Appendix D
TPNP 3D UB SSI Analysis Transfer Functions – NI Key Nodes

The interpolation function for the NI20r model was manually checked to ensure the correct starting point for the transfer functions. The TPNP 3D UB SSI analysis un-interpolated and interpolated transfer functions for the NI six key locations, defined in Table 3.4-1, are shown in Figures D-1 through D-18.

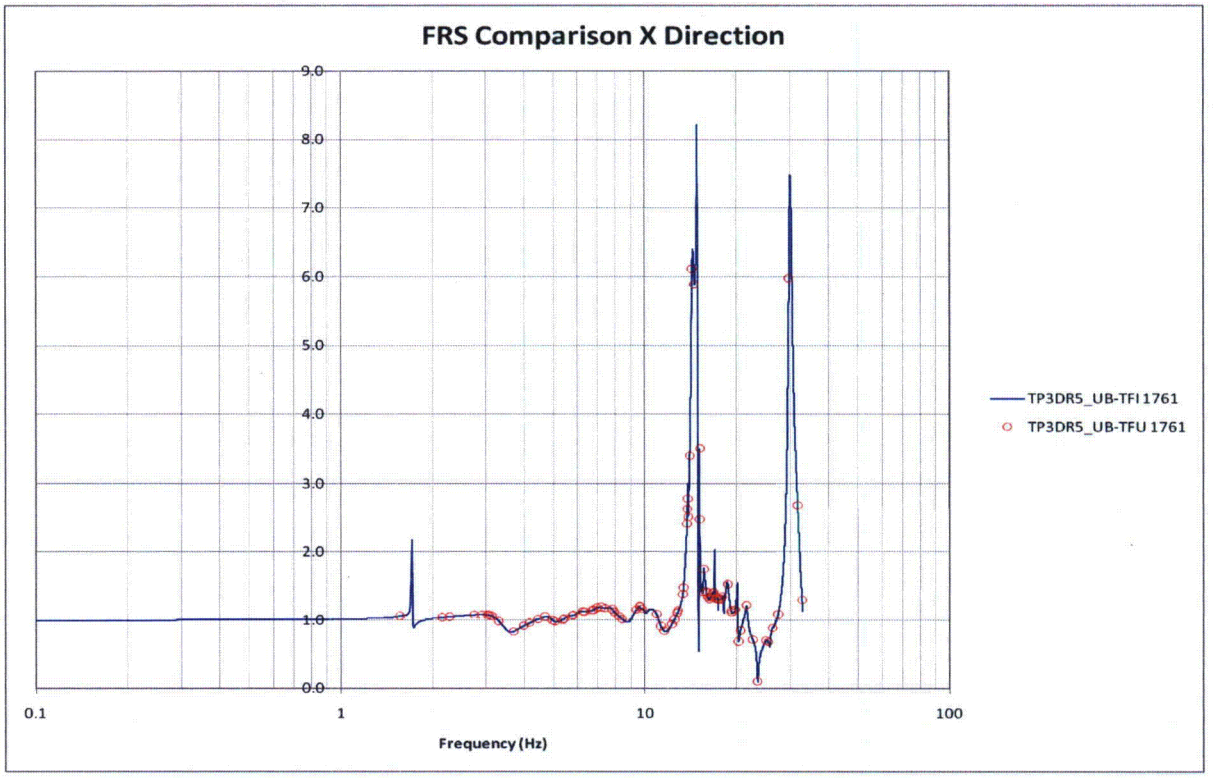

Figure D-1. TPNP 3D NI SSI UB Transfer Function in X-Direction – Node 1761

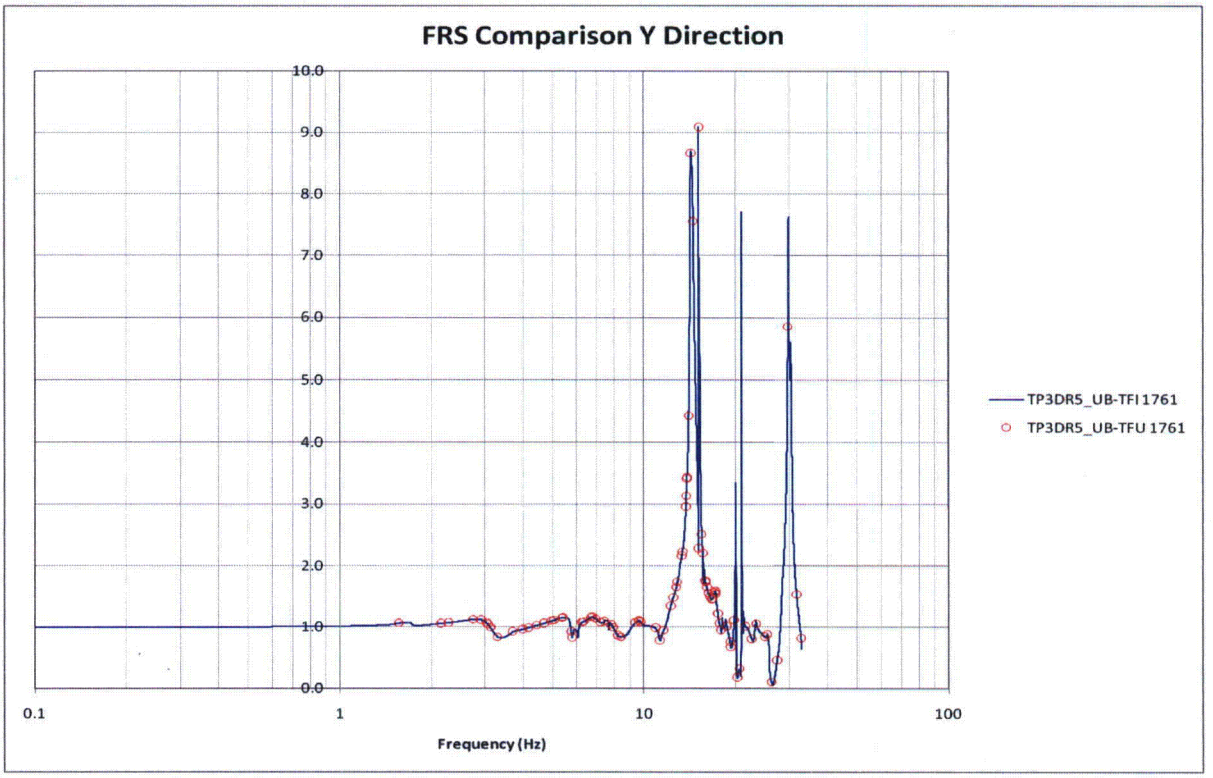

Figure D-2. TPNP 3D NI SSI UB Transfer Function in Y-Direction – Node 1761

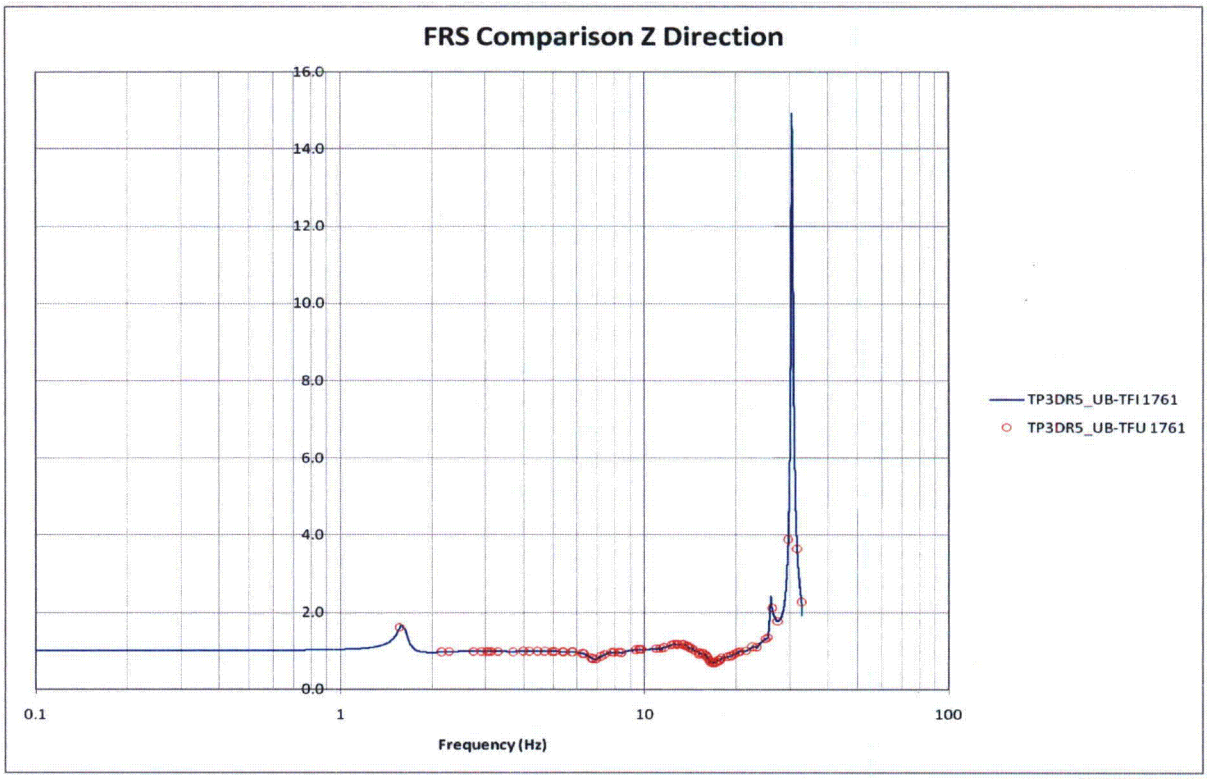

Figure D-3. TPNP 3D NI SSI UB Transfer Function in Z-Direction – Node 1761

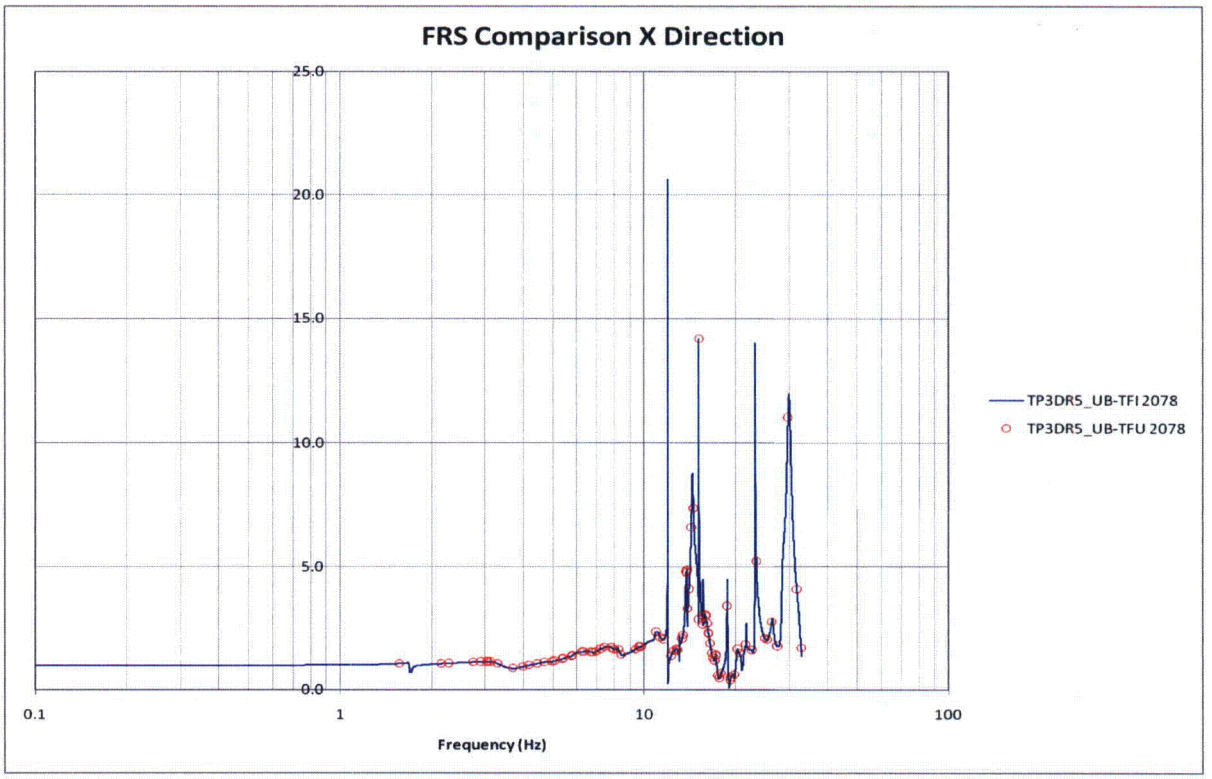

Figure D-4. TPNP 3D NI SSI UB Transfer Function in X-Direction – Node 2078

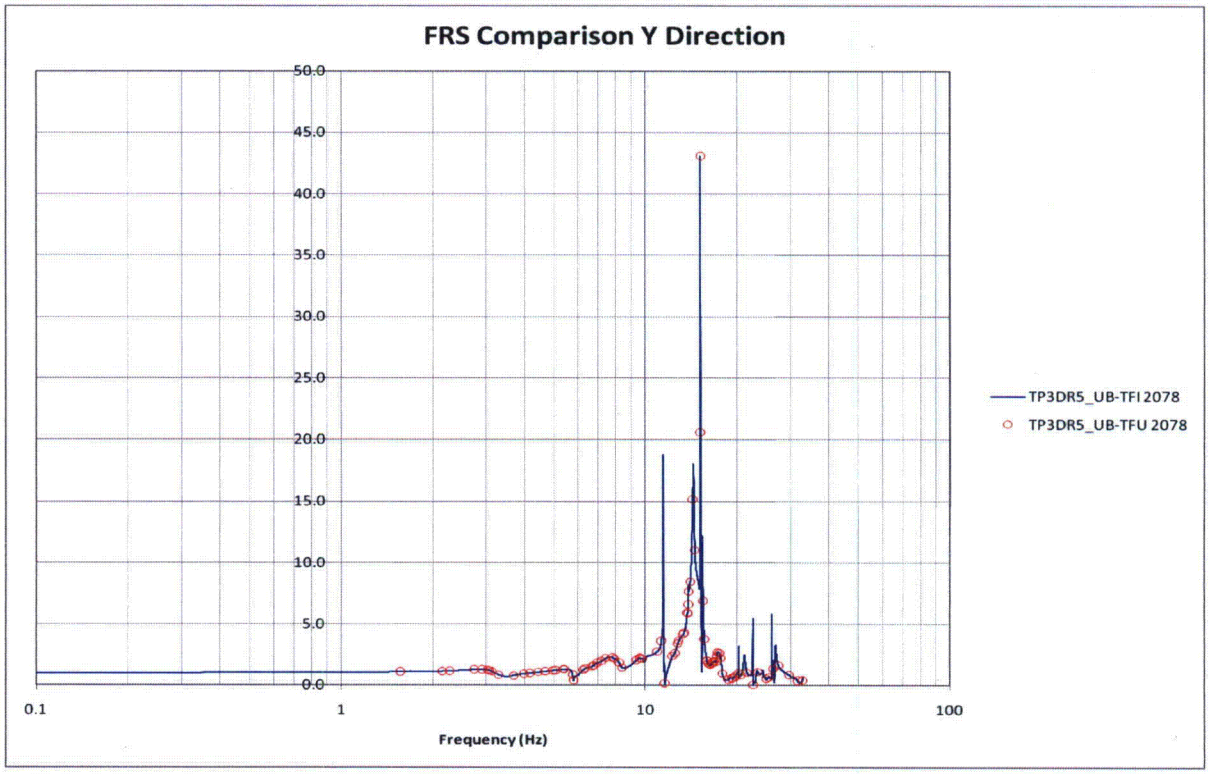

Figure D-5. TPNP 3D NI SSI UB Transfer Function in Y-Direction – Node 2078

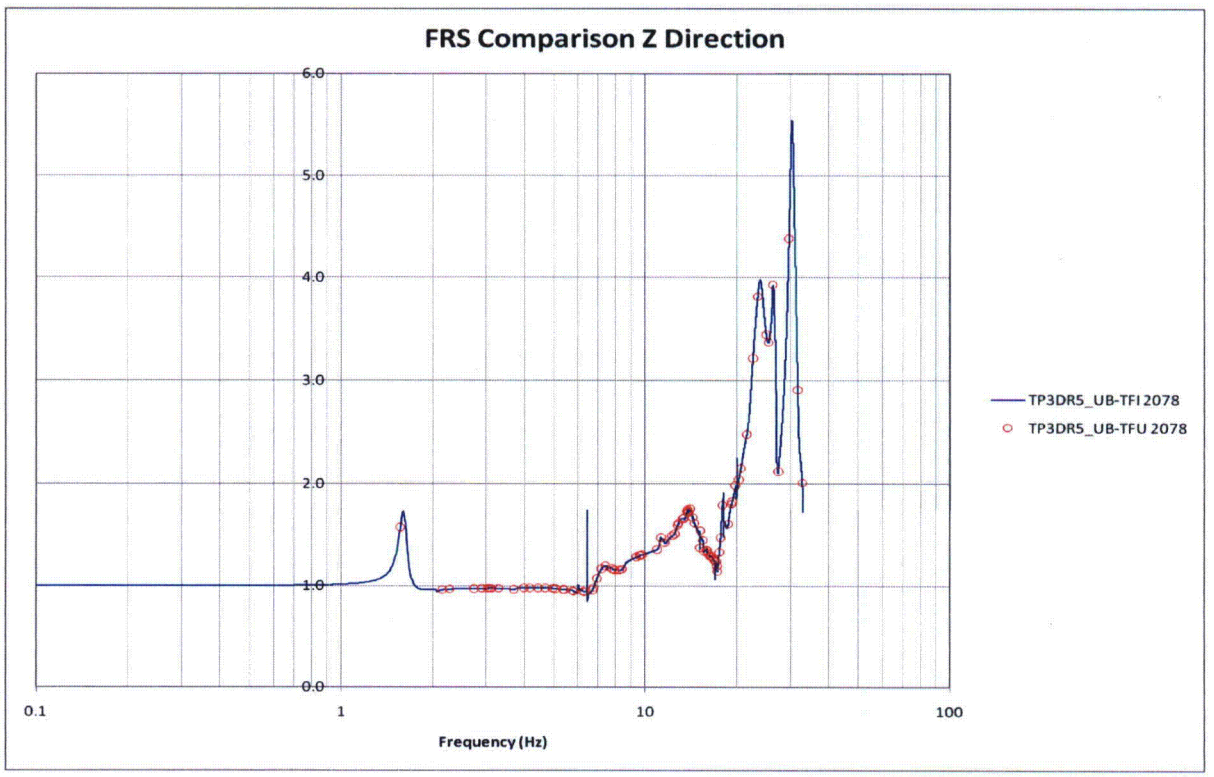

Figure D-6. TPNP 3D NI SSI UB Transfer Function in Z-Direction – Node 2078

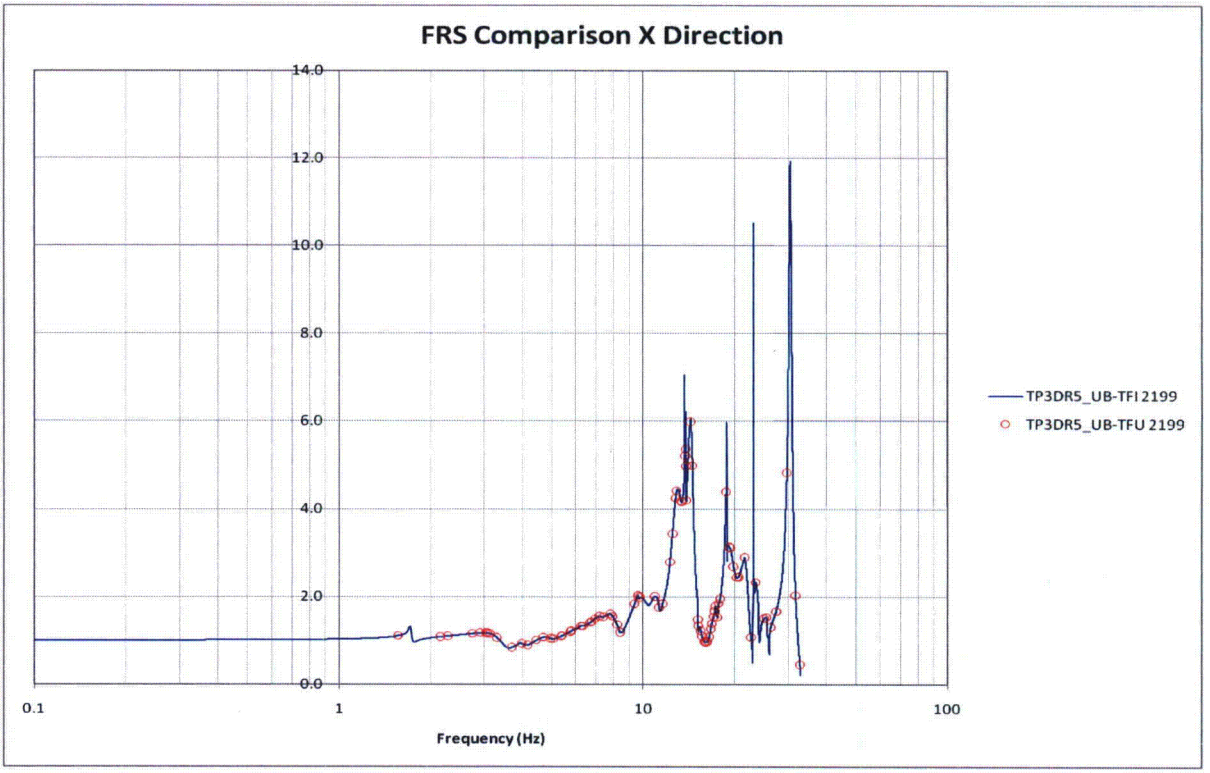

Figure D-7. TPNP 3D NI SSI UB Transfer Function in X-Direction – Node 2199

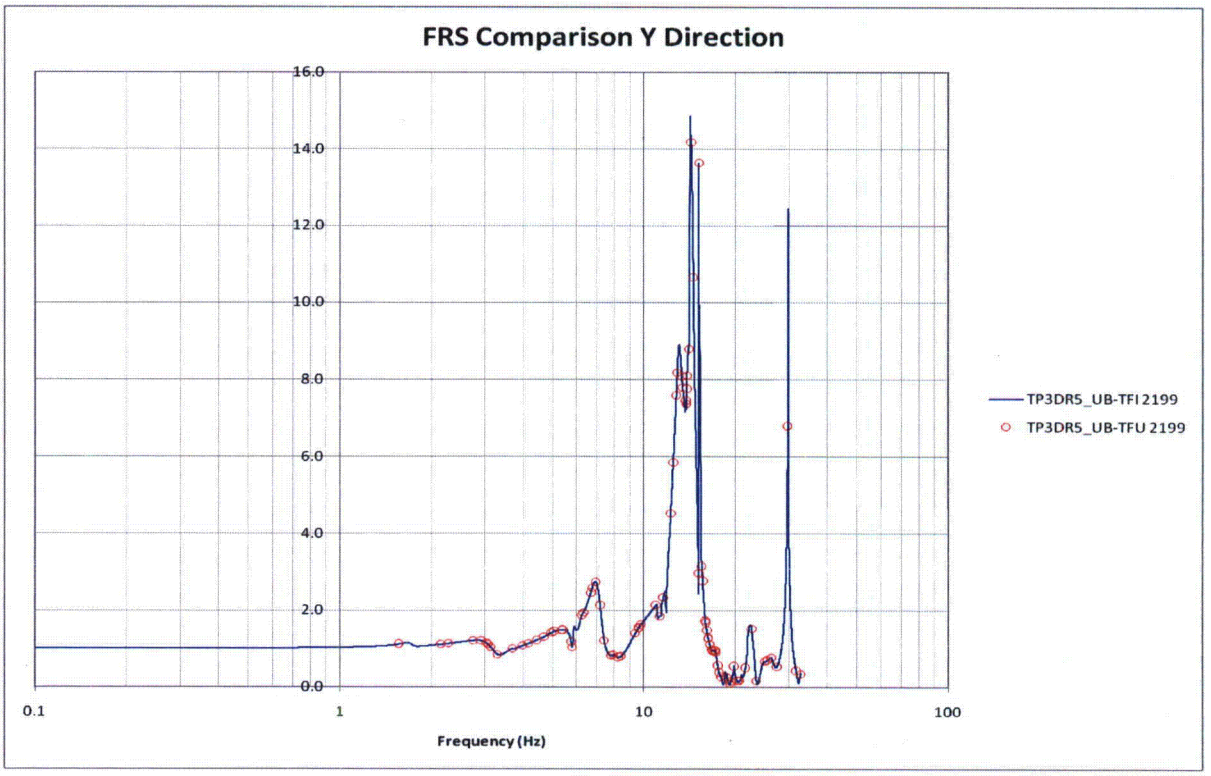

Figure D-8. TPNP 3D NI SSI UB Transfer Function in Y-Direction – Node 2199

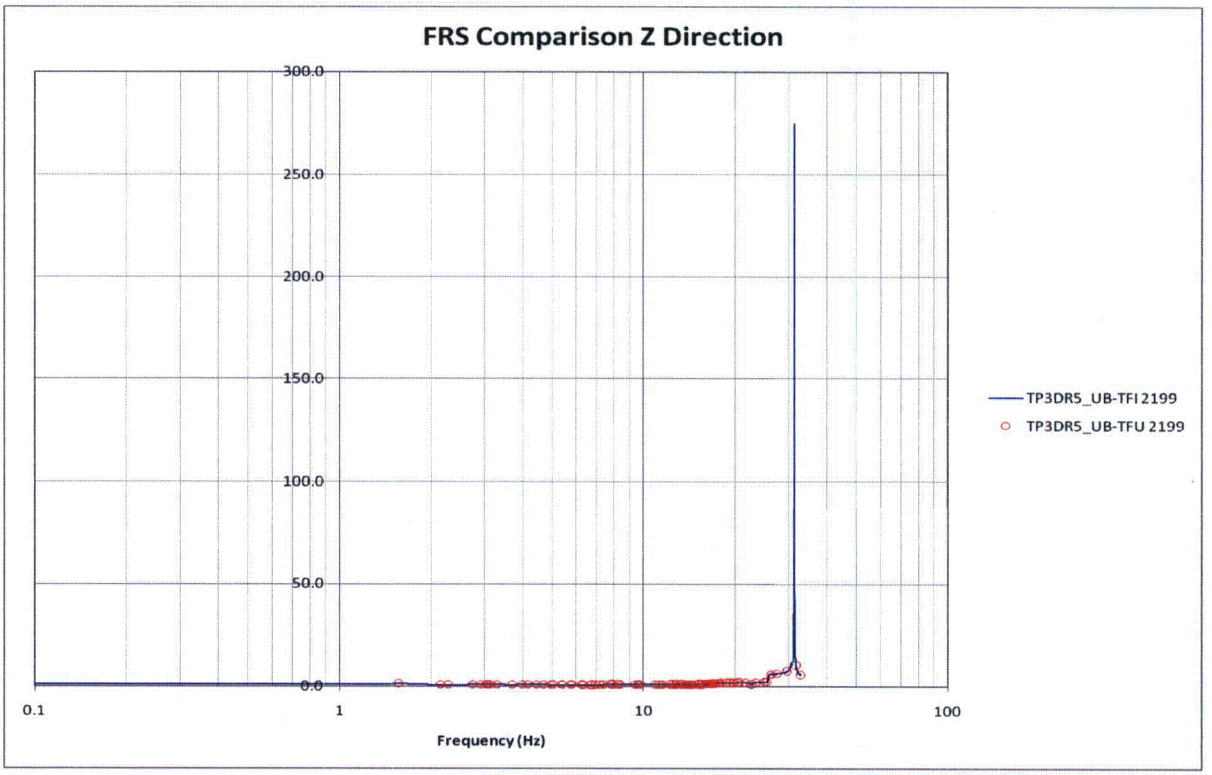

Figure D-9. TPNP 3D NI SSI UB Transfer Function in Z-Direction – Node 2199

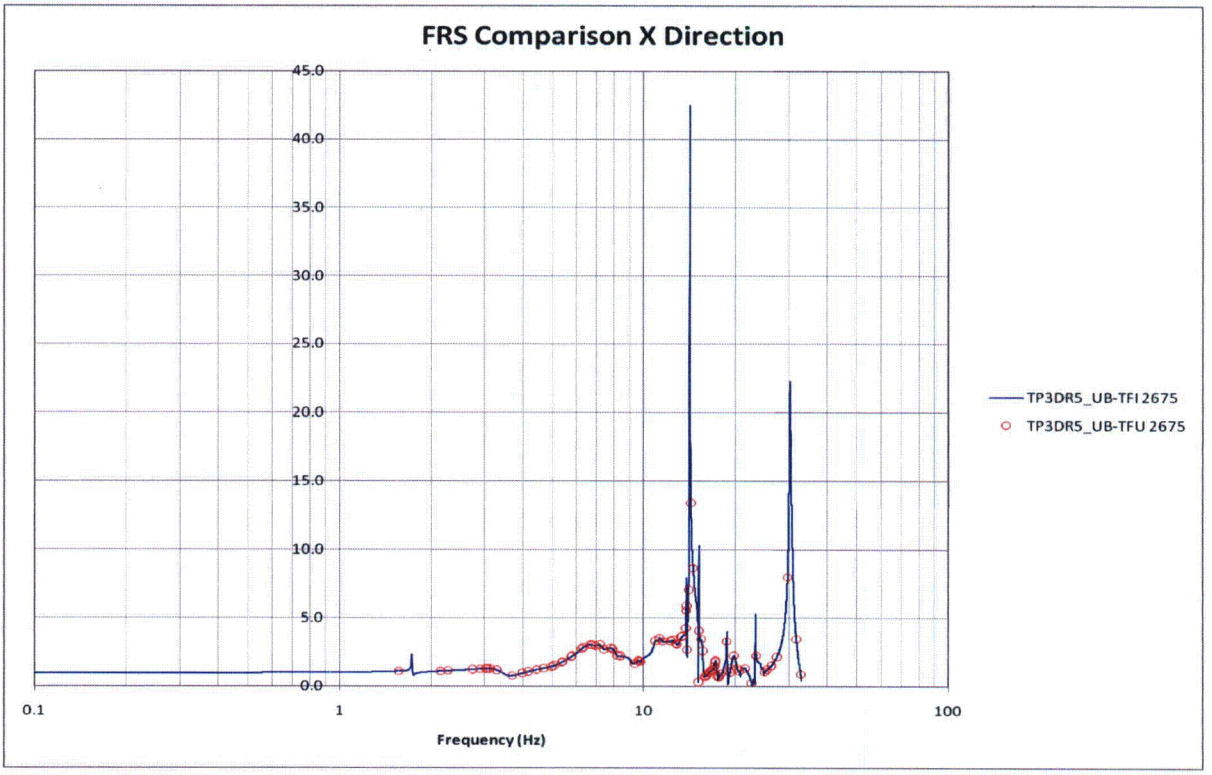

Figure D-10. TPNP 3D NI SSI UB Transfer Function in X-Direction – Node 2675

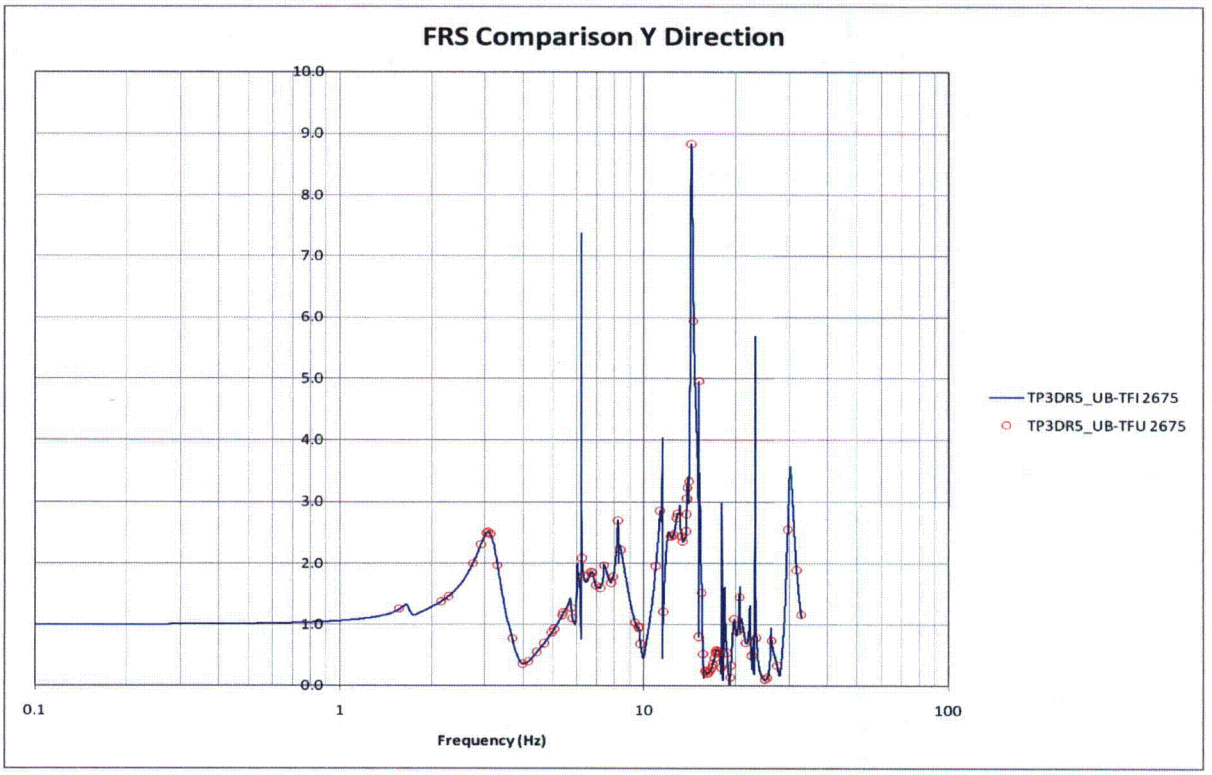

Figure D-11. TPNP 3D NI SSI UB Transfer Function in Y-Direction – Node 2675

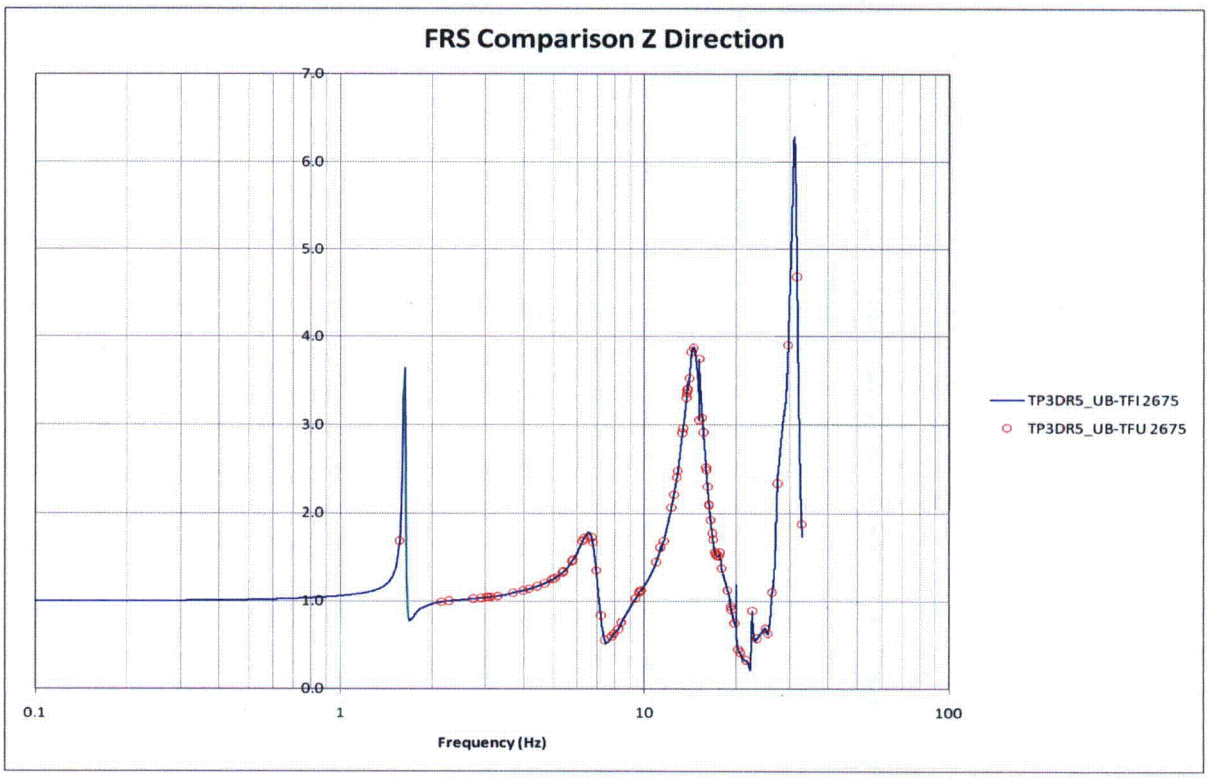

Figure D-12. TPNP 3D NI SSI UB Transfer Function in Z-Direction – Node 2675

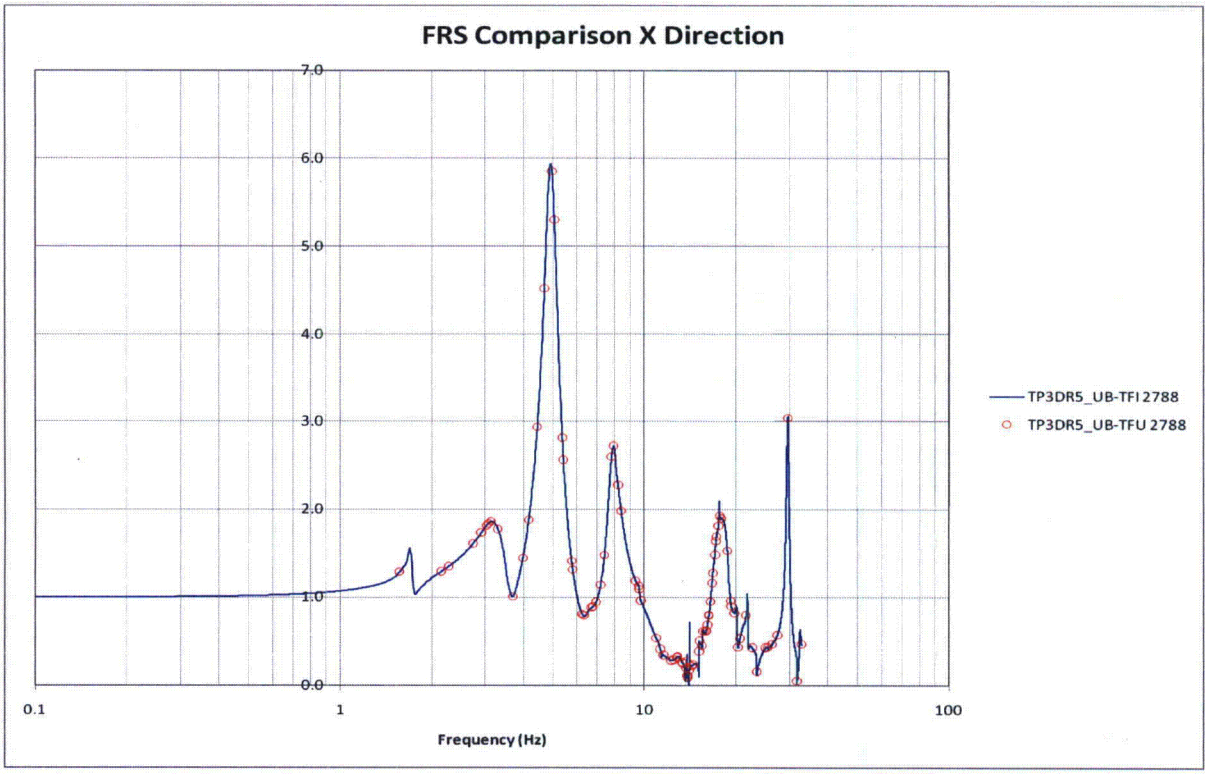

Figure D-13. TPNP 3D NI SSI UB Transfer Function in X-Direction – Node 2788

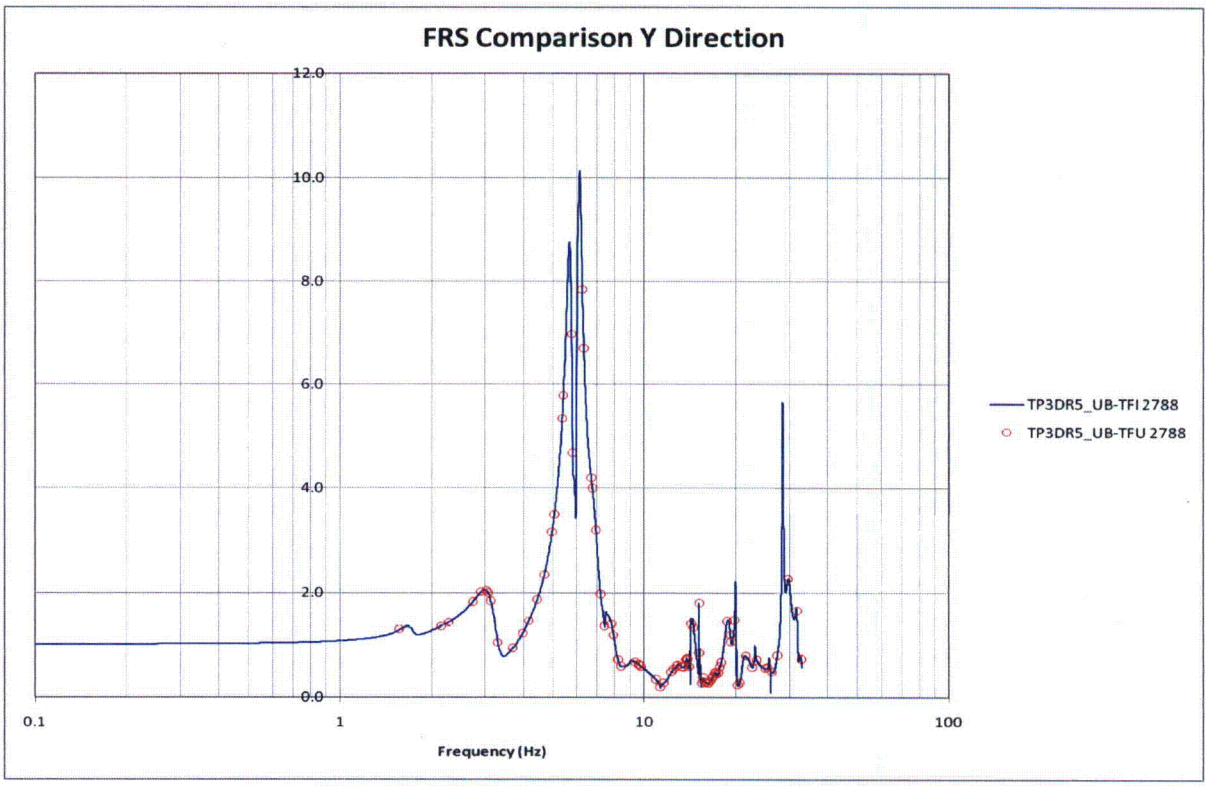

Figure D-14. TPNP 3D NI SSI UB Transfer Function in Y-Direction – Node 2788

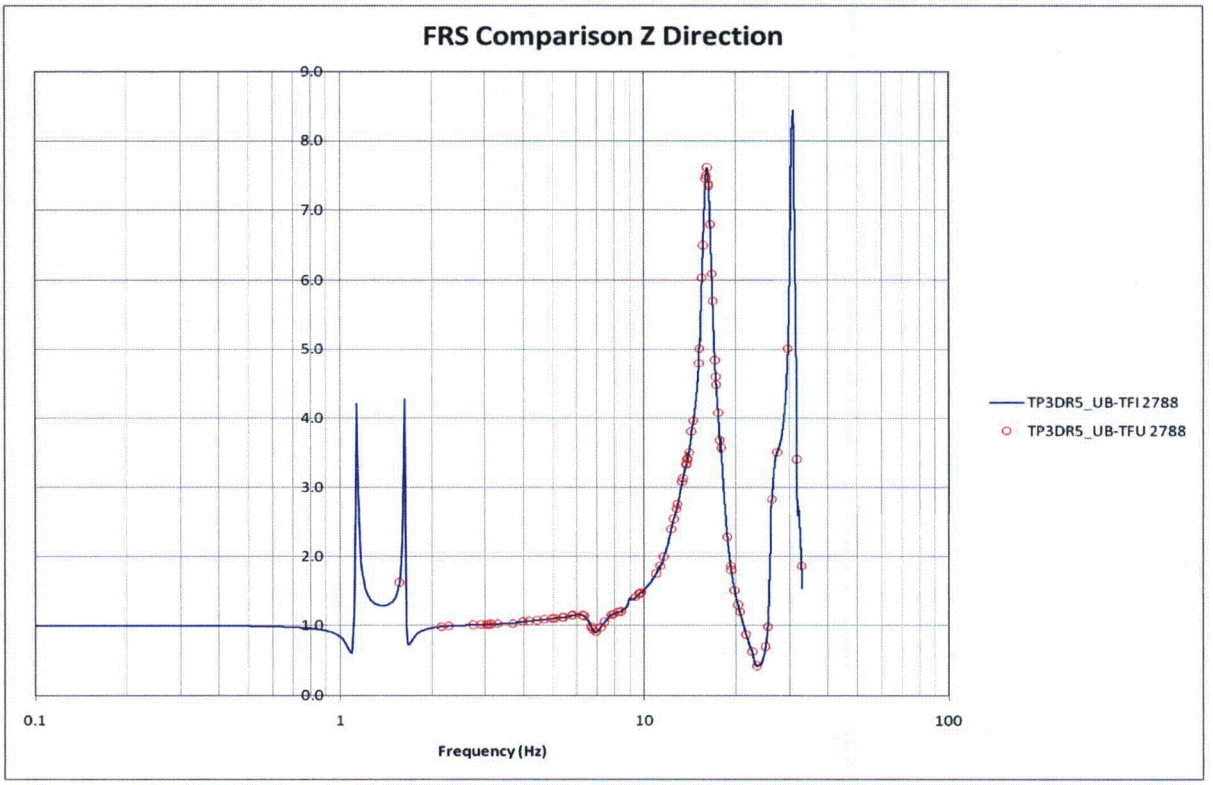

Figure D-15. TPNP 3D NI SSI UB Transfer Function in Z-Direction – Node 2788

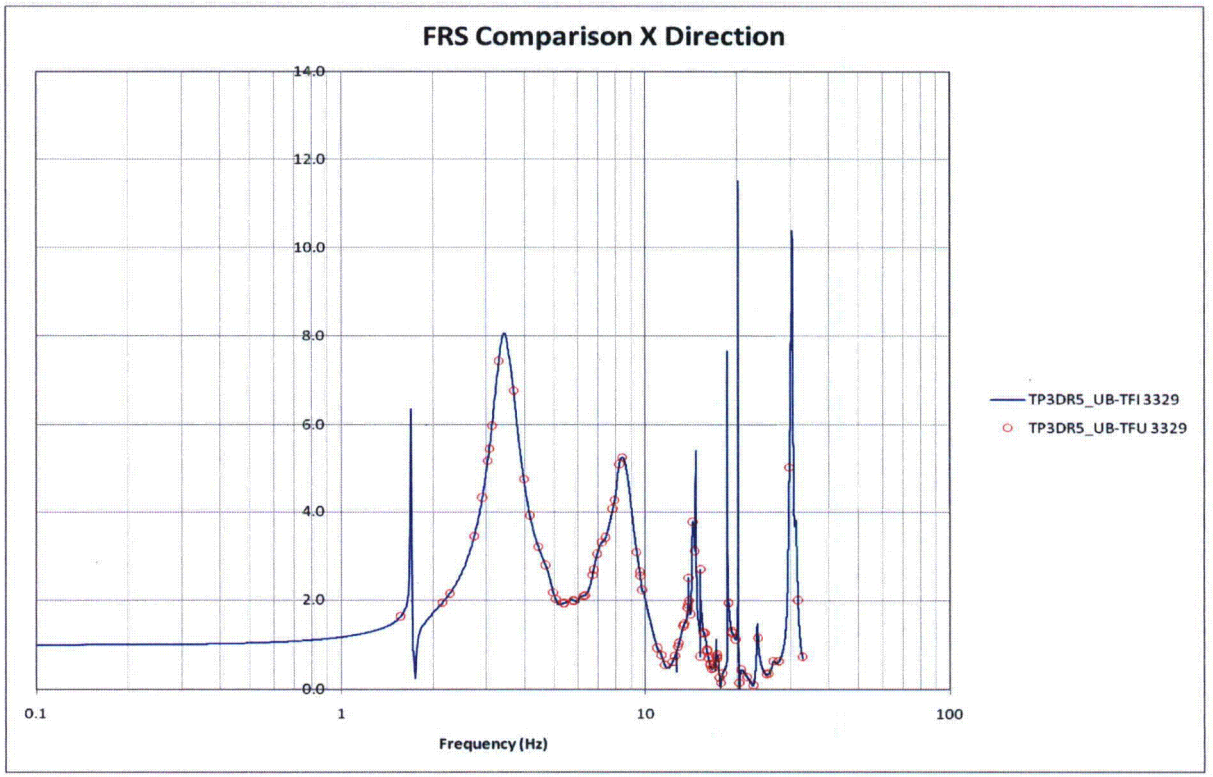

Figure D-16. TPNP 3D NI SSI UB Transfer Function in X-Direction – Node 3329

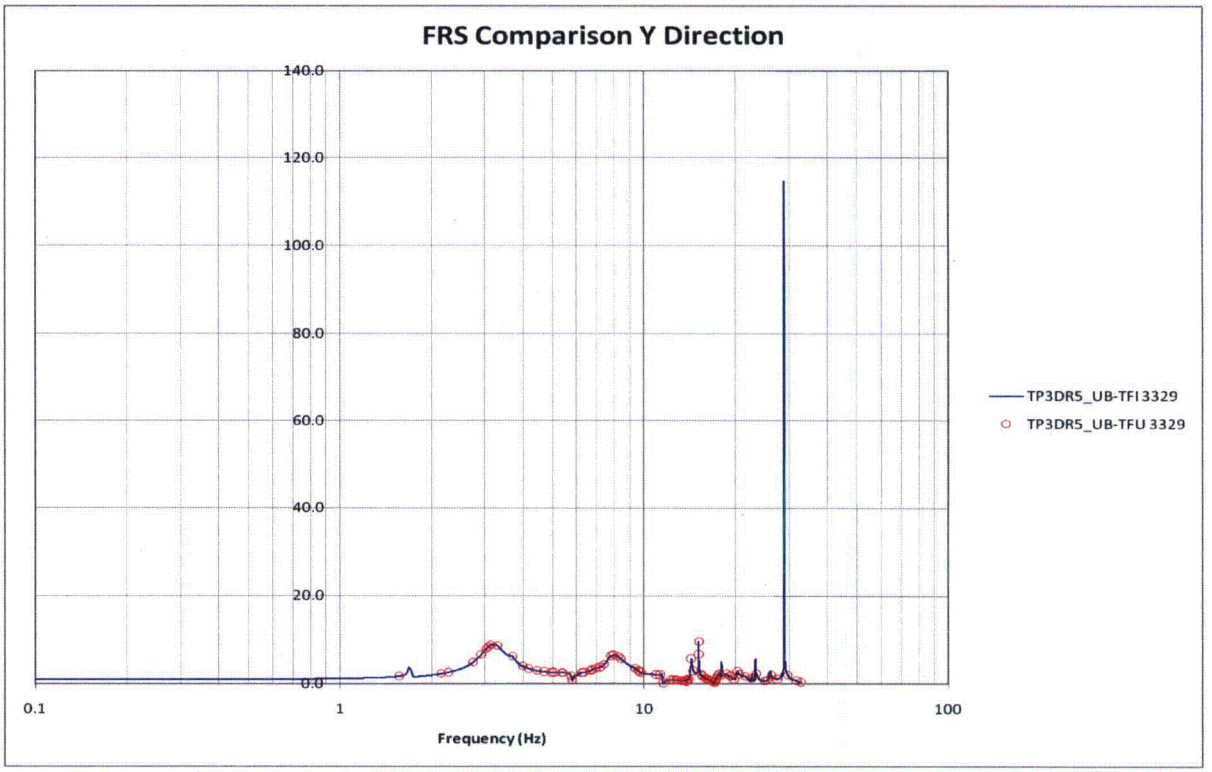

Figure D-17. TPNP 3D NI SSI UB Transfer Function in Y-Direction – Node 3329

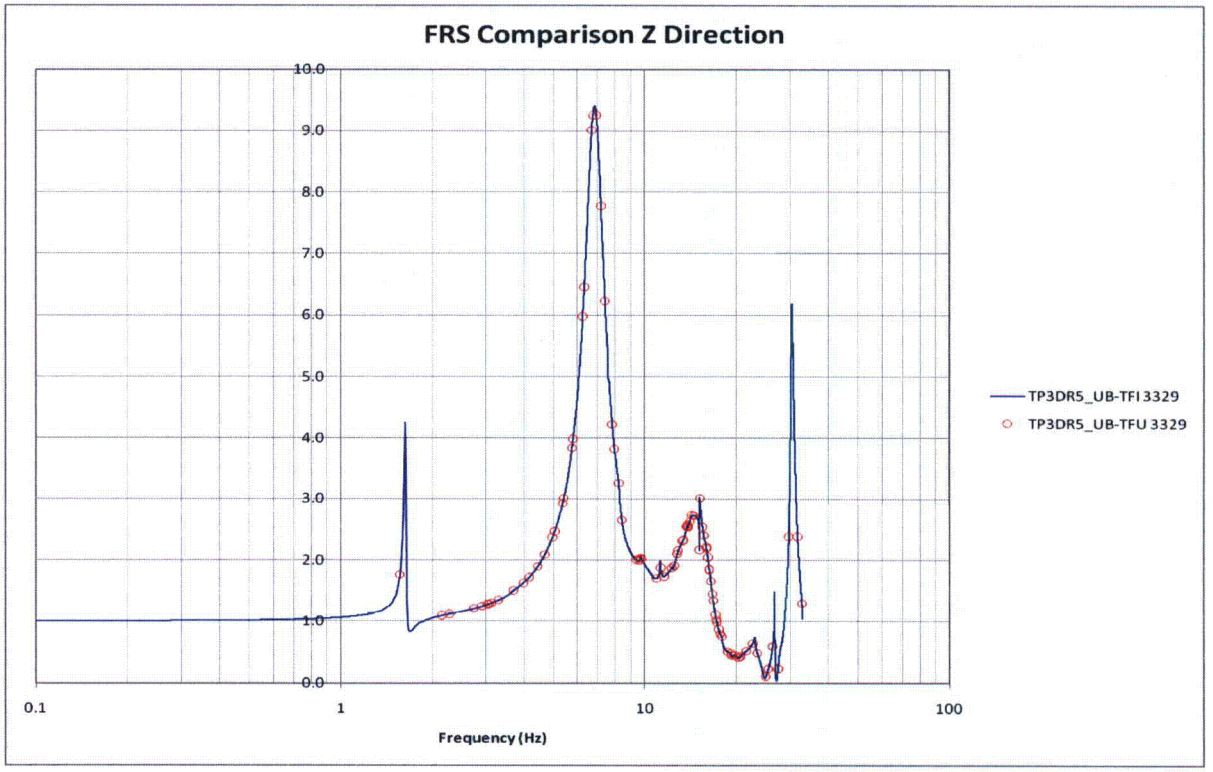

Figure D-18. TPNP 3D NI SSI UB Transfer Function in Z-Direction – Node 3329

Appendix E
Turkey Point Units 6 & 7 – Updated Site Characterization Sensitivity Assessment of Nuclear Island SSI Analysis

E.1 Background and Purpose

In 2013, a supplemental site subsurface investigation was performed at the Turkey Point Units 6 & 7 site as described in FSAR Subsection 2.5.4 (Reference 7). The additional site characterization data was used to update the site profile (S-wave velocity, layer thickness, and unit weight), as well as the nonlinear curves (G/Gmax and damping ratio). Bechtel evaluated the sensitivity of the updated site properties on the GMRS, FIRS, and SSI properties on both near NI and FAR profiles (Reference 12), and provided updated SSI BE soil/rock properties for further seismic SSI sensitivity analysis described this appendix for the NI. Reiterating, Bechtel concluded the following (Reference 12):

1. The RG 1.60 spectrum with a peak ground acceleration (PGA) of 0.1 g envelopes the sensitivity NI FIRS (see Figure 2.1-17). Thus, the previously established SSE is still valid, which was partially based on the RG 1.60 spectrum with a PGA of 0.1 g; and
2. The approximate sensitivity GMRS (developed in Appendix 3 of Reference 12 using the updated site characteristics) is slightly higher than the initial GMRS (computed in Reference 1). At a frequency of 100 HZ, the sensitivity horizontal GMRS increased from 0.058 g to 0.062 g (a ratio of 1.07); with a maximum ground-motion change from 0.0635 g to 0.0698 g (a ratio of 1.10) at a frequency of 45 Hz. The ratio of these differences may indicate a significant change due to the updated site properties; however the ground-motion difference of 0.004 g at a frequency of 100 Hz, and 0.006 g at a frequency of 45 Hz is well within the confidence bounds of probabilistic seismic hazard analysis (PSHA) and seismic site response. Furthermore, the GMRS developed for the initial and updated site properties both characterize Turkey Point Units 6 & 7 site as a site with low seismic hazard.

