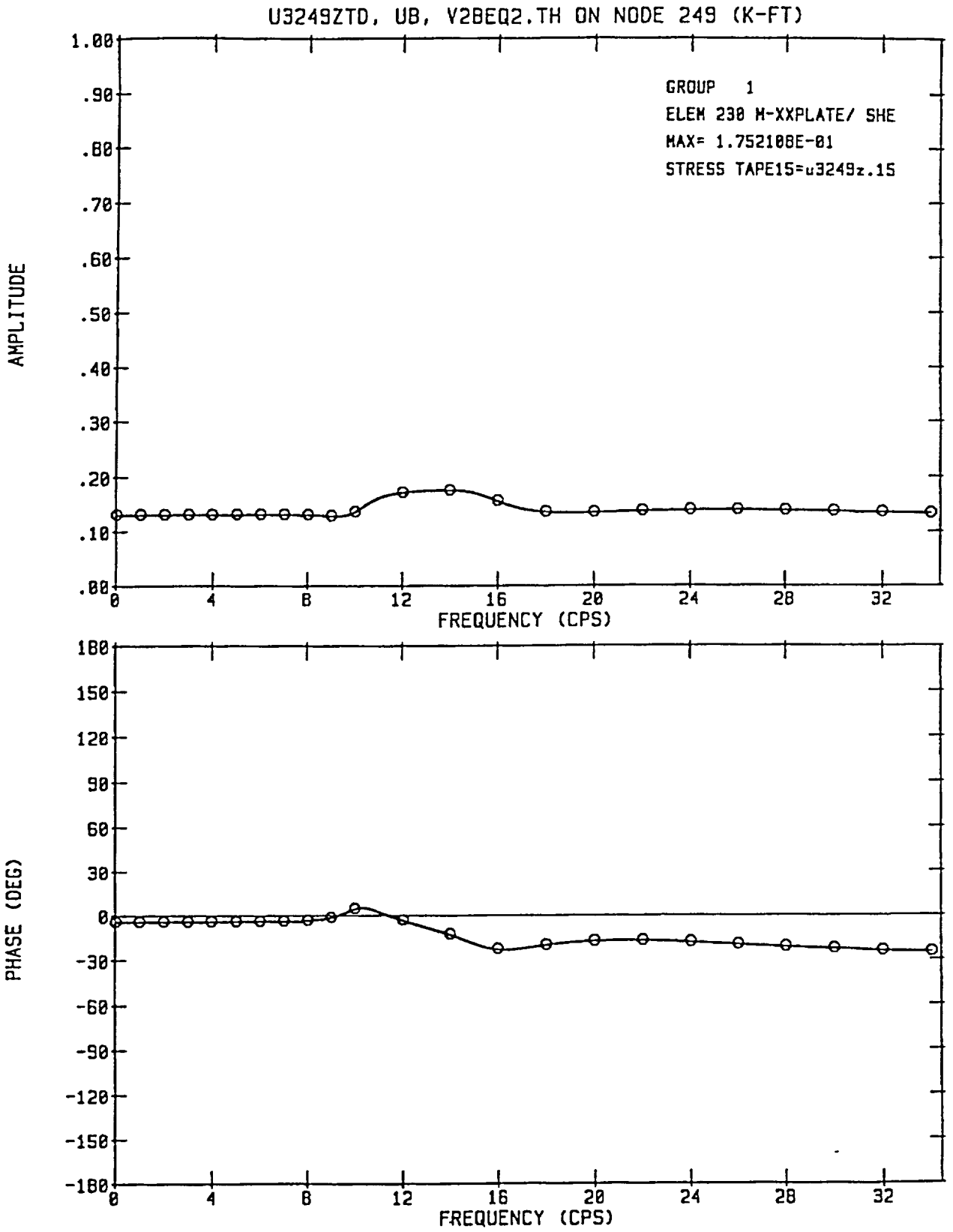

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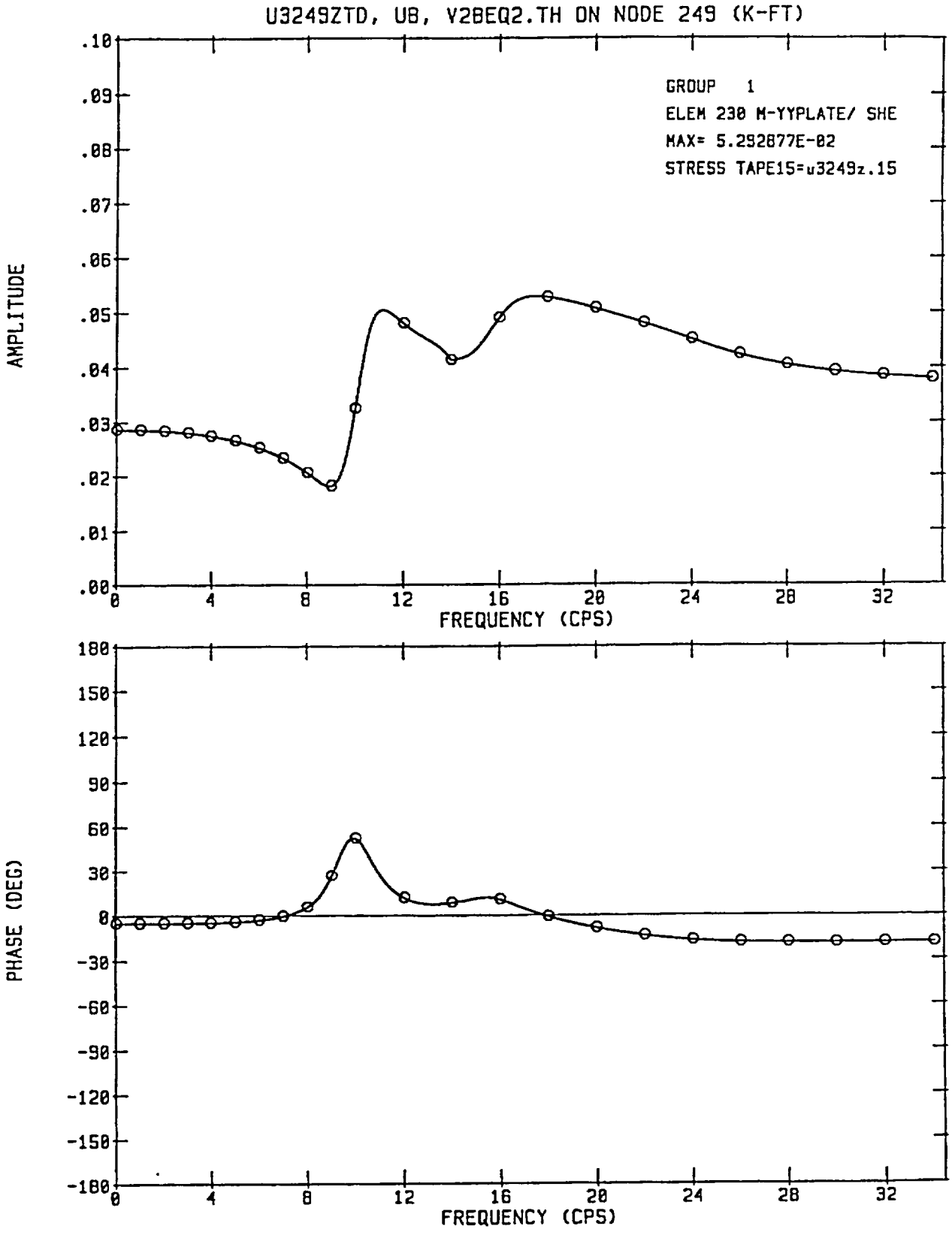

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5.2.5 COMPARISON OF CECSAP AND SASSI RESULTS

Results of the CECSAP and SASSI analyses, in terms of maximum displacements, maximum bending moments, and maximum shear force are shown and compared in Tables 5.2.5-1, 5.2.5-2, and 5.2.5-3 respectively. This comparison is performed for lower-bound, best-estimate, and upper-bound soil conditions as shown in the tables. The displacement time histories at selected nodes for SASSI and CECSAP are compared in Figs. 5.2.5-1 through 5.2.5-9 for lower-bound, best-estimate, and upper-bound soil conditions. Similarly, moment time histories for plate element 217 from SASSI and CECSAP are compared in Figs. 5.2.5-10 through 5.2.5-18. The printed input and output files for SASSI and CECSAP analyses are given in Attachment B.

The CECSAP dynamic models are the same as given in Section 5, except a single vertical force time history is applied at the second quadrant of the first cask (Node No. 249). Analyses are performed for the lower-bound, best-estimate, and upper-bound soil conditions.

The maximum displacements from CECSAP are consistent with the displacements from the SASSI. Maximum bending moments and maximum shear forces from CECSAP are consistently higher than the results from SASSI. Thus, the maximum bending moments and shear forces from CECSAP are used for the design of the pad.

Table 5.2.5-1

Maximum Vertical Displacements (ft) at Selected Nodes

Selected Node No.	Lower-Bound Properties			Best-Estimate Properties			Upper-Bound Properties		
	SASSI (A)	CECSAP (B)	% Diff. [(B)/(A)-1]100	SASSI (A)	CECSAP (B)	% Diff. [(B)/(A)-1]100	SASSI (A)	CECSAP (B)	% Diff. [(B)/(A)-1]100
144	0.0067	0.0058	-14	0.0055	0.0027	-51	0.0043	0.0014	-67
157	0.0076	0.0069	-9	0.0061	0.0035	-43	0.0047	0.0018	-61
170	0.0086	0.0084	-2	0.0069	0.0046	-34	0.0052	0 0026	-50
183	0.0099	0.0101	2	0 0078	0.0059	-25	0.0057	0.0036	-37
196	0.0114	0.0120	5	0 009	0.0076	-16	0.0066	0.0049	-26
209	0.013	0.0141	8	0 0102	0.0094	-8	0 0077	0.0065	-16
222	0 0164	0.0180	10	0.013	0.0134	3	0.0095	0.0099	5
235	0.0182	0.0202	11	0.0142	0.0153	8	0.0106	0.0117	10
248	0.0195	0.0220	13	0.0152	0 0165	9	0.0113	0.0130	15
261	0.0201	0.0230	14	0.0152	0.0172	13	0 0111	0.0127	14
274	0.0203	0.0236	16	0.015	0.0173	15	0.0104	0.0125	21
287	0.0202	0.0242	20	0.0146	0.0182	25	0.0096	0.0119	24
288	0.0184	0.0279	52	0.0132	0.0162	22	0.0087	0.0103	18
289	0.0161	0.0184	14	0.0112	0.0131	17	0.0074	0.0083	12
290	0.0138	0.0155	12	0.0096	0.0109	13	0.0063	0.0062	-2
291	0.0116	0.0128	10	0.0082	0.0086	5	0.0052	0.0048	-8
292	0.0098	0.0120	23	0.0067	0.0069	4	0.0043	0.0034	-20
293	0.0083	0.0085	3	0.0057	0.0057	1	0.0038	0.0028	-25
294	0.0069	0.0070	1	0.0049	0.0047	-4	0.0031	0.0023	-26

Notes: The displacements obtained from CECSAP at nodes near application of load (the pad interfaced-forcing function) at Node 249, are about 10% higher than those obtained from SASSI. However, the displacements obtained from CECSAP at nodes away from application of the load, which have relatively smaller magnitude than those at nodes near the application of load, are somewhat lower than those obtained from SASSI. For location of nodes selected in this Table, see Fig. 5.1-1.

See Attachment B for SASSI and CECSAP comparison results.