The purpose of Appendix E is to summarize the updated seismic input, 3D SASSI SSI sensitivity analysis, which uses the Section 4.1 embedded model and Section 5.1 SSI analysis techniques, and incorporates the updated (Reference 12) BE properties for the 19-foot thick, lean concrete fill, grouted rock zone, and rock profile. The NI SSI sensitivity analyses also include incorporating the previous FIRS and the corresponding foundation level time histories presented in Sections 2.1 and 3.5, respectively. Further, References 12 and 13 confirm that the RG 1.60 envelop spectra and time histories are applicable to these sensitivity analyses, which meet the minimum 0.1g outcrop SSE requirements of Appendix S of 10 CFR Part 50.

The Section 4.1 3D, 41.5-foot embedded FEM was used to perform SSI sensitivity analyses, which follow the same methodology used previously in Section 5.1; however, updated BE soil/rock, lean concrete and grouted rock properties provided in Reference 12 were incorporated where appropriate into the SASSI2000 SITE and HOUSE files. SSI analyses are performed to calculate the updated in-structure FRS at the six (6) key NI locations shown in Table E.1-7, which are compared to assess the validity of the more rigorously derived Reference 1 SSI seismic input and complete Reference 11 design-basis SSI analyses results. Specifics pertaining to the model input are described above in various sub-sections of Section 4.0.

The 3D SSI analyses were performed using the computer code SASSI2000 (Reference 5) specifically modules SITE, POINT, HOUSE, ANALYS. ACS SASSI (Reference 6) was used specifically for the MOTION module. All 3D SASSI SSI analyses performed and described in this report have utilized the SASSI Direct Method for computing in-structure response spectra.

E.1.1 TPNP Updated Best Estimate Profile

SSI analyses are performed utilizing the updated TPNP site characterization data and include both the initial and updated strain compatible BE soil/rock, grouted rock and lean concrete fill properties developed by Bechtel in Reference 12. The initial (Reference 1) and updated (Reference 12) BE NI and FAR layer thickness, unit weight, shear wave velocity (Vs), compression wave velocity (Vp) and damping values, from the ground surface to the simulated half-space at a depth of about 600 feet are presented in Tables E.1-1 to E.1-6. Figures E.1-1 through E.1-6 graphically present the TPNP Vs, Vp and damping profiles over the approximately 600-foot depth. Based on the site response sensitivity analysis, Reference 12 recommends using the updated properties; however, the NI materials (first 8 layers in Table E.1--2) and FAR materials (first 6 layers in Table E.1-4) were replaced with the first 8 and 6 layers of Reference 1 materials from Tables E.1-1 and E.1-3, respectively. Updated BE concrete properties from Table E.1-2 were used as well as an increased density of 155 pcf for the grouted rock zone between El. -35 to -60 feet (depth range 60.5 to 85.5 feet).

Table E.1-1. Best-Estimate NI SSI Profile from 25409-000-K0C-0000-00066 – Reference 1

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
1	5.00	0.130	610.4	1142.0	2.72
2	5.00	0.130	715.7	1339.0	3.83
3	5.00	0.130	756.7	1415.7	4.59
4	5.00	0.130	756.6	1415.5	5.21
5	5.00	0.130	761.9	1425.3	5.74
6	5.50	0.130	728.5	3714.7	6.42
7	6.00	0.130	721.1	3676.9	6.83
8	5.00	0.130	726.7	3705.4	7.10
9	6.33	0.150	5518.5	8600.0	1.05
10	6.33	0.150	5518.5	8600.0	1.05
11	6.33	0.150	5518.5	8600.0	1.05
12	6.00	0.136	5674.2	8842.7	0.99
13	10.00	0.136	5781.3	10815.9	0.99
14	10.00	0.136	5449.9	10015.8	0.99
15	10.00	0.136	4858.1	9006.7	0.99
16	10.00	0.136	4768.7	9622.9	0.99
17	10.00	0.136	4712.1	9446.3	0.99
18	10.00	0.136	4670.9	9223.8	0.99
19	10.00	0.136	4559.3	9080.0	0.99
20	10.00	0.136	1847.0	5000.0	0.99
21	10.00	0.120	1469.6	5000.0	1.89
22	10.00	0.120	1531.8	6388.5	1.82
23	10.00	0.120	1532.4	5079.2	1.84
24	10.00	0.120	1596.1	6309.2	1.70
25	10.00	0.120	1606.9	5860.8	1.69
26	10.00	0.120	1622.1	5640.3	1.67
27	10.00	0.120	1626.0	5819.6	1.68
28	10.00	0.120	1647.0	5981.3	1.67
29	10.00	0.120	1734.7	6059.5	1.57
30	10.00	0.120	1941.1	6303.2	1.38
31	10.00	0.120	1958.5	5563.6	1.37
32	10.00	0.120	1886.2	5085.9	1.43
33	10.00	0.120	1839.0	5698.6	1.48
34	10.00	0.120	1754.1	5082.1	1.57
35	10.00	0.120	1679.1	5410.9	1.65
36	10.00	0.120	1675.0	5880.4	1.66
37	10.00	0.120	1608.9	5533.7	1.75
38	10.00	0.120	1558.7	5021.6	1.82
39	10.00	0.120	1554.7	5327.5	1.82
40	10.00	0.120	1518.3	5163.6	1.89
41	10.00	0.120	1445.0	5000.0	2.02
42	10.00	0.120	1440.3	5650.4	2.03
43	10.00	0.120	1439.7	5745.5	2.03

Table E.1-1. Best-Estimate NI SSI Profile from 25409-000-K0C-0000-00066 – Reference 1 (cont.)

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
44	10.00	0.120	1438.1	5682.1	2.04
45	10.00	0.120	1437.8	5615.5	2.04
46	10.00	0.120	1424.5	5629.8	2.07
47	10.00	0.120	1416.2	5707.3	2.09
48	10.00	0.120	1407.5	5360.2	2.12
49	10.00	0.120	1398.7	5599.0	2.14
50	10.00	0.120	1394.9	5438.2	2.16
51	10.00	0.120	1395.3	5586.8	2.18
52	10.00	0.120	1390.5	5588.1	2.19
53	10.00	0.120	1389.8	5582.4	2.21
54	10.00	0.130	3911.1	15710.3	0.79
55	10.00	0.130	3910.9	15709.5	0.80
56	10.00	0.130	3910.6	8543.3	0.81
57	10.00	0.130	3910.1	7713.9	0.82
58	10.00	0.130	3897.2	7895.1	0.83
59	10.00	0.130	3886.0	7881.0	0.85
60	10.00	0.130	3866.8	8006.0	0.85
61	10.00	0.130	3839.6	8011.6	0.86
62	10.00	0.130	3789.4	7637.4	0.87
63	10.00	0.130	3778.8	7913.5	0.89
64	10.00	0.130	3568.7	7860.7	0.93
65	10.00	0.130	3407.3	7719.2	0.97
66	10.00	0.130	3151.4	7436.6	1.04
67	10.00	0.130	3158.5	7682.8	1.04
68	10.00	0.130	3189.4	7486.7	1.03
69	10.00	0.130	3381.8	7493.4	1.00
70	10.00	0.130	3529.0	7346.1	0.96
71	64.00	0.130	4308.0	8967.7	0.29
72	100.00	0.130	4304.4	8960.4	0.29
73	200.00	0.130	4483.1	9105.3	0.29
74	200.00	0.130	4895.2	9514.6	0.29
75	200.00	0.130	5131.4	9600.0	0.29
76	200.00	0.130	5375.9	10057.4	0.29
77	200.00	0.130	5640.4	10552.3	0.29
78	200.00	0.130	5665.1	10598.5	0.29
79	200.00	0.130	6496.8	12154.4	0.29
80	200.00	0.130	6705.9	12545.6	0.29
81	200.00	0.130	6771.8	12668.9	0.29
82	200.00	0.130	6771.8	12668.9	0.29
83	200.00	0.130	6779.1	12682.6	0.29
84	200.00	0.130	6717.1	12566.6	0.29
85	200.00	0.130	6724.7	12580.8	0.29
86	200.00	0.130	6724.7	12580.8	0.29
87	200.00	0.130	6756.6	12640.4	0.29
88	200.00	0.130	8996.6	16831.0	0.29

Table E.1-1. Best-Estimate NI SSI Profile from 25409-000-K0C-0000-00066 – Reference 1 (cont.)

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
89	200.00	0.130	9050.7	16932.3	0.29
90	200.00	0.130	9132.9	17086.1	0.29
91	200.00	0.130	9113.1	17049.0	0.29
92	200.00	0.130	8800.1	16463.4	0.29
93	200.00	0.130	8750.5	16370.7	0.29
94	200.00	0.130	8444.8	15798.7	0.29
95	200.00	0.130	8119.4	15190.0	0.29
96	200.00	0.130	8034.9	15032.0	0.29
97	200.00	0.130	7967.0	14904.9	0.29
98	200.00	0.130	7755.8	14509.8	0.29
99	200.00	0.130	7761.2	14519.8	0.29
100	200.00	0.130	7676.3	14361.0	0.29
101	200.00	0.130	7678.0	14364.3	0.29
102	200.00	0.130	7673.1	14355.0	0.29
103	200.00	0.130	7616.5	14249.2	0.29
104	200.00	0.130	7601.7	14221.5	0.29
105	200.00	0.130	7755.0	14508.2	0.29
106	200.00	0.130	7827.7	14644.2	0.29
107	200.00	0.130	7812.5	14615.9	0.29
108	200.00	0.130	7823.1	14635.6	0.29
109	200.00	0.130	7953.1	14878.8	0.27
110	200.00	0.130	7953.1	14878.8	0.27
111	200.00	0.130	7967.0	14904.9	0.27
112	200.00	0.130	8059.6	15078.2	0.26
113	200.00	0.130	8276.7	15484.3	0.25
114	200.00	0.130	8394.8	15705.3	0.26
115	200.00	0.130	8499.1	15900.4	0.25
116	200.00	0.130	8499.1	15900.4	0.25
117	200.00	0.130	8632.8	16150.6	0.24
118	200.00	0.130	8683.6	16245.5	0.24
119	200.00	0.130	8629.9	16145.1	0.24
120	200.00	0.130	8655.0	16191.9	0.25
121	200.00	0.130	8684.4	16247.0	0.25
122	200.00	0.130	8749.0	16367.9	0.25
123	200.00	0.130	8749.0	16367.9	0.25
124	200.00	0.130	8760.9	16390.2	0.25
125	200.00	0.130	8726.0	16324.9	0.22
126	--	0.170	9200.0	17211.6	1.00

Note: % = percent; ft. = feet; ft/sec = feet per second; kcf = kips per cubic foot; SSI = soil structure interaction

Table E.1-2. Best-Estimate NI SSI Properties for the "Updated" Profile – Reference 12

The strain compatible properties are struck through to indicate that they are not recommended for use.

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
1	5	0.130	~~519.0~~	~~971.0~~	~~3.17~~
2	5	0.130	~~607.3~~	~~1136.1~~	~~4.47~~
3	5	0.130	~~633.0~~	~~1184.2~~	~~5.57~~
4	5	0.130	~~649.7~~	~~1215.4~~	~~6.32~~
5	5	0.130	~~665.4~~	~~1244.8~~	~~6.73~~
6	5.2	0.130	~~667.5~~	~~3403.7~~	~~7.13~~
7	6.3	0.130	~~682.6~~	~~3480.7~~	~~7.35~~
8	5	0.130	~~684.7~~	~~3491.5~~	~~7.60~~
9	9	0.150	5000.0	7791.9	1.00
10	10	0.150	5000.0	7791.9	1.00
11	6	0.137	5554.5	10724.8	1.00
12	8.4	0.137	6860.2	12666.1	0.80
13	1.6	0.137	6847.9	12643.4	0.80
14	10	0.137	5715.6	10802.1	0.80
15	10	0.137	4676.9	9604.0	0.80
16	10	0.137	4462.0	9231.9	0.83
17	10	0.137	4541.8	9127.3	0.80
18	10	0.137	4241.7	8621.6	0.83
19	10	0.137	4428.3	8541.7	0.80
20	4.4	0.137	2521.5	6682.9	1.03
21	5.6	0.119	2538.1	6726.9	0.82
22	10	0.119	1117.0	5000.0	1.58
23	10	0.119	1667.5	5572.4	1.09
24	10	0.119	1271.1	5019.5	1.39
25	10	0.119	1419.8	5357.3	1.23
26	6.6	0.119	1601.7	5541.7	1.10
27	3.4	0.117	1596.1	5522.4	1.10
28	10	0.117	1524.6	5469.3	1.20
29	10	0.117	1507.9	5449.6	1.20
30	10	0.117	1558.6	5505.5	1.16
31	10	0.117	1702.9	5581.4	1.10
32	6.8	0.117	2089.8	6108.1	0.93
33	3.2	0.121	2090.4	6110.0	0.93
34	10	0.121	2333.6	6414.5	0.87
35	10	0.121	1988.7	5955.9	0.96
36	10	0.121	1988.5	5941.1	0.96
37	10	0.121	1812.2	5807.8	1.00
38	10	0.121	1576.2	5610.5	1.16
39	10	0.121	1635.8	5639.9	1.10
40	10	0.121	1754.7	5752.9	1.06

Table E.1-2. Best-Estimate NI SSI Properties for the "Updated" Profile – Reference 12 (cont.)

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
41	10	0.121	1702.9	5770.6	1.10
42	10	0.121	1655.5	5655.7	1.10
43	10	0.121	1537.7	5500.6	1.20
44	10	0.121	1375.0	5528.3	1.33
45	10	0.121	1366.1	5382.2	1.33
46	10	0.121	1348.3	5450.3	1.33
47	10	0.121	1414.4	5517.1	1.30
48	10	0.121	1408.6	5506.8	1.30
49	10	0.121	1359.4	5447.9	1.33
50	10	0.121	1413.7	5481.1	1.33
51	10	0.121	1358.2	5422.1	1.33
52	10	0.121	1367.6	5376.9	1.33
53	10	0.121	1377.6	5441.6	1.33
54	10	0.121	1389.7	5464.9	1.33
55	10	0.121	1379.7	5430.1	1.36
56	10	0.121	1369.2	5284.9	1.39
57	3.8	0.121	3985.4	8755.7	0.70
58	6.2	0.129	3993.8	8774.2	0.70
59	10	0.129	3993.4	8773.4	0.70
60	10	0.129	4214.3	8415.3	0.70
61	10	0.129	3779.1	7657.4	0.73
62	10	0.129	3923.9	7963.1	0.73
63	10	0.129	3887.4	8056.2	0.73
64	10	0.129	3921.9	8197.4	0.73
65	10	0.129	3814.6	7772.5	0.73
66	10	0.129	3887.5	8007.2	0.73
67	10	0.129	3544.3	7748.2	0.77
68	10	0.129	3415.5	7685.4	0.77
69	10	0.129	3011.5	7131.8	0.83
70	10	0.129	3031.3	7264.3	0.83
71	10	0.129	3084.8	7348.5	0.83
72	10	0.129	3633.8	8119.1	0.77
73	10	0.129	3289.1	7747.8	0.83
74	64	0.130	4027.0	8382.9	0.30
75	100	0.130	4071.0	8474.5	0.30
76	200	0.130	4356.0	8847.1	0.30
77	200	0.130	4878.0	9481.1	0.30
78	200	0.130	5080.0	9503.8	0.30
79	200	0.130	5396.0	10095.0	0.30
80	200	0.130	5700.0	10663.7	0.30
81	200	0.130	5700.0	10663.7	0.30
82	200	0.130	6500.0	12160.4	0.30
83	200	0.130	6769.0	12663.6	0.30
84	200	0.130	6900.0	12908.7	0.30
85	200	0.130	6950.0	13002.3	0.30

Table E.1-2. Best-Estimate NI SSI Properties for the "Updated" Profile – Reference 12 (cont.)

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
86	200	0.130	6800.0	12721.6	0.30
87	200	0.130	6450.0	12066.8	0.30
88	200	0.130	6400.0	11973.3	0.30
89	200	0.130	6403.0	11978.9	0.30
90	200	0.130	6518.0	12194.1	0.30
91	200	0.130	8397.0	15709.3	0.30
92	200	0.130	8821.0	16502.6	0.30
93	200	0.130	9273.0	17348.2	0.30
94	200	0.130	9834.0	18397.7	0.30
95	200	0.130	9152.0	17121.8	0.30
96	200	0.130	8995.0	16828.1	0.30
97	200	0.130	8670.0	16220.1	0.30
98	200	0.130	8229.0	15395.1	0.30
99	200	0.130	7993.0	14953.5	0.30
100	200	0.130	7908.0	14794.5	0.30
101	200	0.130	7607.0	14231.4	0.30
102	200	0.130	7511.0	14051.8	0.30
103	200	0.130	7340.0	13731.9	0.30
104	200	0.130	7222.0	13511.1	0.30
105	200	0.130	7207.0	13483.1	0.30
106	200	0.130	7063.0	13213.7	0.30
107	200	0.130	7118.0	13316.6	0.30
108	200	0.130	7584.0	14188.4	0.30
109	200	0.130	7787.0	14568.1	0.30
110	200	0.130	7822.0	14633.6	0.30
111	200	0.130	7741.0	14482.1	0.30
112	200	0.130	8256.0	15445.6	0.30
113	200	0.130	8219.0	15376.3	0.30
114	200	0.130	8120.0	15191.1	0.30
115	200	0.130	8388.0	15692.5	0.30
116	200	0.130	8905.0	16659.7	0.30
117	200	0.130	9265.0	17333.2	0.30
118	200	0.130	9073.0	16974.0	0.30
119	200	0.130	9227.0	17262.1	0.30
120	200	0.130	9629.0	18014.2	0.30
121	200	0.130	9938.0	18592.3	0.30
122	200	0.130	9652.0	18057.2	0.30
123	200	0.130	8777.0	16420.3	0.30
124	200	0.130	8955.0	16753.3	0.30
125	--	0.170	9200.0	17211.6	1.00

Note: % = percent; ft. = feet; ft/sec = feet per second; kcf = kips per cubic foot; SSI = soil structure interaction

Table E.1-3. Best-Estimate FAR SSI profile from 25409-000-K0C-0000-00066 – Reference 1

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
1	5.0	0.130	729.1	1364.0	2.40
2	5.0	0.130	802.4	1501.1	3.46
3	5.0	0.130	775.4	1450.7	4.45
4	5.0	0.130	769.2	1439.1	5.16
5	5.0	0.130	735.1	1375.2	5.90
6	5.5	0.130	718.8	3665.2	6.48
7	6.0	0.125	2680.5	7458.3	0.62
8	5.0	0.125	4735.1	10085.5	0.62
9	5.0	0.125	4735.1	10085.5	0.62
10	10.0	0.125	5053.1	9998.6	0.62
11	4.0	0.136	5658.6	10552.7	0.95
12	6.0	0.136	5680.4	10593.4	0.95
13	10.0	0.136	5728.9	10528.6	0.95
14	10.0	0.136	5426.4	10060.1	0.95
15	10.0	0.136	4784.2	9654.2	0.95
16	10.0	0.136	4762.5	9547.3	0.95
17	10.0	0.136	4704.8	9290.7	0.95
18	10.0	0.136	4633.9	9228.5	0.95
19	10.0	0.136	4613.8	8919.6	0.95
20	10.0	0.136	1681.1	5000.0	0.95
21	10.0	0.120	1325.7	5529.0	2.07
22	10.0	0.120	1461.8	5000.0	1.85
23	10.0	0.120	1460.0	5771.2	1.86
24	10.0	0.120	1550.5	5655.0	1.83
25	10.0	0.120	1555.3	5408.0	1.83
26	10.0	0.120	1585.5	5674.8	1.79
27	10.0	0.120	1592.6	5783.7	1.79
28	10.0	0.120	1627.3	5684.2	1.74
29	10.0	0.120	1690.4	5489.3	1.67
30	10.0	0.120	1932.9	5490.7	1.42
31	10.0	0.120	1934.3	5215.4	1.42
32	10.0	0.120	1876.8	5815.8	1.47
33	10.0	0.120	1810.8	5246.1	1.54
34	10.0	0.120	1783.9	5748.3	1.57
35	10.0	0.120	1712.5	6012.2	1.67
36	10.0	0.120	1701.6	5852.2	1.69
37	10.0	0.120	1629.9	5250.9	1.80
38	10.0	0.120	1611.5	5522.2	1.83
39	10.0	0.120	1611.3	5480.1	1.83
40	10.0	0.120	1575.2	5436.3	1.90
41	10.0	0.120	1493.4	5858.7	2.03
42	10.0	0.120	1458.8	5821.9	2.10
43	10.0	0.120	1439.1	5685.9	2.13

Table E.1-3. Best-Estimate FAR SSI profile from 25409-000-K0C-0000-00066 – Reference 1 (cont.)

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
44	10.0	0.120	1433.2	5597.5	2.14
45	10.0	0.120	1432.9	5663.1	2.15
46	10.0	0.120	1417.6	5712.8	2.19
47	10.0	0.120	1407.9	5361.7	2.21
48	10.0	0.120	1404.4	5621.5	2.23
49	10.0	0.120	1406.9	5485.2	2.23
50	10.0	0.120	1420.1	5685.9	2.23
51	10.0	0.120	1415.2	5687.4	2.25
52	10.0	0.120	1412.2	5672.7	2.28
53	10.0	0.120	1411.4	5669.4	2.29
54	10.0	0.130	3911.9	15713.4	0.85
55	10.0	0.130	3911.7	8545.8	0.85
56	10.0	0.130	3911.3	7716.3	0.85
57	10.0	0.130	3910.7	7922.5	0.86
58	10.0	0.130	3845.3	7798.5	0.88
59	10.0	0.130	3829.2	7928.1	0.89
60	10.0	0.130	3826.2	7983.7	0.90
61	10.0	0.130	3747.4	7552.8	0.92
62	10.0	0.130	3746.0	7844.7	0.92
63	10.0	0.130	3488.1	7683.3	0.99
64	10.0	0.130	3369.4	7633.4	1.02
65	10.0	0.130	3240.5	7646.8	1.05
66	10.0	0.130	3225.9	7846.8	1.07
67	10.0	0.130	3272.2	7681.1	1.06
68	10.0	0.130	3484.3	7720.5	1.02
69	10.0	0.130	3608.3	8500.0	1.00
70	64.0	0.130	4184.5	8710.7	0.30
71	100.0	0.130	4225.7	8796.6	0.30
72	200.0	0.130	4448.1	9034.0	0.30
73	200.0	0.130	5043.4	9802.5	0.30
74	200.0	0.130	5282.7	9883.1	0.30
75	200.0	0.130	5498.6	10287.0	0.30
76	200.0	0.130	5670.7	10609.0	0.30
77	200.0	0.130	5670.7	10609.0	0.30
78	200.0	0.130	6325.5	11833.9	0.30
79	200.0	0.130	6469.4	12103.1	0.30
80	200.0	0.130	6530.7	12217.8	0.30
81	200.0	0.130	6533.4	12222.8	0.30
82	200.0	0.130	6619.6	12384.2	0.30
83	200.0	0.130	6581.8	12313.5	0.30
84	200.0	0.130	6575.4	12301.5	0.30
85	200.0	0.130	6575.4	12301.5	0.30
86	200.0	0.130	6637.5	12417.6	0.30
87	200.0	0.130	8875.7	16605.0	0.30
88	200.0	0.130	8974.3	16789.3	0.30

Table E.1-3. Best-Estimate FAR SSI profile from 25409-000-K0C-0000-00066 – Reference 1 (cont.)

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
89	200.0	0.130	9070.2	16968.7	0.30
90	200.0	0.130	9037.4	16907.5	0.30
91	200.0	0.130	8822.5	16505.4	0.30
92	200.0	0.130	8696.8	16270.1	0.30
93	200.0	0.130	8373.1	15664.7	0.30
94	200.0	0.130	8043.4	15047.7	0.30
95	200.0	0.130	7829.9	14648.3	0.30
96	200.0	0.130	7767.4	14531.6	0.30
97	200.0	0.130	7501.9	14034.8	0.30
98	200.0	0.130	7457.2	13951.2	0.30
99	200.0	0.130	7395.1	13835.0	0.30
100	200.0	0.130	7408.1	13859.4	0.30
101	200.0	0.130	7408.1	13859.4	0.30
102	200.0	0.130	7414.9	13872.0	0.30
103	200.0	0.130	7384.3	13814.7	0.30
104	200.0	0.130	7509.0	14048.1	0.30
105	200.0	0.130	7600.5	14219.2	0.30
106	200.0	0.130	7615.6	14247.5	0.30
107	200.0	0.130	7736.9	14474.4	0.30
108	200.0	0.130	7924.8	14825.9	0.30
109	200.0	0.130	7924.8	14825.9	0.30
110	200.0	0.130	7968.8	14908.3	0.30
111	200.0	0.130	8046.5	15053.6	0.29
112	200.0	0.130	8237.9	15411.7	0.28
113	200.0	0.130	8304.3	15536.0	0.27
114	200.0	0.130	8470.7	15847.2	0.28
115	200.0	0.130	8470.7	15847.2	0.28
116	200.0	0.130	8642.6	16168.8	0.30
117	200.0	0.130	8659.8	16201.0	0.31
118	200.0	0.130	8684.6	16247.4	0.31
119	200.0	0.130	8651.9	16186.2	0.30
120	200.0	0.130	8658.5	16198.6	0.30
121	200.0	0.130	8611.3	16110.3	0.30
122	200.0	0.130	8617.2	16121.3	0.29
123	200.0	0.130	8624.9	16135.7	0.29
124	200.0	0.130	8558.5	16011.5	0.29
125	82.0	0.130	8558.5	16011.5	0.29
126	--	0.170	9200.0	17211.6	1.00

Note: % = percent; ft. = feet; ft/sec = feet per second; kcf = kips per cubic foot; SSI = soil structure interaction

Table E.1-4. Best-Estimate FAR SSI Properties for the "Updated" Profile – Reference 12

The strain compatible properties are struck through to indicate that they are not recommended for use.

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
1	5	0.130	~~525.9~~	~~983.9~~	~~3.00~~
2	5	0.130	~~618.6~~	~~1157.3~~	~~4.18~~
3	5	0.130	~~650.8~~	~~1217.6~~	~~5.00~~
4	5	0.130	~~672.8~~	~~1258.7~~	~~5.60~~
5	5	0.130	~~693.5~~	~~1297.5~~	~~6.05~~
6	5.2	0.130	~~702.2~~	~~3580.3~~	~~6.37~~
7	6.3	0.125	2258.2	5273.4	0.60
8	5	0.125	3551.2	7526.9	0.60
9	5	0.125	3551.2	7526.9	0.60
10	5.9	0.125	4660.9	9298.6	0.60
11	4.1	0.137	4653.8	9284.5	0.80
12	4	0.137	5547.1	10710.4	0.80
13	6	0.137	5546.5	10709.3	0.80
14	8.4	0.137	6860.5	12666.7	0.80
15	1.6	0.137	6848.5	12644.6	0.80
16	10	0.137	5716.4	10803.5	0.80
17	10	0.137	4677.4	9605.0	0.80
18	10	0.137	4462.4	9232.7	0.83
19	10	0.137	4542.2	9128.1	0.80
20	10	0.137	4242.1	8622.5	0.83
21	10	0.137	4428.7	8542.4	0.80
22	4.4	0.137	2521.5	6683.0	1.03
23	5.6	0.119	2537.6	6725.7	0.82
24	10	0.119	1117.5	5000.0	1.55
25	10	0.119	1667.1	5570.7	1.11
26	10	0.119	1271.2	5020.1	1.39
27	10	0.119	1420.1	5358.0	1.23
28	6.6	0.119	1602.0	5542.8	1.10
29	3.4	0.117	1596.4	5523.2	1.10
30	10	0.117	1524.9	5470.3	1.20
31	10	0.117	1508.2	5451.0	1.20
32	10	0.117	1559.2	5507.4	1.13
33	10	0.117	1703.8	5584.2	1.10
34	6.8	0.117	2090.3	6109.6	0.93
35	3.2	0.121	2091.0	6111.7	0.93
36	10	0.121	2334.3	6416.4	0.87
37	10	0.121	1989.4	5957.9	0.96
38	10	0.121	1989.2	5943.0	0.93
39	10	0.121	1812.9	5810.0	1.00
40	10	0.121	1577.0	5613.3	1.13

Table E.1-4. Best-Estimate FAR SSI Properties for the "Updated" Profile – Reference 1 (cont.)

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
41	10	0.121	1636.6	5642.8	1.10
42	10	0.121	1755.4	5755.4	1.03
43	10	0.121	1703.7	5773.3	1.10
44	10	0.121	1656.6	5659.5	1.10
45	10	0.121	1538.8	5504.7	1.20
46	10	0.121	1376.3	5533.2	1.33
47	10	0.121	1367.5	5387.6	1.33
48	10	0.121	1349.8	5456.4	1.33
49	10	0.121	1415.8	5522.7	1.23
50	10	0.121	1409.9	5511.8	1.30
51	10	0.121	1360.6	5452.4	1.33
52	10	0.121	1414.5	5484.2	1.29
53	10	0.121	1359.0	5425.2	1.33
54	10	0.121	1368.1	5379.0	1.33
55	10	0.121	1377.9	5442.8	1.33
56	10	0.121	1389.8	5465.4	1.33
57	10	0.121	1379.9	5431.0	1.39
58	10	0.121	1369.4	5285.7	1.39
59	3.8	0.121	3985.5	8755.9	0.70
60	6.2	0.129	3993.8	8774.4	0.70
61	10	0.129	3993.6	8773.7	0.70
62	10	0.129	4214.5	8415.6	0.70
63	10	0.129	3779.3	7657.9	0.73
64	10	0.129	3924.3	7963.8	0.73
65	10	0.129	3887.8	8057.0	0.73
66	10	0.129	3922.4	8198.3	0.73
67	10	0.129	3815.2	7773.7	0.73
68	10	0.129	3888.2	8008.5	0.73
69	10	0.129	3544.9	7749.5	0.77
70	10	0.129	3416.2	7687.0	0.77
71	10	0.129	3012.3	7133.8	0.83
72	10	0.129	3032.1	7266.2	0.83
73	10	0.129	3085.5	7350.2	0.83
74	10	0.129	3634.4	8120.4	0.77
75	10	0.129	3289.7	7749.1	0.83
76	64	0.130	4027.0	8382.9	0.30
77	100	0.130	4071.0	8474.5	0.30
78	200	0.130	4356.0	8847.1	0.30
79	200	0.130	4878.0	9481.1	0.30
80	200	0.130	5080.0	9503.8	0.30
81	200	0.130	5396.0	10095.0	0.30
82	200	0.130	5700.0	10663.7	0.30
83	200	0.130	5700.0	10663.7	0.30
84	200	0.130	6500.0	12160.4	0.30
85	200	0.130	6769.0	12663.6	0.30

Table E.1-4. Best-Estimate FAR SSI Properties for the "Updated" Profile – Reference 1 (cont.)