Table 5.2.5-2

Maximum Bending Moment (k-ft/ft) for Selected Elements

Selected Element No.	Lower-Bound Prop. SASSI (A)	Lower-Bound Prop. CECSAP (B)	Lower-Bound Prop. % Diff. [(B)/(A)-1]100	Best-Est. Prop. SASSI (A)	Best-Est. Prop. CECSAP (B)	Best-Est. Prop. % Diff. [(B)/(A)-1]100	Upper-Bound Prop. SASSI (A)	Upper-Bound Prop. CECSAP (B)	Upper-Bound Prop. % Diff. [(B)/(A)-1]100
Mxx (about Y-axis)									
217	40.2	75.4	88	39.4	75.3	91	37.6	75.0	99
218	27.1	39.8	47	28.5	40.0	40	28.0	40.2	43
229	39.7	75.1	89	39.1	75.0	92	37.4	74.8	100
230	26.0	39.4	51	27.8	39.7	43	27.7	39.9	44
Myy (about X-axis)									
217	175.9	294.8	68	157.9	286 8	82	134.9	272.4	102
218	141.0	227.8	62	126.1	221.0	75	106.8	208 9	96
229	173.1	305.8	77	155.6	297.9	91	132.4	283.7	114
230	139.2	239.3	72	124.1	232.6	87	105.3	220 4	109

Note: See Attachment B for SASSI and CECSAP comparison results.

Table 5.2.5-3

Shear Forces (k/ft) for Selected Elements (x-dir)

Selected Element No.	Lower-Bound Prop SASSI (A)	Lower-Bound Prop CECSAP (B)	Lower-Bound Prop % Diff. [(B)/(A)-1]100	Best-Est Prop. SASSI (A)	Best-Est Prop. CECSAP (B)	Best-Est Prop. % Diff [(B)/(A)-1]100	Upper-Bound Prop. SASSI (A)	Upper-Bound Prop. CECSAP (B)	Upper-Bound Prop. % Diff. [(B)/(A)-1]100
217-218	14.7	28.3	92	13 4	27.8	107	11.9	26.8	126
229-230	14.3	28.1	96	13.3	27.6	107	11.4	26.7	134

$S_{xx} = (M_{yy1} - M_{yy2})/ L$

$L = 2.37$ ft

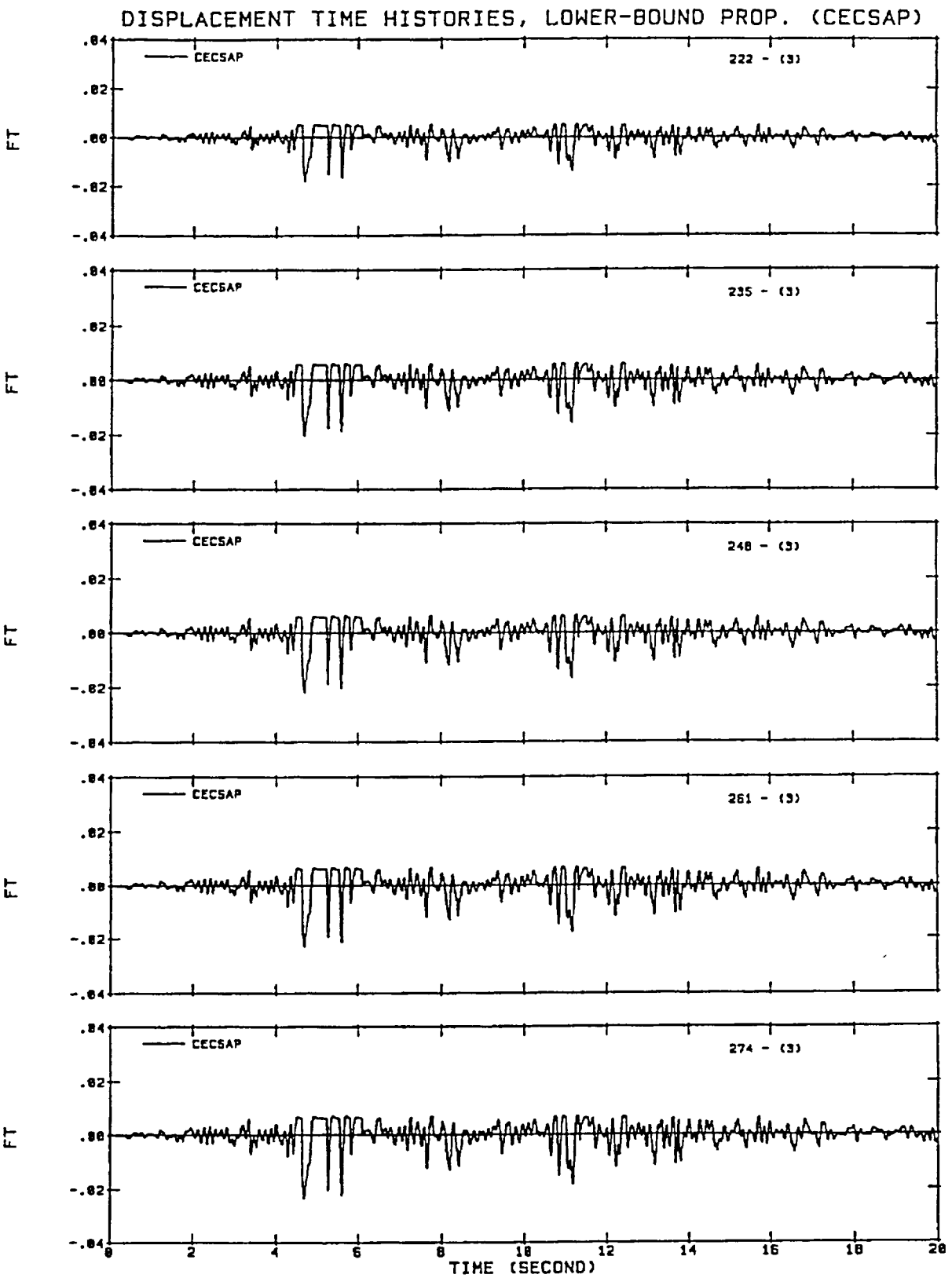

Fig. 5.2.5-1

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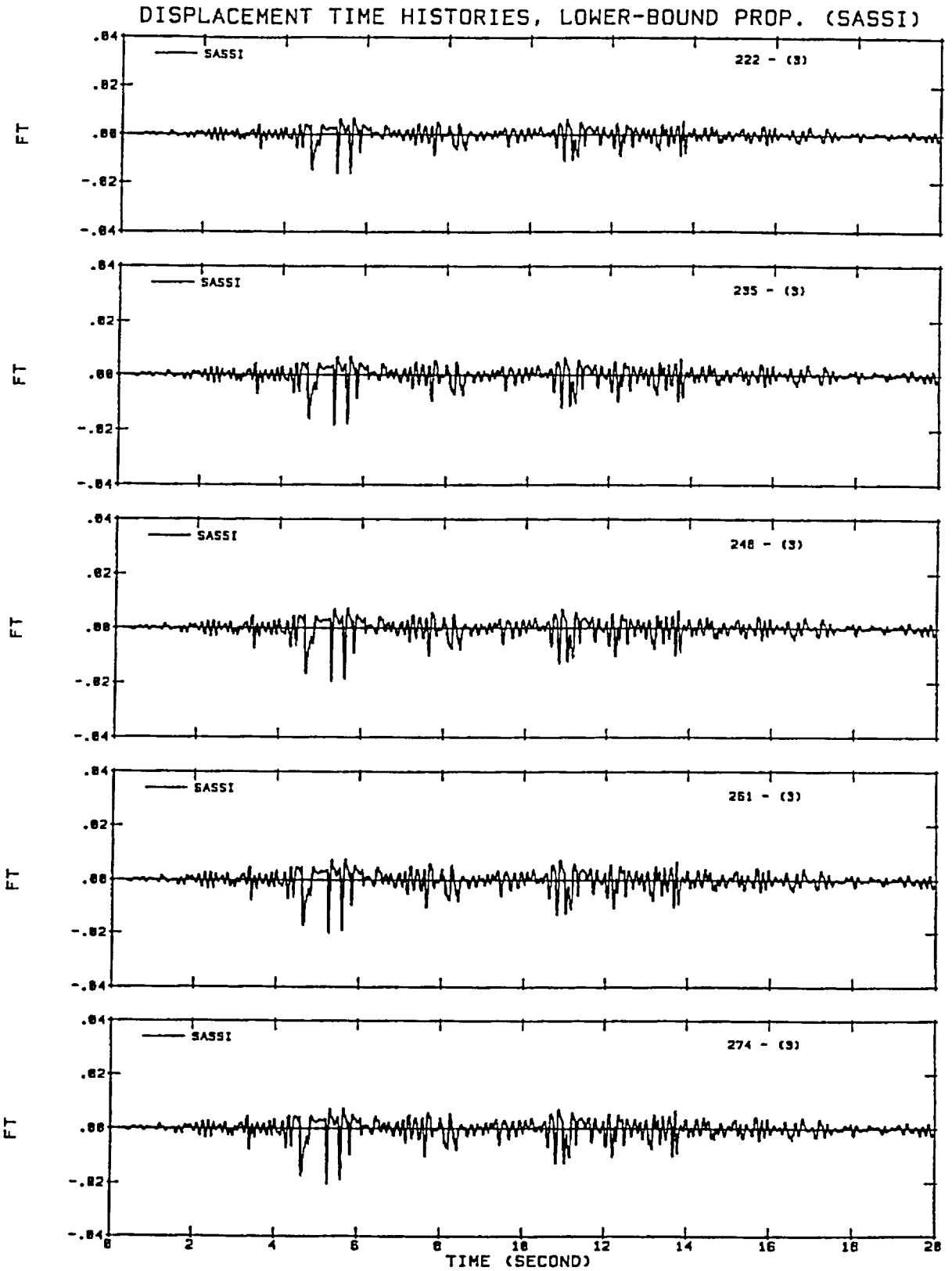

Fig. 5.2.5-2

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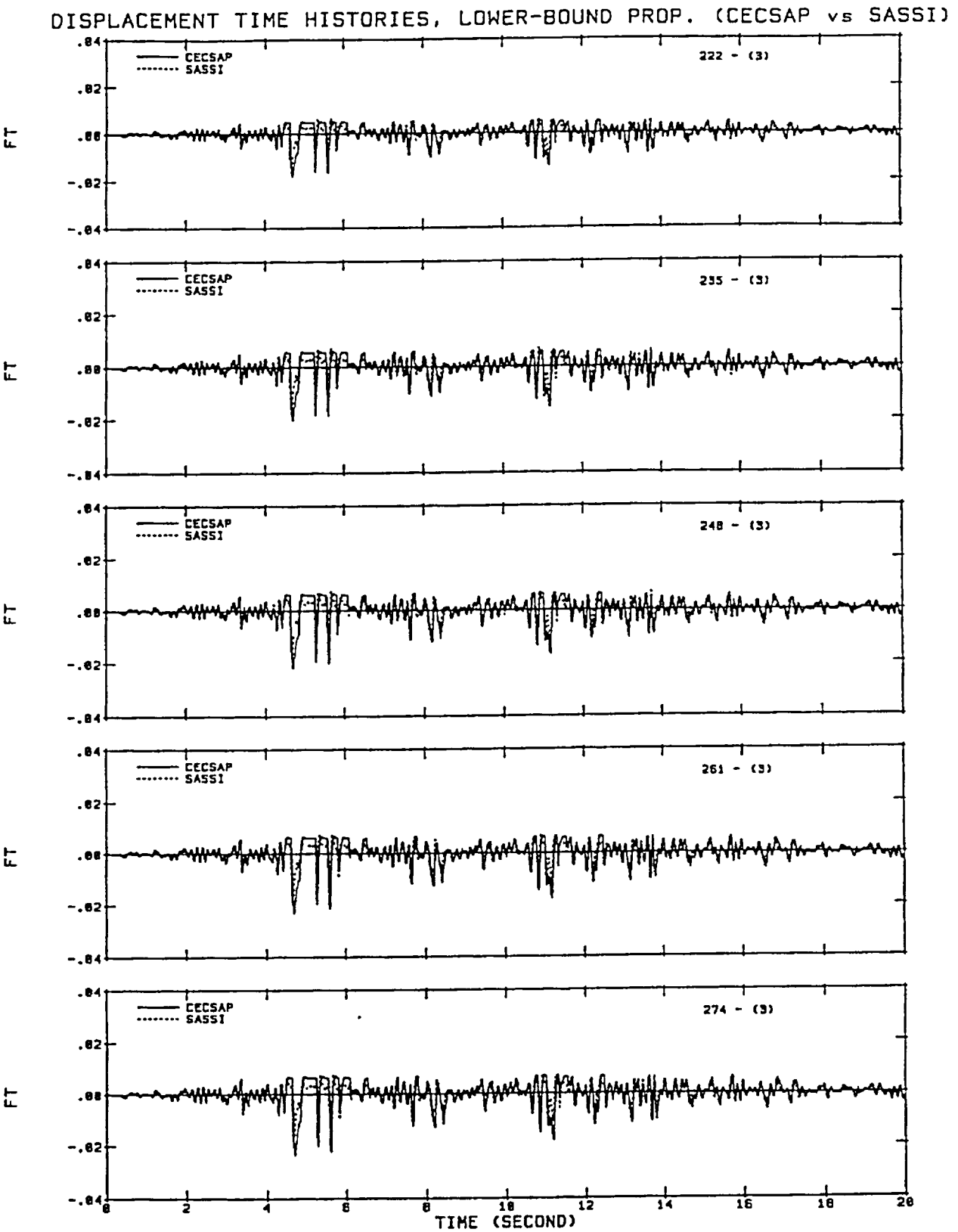

Fig. 5.2.5-3

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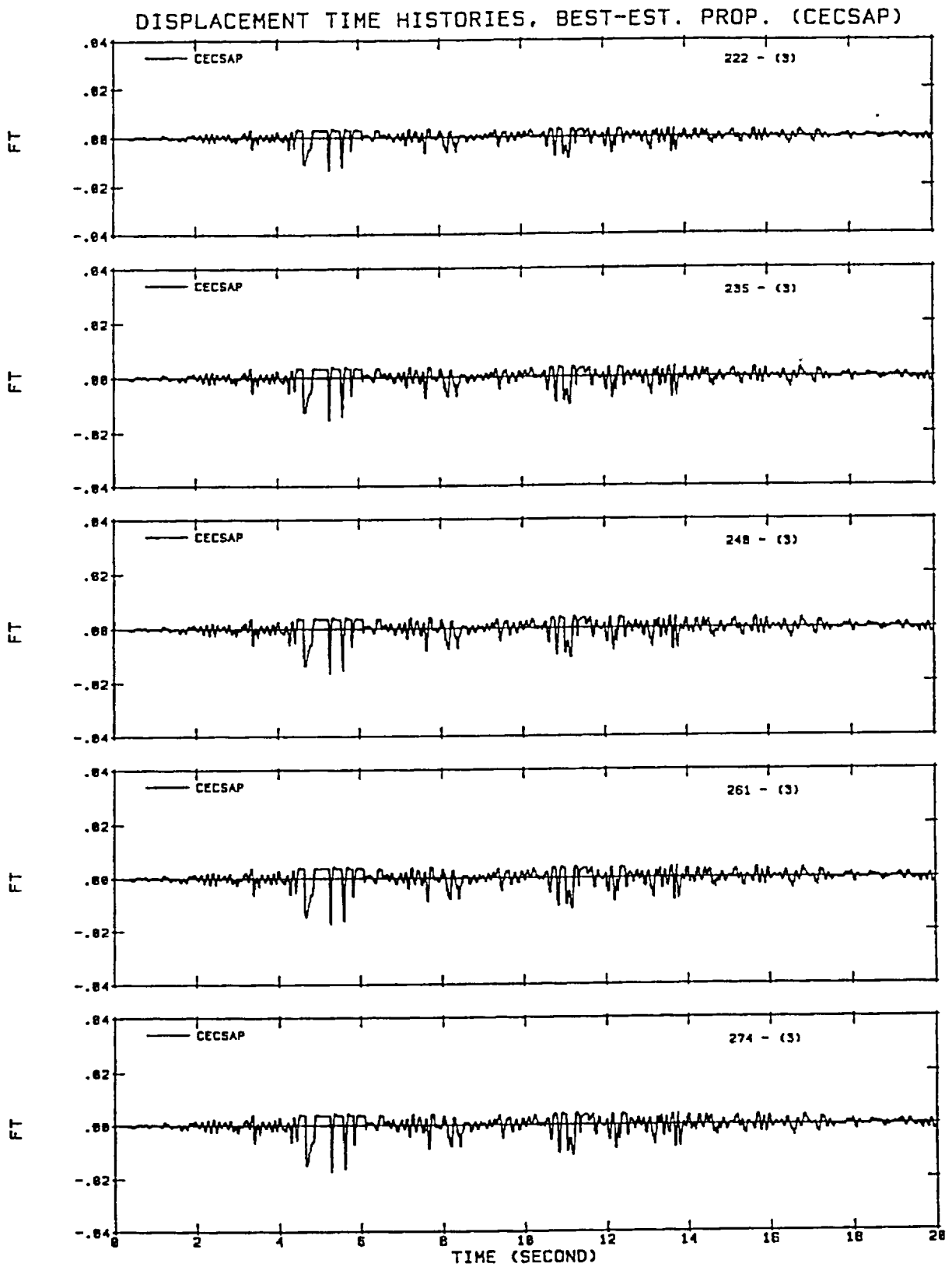

Fig. 5.2.5-4

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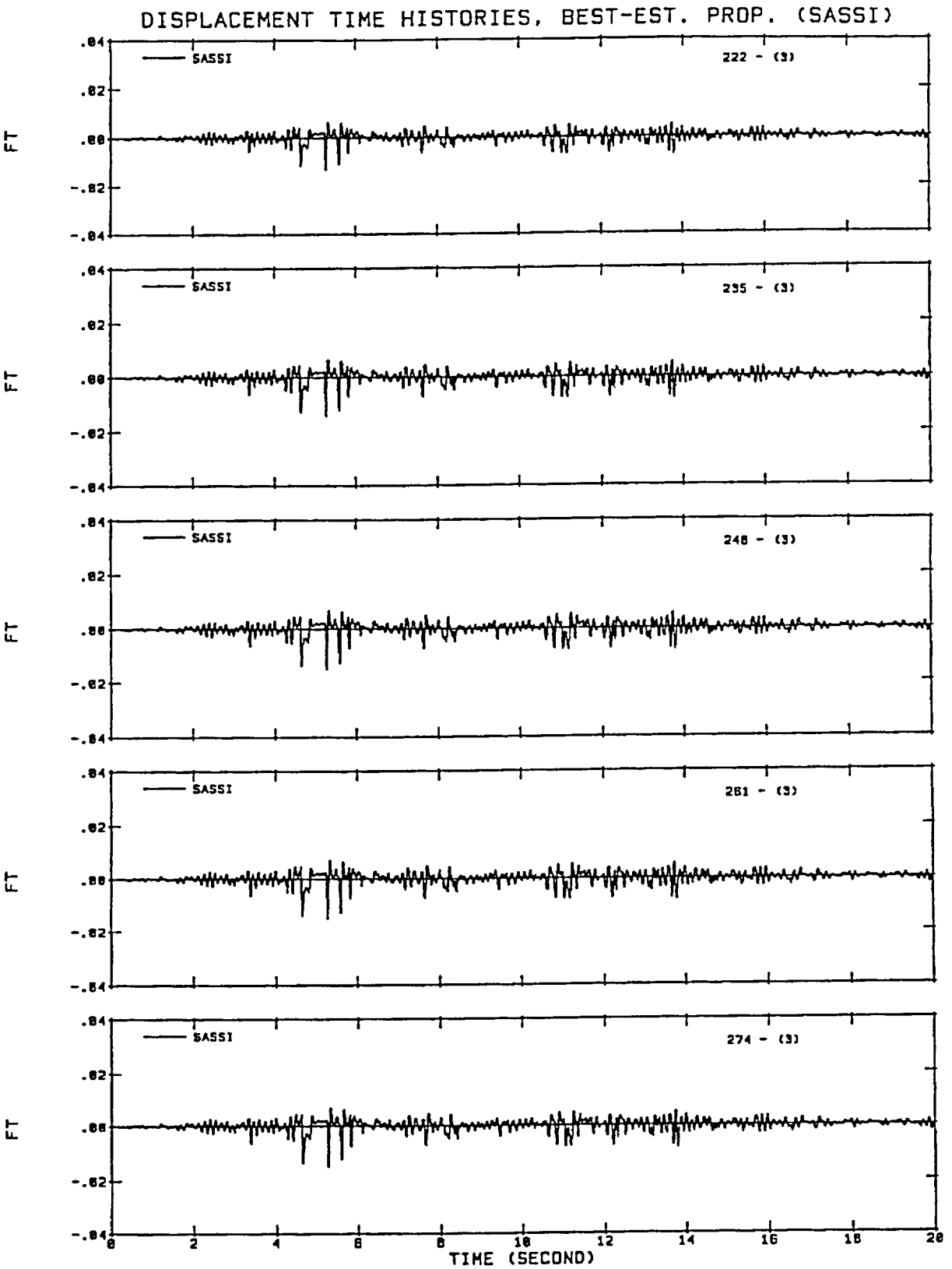

Fig. 5.2.5-5

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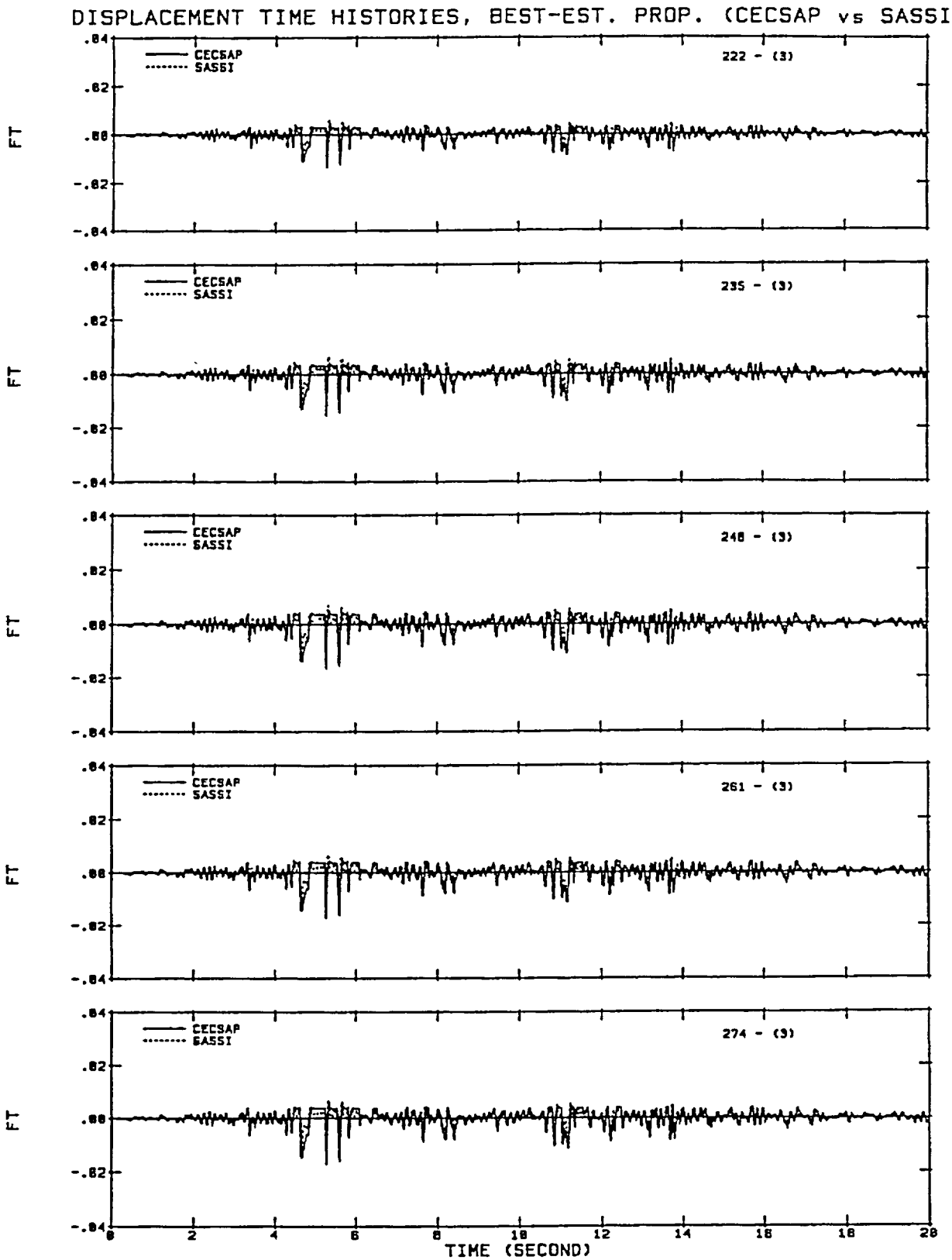