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
86	200	0.130	6900.0	12908.7	0.30
87	200	0.130	6950.0	13002.3	0.30
88	200	0.130	6800.0	12721.6	0.30
89	200	0.130	6450.0	12066.8	0.30
90	200	0.130	6400.0	11973.3	0.30
91	200	0.130	6403.0	11978.9	0.30
92	200	0.130	6518.0	12194.1	0.30
93	200	0.130	8397.0	15709.3	0.30
94	200	0.130	8821.0	16502.6	0.30
95	200	0.130	9273.0	17348.2	0.30
96	200	0.130	9834.0	18397.7	0.30
97	200	0.130	9152.0	17121.8	0.30
98	200	0.130	8995.0	16828.1	0.30
99	200	0.130	8670.0	16220.1	0.30
100	200	0.130	8229.0	15395.1	0.30
101	200	0.130	7993.0	14953.5	0.30
102	200	0.130	7908.0	14794.5	0.30
103	200	0.130	7607.0	14231.4	0.30
104	200	0.130	7511.0	14051.8	0.30
105	200	0.130	7340.0	13731.9	0.30
106	200	0.130	7222.0	13511.1	0.30
107	200	0.130	7207.0	13483.1	0.30
108	200	0.130	7063.0	13213.7	0.30
109	200	0.130	7118.0	13316.6	0.30
110	200	0.130	7584.0	14188.4	0.30
111	200	0.130	7787.0	14568.1	0.30
112	200	0.130	7822.0	14633.6	0.30
113	200	0.130	7741.0	14482.1	0.30
114	200	0.130	8256.0	15445.6	0.30
115	200	0.130	8219.0	15376.3	0.30
116	200	0.130	8120.0	15191.1	0.30
117	200	0.130	8388.0	15692.5	0.30
118	200	0.130	8905.0	16659.7	0.30
119	200	0.130	9265.0	17333.2	0.30
120	200	0.130	9073.0	16974.0	0.30
121	200	0.130	9227.0	17262.1	0.30
122	200	0.130	9629.0	18014.2	0.30
123	200	0.130	9938.0	18592.3	0.30
124	200	0.130	9652.0	18057.2	0.30
125	200	0.130	8777.0	16420.3	0.30
126	200	0.130	8955.0	16753.3	0.30
127	--	0.170	9200.0	17211.6	1.00

Note: % = percent; ft. = feet; ft/sec = feet per second; kcf = kips per cubic foot; SSI = soil structure interaction

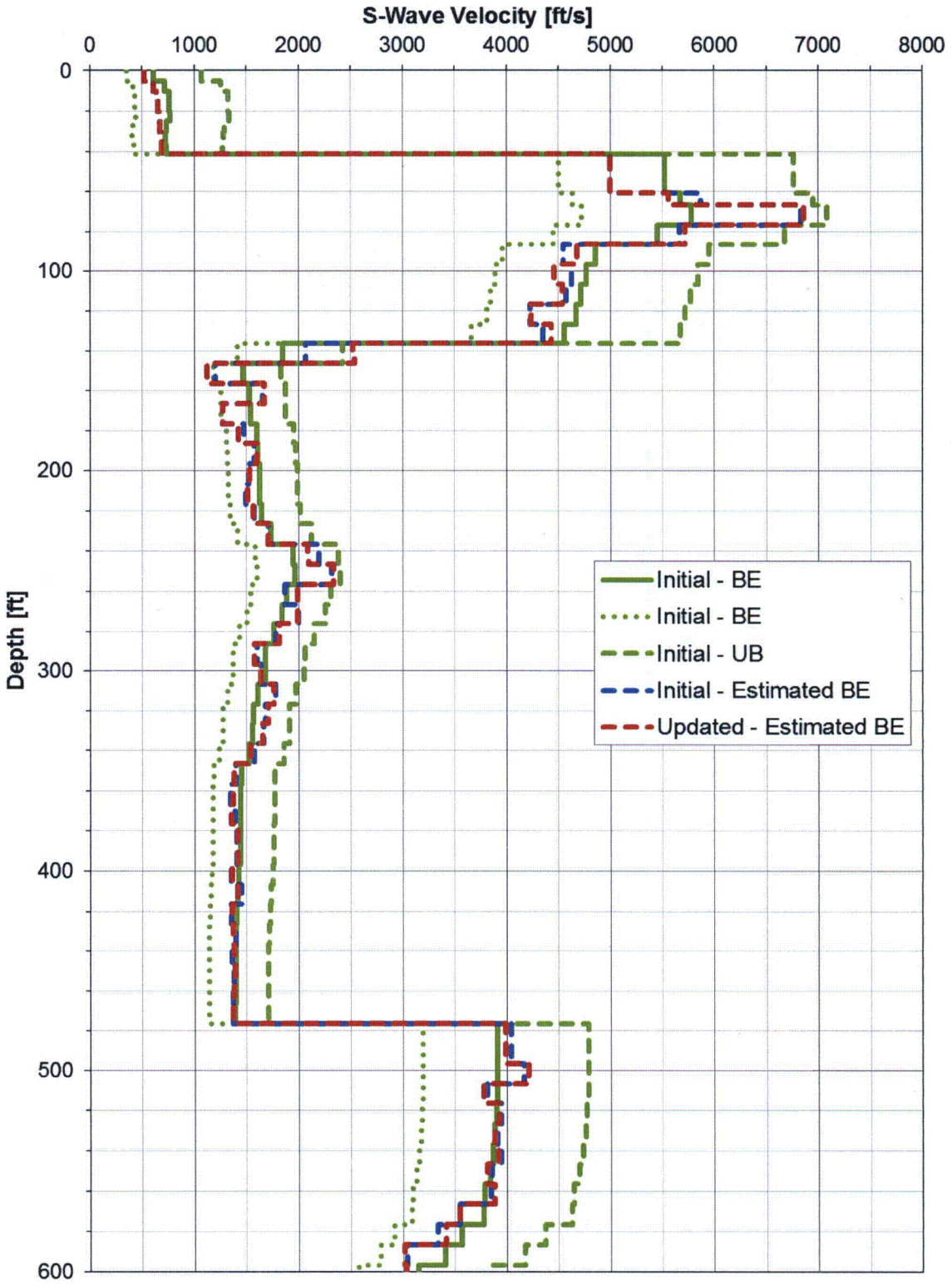

Figure E.1-1. Turkey Point Estimated Best-Estimate S-Wave Velocity Profile for the NI Profile for the RG 1.60 Motion

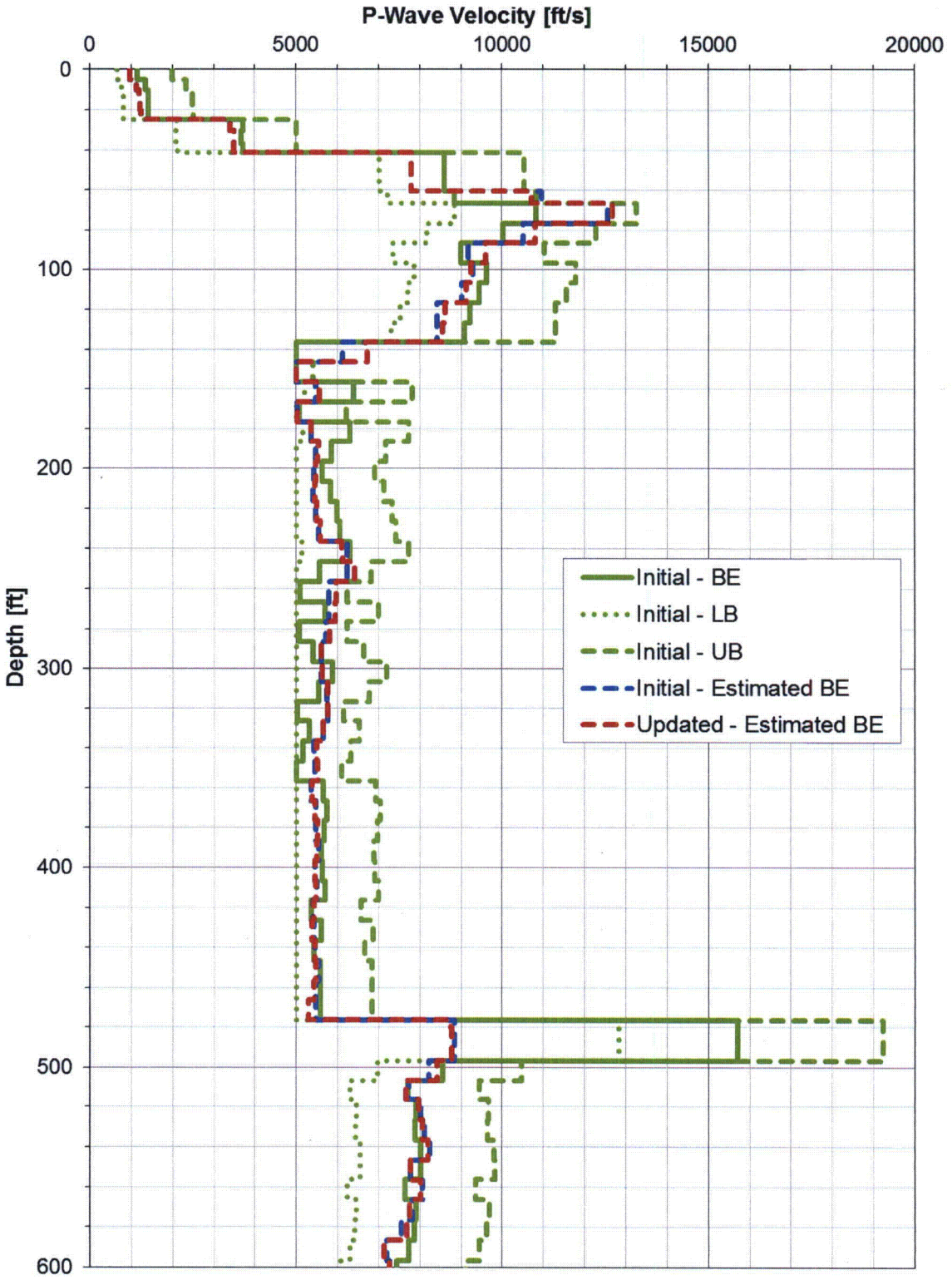

Figure E.1-2. Turkey Point Estimated Best-Estimate P-Wave Velocity Profile for the NI Profile for the RG 1.60 Motion

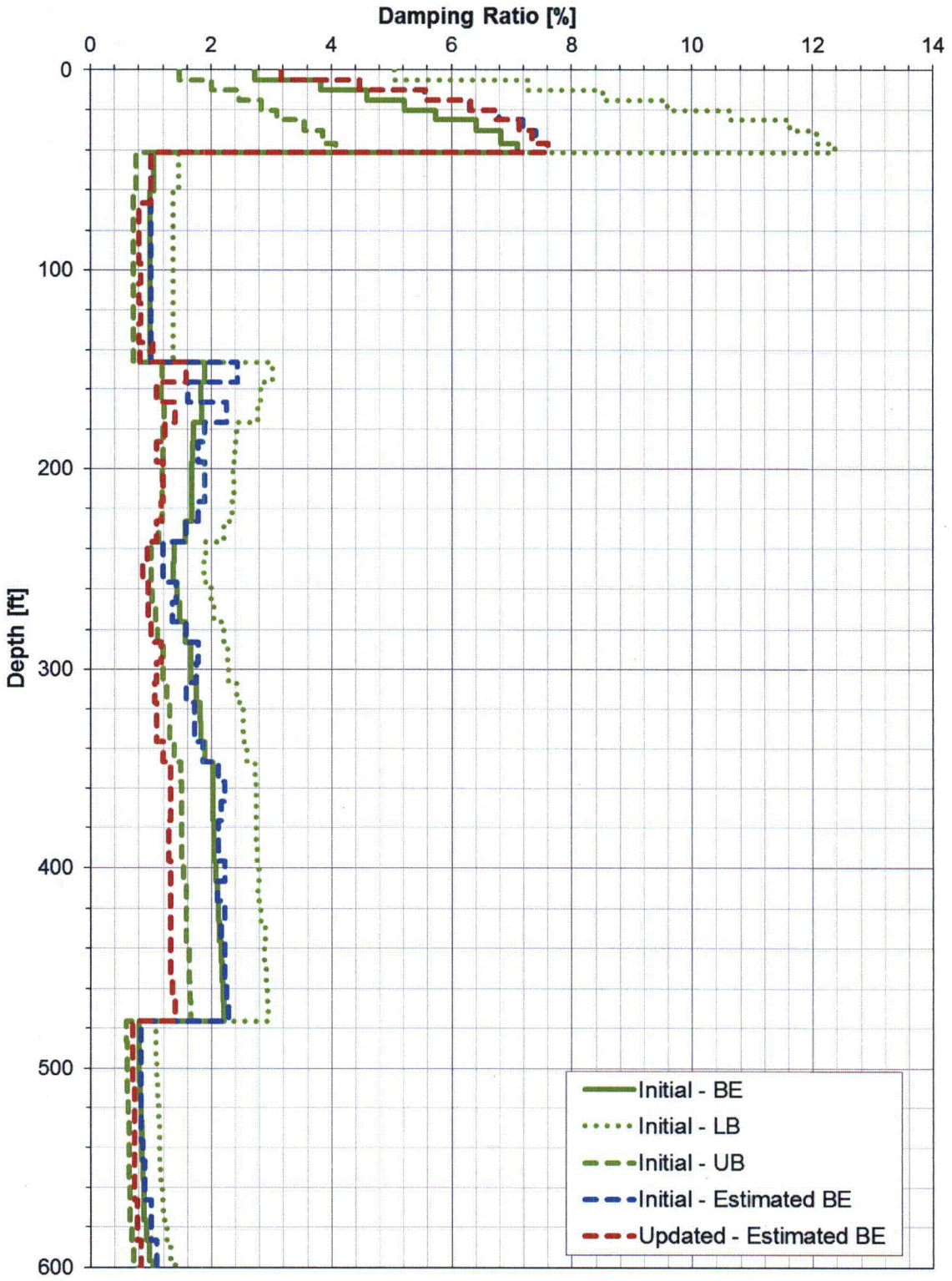

Figure E.1-3. Turkey Point Estimated Best-Estimate Damping Profile for the NI Profile for the RG 1.60 Motion

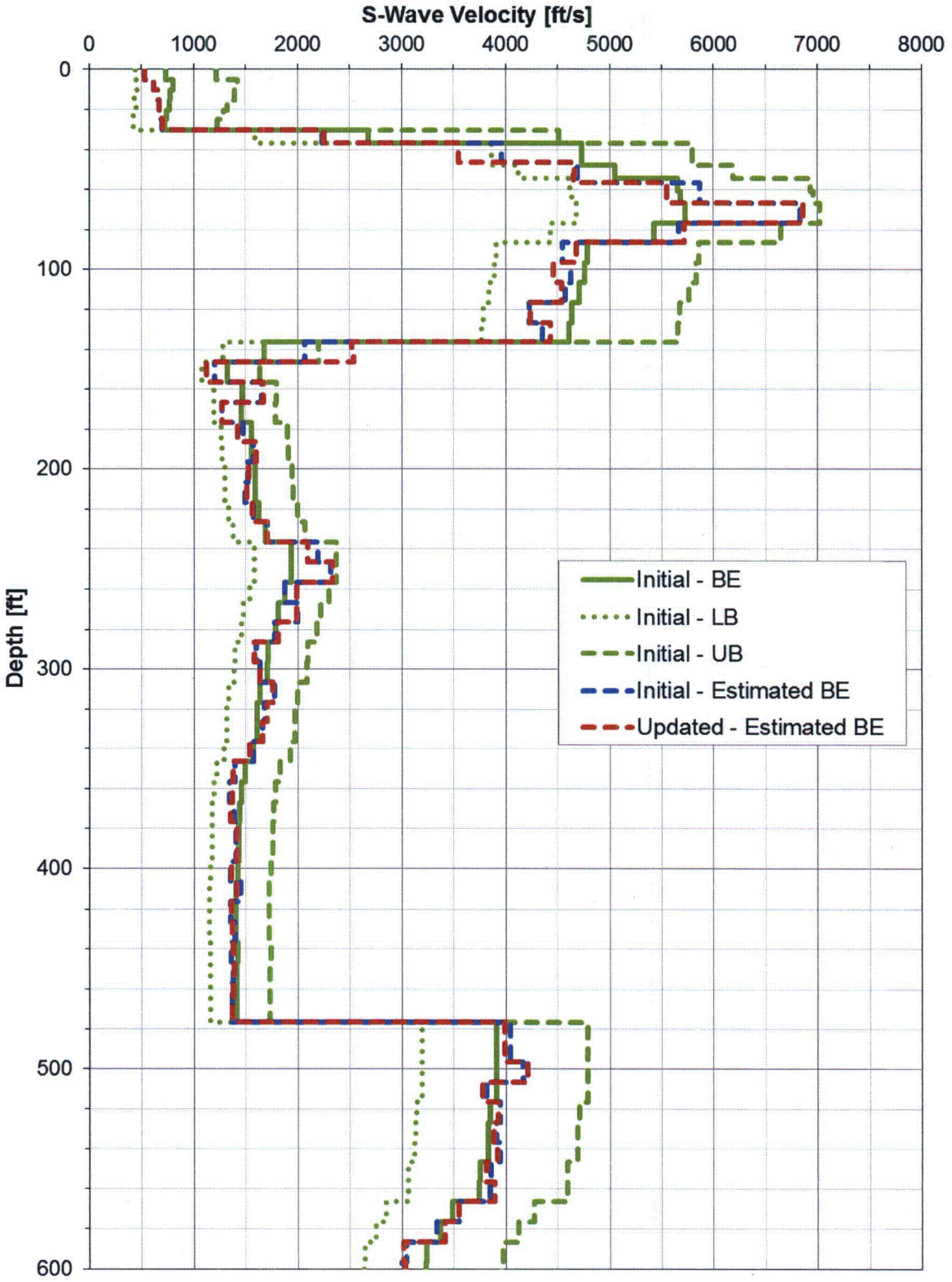

Figure E.1-4. Turkey Point Estimated Best-Estimate S-Wave Velocity Profile for the FAR Profile

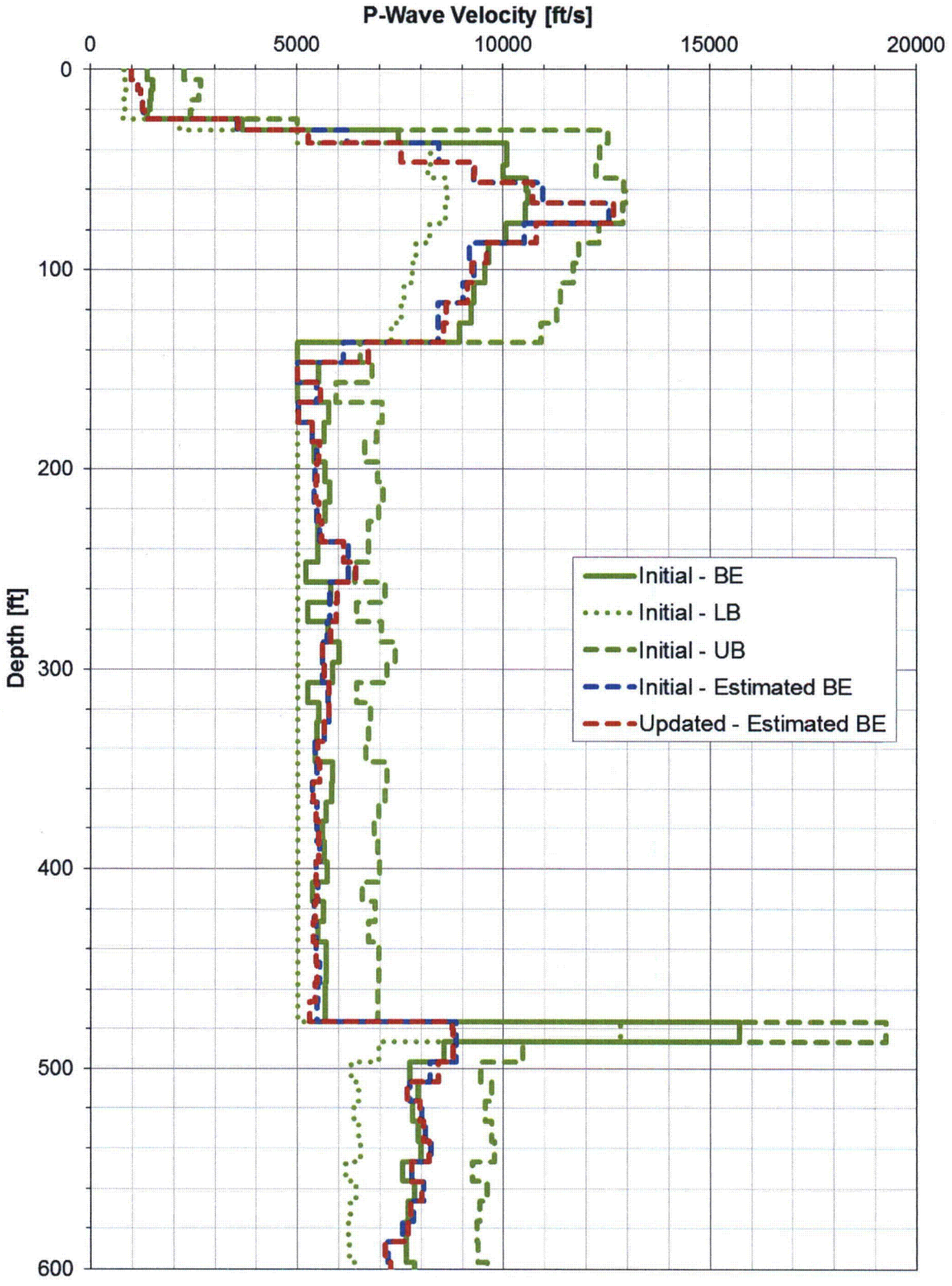

Figure E.1-5. Turkey Point Estimated Best-Estimate P-Wave Velocity Profile for the FAR Profile

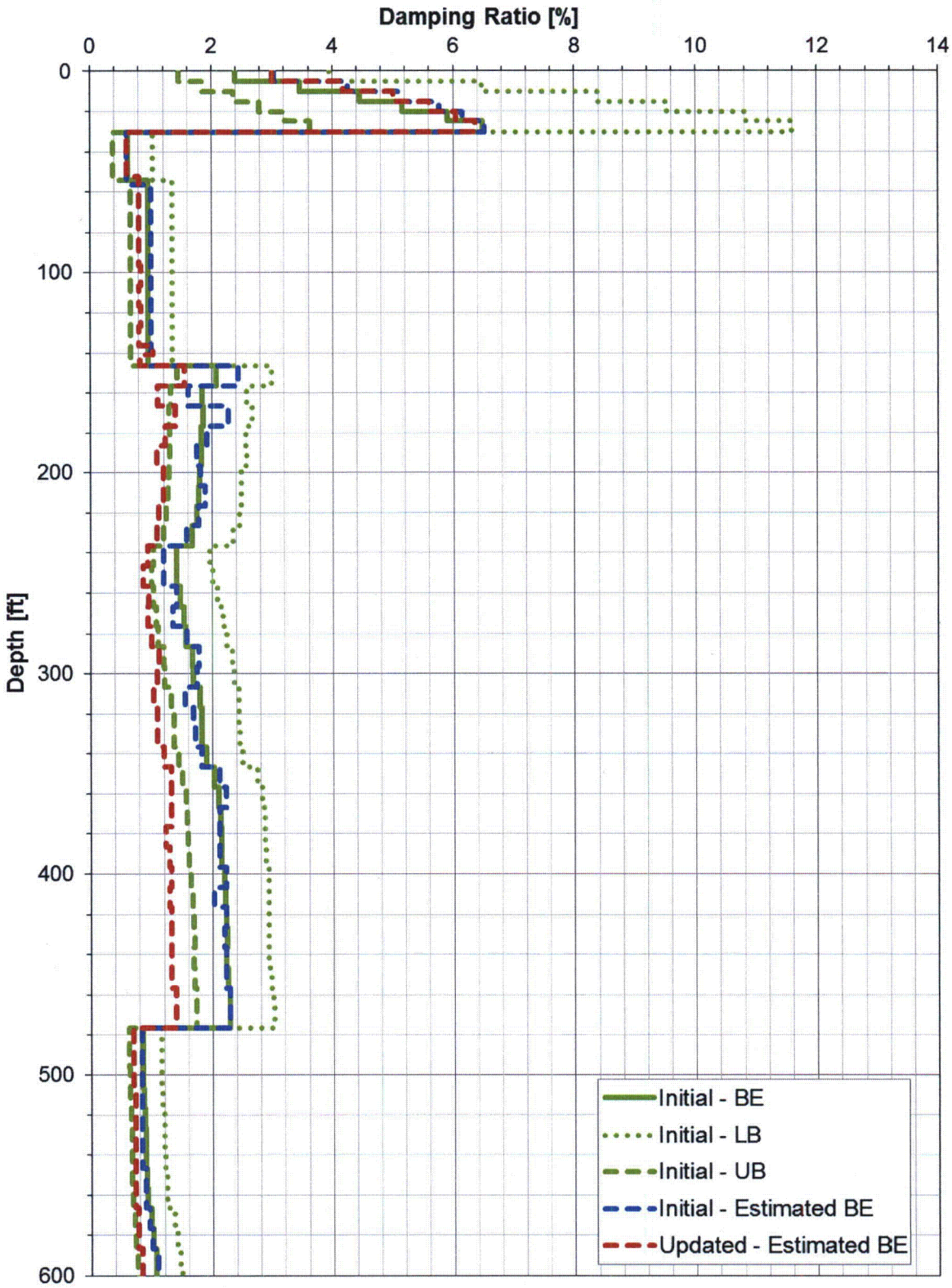

Figure E.1-6. Turkey Point Estimated Best-Estimate Damping Profile for the FAR Profile

E.1.1.1 TPNP Engineered Fill, Lean Concrete and Grouted Rock Properties for SSI Analyses

Tables E.1-6 present the updated BE dynamic material properties for the engineered fill, lean concrete fill and grouted rock for the BE sensitivity case, which were provided in Reference 12:

Table E.1-5. NI BE Backfill Soil, Fill Concrete and Grouted Rock Profile – BE Initial – Reference 1

Material	Thickness [feet]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping
Engineered Fill	5.0	0.130	610.4	1142.0	0.027
Engineered Fill	5.0	0.130	715.7	1339.0	0.038
Engineered Fill	5.0	0.130	756.7	1415.7	0.046
Engineered Fill	5.0	0.130	756.6	1415.5	0.052
Engineered Fill	5.0	0.130	761.9	1425.3	0.057
Engineered Fill	5.5	0.130	728.5	3714.7	0.064
Engineered Fill	6.0	0.130	721.1	3676.9	0.068
Engineered Fill	5.0	0.130	726.7	3705.4	0.071
Lean Concrete	6.33	0.150	5518.5	8600.0	0.011
Lean Concrete	6.33	0.150	5518.5	8600.0	0.011
Lean Concrete	6.33	0.150	5518.5	8600.0	0.011
Grouted Rock	6.0	0.155	5674.2	8842.7	0.0099
Grouted Rock	10.0	0.155	5781.3	10815.9	0.0099
Grouted Rock	10.0	0.155	5449.9	10015.8	0.0099

Table E.1-6. NI Backfill Soil, Fill Concrete and Grouted Rock Profile – BE Updated Profile – Reference 12

Material	Thickness [feet]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping
Engineered Fill	5.0	0.130	610.4	1142.0	0.027
Engineered Fill	5.0	0.130	715.7	1339.0	0.038
Engineered Fill	5.0	0.130	756.7	1415.7	0.046
Engineered Fill	5.0	0.130	756.6	1415.5	0.052
Engineered Fill	5.0	0.130	761.9	1425.3	0.057
Engineered Fill	5.2	0.130	728.5	3714.7	0.064
Engineered Fill	6.3	0.130	721.1	3676.9	0.068
Engineered Fill	5.0	0.130	726.7	3705.4	0.071
Lean Concrete	9.0	0.150	5000.0	7791.9	0.010
Lean Concrete	10.0	0.150	5000.0	7791.9	0.010
Grouted Rock	6.0	0.155	5554.5	10724.8	0.010
Grouted Rock	8.4	0.155	6860.2	12666.1	0.008
Grouted Rock	1.6	0.155	6847.9	12643.4	0.008
Grouted Rock	10.0	0.155	5715.6	10802.1	0.008

E.1.1.2 Key Nodes Selected

The key nodes selected to obtain floor response spectra are shown below in Table E.1-7.

Table E.1-7. Key Nodes at Location

NI20r Nodes	X (feet)	Y (feet)	Z (feet)	Location
1761	1000	1000	100	CIS at Reactor Vessel Support Elevation
2078	1116.5	948.5	116.5	ASB NE Corner at Control Room Floor
2199	1008	1014	134.25	CIS at Operating Deck
2675	929	1000	179.19	ASB Corner of Fuel Building Roof at Shield Building
2788	1000	1000	224	SCV Near Polar Crane
3329	956.5	1000	327.41	ASB Shield Building Roof Area

E.1.2 TPNP Time History Inputs – El. -16' (Foundation/Top of Lean Concrete)

TPNP input acceleration time histories were provided via Reference 1 and are graphically presented in Figures 3.5-1 through 3.5-6 of this report for the TPNP BE, LB and UB soil cases. For the purpose of this SSI sensitivity analysis, only the BE case time histories are used in conjunction with the updated site response BE properties. Reference 12 indicates, and shown below in Figure E.1-7, that the previous (Reference 11) and updated (Reference 12) site specific FIRS are similar, and both are enveloped by the initial RG 1.60 SSE curve. Thus, the previous (References 1 and 11) time histories are applicable for this BE sensitivity analysis.

For information, the (Reference 1) TPNP 'within' time histories were provided at the foundation level following site response analysis, which included as input the minimum PGA = 0.1g outcrop SSE envelop of the site-specific FIRS and RG 1.60 spectra anchored to 0.1g. The input time histories are used as seismic input in three orthogonal directions at the foundation/ top of the TPNP lean concrete mat (El. -16') in the TPNP SSI sensitivity analyses.

Reference 1 provides two horizontal and one vertical time history (El. -16') for 32768 BE, LB and UB discrete values of acceleration with a time step of 0.005 seconds in files FPL-NI-BE-H1.ath, FPL-NI-BE-H2.ath, and FPL-NI-BE-UP.ath, FPL-NI-LB-H1.ath, FPL-NI-LB-H2.ath, and FPL-NI-LB-UP.ath, FPL-NI-UB-H1.ath, FPL-NI-UB-H2.ath, and FPL-NI-UB-UP.ath for the (near) NI conditions. FAR conditions time histories were provided in files FPL-FAR-BE-H1.ath, FPL-FAR-BE-H2.ath, and FPL-FAR-BE-UP.ath, FPL-FAR-LB-H1.ath, FPL-FAR-LB-H2.ath, and FPL-FAR-LB-UP.ath, FPL-FAR-UB-H1.ath, FPL-FAR-UB-H2.ath, and FPL-FAR-UB-UP.ath. The updated BE NI seismic sensitivity analysis was executed separately with the BE NI H1, H2 and UP excitation directions.

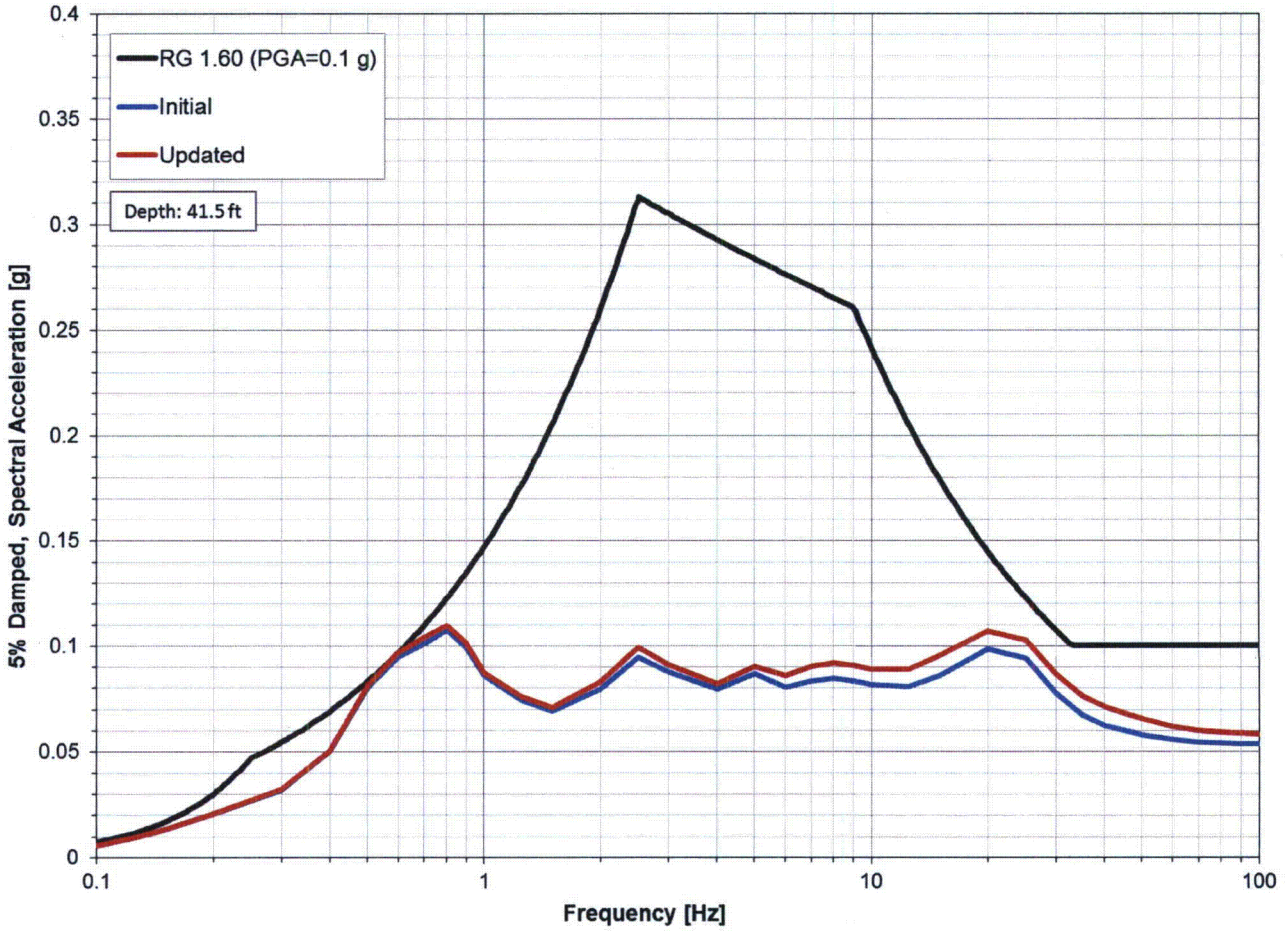

Figure E.1-7. Comparison Between the NI FIRS Computed with the Sensitivity Analysis and the Initial Analysis (NI Profile)

E.2 SASSI FRS Comparison – Updated TPNP 3D BE SSI Sensitivity Analysis and Results

The TPNP sensitivity time history SSI analyses were carried out using the TPNP BE seismic input and updated BE soil/rock, grouted rock and lean concrete properties (Reference 12), and the resulting FRS are compared to the previous Reference 11 FRS results, as well as the 3D AP1000 CSDRS and HRHF FRS envelopes at the six (6) key NI locations defined in Table E.1-7.

The TPNP NI acceleration time histories are shown in Figures 3.5-1 to 3.5-3; however, only the NI BE time histories are used for this analysis. For comparison, dynamic material properties for the lean concrete, grouted rock and engineered fill side soil for the previous (Reference 2) and updated (Reference 12) BE cases are presented in Tables E.1-5 and E.1-6, respectively. As shown, the updated material properties are minor variations of the previous dynamic material properties.