Fig. 5.2.5-6

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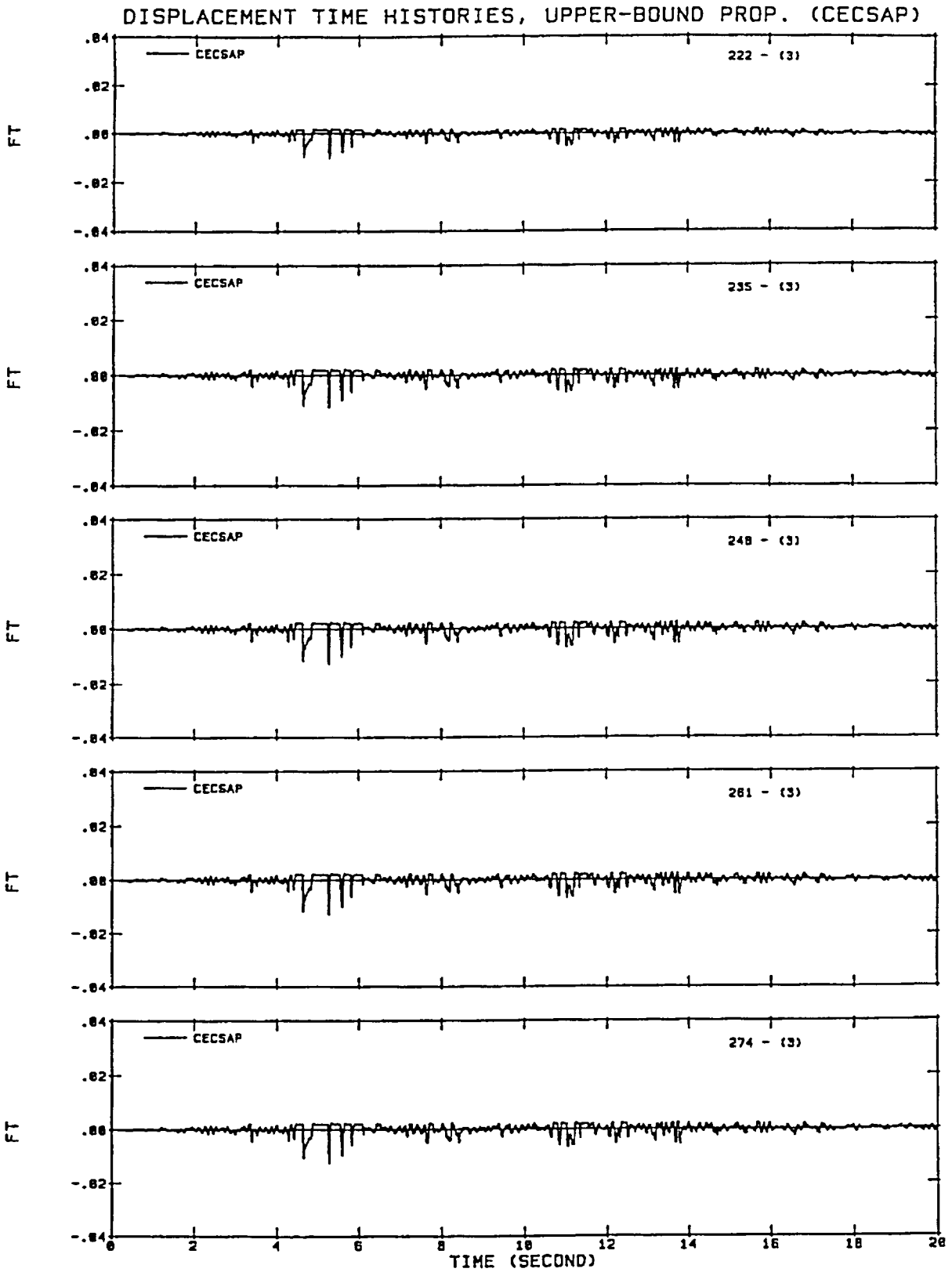

Fig. 5.2.5-7

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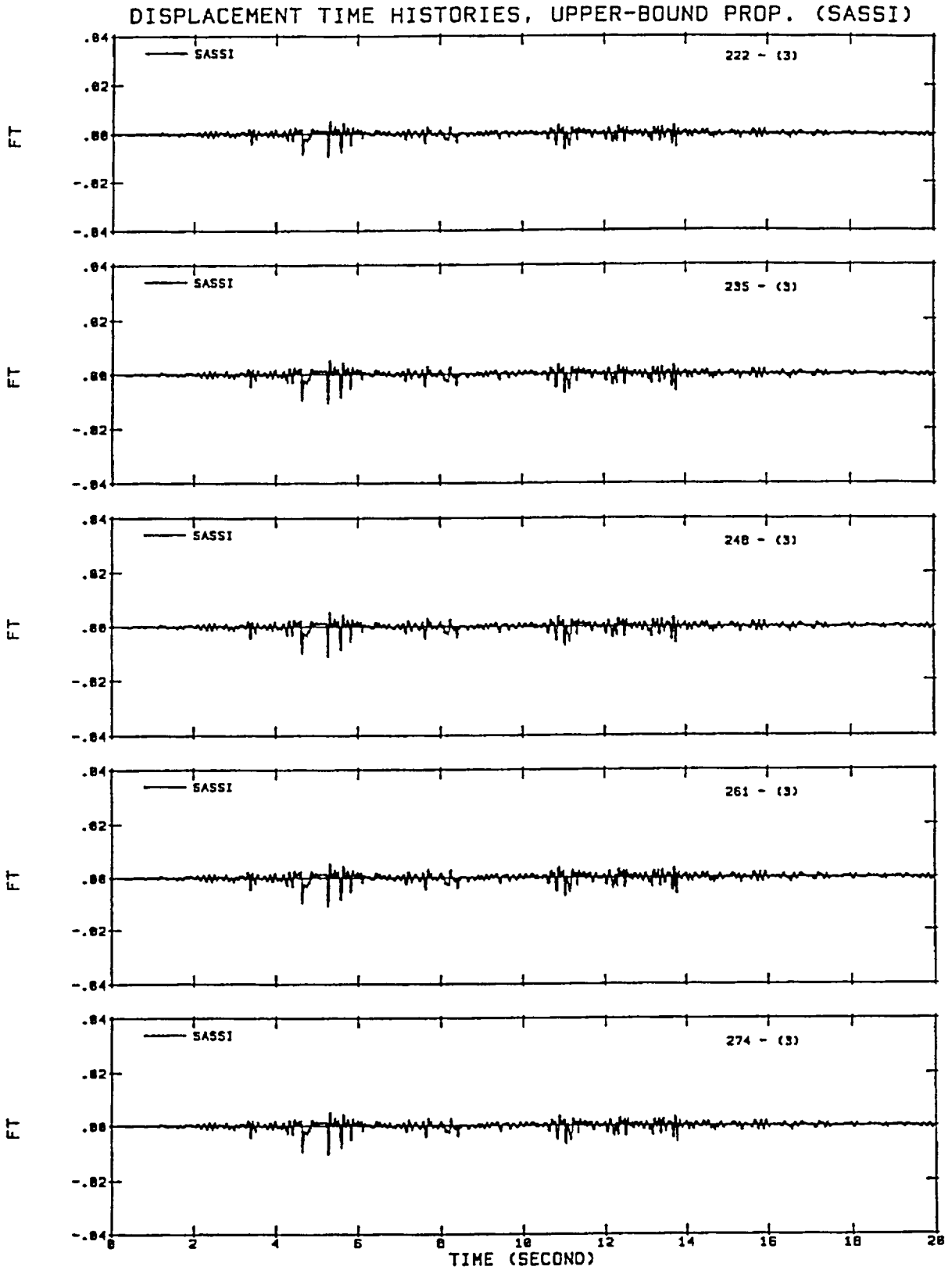

Fig. 5.2.5-8

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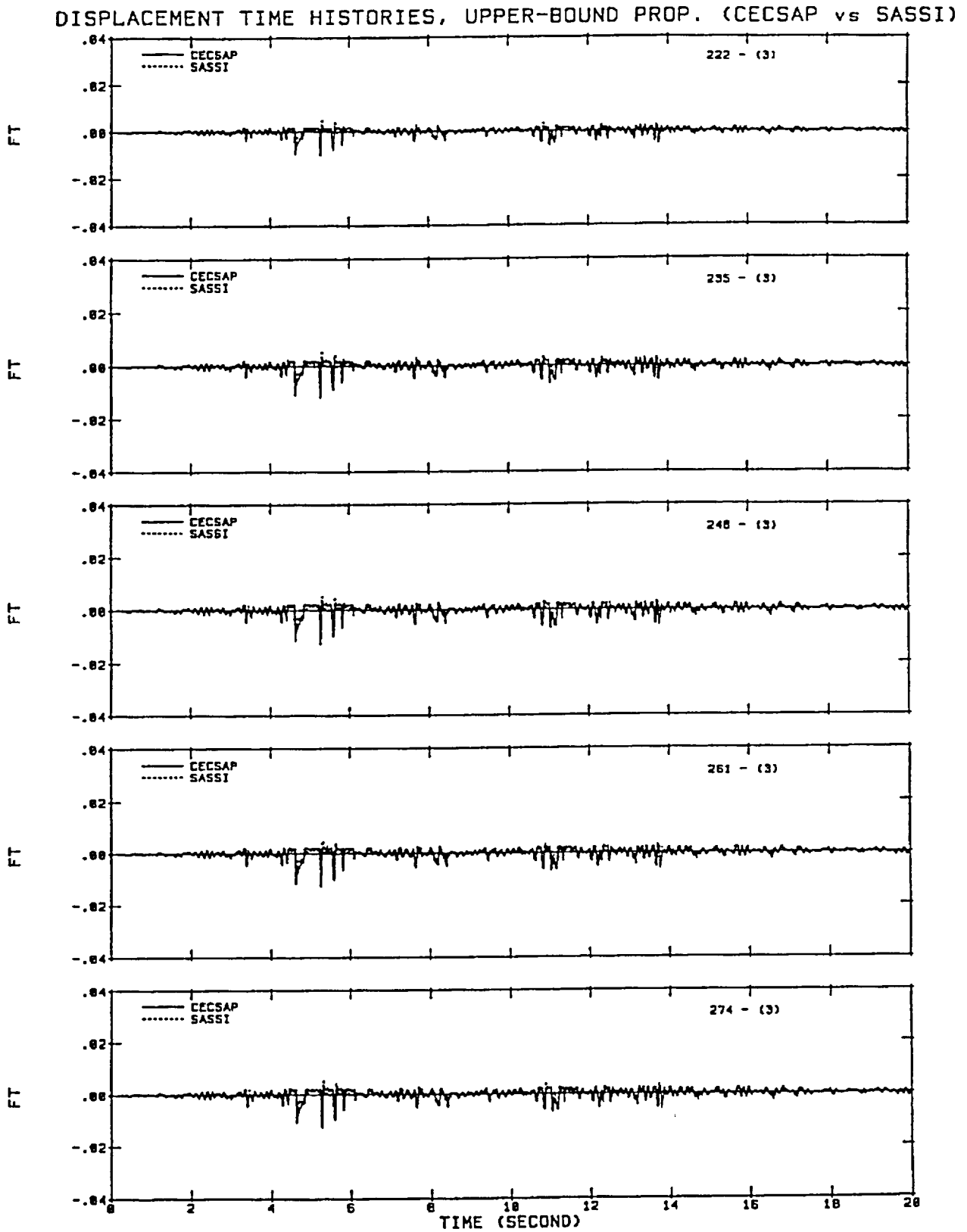

Fig. 5.2.5-9

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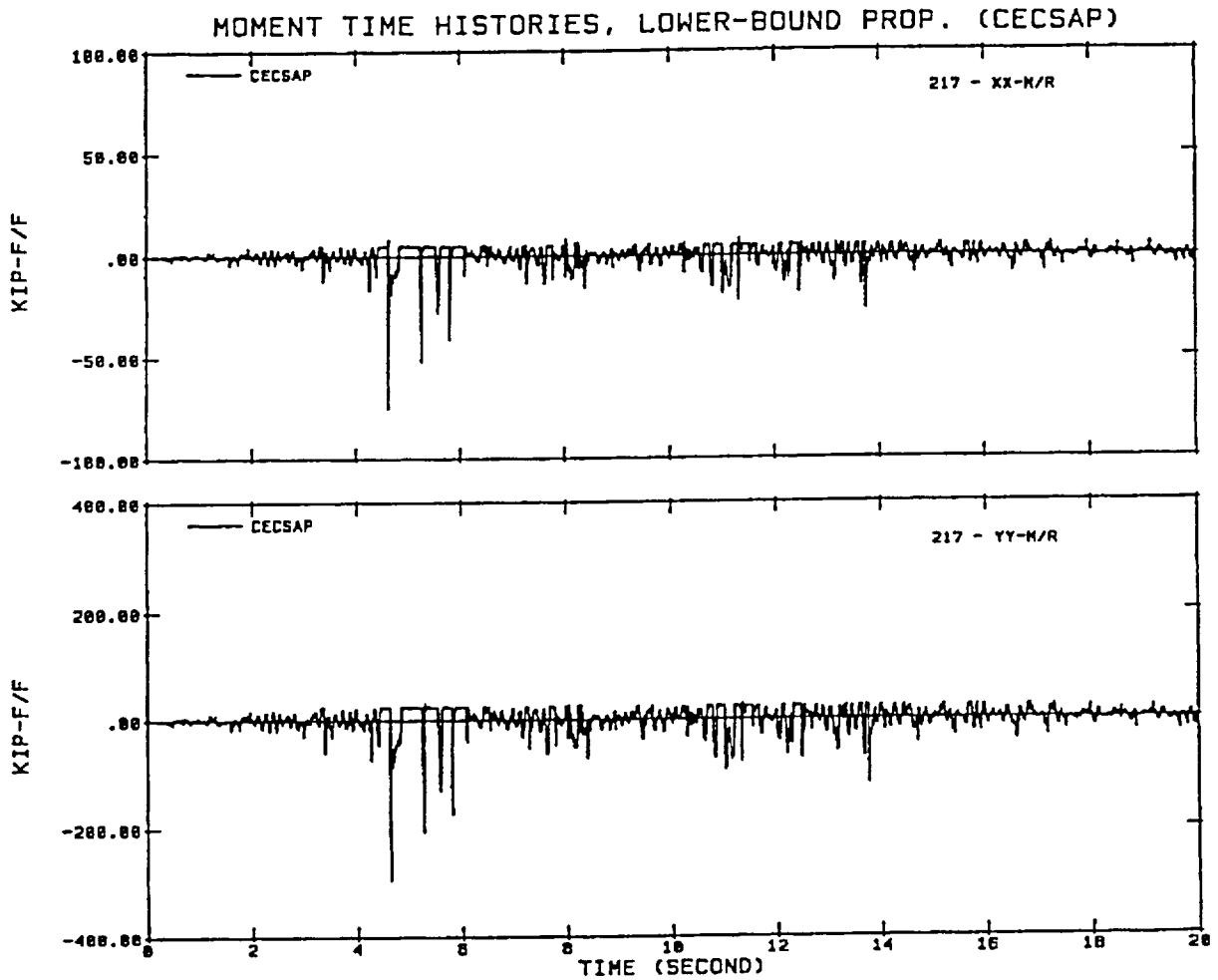

Fig. 5.2.5-10

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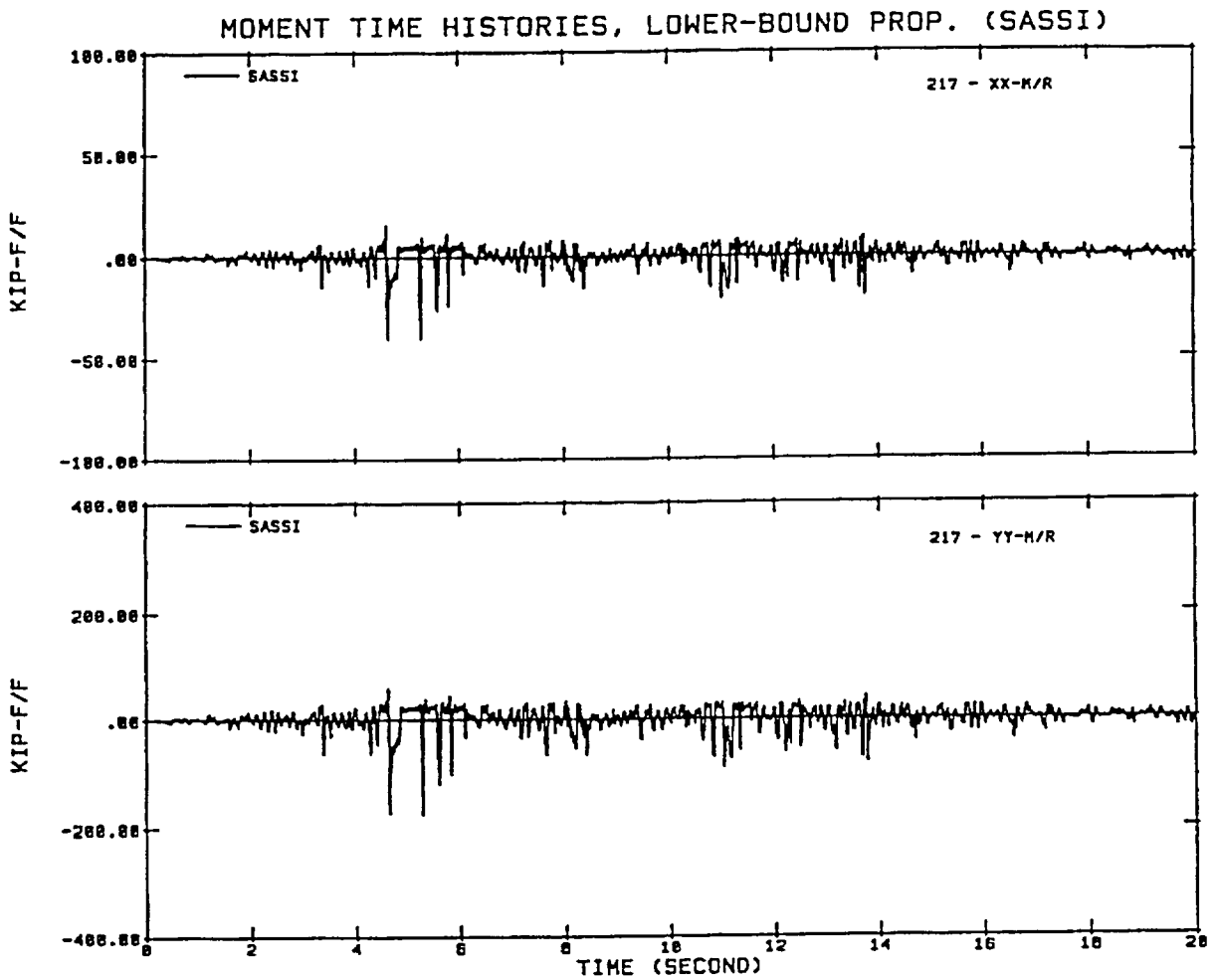

Fig. 5.2.5-11

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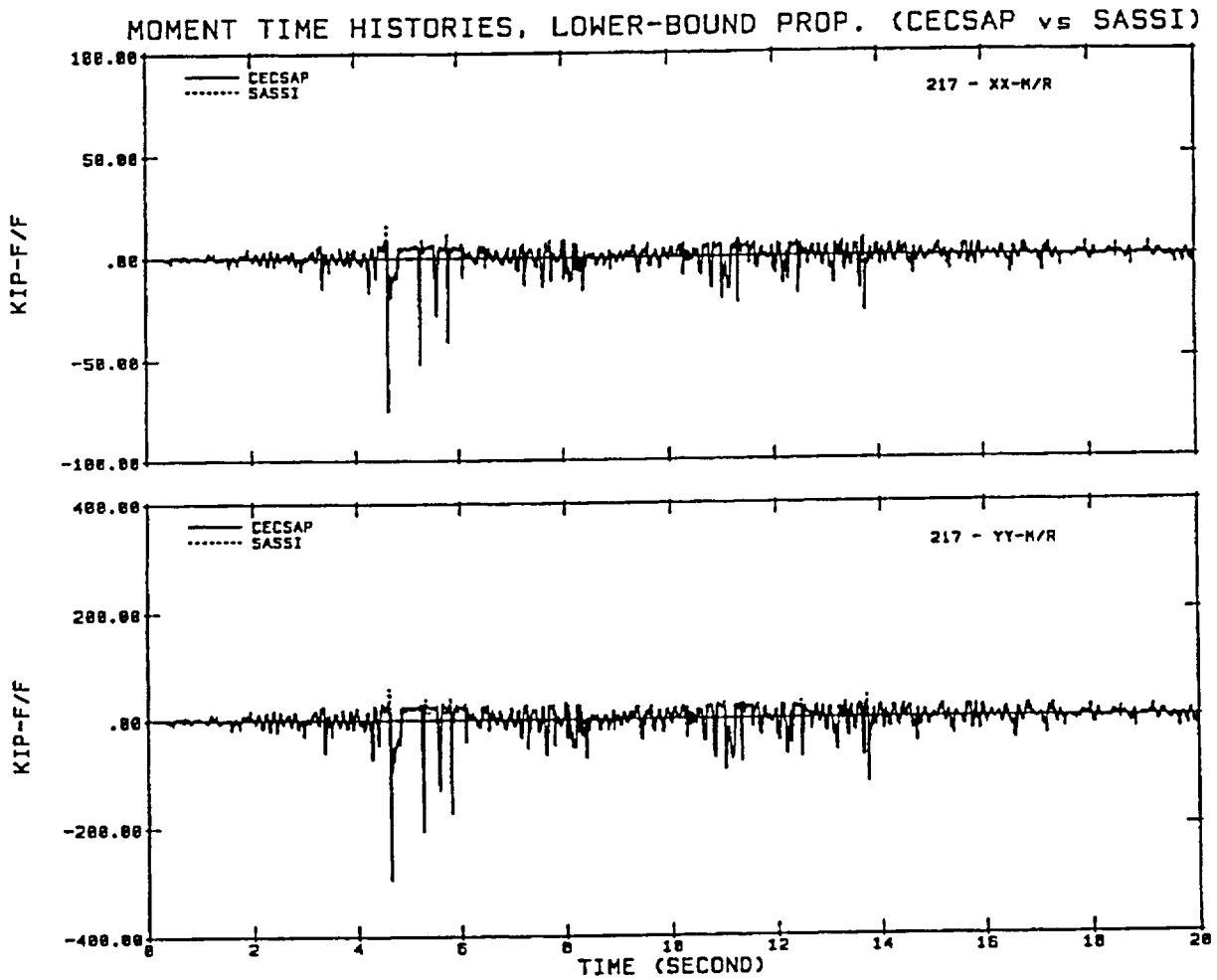