Time history seismic analyses for the updated TPNP BE case were performed in two horizontal and one vertical direction. The TPNP top of lean concrete mat (El. -16) input time histories were used in SASSI with the SASSI Direct method of analysis. FRS for 5 percent damping were obtained at the six key NI locations shown in Table E.1-7.

Figures E.2-1 through E.2-18 present the comparison of the horizontal and vertical TPNP 3D Design-Basis Factored (TP3D BE R5) FRS (Section 6.2) and the updated SSI sensitivity analysis (TP3D BE R6 Sensitivity) FRS, which are also compared to the previous (Section 6.2) 3D TPNP BE, LB and UB Broadened FRS envelope, and the AP1000 CSDRS and HRHF design FRS envelopes at the six (6) key locations. The HRHF FRS envelope is presented to demonstrate that additional and significant margin exists at the key nodes in the high frequency range (20-50 Hz).

As shown, the TPNP updated sensitivity analysis BE FRS are very similar to and negligibly effect the previous (Section 6.2) BE FRS, and are enveloped by the AP1000 and HRHF FRS envelopes at each of the six key NI locations with margin.

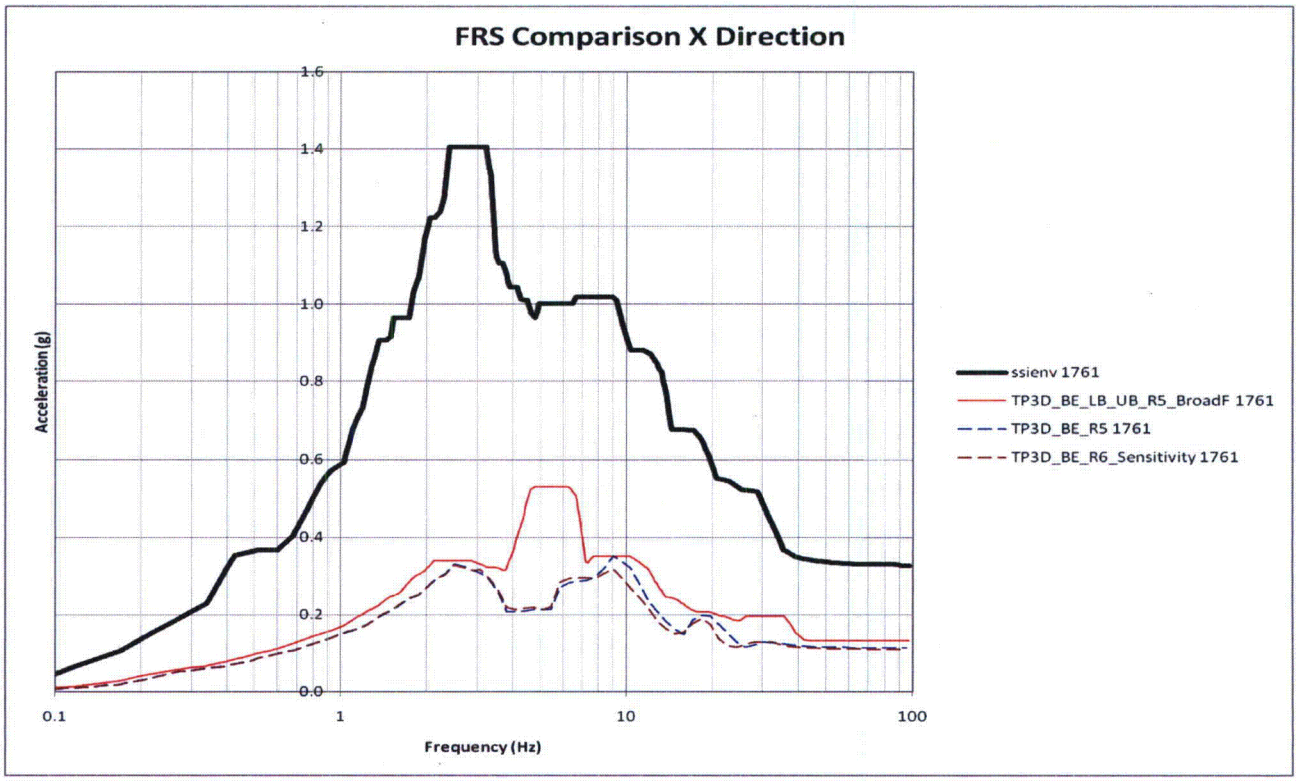

Figure E.2-1. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in X-Direction – Node 1761

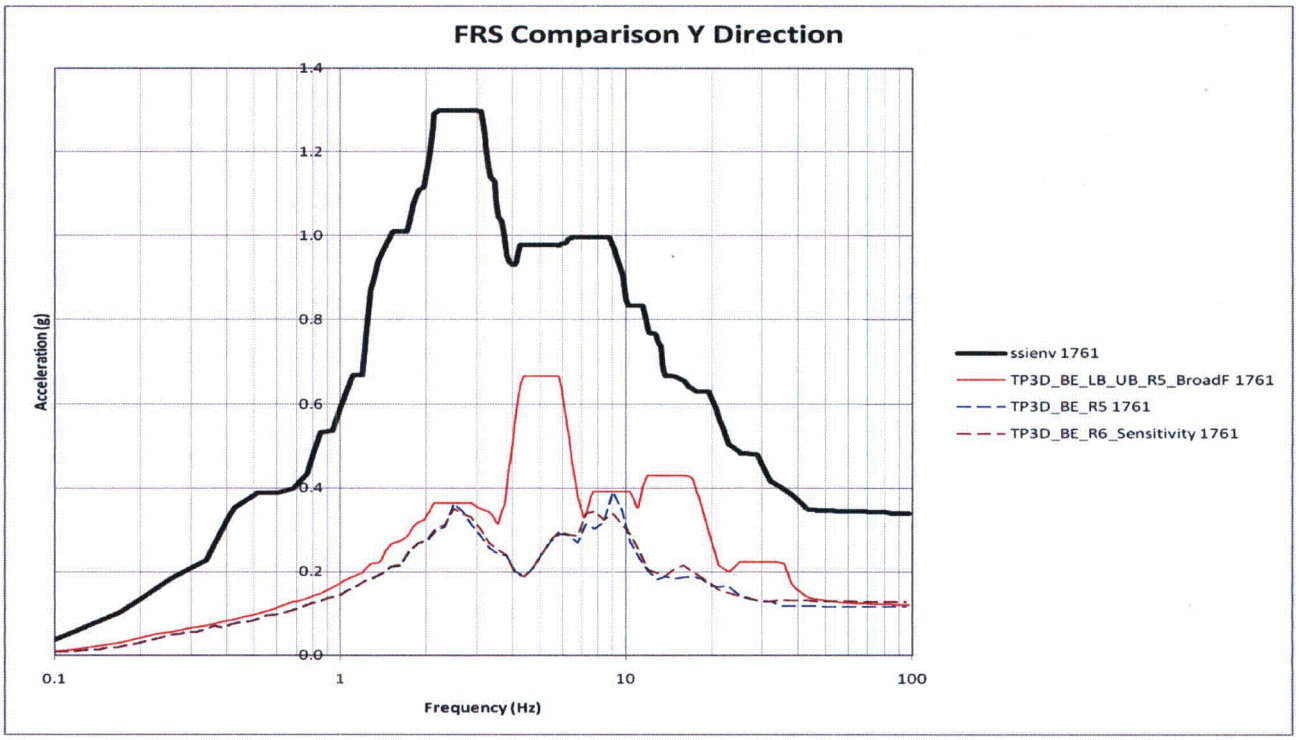

Figure E.2-2. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in Y-Direction – Node 1761

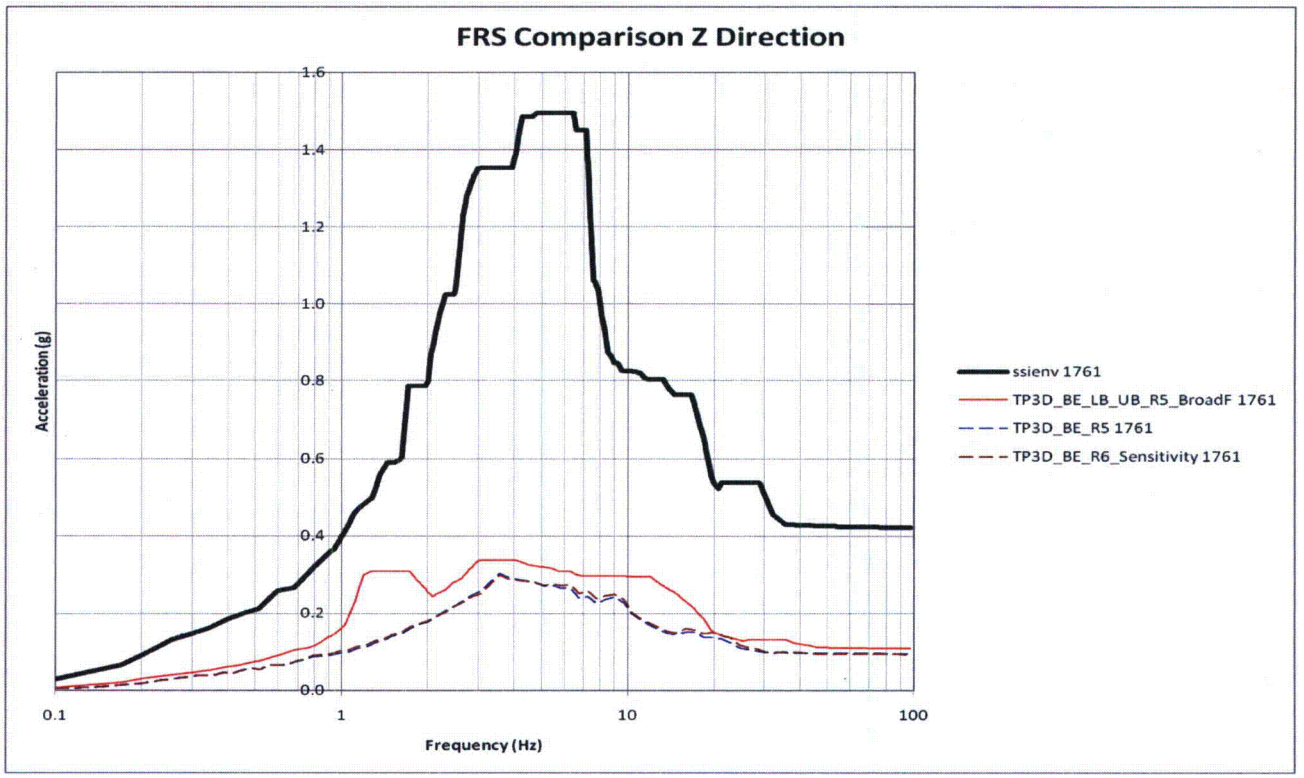

Figure E.2-3. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in Z-Direction – Node 1761

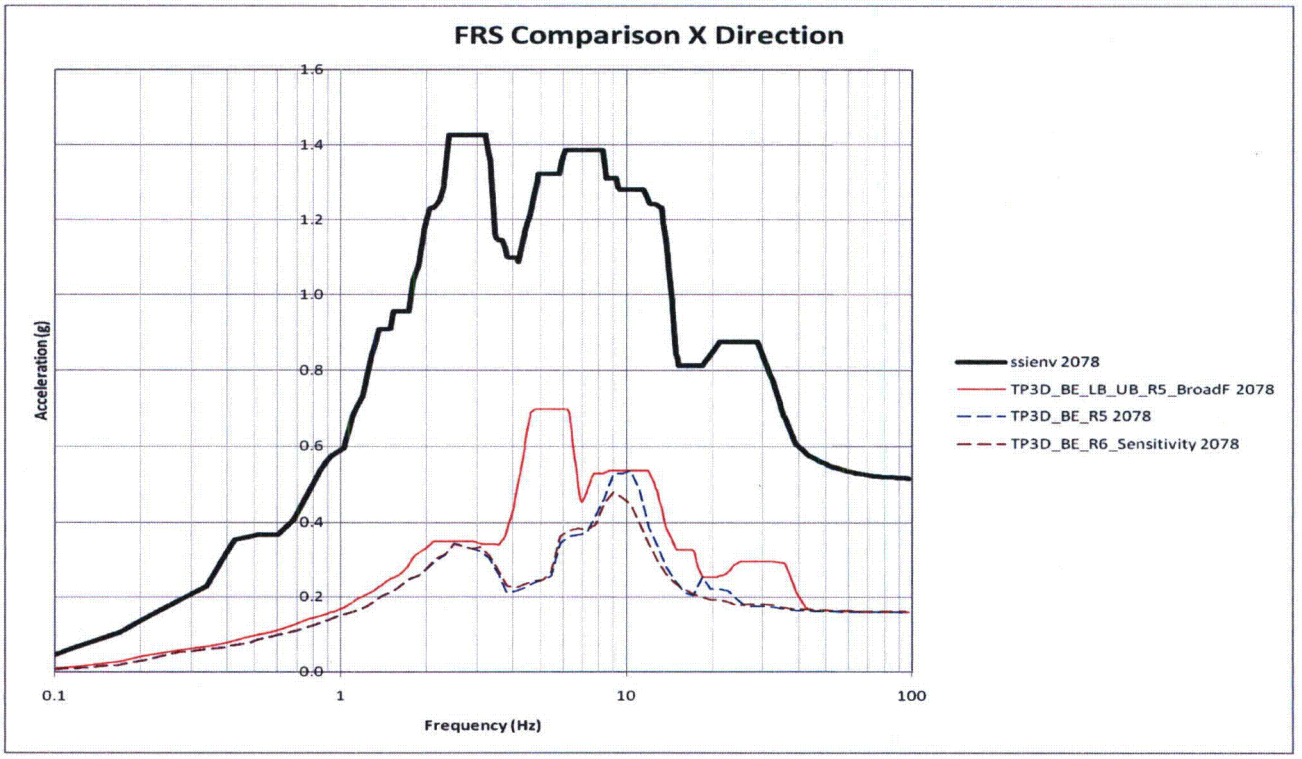

Figure E.2-4. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in X-Direction – Node 2078

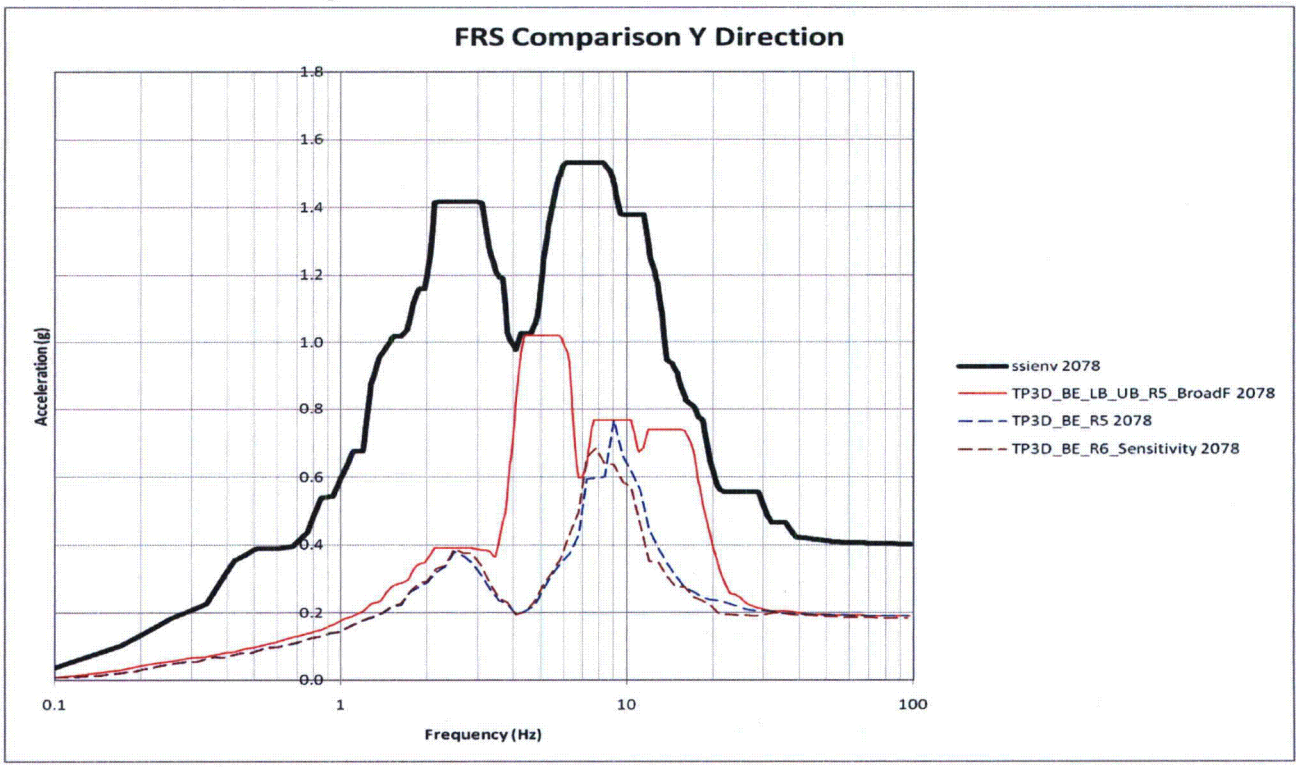

Figure E.2-5. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in Y-Direction – Node 2078

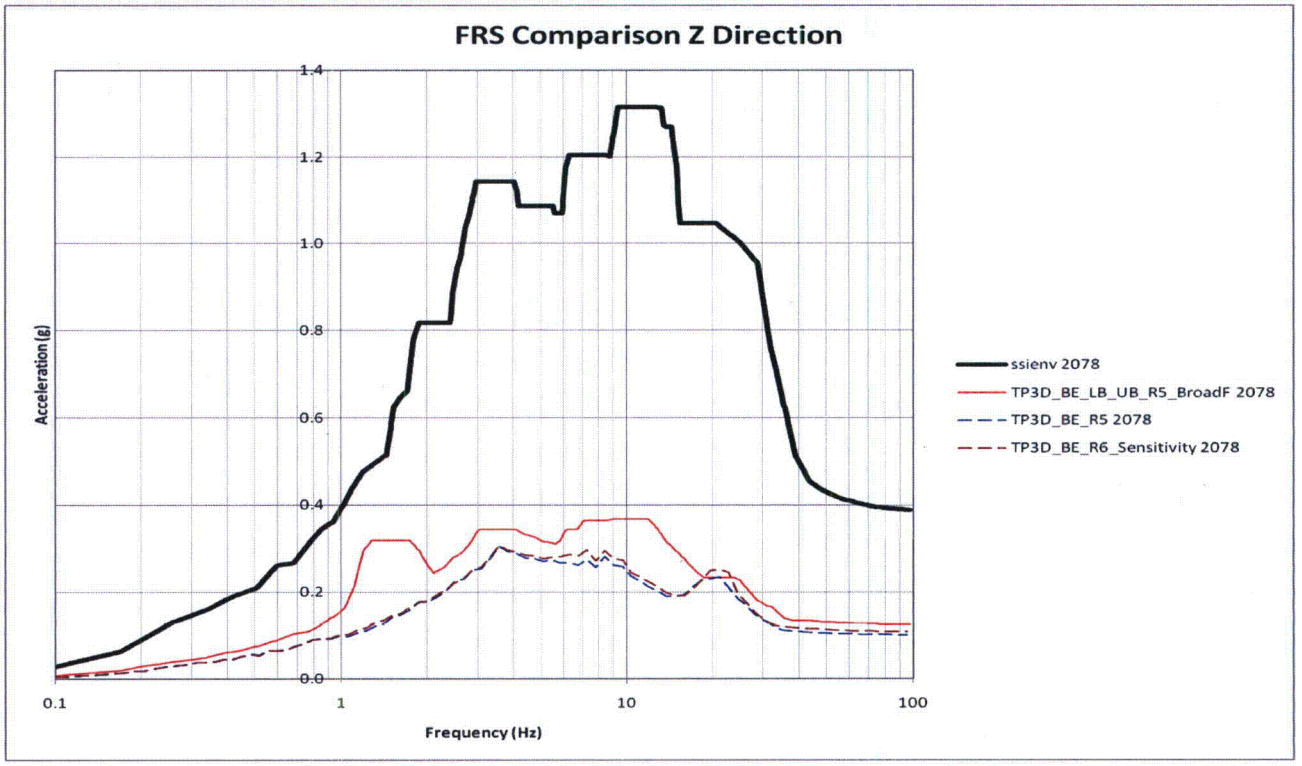

Figure E.2-6. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in Z-Direction – Node 2078

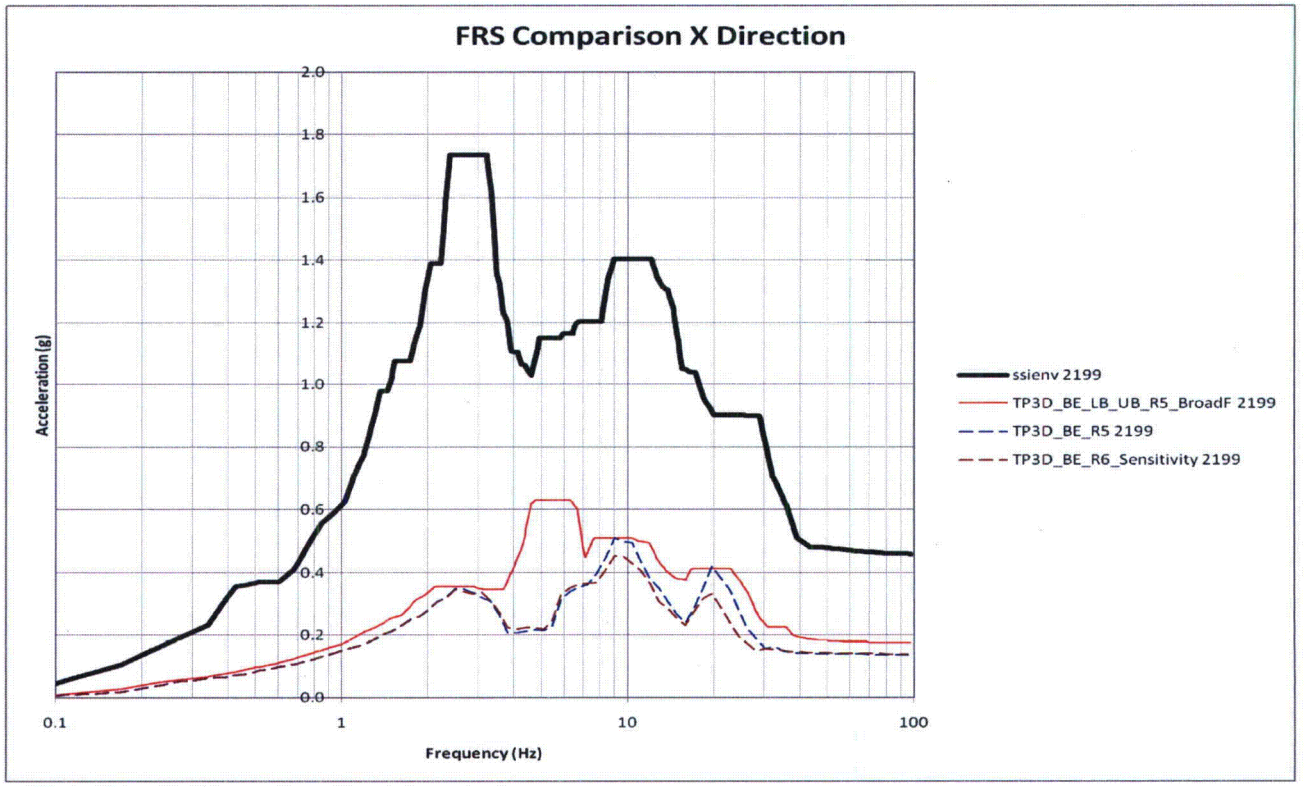

Figure E.2-7. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in X-Direction – Node 2199

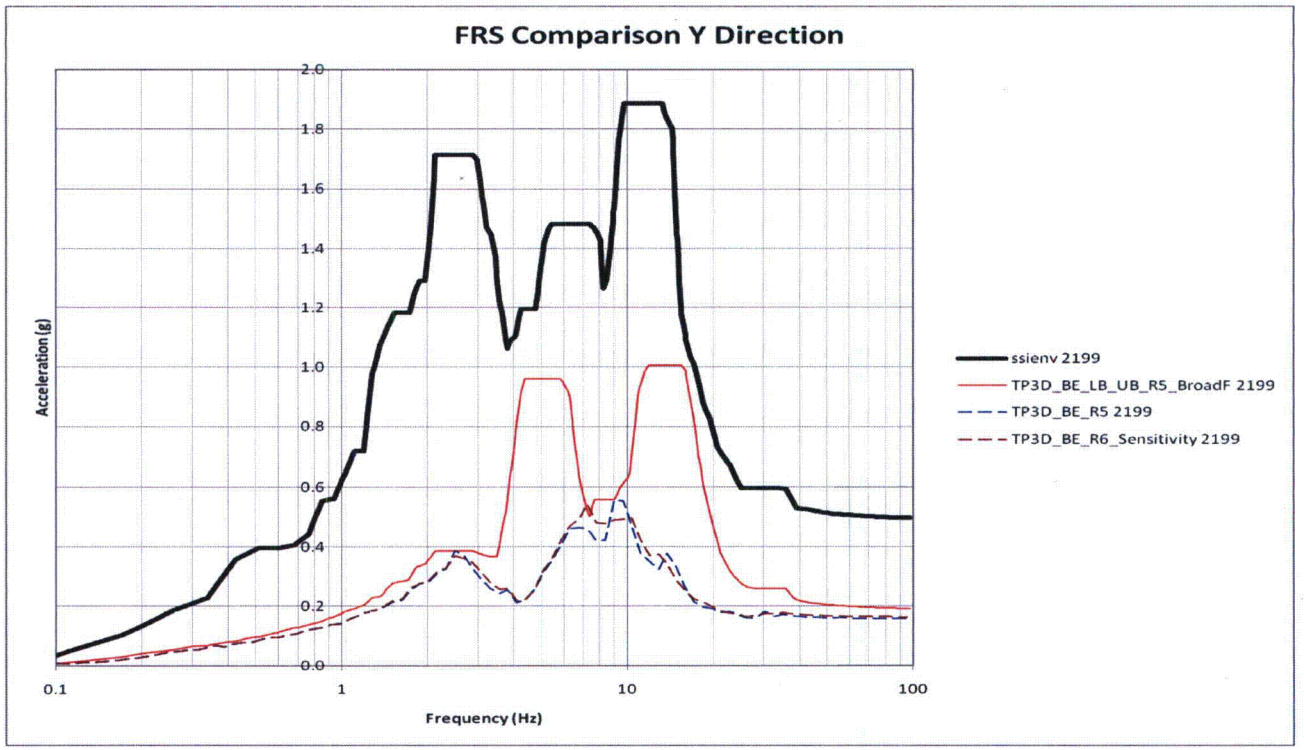

Figure E.2-8. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in Y-Direction – Node 2199

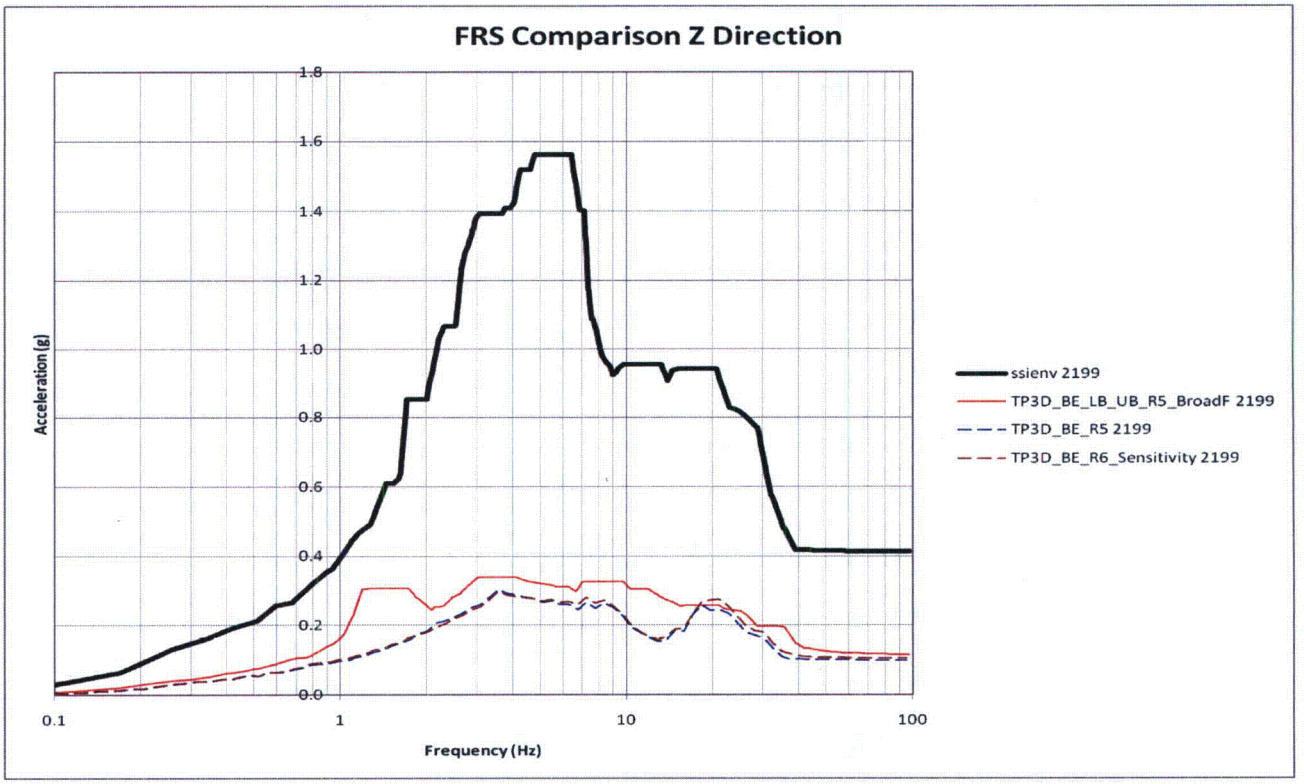

Figure E.2-9. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in Z-Direction – Node 2199