Fig. 5.2.5-12

1101-01

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CALC. NO. A(P017)-2 REV. NO. 3

SHEET NO. 220

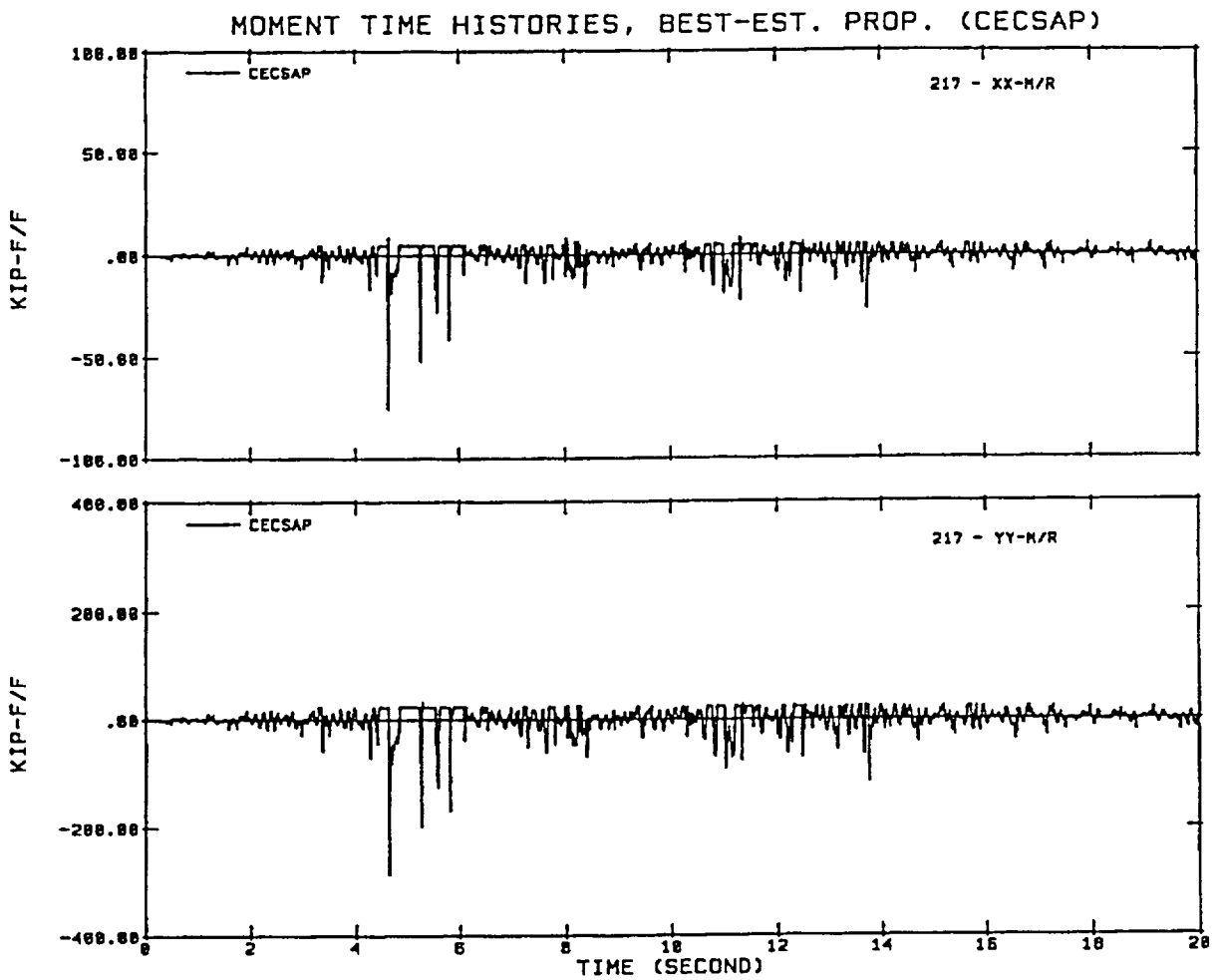

Fig. 5.2.5-13

1101-01
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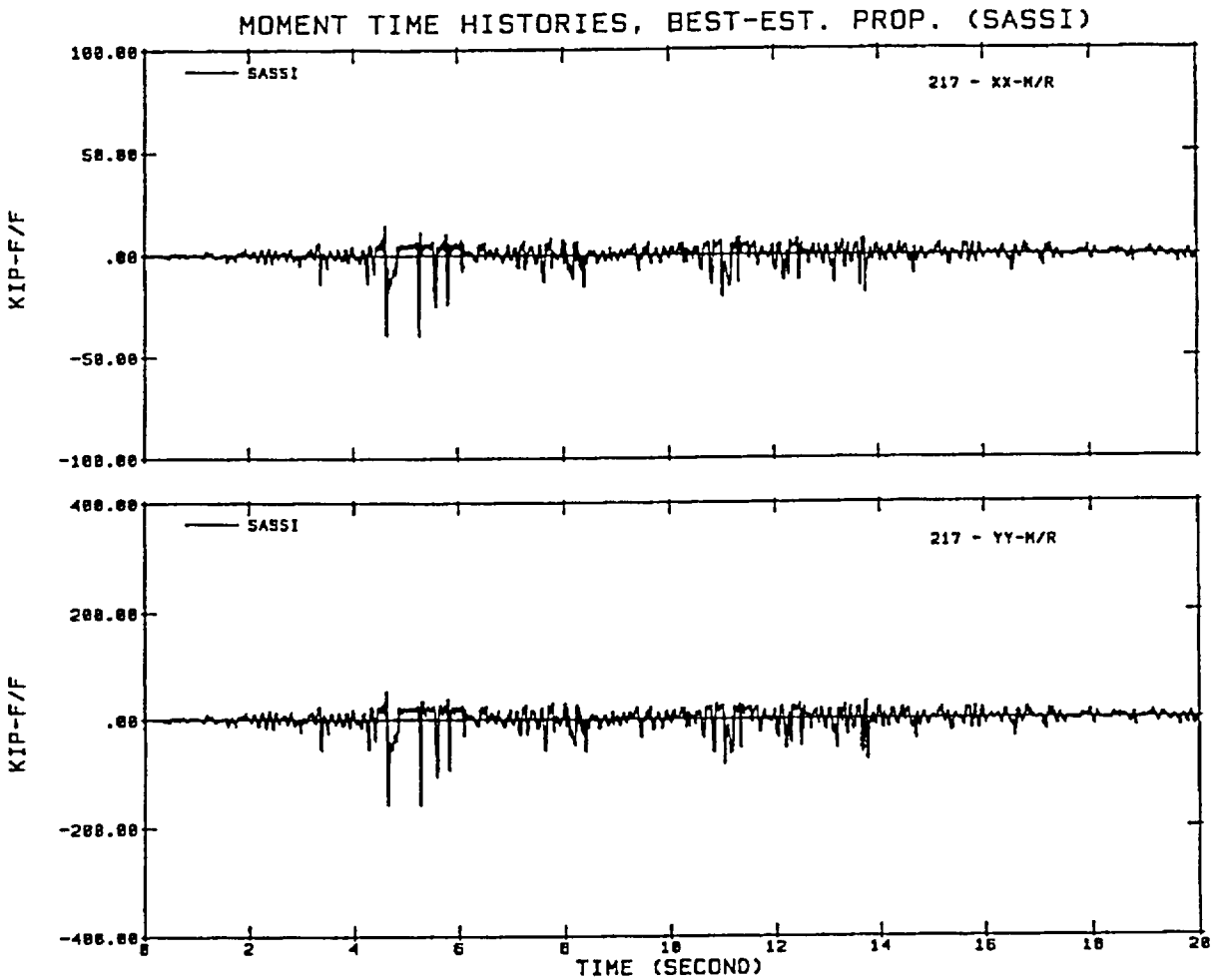

Fig. 5.2.5-14

JOB NO. 1101-01
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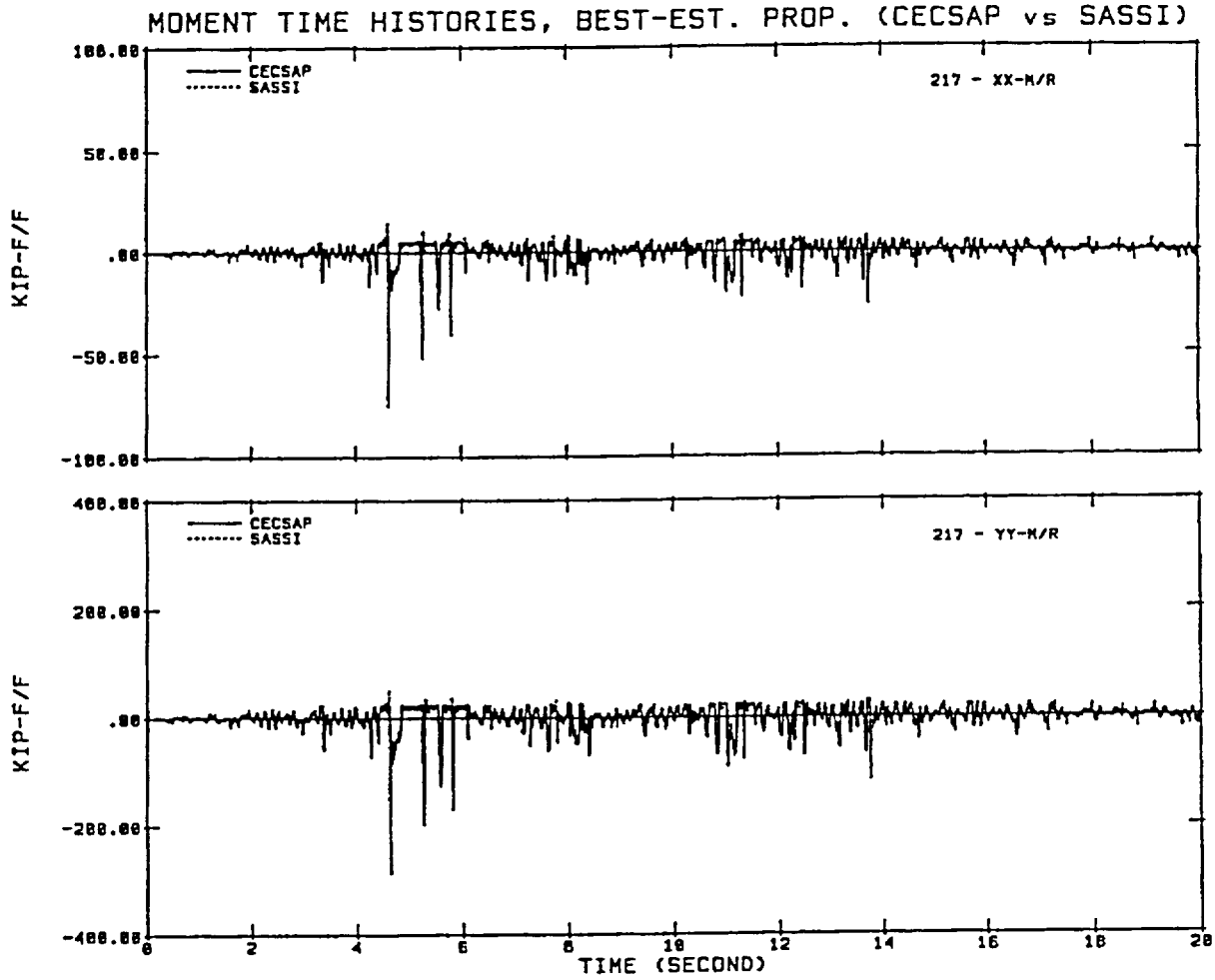