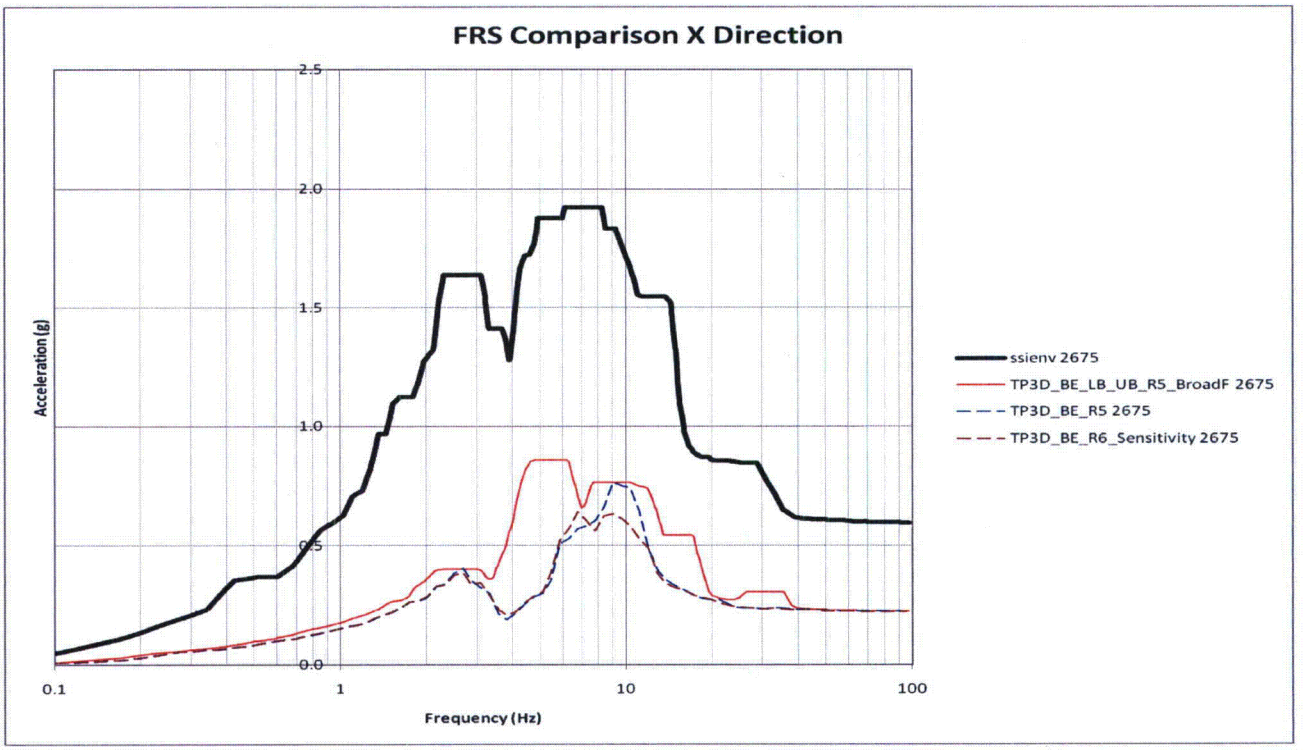

Figure E.2-10. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in X-Direction – Node 2675

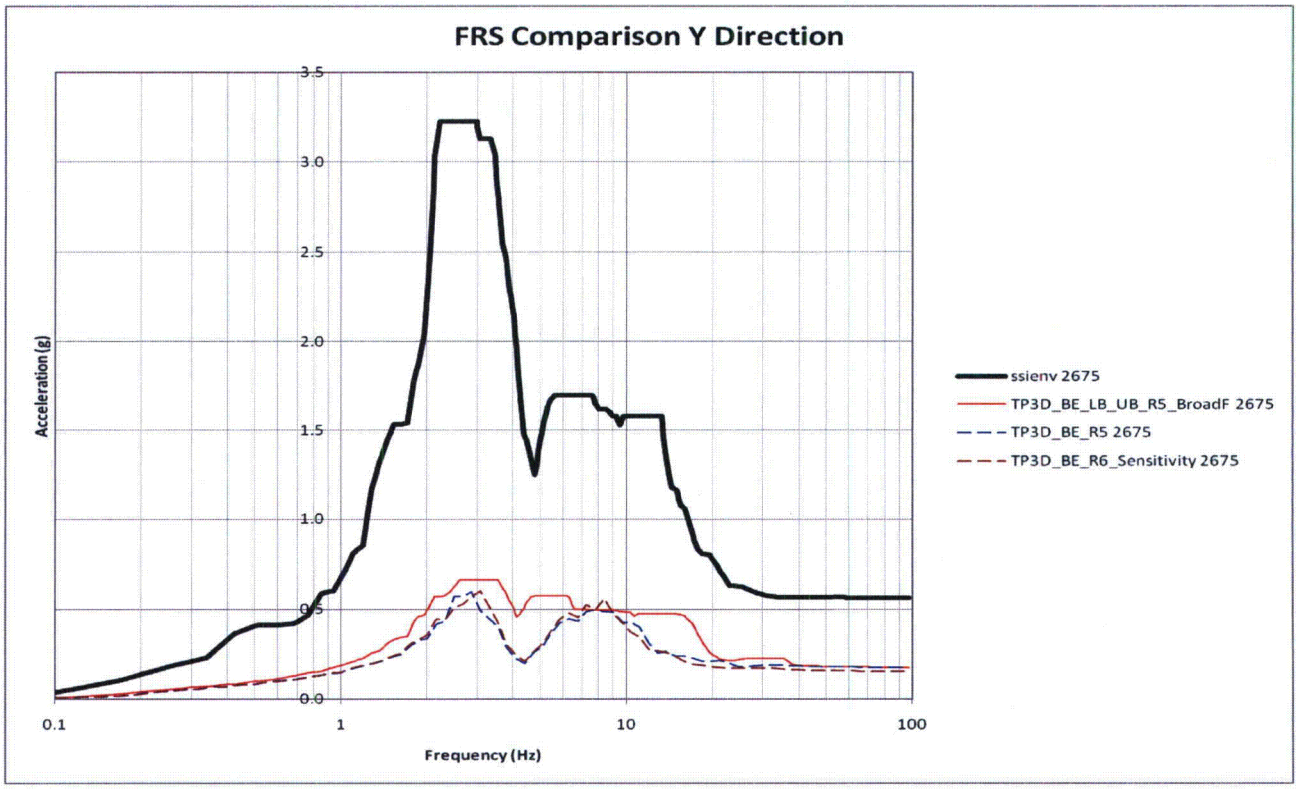

Figure E.2-11. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in Y-Direction – Node 2675

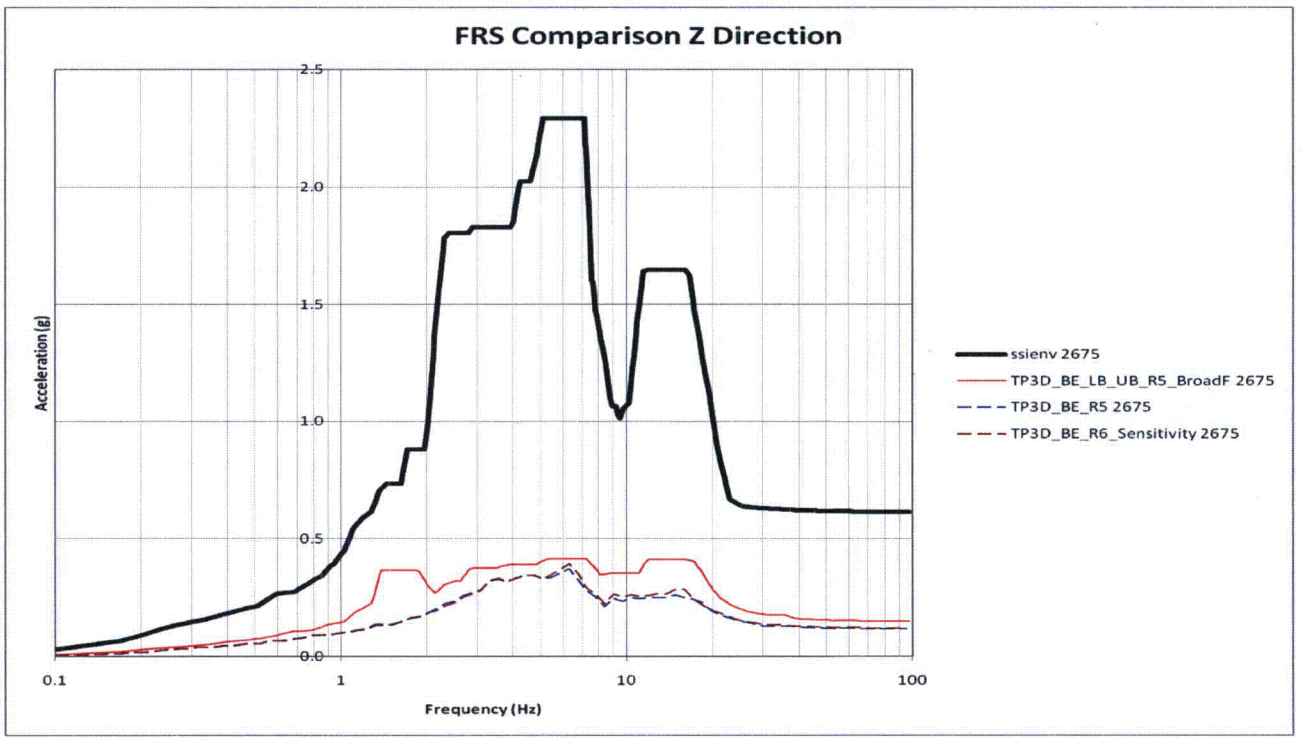

Figure E.2-12. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in Z-Direction – Node 2675

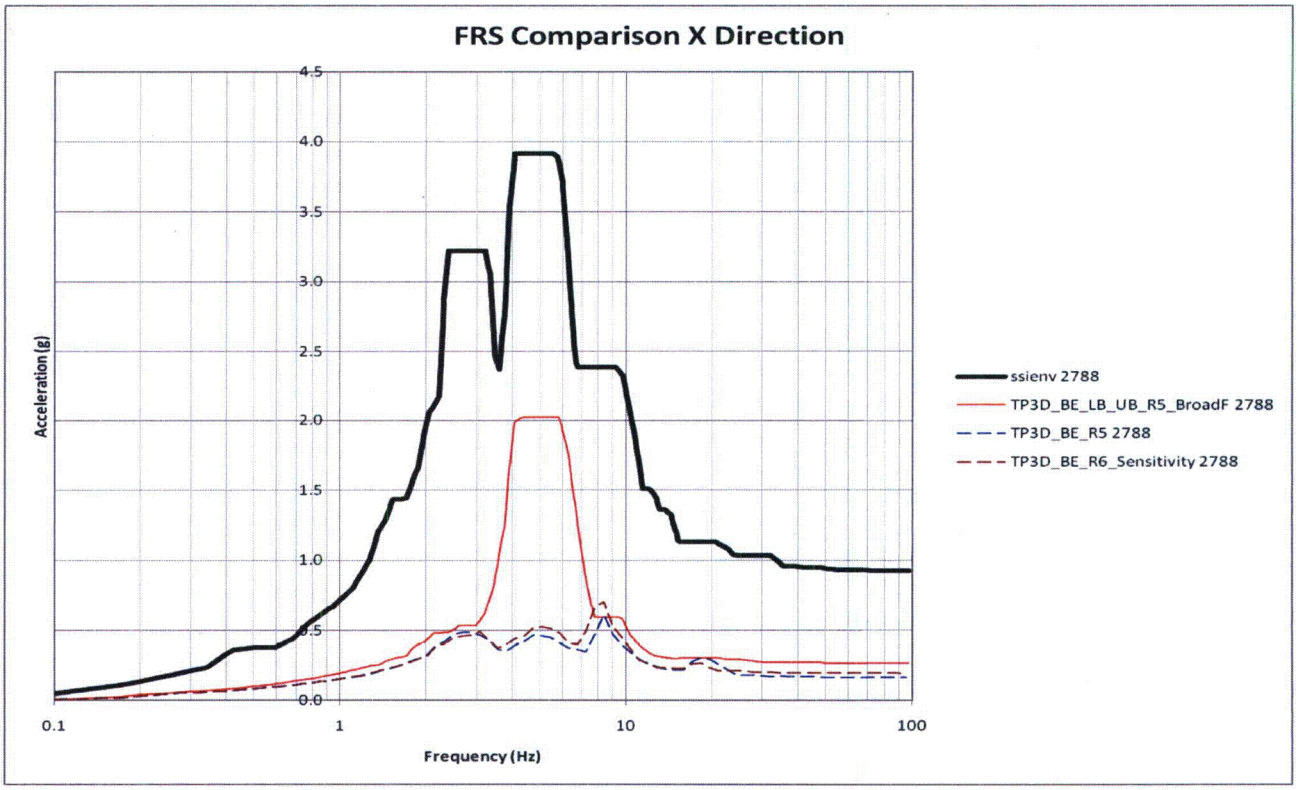

Figure E.2-13. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in X-Direction – Node 2788

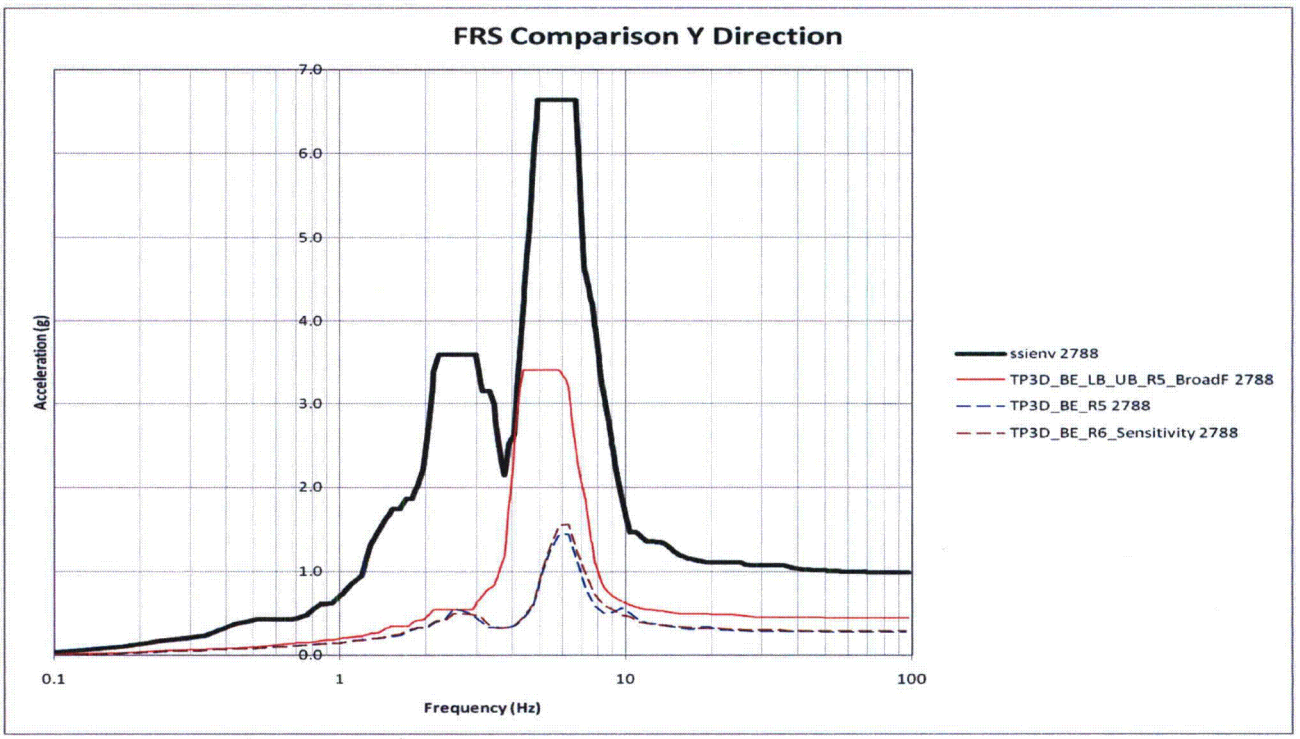

Figure E.2-14. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in Y-Direction – Node 2788

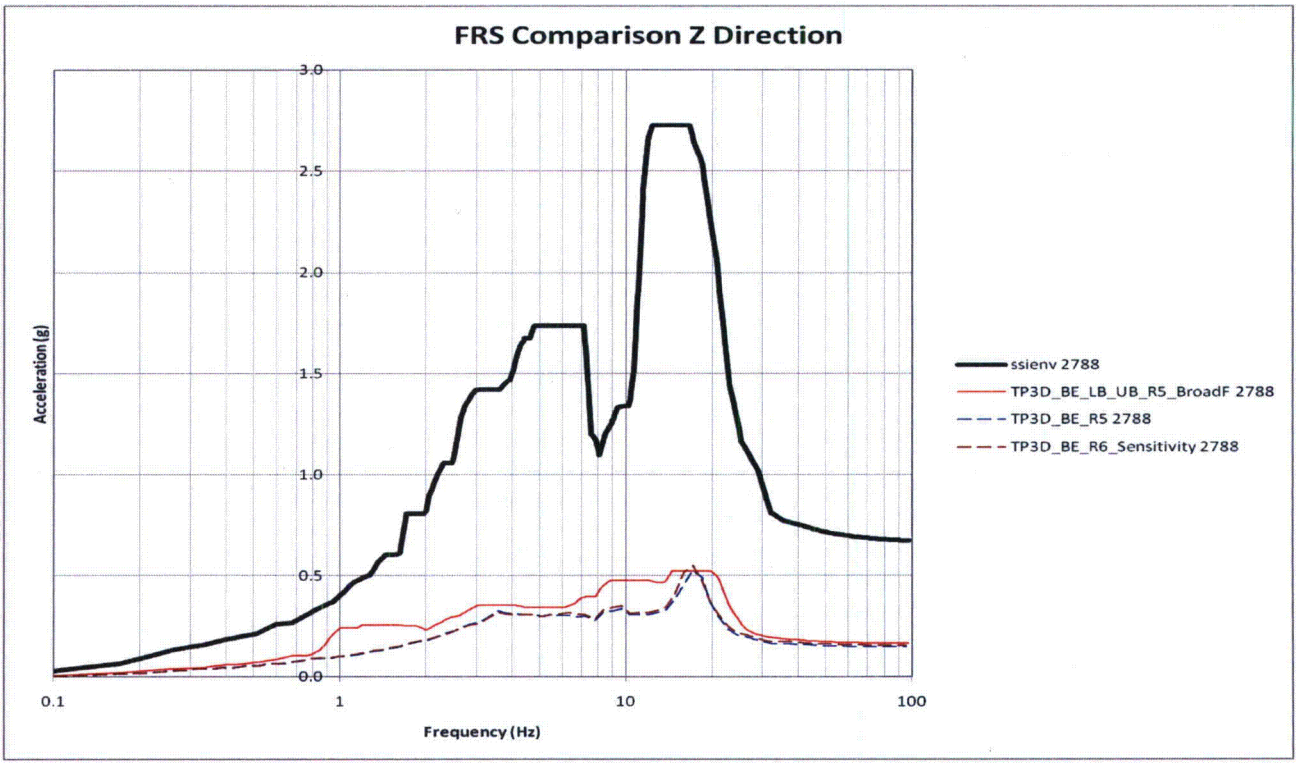

Figure E.2-15. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in Z-Direction – Node 2788

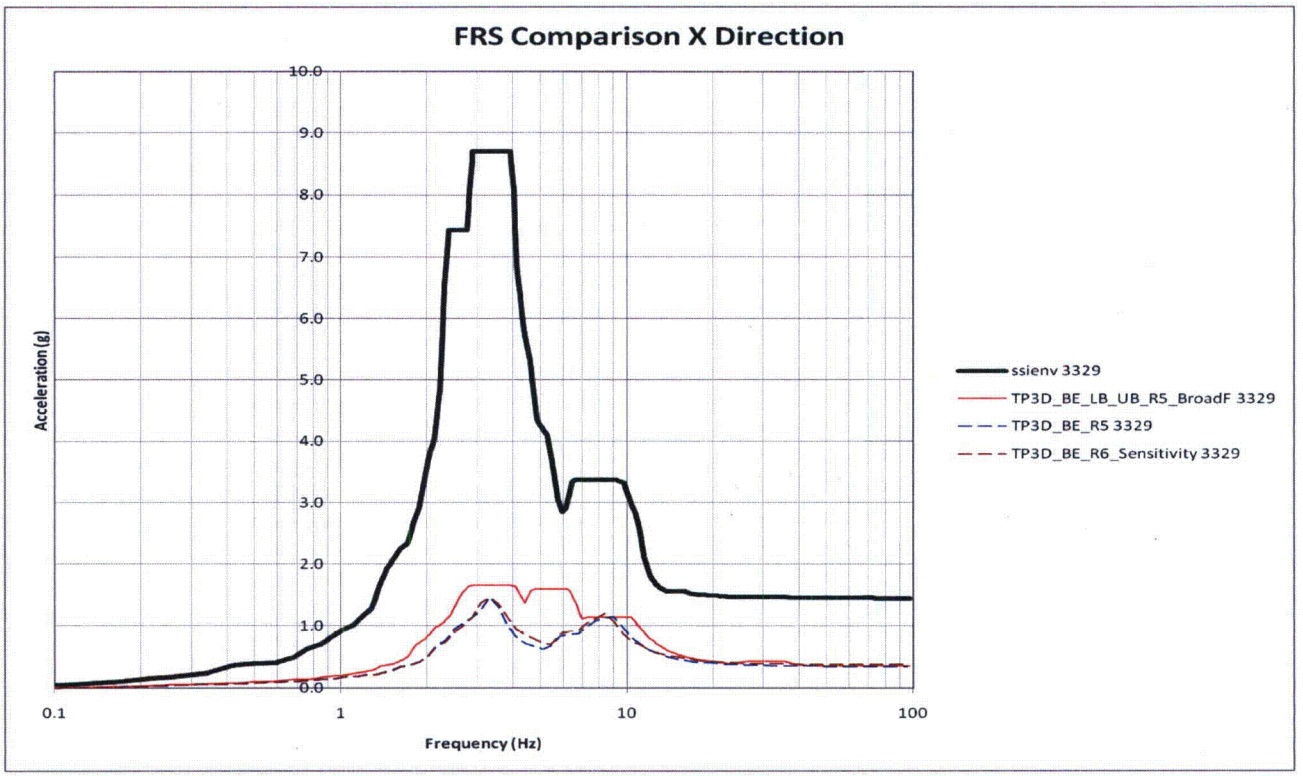

Figure E.2-16. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in X-Direction – Node 3329

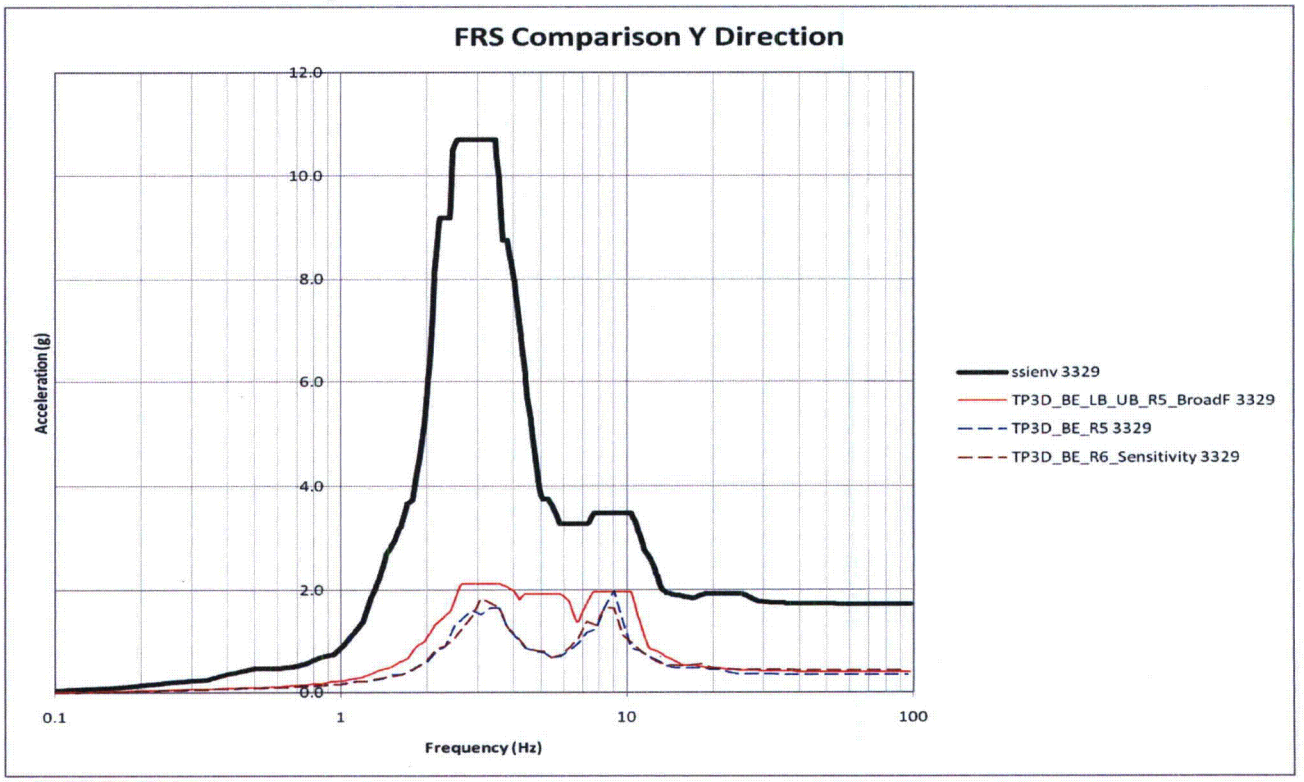

Figure E.2-17. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in Y-Direction – Node 3329

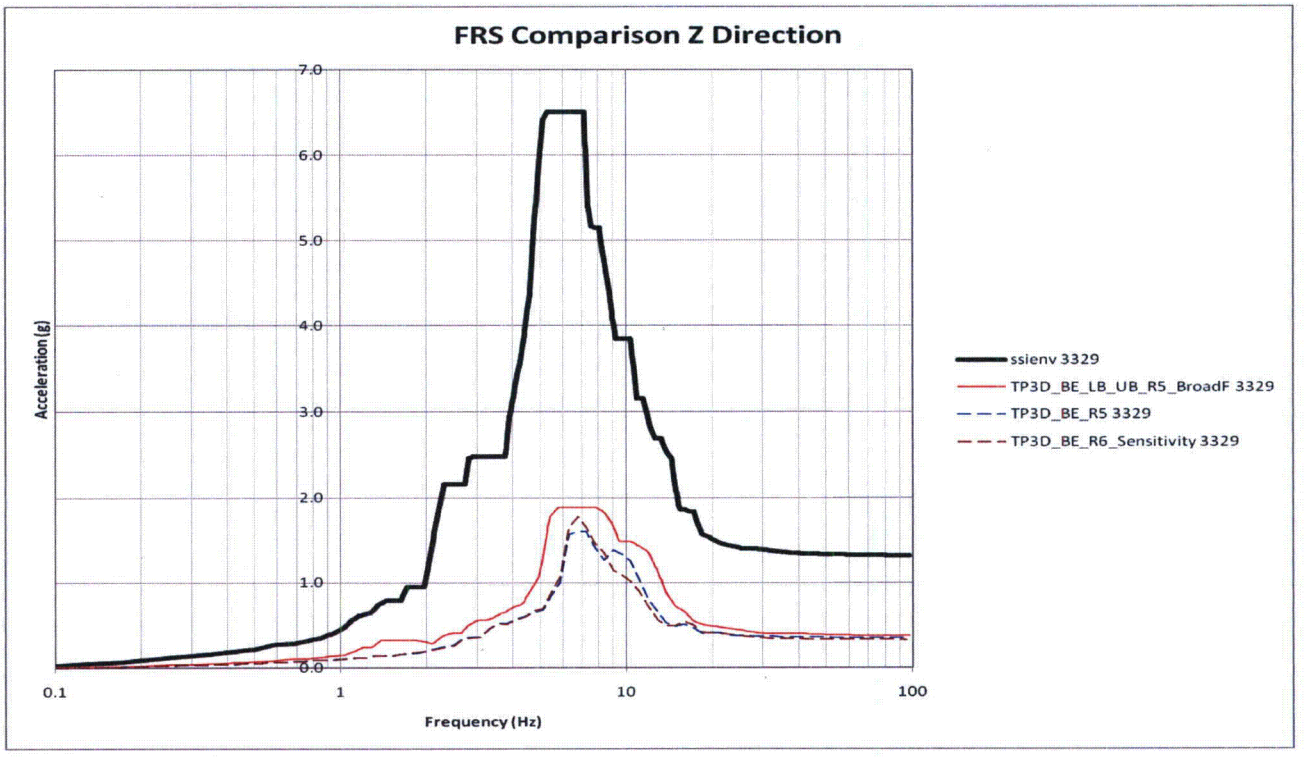

Figure E.2-18. TPNP 3D BE Sensitivity FRS Comparison and FRS Envelope in Z-Direction – Node 3329

E.3 Summary of Results and Conclusions

E.3.1 Results

Seismic SSI sensitivity analyses were performed to assess the potential effect of an updated 2013 site characterization and updated 2014 BE soil/rock, grouted rock and lean concrete properties (Reference 12) on the TPNP NI FRS at the six key locations. Since the only change to the analysis was the updated BE properties, all other model data and NI BE FIRS time histories at the basemat (El. -16) (Reference 1) from the previous analysis were used as seismic input to these sensitivity analyses.

Section E.2, Figures E.2-1 through E.2-18 compare the individual BE seismic FRS based on the Reference 11 analysis and the updated SSI analysis documented in Appendix E, and both are further compared to the (Reference 11) broadened TPNP factored FRS. All of the individual and broadened TPNP FRS results are compared to the AP1000 FRS envelopes at the six (6) NI key nodes.

As shown in Figures E.2-1 through E.2-18, the SSI sensitivity analysis results indicate that the FRS due to the updated properties from supplemental geotechnical data are very similar (within about $\pm$ 10 percent) of the TPNP Reference 11 design-basis FRS at the same 6 key locations indicating the NI FRS are negligibly influenced by the difference in previous and updated seismic input. Also, and most importantly, the TPNP NI site-specific FRS are enveloped by the AP1000 FRS envelope at all six key locations.

E.3.2 Conclusions

Based on the results of the TPNP 3D NI SSI sensitivity analyses presented in Appendix E and comparisons with the design-basis (Reference 11) analysis results at the 6 key NI locations, the effect of the updated site characterization and site response at Turkey Point Units 6&7 on the NI response is considered negligible. Therefore, the design-basis results and conclusions presented in Section 6.2, Figures 6.2-1 through 6.2-18, and Section 7.0, respectively are considered still valid.

Appendix F
Turkey Point Units 6 & 7 – Updated Site Characterization Sensitivity Assessment of SCII Adjacent Structures SSI Analysis

F.1 Background and Purpose

In 2013 and 2014, a supplemental site subsurface investigation and update site response analysis was performed and updated BE seismic input provided in Reference 12 for both the Turbine Building First Bay and Annex Building including updated SCII SSI strain compatible BE engineered fill near NI and FAR profiles, and corresponding hazard consistent time histories for further seismic SSI sensitivity analysis of the SCII adjacent structures.

The purpose of Appendix F is to summarize the 2D SASSI parametric SSI sensitivity analysis using the Section 4.4 TPNP 2D embedded model, which incorporates the updated (Reference 12) site specific NI lean concrete, rock and grouted rock properties beneath the NI basemat, as well as the updated strain compatible engineered fill beneath the SCII adjacent structures.

The 2D SSI sensitivity analyses also include incorporating updated seismic input, specifically updated surface design response spectra (DRS) and the corresponding foundation level time histories for the Turbine Building First Bay and Annex Building provided in Reference 12.