Fig. 5.2.5-15

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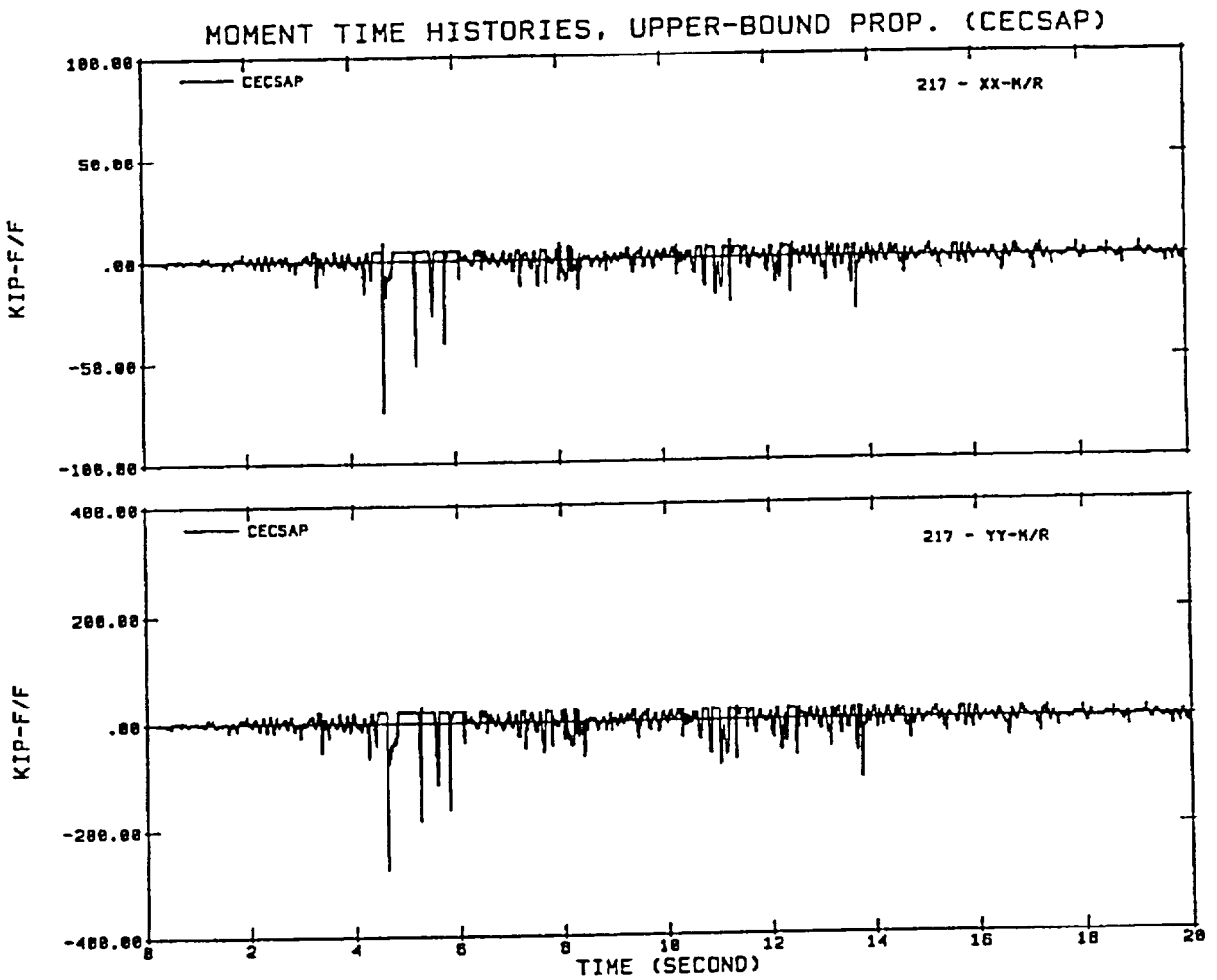

Fig. 5.2.5-16

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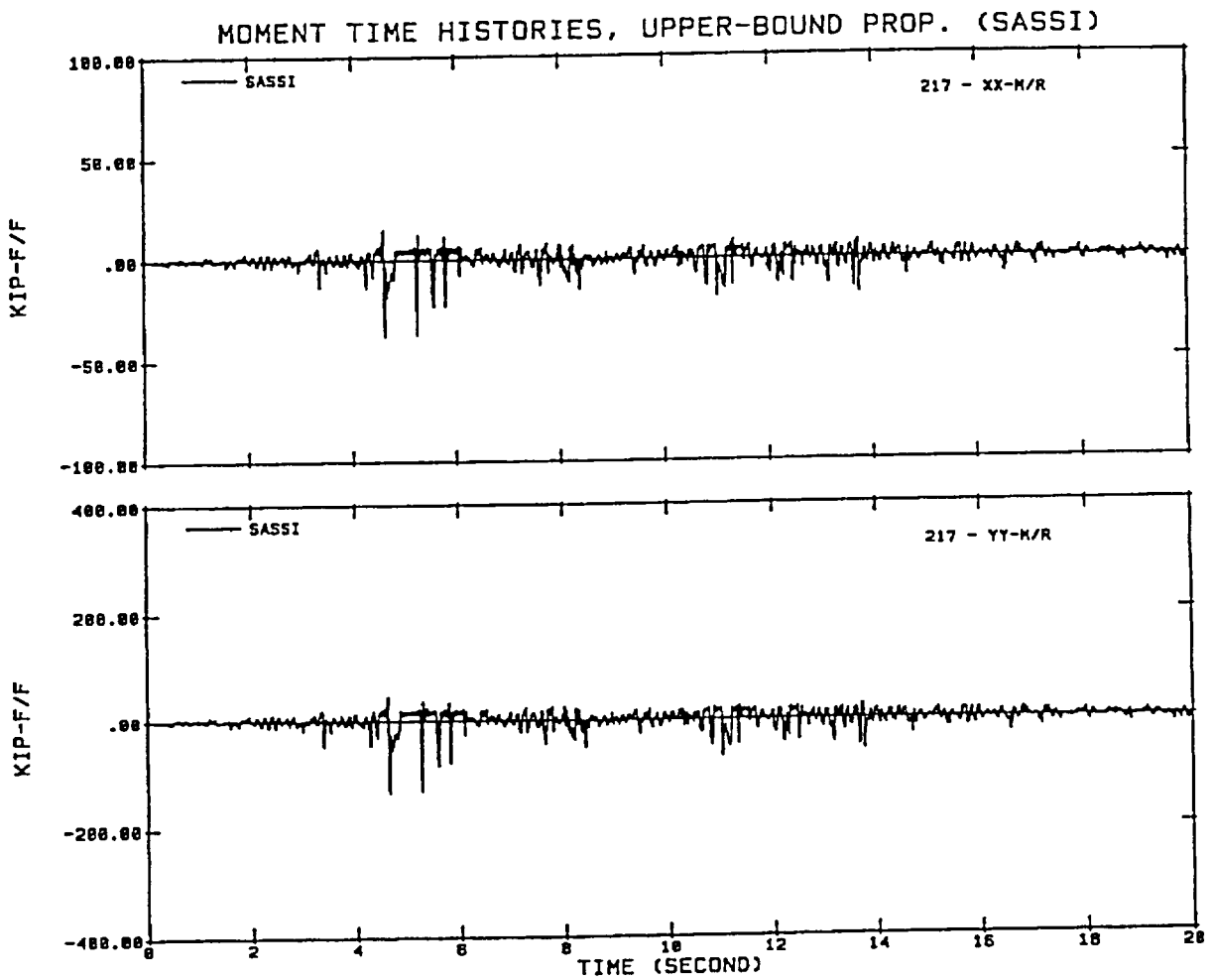

Fig. 5.2.5-17

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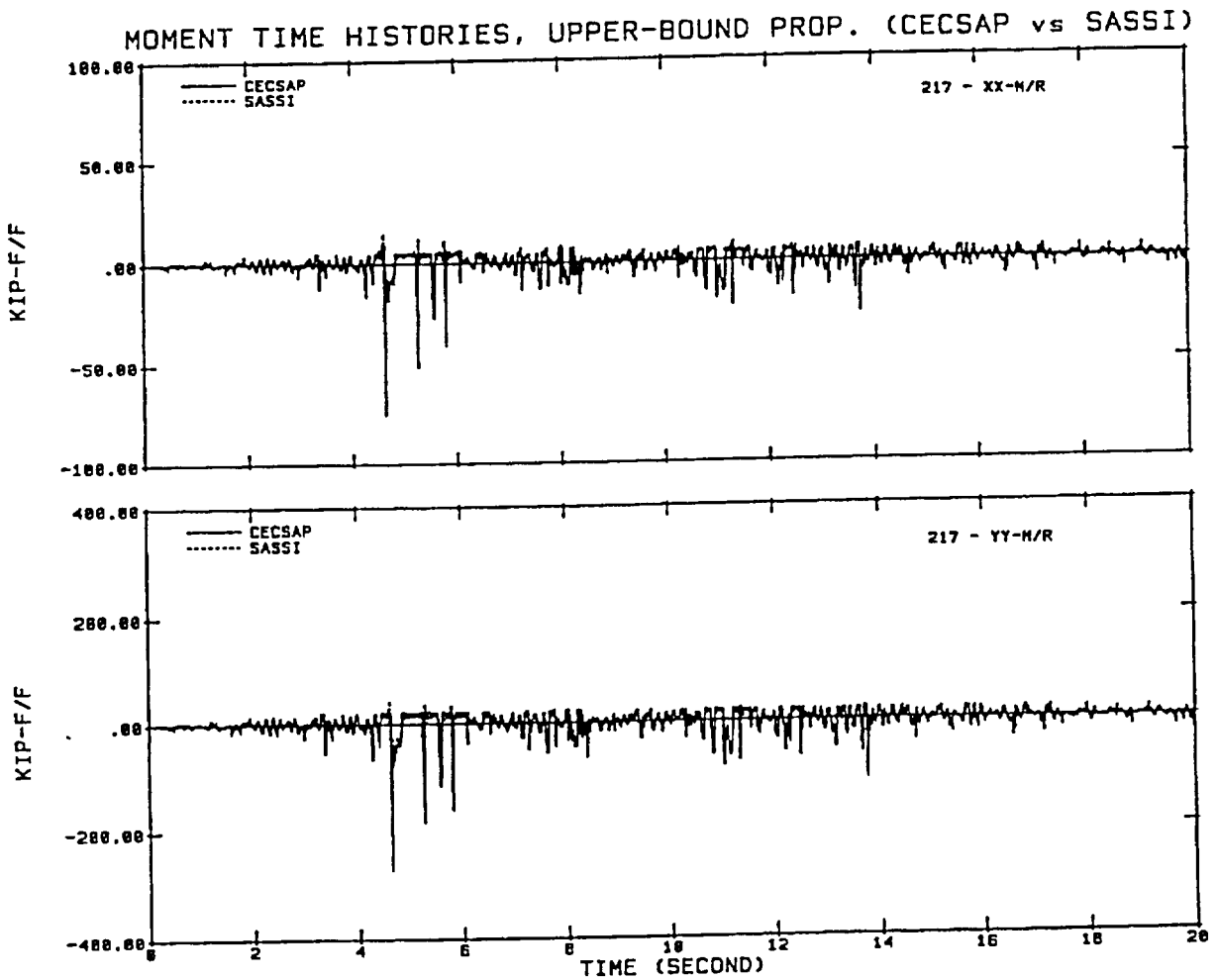

Fig. 5.2.5-18

1101-01
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P.O. G(P017)-2 REV NO 3
SET NO 226

5.3 Soil Pressures

5.3.1 Static Soil Pressure

Calculations of static soil pressure due to dead load (DL) and cask live load (LL) are given in Table S-1 and S-2, respectively.

Table S-1
Maximum Vertical Displacements and Soil Bearing Pressures
Dead Load

	k_s = 2.75 kcf	k_s = 26.2 kcf
Z_w(ft) =	0.164	0.017
q_{zw}(ksf) =	0.45	0.45

Notes:
1. Z_w = maximum vertical displacement due to dead load (wt. of the pad only) obtained from CECSAP analysis results.
2. q_{zw} = vertical soil bearing pressure = k_s x Z_w, where k_s = subgrade modulus=2.75 and 26.2 kcf for lower-bound and upper-bound soils,respectively.

Table S-2
Maximum Vertical Displacements and Soil Bearing Pressures
Live Load

Node No	(Z_l)max (x10^{-2} ft.)							
	subgrade modulus = 2.75 kcf				subgrade modulus = 26 2 kcf			
	2 Casks	4 Casks	8 Casks	7 Casks + OLT	2 Casks	4 Casks	8 Casks	7 Casks + OLT
1	13 06	11.29	-50.97	-57.81	0 61	1.16	-4 83	-5.30
7	13 02	11.28	-50 97	-41.84	0.59	1.14	-4.84	-4.42
13	13.06	11.29	-50.97	-25.83	0.61	1.16	-4.83	-3.50
144	-11.82	-26.36	-52.73	-78.21	-0.70	-2.89	-5.78	-7.95
150	-11.93	-26.35	-52.71	-61.06	-0.76	-2.89	-5 79	-6.31
156	-11.82	-26.36	-52.71	-43.87	-0.70	-2.89	-5.78	-4.65
287	-42.54	-62.26	-50.97	-100.20	-5.13	-5.98	-4.83	-11.81
293	-42.59	-62.25	-50.97	-80.88	-5.16	-5.98	-4.84	-8.48
299	-42.54	-62.26	-50.97	-61.84	-5.13	-5.98	-4.83	-5.47
	Maximum Soil Bearing Pressure $q_{zl}^{(1)}$ (ksf)							
1	0	0	-1.402	-1.590	0	0	-1.264	-1.390
7	0	0	-1.402	-1.151	0	0	-1.267	-1.159
13	0	0	-1.402	-0.710	0	0	-1.264	-0.917
144	-0.325	-0.725	-1.450	-2.151	-0.185	-0.757	-1.514	-2.082
150	-0.328	-0.725	-1.450	-1.679	-0.199	-0.758	-1.516	-1.653
156	-0.325	-0.725	-1.450	-1.206	-0.185	-0.757	-1.514	-1.219
287	-1.170	-1.712	-1.402	-2.756	-1.345	-1.567	-1.264	-3.094
293	-1.171	-1.712	-1.402	-2.224	-1.352	-1.565	-1.267	-2.222
299	-1.170	-1.712	-1.402	-1.701	-1.345	-1.567	-1.264	-1.434

Notes:
1. $q_{zl} = k_s \times Z_l$ where k_s = 2.75 and 26.2 kcf for lower-bound and upper-bound subgrade moduli, respectively, and Z_l are obtained from CECSAP analysis results (Att A)
2. Negative displacements imply downward movements.
3. The locations of nodes listed are shown in Figure 5.1-1.
4. For snow load, the soil bearing pressures is .045 ksf (Ref. 11).

5.3.2 Dynamic Horizontal and Vertical Soil Pressures

Calculations of lateral and vertical soil pressures due to dynamic cask loadings resulting from 2000-year event earthquake are given in the following tables:

Table D-1(a) shows calculation of horizontal dynamic soil pressures in the X-direction (short direction of pad).

Table D-1(b) shows calculation of horizontal dynamic soil pressures in the Y-direction (long direction of pad).

Table D-1(c) shows a summary of averaged horizontal dynamic soil reactions.

Table D-1(d) shows calculation of vertical dynamic soil pressures.

Table D-1(a)
Averaged Maximum Horizontal Soil Reactions in the X Direction
Dynamic Load

Node No.	Maximum Displacement Xd ($x10^{-3}$ ft.)								
	LB			BE			UB		
	2 Casks	4 Casks	8 Casks	2 Casks	4 Casks	8 Casks	2 Casks	4 Casks	8 Casks
1	3.512	2.409	17.160	1.624	1.177	9.076	0.798	0.547	3.597
7	3.515	2.405	17.180	1.625	1.170	9.085	0.801	0.552	3.625
13	3.512	2.409	17.190	1.624	1.177	9.060	0.799	0.550	3.618
144	4.461	9.712	17.460	2.021	4.241	9.127	1.017	2.325	3.952
150	4.461	9.729	17.470	2.021	4.242	9.156	0.999	2.294	3.951
156	4.467	9.733	17.470	2.029	4.244	9.171	0.982	2.272	3.947
287	12.800	21.490	17.510	6.201	9.504	8.860	3.345	5.306	4.514
293	12.800	21.490	17.530	6.186	9.512	8.886	3.360	5.341	4.566
299	12.800	21.470	17.530	6.173	9.516	8.886	3.381	5.349	4.565
Avg =	6.925	11.205	17.389	3.278	4.976	9.034	1.720	2.726	4.037
Kxd =	1.14E+05	1.14E+05	1.14E+05	2.33E+05	2.33E+05	2.33E+05	5.48E+05	5.48E+05	5.48E+05
Qxd =	789	1277	1982	764	1159	2105	943	1494	2212

Notes:

1. Avg = {sum (Xd)$_i$}/N; Xd = max. x-displ.; i = nodes 1, 7, 13, 144, 150, 156, 287, 293, 299; and N = 9.
2. Qxd = Kxd x Avg = averaged maximum horizontal-x soil reaction in Kips due to dynamic loading.
3. Kxd for LB, BE, and UB soils are dynamic horizontal-x soil spring stiffnesses given below.

(Kxd)LB = 9.51E+06 lb/in (Kxd)BE = 1.94E+07 lb/in (Kxd)UB = 4.57E+07 lb/in
1.14E+05 Kips/ft 2.33E+05 Kips/ft 5.48E+05 Kips/ft

4. LB = lower-bound soil, BE = best-estimate soil, UB = upper-bound soil.
5. Xd are obtained from CECSAP analysis results given in Att. A.

Table D-1(b)
Averaged Maximum Horizontal Soil Reactions in the Y Direction
Dynamic Load

Node No.	Max. Displacement Yd (x10^{-3} ft.)								
	LB			BE			UB		
	2 Casks	4 Casks	8 Casks	2 Casks	4 Casks	8 Casks	2 Casks	4 Casks	8 Casks
1	5.107	8.657	13.550	2.194	4.059	8.393	1.413	2 578	3.979
7	3.916	7.318	14.030	2.055	4.313	8.173	1.195	1.962	4.056
13	4.303	7.097	14.510	2.567	4.664	7.937	1.337	2.161	4.109
144	5.231	8.763	13.450	2.332	4.187	8.430	1.513	2.714	3.975
150	3.946	7.447	13.960	2.122	4.429	8.132	1.267	2.133	4.042
156	4.379	7.207	14.450	2.690	4.767	7.834	1.442	2.301	4.121
287	5.389	8.870	27.260	2.449	4.357	8.396	1.651	2.821	3.926
293	4.016	7.584	13.840	2.253	4.556	8.048	1.464	2.380	4.013
299	4.476	7.253	14.370	2.877	4.846	7.795	1.657	2.334	4.097
Avg =	4.529	7.800	15.491	2.393	4.464	8.126	1.438	2.376	4.035
Kyd =	1.08E+05	1.08E+05	1.08E+05	2.21E+05	2.21E+05	2.21E+05	5.21E+05	5.21E+05	5.21E+05
Qyd =	491	846	1680	528	986	1794	749	1237	2102

Notes
1. Avg = {sum (Yd)i}/N; Yd = max. y-displ.; i = nodes 1, 7, 13, 144, 150, 156, 287, 293, 299; and N = 9.
2. Qyd = Kyd x Avg = averaged maximum horizontal-y soil reaction in Kips due to dynamic loading.
3. Kyd for LB, BE, and UB soils are dynamic horizontal-y soil spring stiffnesses given below:

(Kyd)LB = 9.04E+06 lb/in 1.08E+05 Kips/ft (Kyd)BE = 1.84E+07 lb/in 2.21E+05 Kips/ft (Kyd)UB = 4.34E+07 lb/in 5.21E+05 Kips/ft

4. LB = lower-bound soil, BE = best-estimate soil, UB = upper-bound soil.
5. Yd are obtained from CECSAP analysis results given in Att A

Table D-1(c)
Summary of Total Maximum Horizontal Soil Reactions
Dynamic Load

	Max. Soil Reaction (Kips)								
	LB			BE			UB		
	2 Casks	4 Casks	8 Casks	2 Casks	4 Casks	8 Casks	2 Casks	4 Casks	8 Casks
Qxd =	789	1277	1982	764	1159	2105	943	1494	2212
Qyd =	491	846	1680	528	986	1794	749	1237	2102

Notes:
1. Qxd, and Qyd shown are obtained from Tables D-1(a), and (b), respectively.
2. LB = lower-bound soil, BE = best-estimate soil, UB = upper-bound soil

Table D-1(d)
Maximum Vertical Soil Bearing Pressures
Dynamic Load

Node No.	Maximum Displacement Zd ($x10^{-3}$ ft.)								
	LB			BE			UB		
	2 Casks	4 Casks	8 Casks	2 Casks	4 Casks	8 Casks	2 Casks	4 Casks	8 Casks
1	4.051	9.396	-31.02	1.806	4.158	-23.66	0.406	1.654	-15.92
7	3.900	7.973	-24.23	1.964	3.648	-21.18	0.439	1.024	-13.36
13	4.788	11.470	-31.22	2.115	4.636	-17.88	0.528	1.560	-15.31
144	-9.195	-22.58	-34.05	-5.939	-16.84	-22.66	-1.861	-8.34	-13.66
150	-5.063	-15.2	-12.71	-3.683	-11.13	-12.39	-1.332	-6 698	-8.016
156	-6.565	-15.9	-32.24	-2.988	-9.447	-18.42	-1.734	-5.773	-14.53
287	-29.18	-24.39	-17.51	-14.54	-15.67	-18.88	-12.72	-8.52	-8.38
293	-15 57	-16 97	-19.21	-9.019	-12.42	-12.22	-12.08	-10.68	-6 446
299	-21.85	-26.09	-28.04	-12.87	-16 35	-17.02	-9.835	-11.63	-13.12
	Maximum Soil Bearing Pressure q_{zd} (Kips/ft^2)								
1	0	0	-2.22	0	0	-3.35	0	0	-5.14
7	0	0	-1.74	0	0	-3.00	0	0	-4.32
13	0	0	-2.24	0	0	-2.53	0	0	-4.94
144	-0.66	-1.62	-2.44	-0.84	-2.38	-3.21	-0.60	-2.69	-4.41
150	-0.36	-1.09	-0.91	-0.52	-1.57	-1.75	-0 43	-2.16	-2.59
156	-0.47	-1.14	-2.31	-0.42	-1.34	-2.61	-0 56	-1.86	-4.69
287	-2.09	-1.75	-1.25	-2 06	-2.22	-2.67	-4.11	-2.75	-2.71
293	-1.12	-1.22	-1.38	-1.28	-1.76	-1.73	-3.90	-3.45	-2.08
299	-1.57	-1.87	-2.01	-1.82	-2.31	-2 41	-3.18	-3.76	-4.24

Notes:

1. q_{zd} = maximum soil bearing pressure = (Kzd x Z_d)/A, where A = 67' x 30' = 2010 ft^2
2. Kzd for LB, BE, and UB soils are vertical-z dynamic soil spring stiffnesses given below.

(Kzd)LB =	1.20E+07 lb/in	(Kzd)BE =	2.37E+07 lb/in	(Kzd)UB =	5 41E+07 lb/in
	1.44.E+05 Kips/ft		2.84.E+05 Kips/ft		6 49.E+05 Kips/ft

3. LB = lower-bound soil, BE = best-estimate soil, UB = upper-bound soil.
4. Zd are obtained from CECSAP analysis results given in Att. A.
5. Negative displacements imply downward movements
6. The maximum values of Zd shown may not be concurrent. However, they are assumed to be concurrent values and concurrent signs are assigned to them.
7. Node numbers are shown in Figure 5.1-1.

NUCLEAR REGULATORY COMMISSION

Docket No. _____ Official Exh. No. 85

In the matter of _____

Staff ✓	IDENTIFIED ✓
Applicant ✓	RECEIVED ✓
Intervenor _____	REJECTED _____
Other _____	WITHDRAWN _____
DATE 4-29-02	Witness _____
Clerk _____	