The 2D SSI analyses were performed using the computer code SASSI2000 (Reference 5) specifically modules SITE, POINT, HOUSE, ANALYS and MOTION. All 2D SASSI SSI analyses performed and described in this report have utilized the SASSI Direct Method for computing in-structure response spectra.

F.1.2 Soil Profiles and Properties

2D SSI analyses of the SCII Turbine Building First Bay and Annex Building adjacent structures are performed utilizing the updated TPNP site characterization data and include both the updated strain compatible BE soil/rock, grouted rock and lean concrete fill properties developed in Reference 12. The layer thickness, unit weight, shear wave velocity (Vs), compression wave velocity (Vp) and damping values, from the ground surface to the simulated half-space at a depth of about 600 feet for the updated SCII BE NI and FAR updated case are presented in Tables F.1-1 to F.1-2. Figures F.1-1 through F.1-6 graphically present the TPNP Vs, Vp and damping profiles over the approximately 600-foot depth. Updated BE concrete properties from Table F.1-1 were used as well as an increased density of 155 pcf for the grouted rock zone as shown in Table F.1-3 between El. -35 to -60 feet (depth range 60.5 to 85.5 feet).

Table F.1-1. Best-Estimate SCII Near NI SSI Properties for the 'Updated' Profile – Reference 12

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
1	5.0	0.130	586.6	1097.3	1.8166
2	5.0	0.130	721.9	1350.6	2.3300
3	5.0	0.130	777.9	1455.4	2.5598
4	5.0	0.130	817.5	1529.4	2.7199
5	5.0	0.130	850.1	1590.4	2.8850
6	5.2	0.130	866.6	4418.9	3.0428
7	6.3	0.130	893.2	4554.4	3.1474
8	5.0	0.130	898.7	4582.5	3.2495
9	9.0	0.150	5000.0	7791.9	1.0000
10	10.0	0.150	5000.0	7791.9	1.0000
11	6.0	0.137	5554.5	10724.8	1.0000
12	8.4	0.137	6865.1	12675.1	0.8000
13	1.6	0.137	6859.0	12664.0	0.8000
14	10.0	0.137	5729.7	10828.8	0.8000
15	10.0	0.137	4696.5	9644.2	0.8000
16	10.0	0.137	4485.1	9279.7	0.8000
17	10.0	0.137	4565.3	9174.6	0.8000
18	10.0	0.137	4269.2	8677.5	0.8000
19	10.0	0.137	4456.0	8595.0	0.8000
20	4.4	0.137	2575.8	6826.8	0.8350
21	5.6	0.119	2583.6	6847.7	0.7079
22	10.0	0.119	1212.4	5295.0	0.9030
23	10.0	0.119	1737.7	5806.6	0.7721
24	10.0	0.119	1354.7	5349.8	0.8670
25	10.0	0.119	1460.0	5508.8	0.8430
26	6.6	0.119	1637.0	5663.8	0.7895
27	3.4	0.117	1632.2	5647.1	0.7895
28	10.0	0.117	1562.6	5605.6	0.8092
29	10.0	0.117	1546.4	5588.8	0.8212
30	10.0	0.117	1596.1	5637.8	0.8092
31	10.0	0.117	1736.8	5692.6	0.7869
32	6.8	0.117	2116.8	6187.2	0.7468
33	3.2	0.121	2116.5	6186.2	0.7468
34	10.0	0.121	2357.0	6478.8	0.7256
35	10.0	0.121	2016.8	6040.0	0.7658
36	10.0	0.121	2016.6	6024.9	0.7658
37	10.0	0.121	1843.2	5907.0	0.7869
38	10.0	0.121	1612.4	5739.3	0.8221
39	10.0	0.121	1670.5	5759.6	0.8221
40	10.0	0.121	1786.6	5857.6	0.8040
41	10.0	0.121	1735.6	5881.4	0.8159
42	10.0	0.121	1689.1	5770.5	0.8221
43	10.0	0.121	1573.9	5630.2	0.8526

Table F.1-1. Best-Estimate SCII Near NI SSI Properties for the 'Updated' Profile – Reference 12 (cont.)

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
44	10.0	0.121	1414.6	5687.2	0.9081
45	10.0	0.121	1405.5	5537.5	0.9081
46	10.0	0.121	1387.7	5609.6	0.9114
47	10.0	0.121	1451.9	5663.5	0.9021
48	10.0	0.121	1445.9	5652.7	0.9052
49	10.0	0.121	1397.7	5601.1	0.9236
50	10.0	0.121	1450.8	5625.0	0.9052
51	10.0	0.121	1396.7	5575.8	0.9236
52	10.0	0.121	1406.2	5528.8	0.9236
53	10.0	0.121	1416.5	5595.4	0.9236
54	10.0	0.121	1428.9	5619.3	0.9236
55	10.0	0.121	1419.7	5587.8	0.9279
56	10.0	0.121	1409.7	5441.5	0.9467
57	3.8	0.121	3999.8	8787.5	0.6730
58	6.2	0.129	4007.2	8803.7	0.6587
59	10.0	0.129	4007.0	8803.3	0.6587
60	10.0	0.129	4227.3	8441.3	0.6587
61	10.0	0.129	3794.2	7688.1	0.6755
62	10.0	0.129	3939.2	7994.0	0.6755
63	10.0	0.129	3903.4	8089.3	0.6755
64	10.0	0.129	3938.4	8231.8	0.6755
65	10.0	0.129	3832.2	7808.4	0.6901
66	10.0	0.129	3905.5	8044.1	0.6755
67	10.0	0.129	3564.3	7791.9	0.6901
68	10.0	0.129	3437.0	7733.8	0.7100
69	10.0	0.129	3036.7	7191.4	0.7233
70	10.0	0.129	3056.8	7325.5	0.7233
71	10.0	0.129	3110.2	7409.2	0.7233
72	10.0	0.129	3655.3	8167.3	0.7051
73	10.0	0.129	3313.7	7805.7	0.7233
74	64.0	0.130	4027.0	8382.9	0.3000
75	100.0	0.130	4071.0	8474.5	0.3000
76	200.0	0.130	4356.0	8847.1	0.3000
77	200.0	0.130	4878.0	9481.1	0.3000
78	200.0	0.130	5080.0	9503.8	0.3000
79	200.0	0.130	5396.0	10095.0	0.3000
80	200.0	0.130	5700.0	10663.7	0.3000
81	200.0	0.130	5700.0	10663.7	0.3000
82	200.0	0.130	6500.0	12160.4	0.3000
83	200.0	0.130	6769.0	12663.6	0.3000
84	200.0	0.130	6900.0	12908.7	0.3000
85	200.0	0.130	6950.0	13002.3	0.3000
86	200.0	0.130	6800.0	12721.6	0.3000
87	200.0	0.130	6450.0	12066.8	0.3000

Table F.1-1. Best-Estimate SCII Near NI SSI Properties for the 'Updated' Profile – Reference 12 (cont.)

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
88	200.0	0.130	6400.0	11973.3	0.3000
89	200.0	0.130	6403.0	11978.9	0.3000
90	200.0	0.130	6518.0	12194.1	0.3000
91	200.0	0.130	8397.0	15709.3	0.3000
92	200.0	0.130	8821.0	16502.6	0.3000
93	200.0	0.130	9273.0	17348.2	0.3000
94	200.0	0.130	9834.0	18397.7	0.3000
95	200.0	0.130	9152.0	17121.8	0.3000
96	200.0	0.130	8995.0	16828.1	0.3000
97	200.0	0.130	8670.0	16220.1	0.3000
98	200.0	0.130	8229.0	15395.1	0.3000
99	200.0	0.130	7993.0	14953.5	0.3000
100	200.0	0.130	7908.0	14794.5	0.3000
101	200.0	0.130	7607.0	14231.4	0.3000
102	200.0	0.130	7511.0	14051.8	0.3000
103	200.0	0.130	7340.0	13731.9	0.3000
104	200.0	0.130	7222.0	13511.1	0.3000
105	200.0	0.130	7207.0	13483.1	0.3000
106	200.0	0.130	7063.0	13213.7	0.3000
107	200.0	0.130	7118.0	13316.6	0.3000
108	200.0	0.130	7584.0	14188.4	0.3000
109	200.0	0.130	7787.0	14568.1	0.3000
110	200.0	0.130	7822.0	14633.6	0.3000
111	200.0	0.130	7741.0	14482.1	0.3000
112	200.0	0.130	8256.0	15445.6	0.3000
113	200.0	0.130	8219.0	15376.3	0.3000
114	200.0	0.130	8120.0	15191.1	0.3000
115	200.0	0.130	8388.0	15692.5	0.3000
116	200.0	0.130	8905.0	16659.7	0.3000
117	200.0	0.130	9265.0	17333.2	0.3000
118	200.0	0.130	9073.0	16974.0	0.3000
119	200.0	0.130	9227.0	17262.1	0.3000
120	200.0	0.130	9629.0	18014.2	0.3000
121	200.0	0.130	9938.0	18592.3	0.3000
122	200.0	0.130	9652.0	18057.2	0.3000
123	200.0	0.130	8777.0	16420.3	0.3000
124	200.0	0.130	8955.0	16753.3	0.3000
125	-	0.170	9200.0	17211.6	1.0000

Note: % = percent; ft. = feet; ft/sec = feet per second; pcf = pound per cubic foot; SSI = soil structure interaction

Table F.1-2. Best-Estimate SCII FAR SSI Properties for the "Updated" Profile – Reference 12

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
1	5.0	0.130	582.7	1090.1	1.8844
2	5.0	0.130	717.4	1342.2	2.3805
3	5.0	0.130	773.9	1447.9	2.6122
4	5.0	0.130	814.0	1522.8	2.7877
5	5.0	0.130	848.3	1587.1	2.9082
6	5.2	0.130	866.9	4420.5	2.9929
7	6.3	0.125	2258.2	5273.4	0.6000
8	5.0	0.125	3551.2	7526.9	0.6000
9	5.0	0.125	3551.2	7526.9	0.6000
10	5.9	0.125	4660.9	9298.6	0.6000
11	4.1	0.137	4659.2	9295.3	0.8000
12	4.0	0.137	5551.7	10719.3	0.8000
13	6.0	0.137	5551.5	10718.9	0.8000
14	8.4	0.137	6865.1	12675.2	0.8000
15	1.6	0.137	6859.2	12664.2	0.8000
16	10.0	0.137	5729.9	10829.0	0.8000
17	10.0	0.137	4696.6	9644.4	0.8000
18	10.0	0.137	4485.2	9279.9	0.8000
19	10.0	0.137	4565.4	9174.7	0.8000
20	10.0	0.137	4269.2	8677.6	0.8000
21	10.0	0.137	4456.0	8595.0	0.8000
22	4.4	0.137	2575.8	6826.9	0.8334
23	5.6	0.119	2583.6	6847.6	0.7084
24	10.0	0.119	1212.3	5294.9	0.9050
25	10.0	0.119	1737.5	5806.2	0.7733
26	10.0	0.119	1354.6	5349.2	0.8688
27	10.0	0.119	1459.9	5508.4	0.8445
28	6.6	0.119	1636.9	5663.4	0.7906
29	3.4	0.117	1632.0	5646.6	0.7906
30	10.0	0.117	1562.5	5605.1	0.8106
31	10.0	0.117	1546.2	5588.2	0.8225
32	10.0	0.117	1595.9	5637.2	0.8106
33	10.0	0.117	1736.7	5692.2	0.7880
34	6.8	0.117	2116.7	6186.9	0.7475
35	3.2	0.121	2116.4	6185.9	0.7475
36	10.0	0.121	2356.9	6478.6	0.7261
37	10.0	0.121	2016.7	6039.7	0.7618
38	10.0	0.121	2016.5	6024.7	0.7667
39	10.0	0.121	1843.1	5906.8	0.7880
40	10.0	0.121	1612.4	5739.0	0.8235
41	10.0	0.121	1670.4	5759.4	0.8235
42	10.0	0.121	1786.5	5857.3	0.8052
43	10.0	0.121	1735.6	5881.2	0.8170

Table F.1-2. Best-Estimate SCII FAR SSI Properties for the "Updated" Profile – Reference 12 (cont.)

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
44	10.0	0.121	1689.1	5770.3	0.8207
45	10.0	0.121	1573.8	5629.9	0.8540
46	10.0	0.121	1414.5	5686.9	0.9082
47	10.0	0.121	1405.4	5537.2	0.9100
48	10.0	0.121	1387.6	5609.2	0.9114
49	10.0	0.121	1451.8	5663.0	0.9037
50	10.0	0.121	1445.8	5652.2	0.9070
51	10.0	0.121	1397.5	5600.6	0.9256
52	10.0	0.121	1450.7	5624.4	0.9070
53	10.0	0.121	1396.5	5575.1	0.9256
54	10.0	0.121	1406.0	5528.0	0.9256
55	10.0	0.121	1416.3	5594.6	0.9256
56	10.0	0.121	1428.7	5618.6	0.9256
57	10.0	0.121	1419.5	5587.0	0.9284
58	10.0	0.121	1409.5	5440.8	0.9488
59	3.8	0.121	3999.8	8787.3	0.6734
60	6.2	0.129	4007.1	8803.6	0.6592
61	10.0	0.129	4006.9	8803.1	0.6592
62	10.0	0.129	4227.3	8441.2	0.6592
63	10.0	0.129	3794.1	7687.9	0.6759
64	10.0	0.129	3939.1	7993.9	0.6734
65	10.0	0.129	3903.3	8089.2	0.6759
66	10.0	0.129	3938.4	8231.7	0.6759
67	10.0	0.129	3832.2	7808.3	0.6905
68	10.0	0.129	3905.4	8044.0	0.6759
69	10.0	0.129	3564.2	7791.7	0.6905
70	10.0	0.129	3436.9	7733.6	0.7104
71	10.0	0.129	3036.5	7191.1	0.7236
72	10.0	0.129	3056.7	7325.2	0.7236
73	10.0	0.129	3110.1	7408.9	0.7236
74	10.0	0.129	3655.2	8167.0	0.7053
75	10.0	0.129	3313.6	7805.5	0.7236
76	64.0	0.130	4027.0	8382.9	0.3000
77	100.0	0.130	4071.0	8474.5	0.3000
78	200.0	0.130	4356.0	8847.1	0.3000
79	200.0	0.130	4878.0	9481.1	0.3000
80	200.0	0.130	5080.0	9503.8	0.3000
81	200.0	0.130	5396.0	10095.0	0.3000
82	200.0	0.130	5700.0	10663.7	0.3000
83	200.0	0.130	5700.0	10663.7	0.3000
84	200.0	0.130	6500.0	12160.4	0.3000
85	200.0	0.130	6769.0	12663.6	0.3000
86	200.0	0.130	6900.0	12908.7	0.3000
87	200.0	0.130	6950.0	13002.3	0.3000

Table F.1-2. Best-Estimate SCII FAR SSI Properties for the "Updated" Profile – Reference 12 (cont.)

Layer No.	Thickness [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
88	200.0	0.130	6800.0	12721.6	0.3000
89	200.0	0.130	6450.0	12066.8	0.3000
90	200.0	0.130	6400.0	11973.3	0.3000
91	200.0	0.130	6403.0	11978.9	0.3000
92	200.0	0.130	6518.0	12194.1	0.3000
93	200.0	0.130	8397.0	15709.3	0.3000
94	200.0	0.130	8821.0	16502.6	0.3000
95	200.0	0.130	9273.0	17348.2	0.3000
96	200.0	0.130	9834.0	18397.7	0.3000
97	200.0	0.130	9152.0	17121.8	0.3000
98	200.0	0.130	8995.0	16828.1	0.3000
99	200.0	0.130	8670.0	16220.1	0.3000
100	200.0	0.130	8229.0	15395.1	0.3000
101	200.0	0.130	7993.0	14953.5	0.3000
102	200.0	0.130	7908.0	14794.5	0.3000
103	200.0	0.130	7607.0	14231.4	0.3000
104	200.0	0.130	7511.0	14051.8	0.3000
105	200.0	0.130	7340.0	13731.9	0.3000
106	200.0	0.130	7222.0	13511.1	0.3000
107	200.0	0.130	7207.0	13483.1	0.3000
108	200.0	0.130	7063.0	13213.7	0.3000
109	200.0	0.130	7118.0	13316.6	0.3000
110	200.0	0.130	7584.0	14188.4	0.3000
111	200.0	0.130	7787.0	14568.1	0.3000
112	200.0	0.130	7822.0	14633.6	0.3000
113	200.0	0.130	7741.0	14482.1	0.3000
114	200.0	0.130	8256.0	15445.6	0.3000
115	200.0	0.130	8219.0	15376.3	0.3000
116	200.0	0.130	8120.0	15191.1	0.3000
117	200.0	0.130	8388.0	15692.5	0.3000
118	200.0	0.130	8905.0	16659.7	0.3000
119	200.0	0.130	9265.0	17333.2	0.3000
120	200.0	0.130	9073.0	16974.0	0.3000
121	200.0	0.130	9227.0	17262.1	0.3000
122	200.0	0.130	9629.0	18014.2	0.3000
123	200.0	0.130	9938.0	18592.3	0.3000
124	200.0	0.130	9652.0	18057.2	0.3000
125	200.0	0.130	8777.0	16420.3	0.3000
126	200.0	0.130	8955.0	16753.3	0.3000
127		0.170	9200.0	17211.6	1.0000

Note: % = percent; ft. = feet; ft/sec = feet per second; pcf = pound per cubic foot; SSI = soil structure interaction

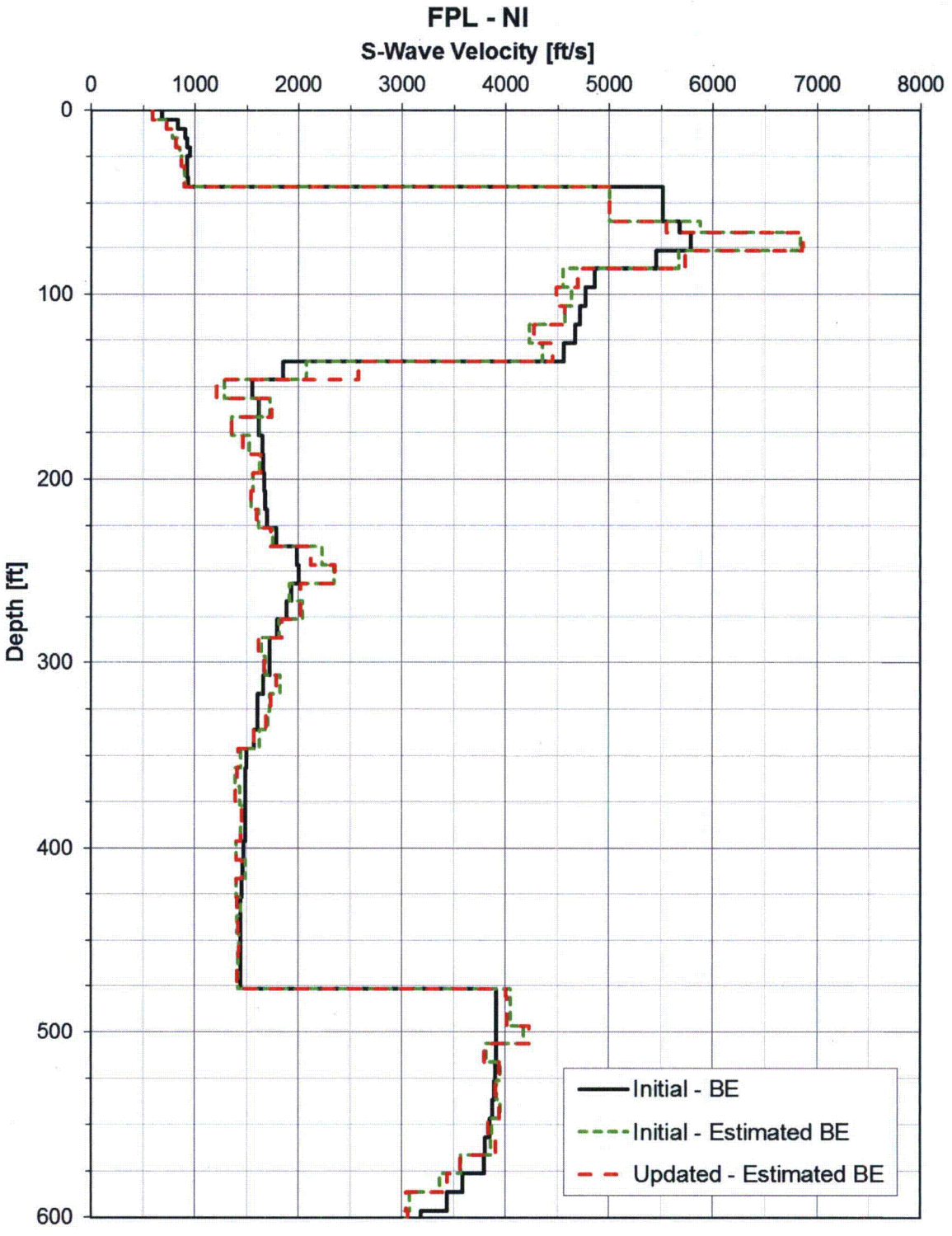

Figure F.1-1. Turkey Point Estimated Best-Estimate S-Wave Velocity Profile for the NI Site Column for the Site-Specific Motion

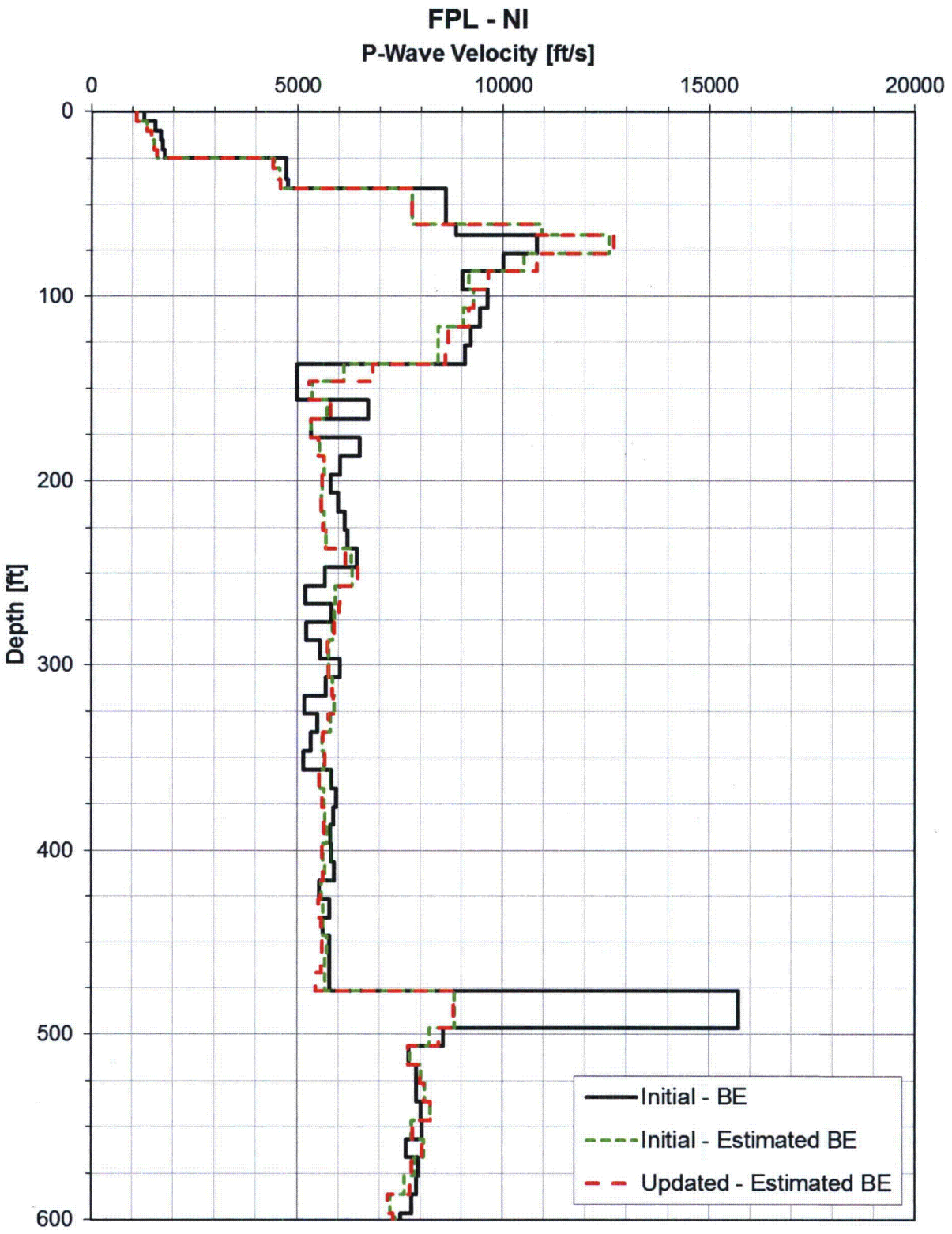

Figure F.1-2. Turkey Point Estimated Best-Estimate P-Wave Velocity Profile for the NI Site Column for the Site-Specific Motion

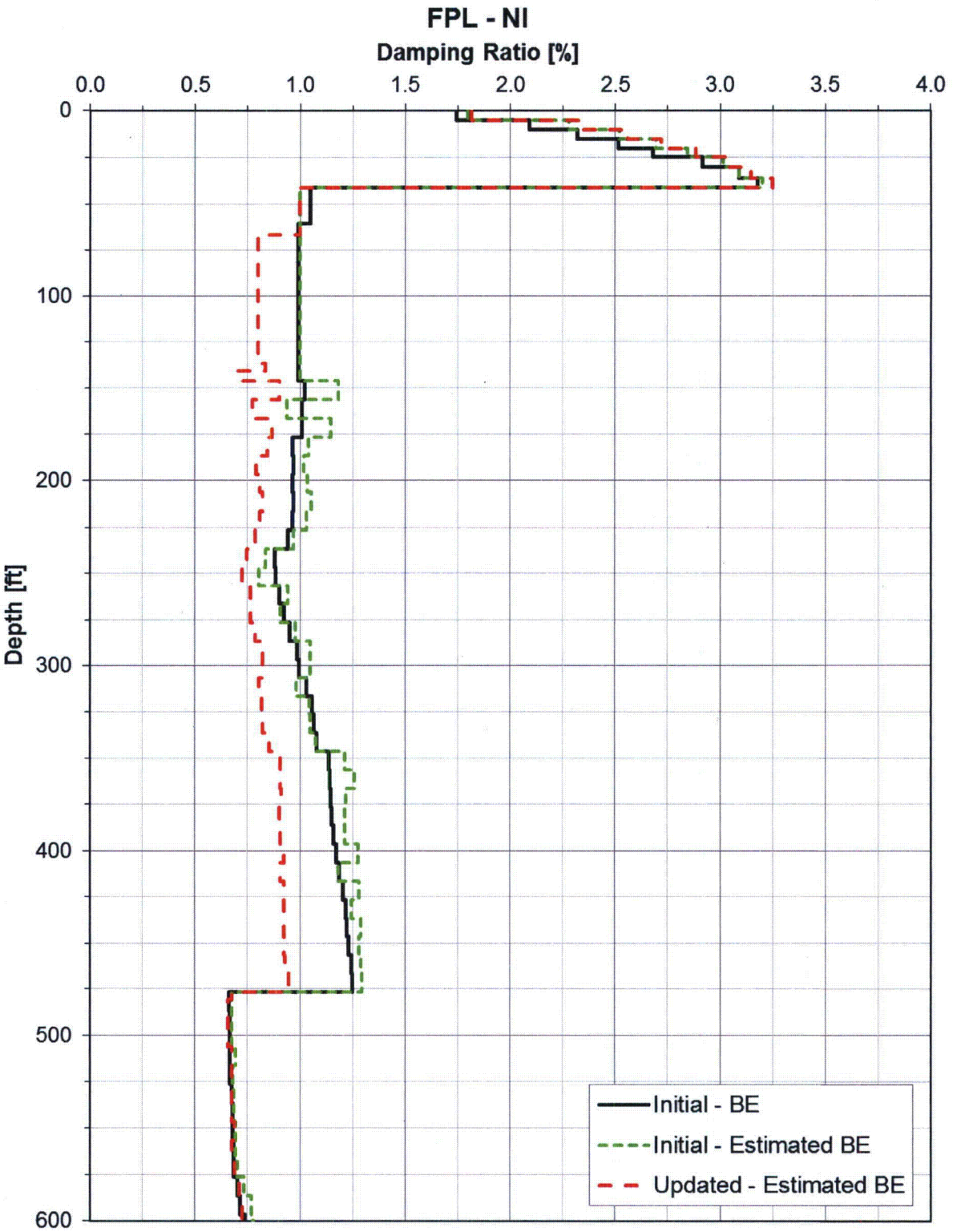

Figure F.1-3. Turkey Point Estimated Best-Estimate Damping Profile for the NI Site Column for the Site-Specific Motion

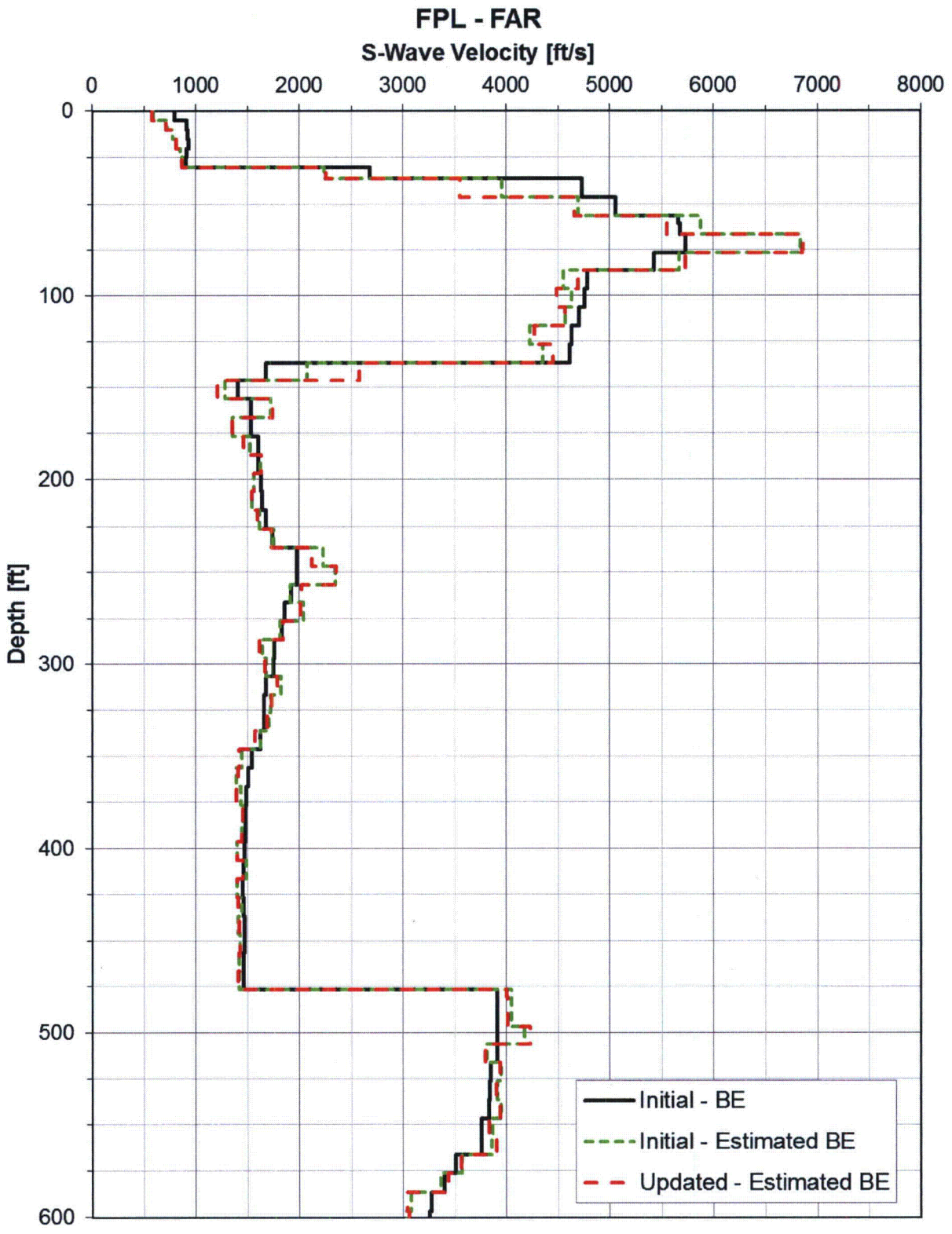

Figure F.1-4. Turkey Point Estimated Best-Estimate S-Wave Velocity Profile for the FAR Site Column for the Site-Specific Motion

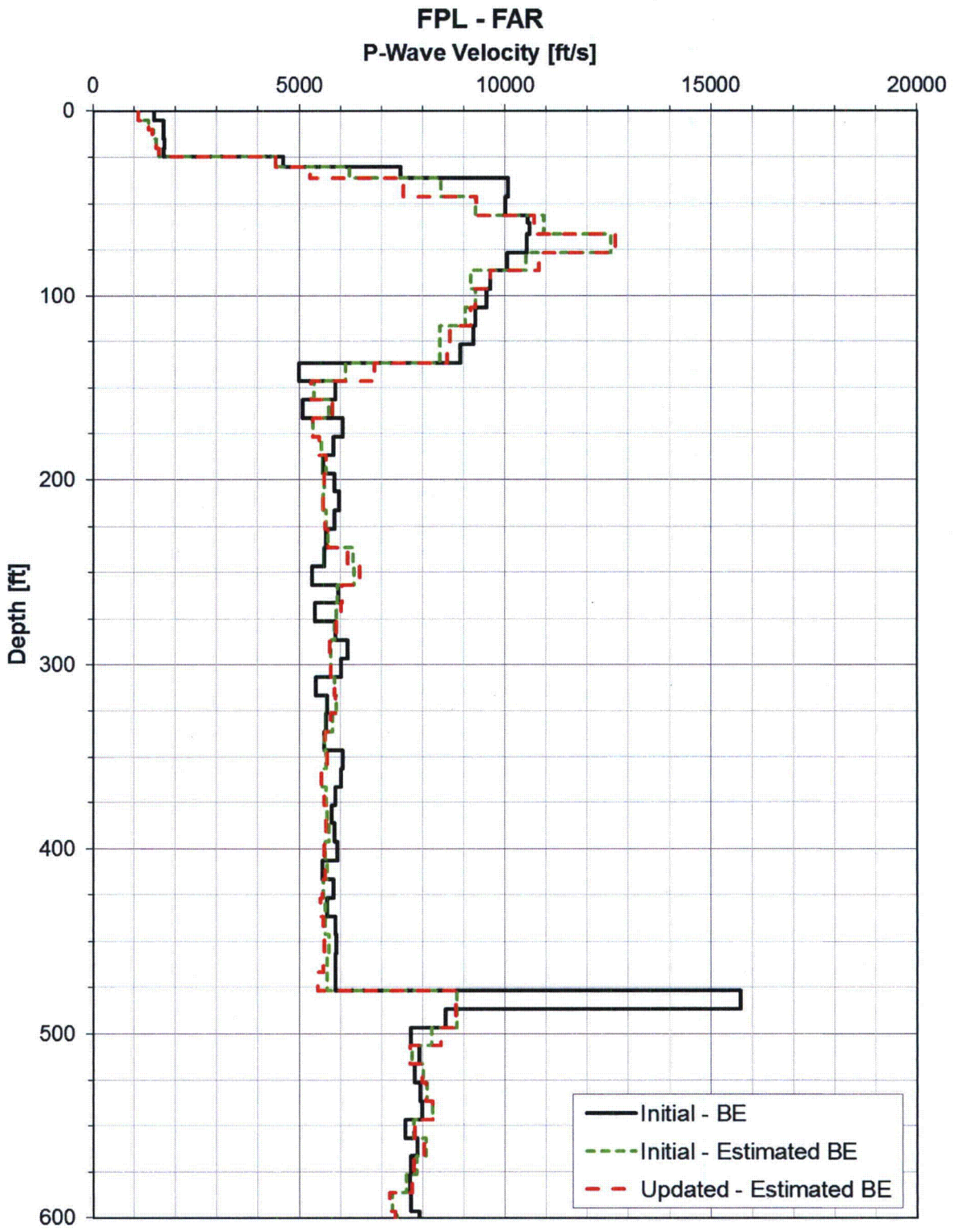

Figure F.1-5. Turkey Point Estimated Best-Estimate P-Wave Velocity Profile for the FAR Site Column for the Site-Specific Motion

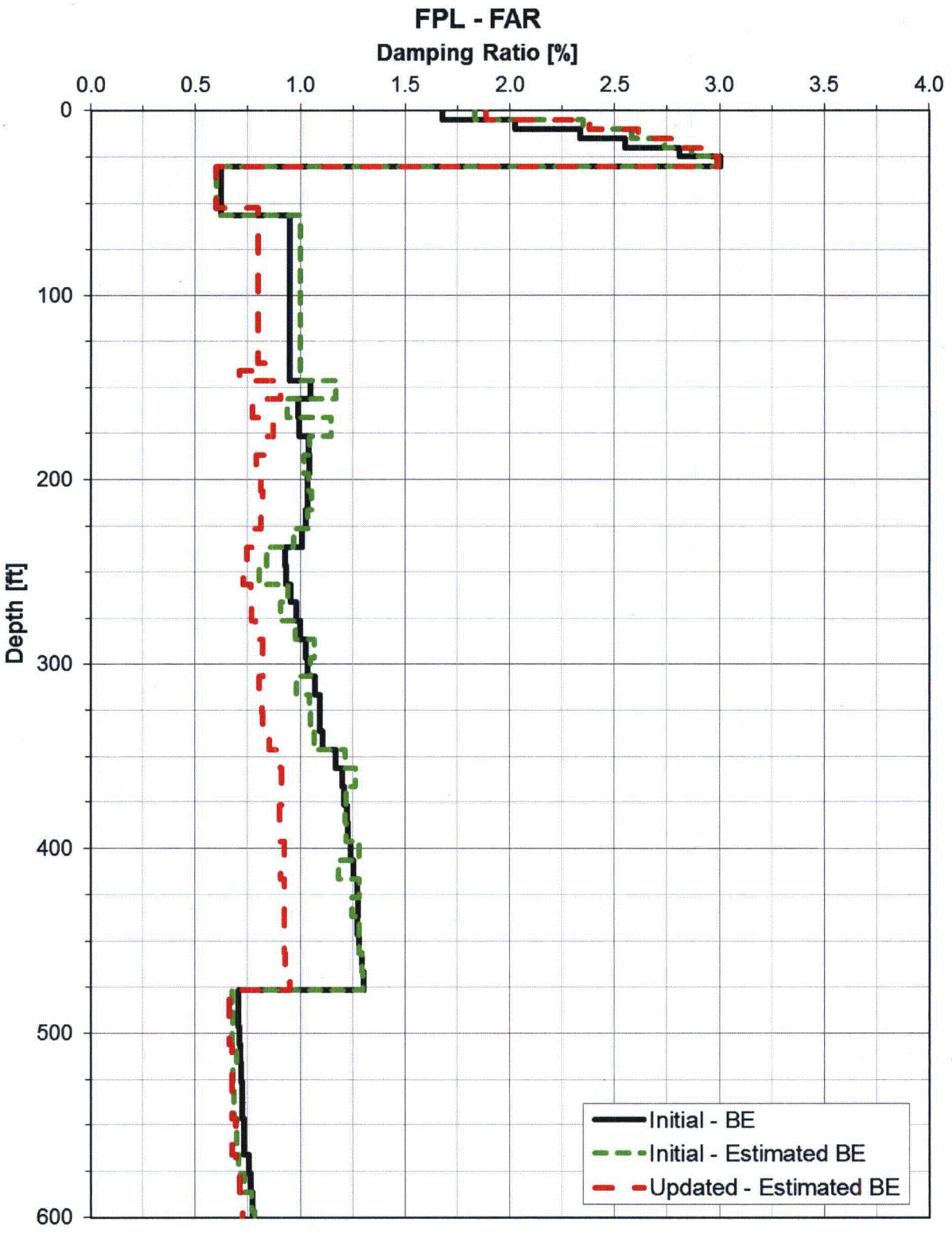

Figure F.1-6. Turkey Point Estimated Best-Estimate Damping Profile for the FAR Site Column for the Site-Specific Motion

Table F.1-3. Near NI SCII Backfill Soil, Fill Concrete and Grouted Rock Profile – BE Updated Profile – Reference 12

Material	Thickness [feet]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping
Engineered Fill	5.0	0.130	586.6	1097.3	1.8166
Engineered Fill	5.0	0.130	721.9	1350.6	2.3300
Engineered Fill	5.0	0.130	777.9	1455.4	2.5598
Engineered Fill	5.0	0.130	817.5	1529.4	2.7199
Engineered Fill	5.0	0.130	850.1	1590.4	2.8850
Engineered Fill	5.2	0.130	866.6	4418.9	3.0428
Engineered Fill	6.3	0.130	893.2	4554.4	3.1474
Engineered Fill	5.0	0.130	898.7	4582.5	3.2495
Lean Concrete	9.0	0.150	5000.0	7791.9	1.0000
Lean Concrete	10.0	0.150	5000.0	7791.9	1.0000
Grouted Rock	6.0	0.155	5554.5	10724.8	1.0000
Grouted Rock	8.4	0.155	6865.1	12675.1	0.8000
Grouted Rock	1.6	0.155	6859.0	12664.0	0.8000
Grouted Rock	10.0	0.155	5729.7	10828.8	0.8000

F.1.1 Key Nodes Selected

The key nodes selected to obtain acceleration response spectra (damping at 5 percent) are shown in Table F.1-4.

Table F.1-4. Key Nodes Selected

Nodes	Elevation (ft)	Description
4041	99.000	CIS at Reactor Vessel Support Elevation
4061	116.500	Auxiliary Shield Building at Control Room Floor
4120	179.560	ASB Auxiliary Building Roof Area
4310	327.410	ASB Shield Building Roof Area
4412	224.000	Steel Containment Vessel near Polar Crane
4535	134.250	Containment Internal Structure at Operating Deck
931	100.000	West end of the Annex Building
2901	100.000	East end of the Annex Building adjacent to the NI
2942	100.000	Base of the Annex Building Stick Model
2947	100.000	South end of the Turbine Building 1st Bay adjacent to the NI
2951	100.000	Base of the Turbine Building 1st Bay Stick Model
2955	100.000	North end of the Turbine Building 1st Bay

X/Y coordinates are -8.84 ft/-13.94 ft for all the nodes in X and Y 2D model, respectively.

F.1.2 Time History Inputs

Updated horizontal and vertical surface DRS for the Annex Building and Turbine Building First Bay (Reference 12) are presented in Figures F.1-7 and F.1-8, respectively. The corresponding hazard consistent acceleration time histories from Reference 12 are presented in Figures F.1-9 to F.1-10 and are used as seismic input in X (North-South) and Z (Vertical) directions for the Turbine Building First Bay. The Annex Building seismic input in the Y (East-West) and Z (Vertical) directions are shown in Figures F.1-11 and F.1-12. The updated, hazard consistent, seismic ground surface input time histories provided in Reference 12 were scaled to 0.1g PGA consistent with Section 3.5.1. Seismic input is applied at the ground surface (AP1000 El. 100 feet; TPNP El. +25.5 feet) in both analyses.

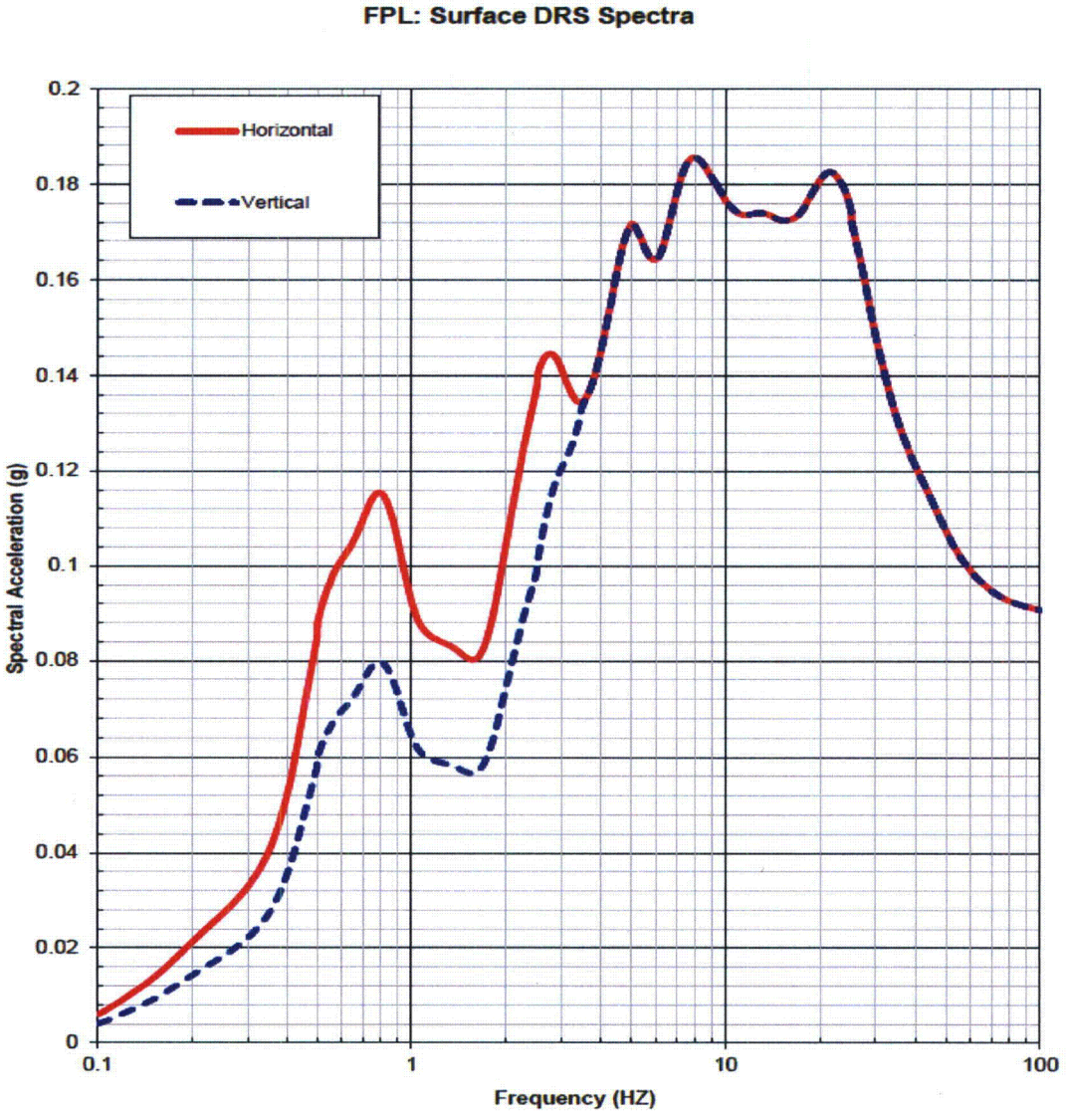

Figure F.1-7. TPNP Updated Annex Building Surface DRS (5% damping) (Reference 12)

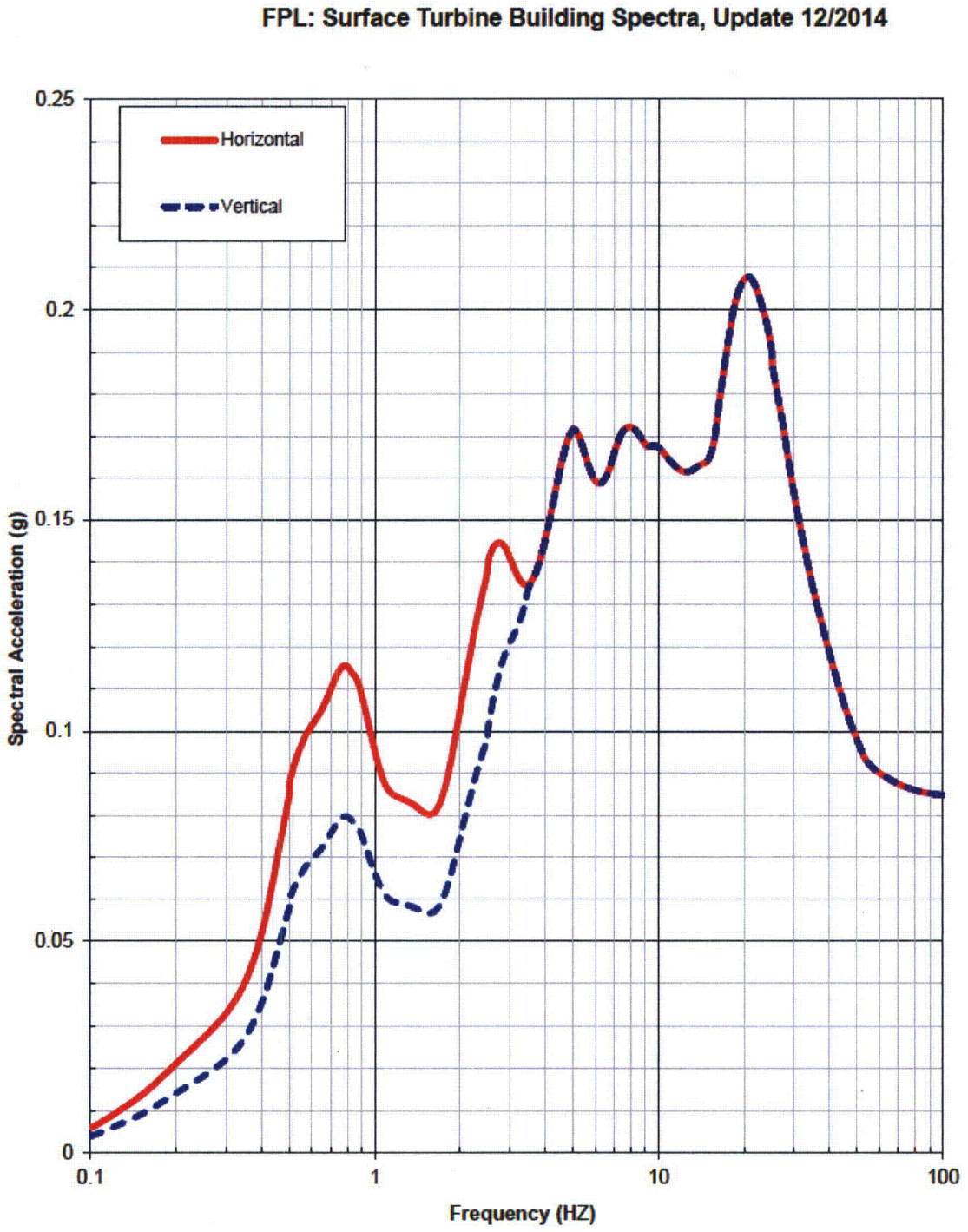

Figure F.1-8. TPNP Updated Turbine Building 1st Bay Surface DRS (5% damping) (Reference 12)

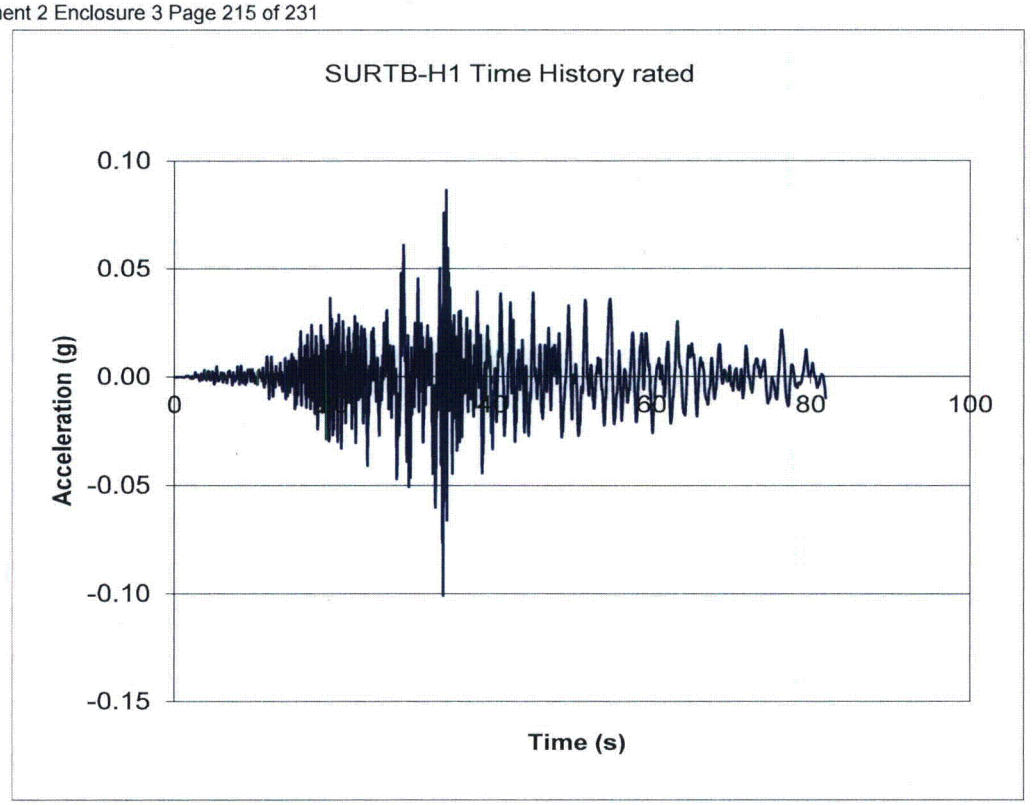

Figure F.1-9. TPNP Updated TB 1st Bay Seismic Input H1 in X-Direction (Scaled to 0.1g) – El. +25.5' – Reference 12

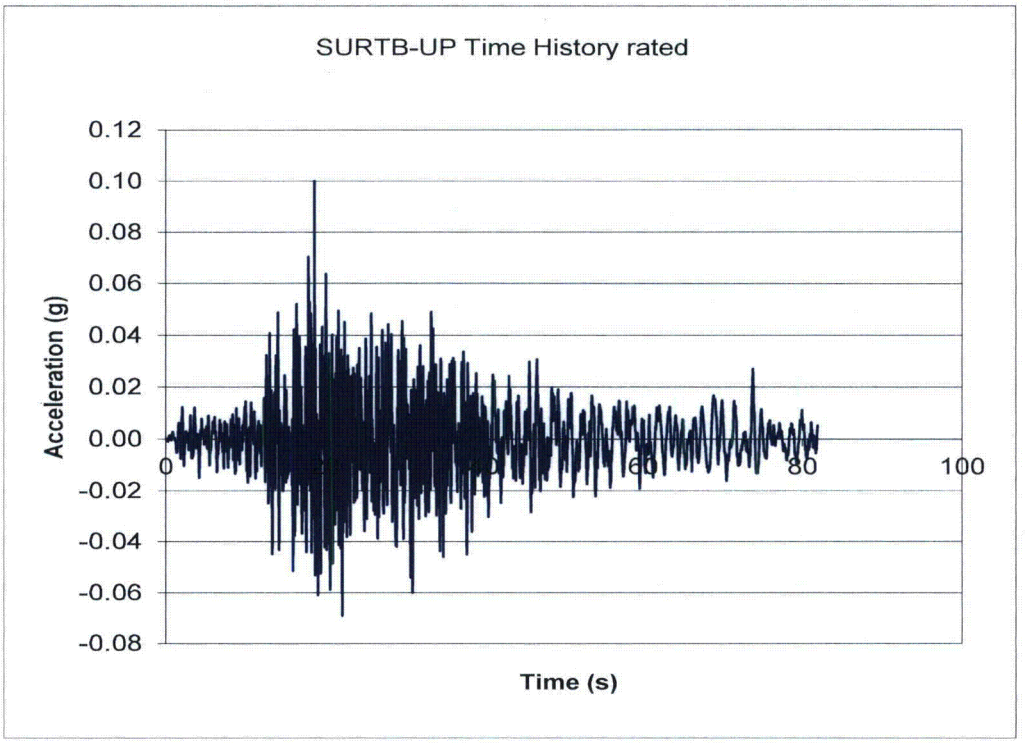

Figure F.1-10. TPNP Updated TB 1st Bay Seismic Input UP in Z-Direction (Scaled to 0.1g) – El. +25.5 – Reference 12

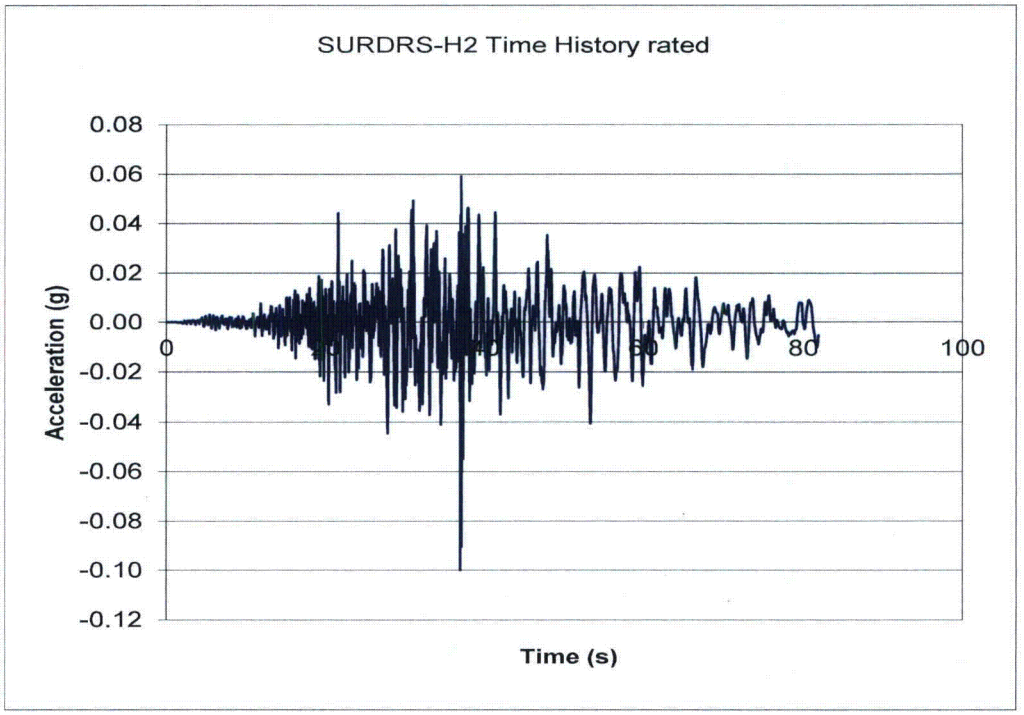

Figure F.1-11. TPNP Updated AB Seismic Input H2 in Y-Direction (Scaled to 0.1g) – El. +25.5' – Reference 12

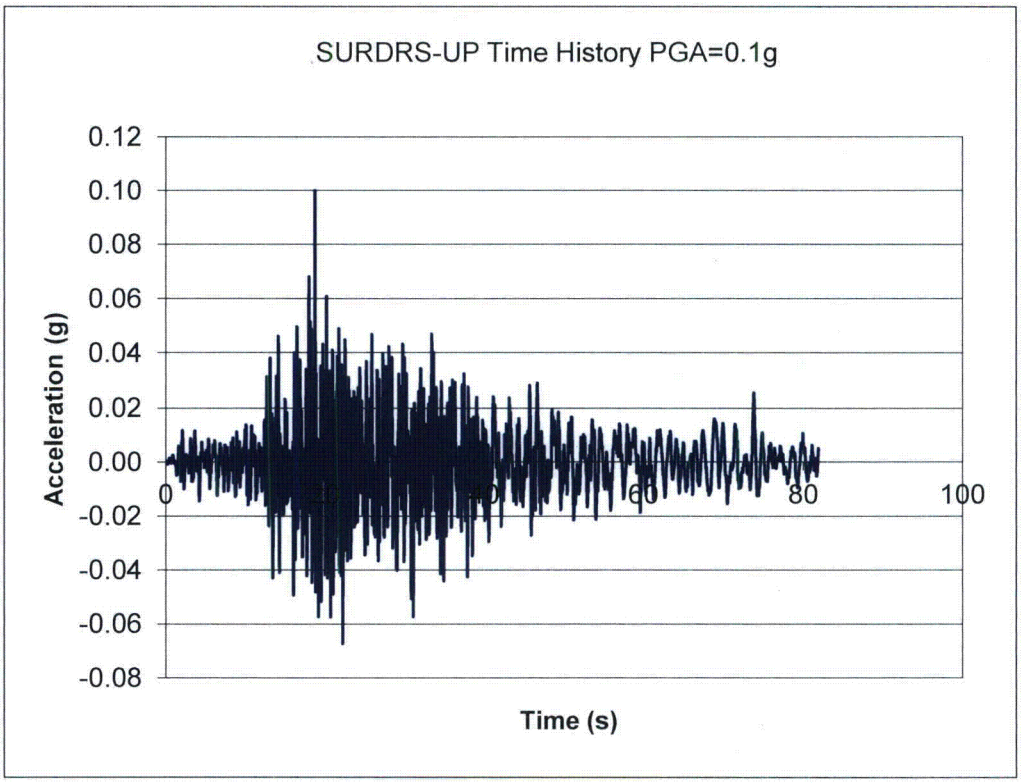

Figure F.1-12. TPNP Updated AB Seismic Input UP in Z-Direction (Scaled to 0.1g) – El. +25.5' – Reference 12

F.2 SASSI FRS Comparison – Updated TPNP 2D BESCII Adjacent Structures SSI Sensitivity Analysis and Results

TPNP adjacent building SSI sensitivity analyses were performed to present FRS comparisons at the ground surface of the Turbine Building First Bay and Annex Building for the updated site characterization and corresponding Reference 12 updated BE seismic input. Also, relative displacements are compared to assess the interaction between the adjacent structures and the NI. Section F.2.1 presents the results of the relative displacement interaction evaluation.

Time history seismic sensitivity analyses using the 2D Turbine Building First Bay (NS) model, 2D Annex Building (EW) model, and the updated BE strain compatible soil profile were performed in one horizontal and one vertical direction (X and Z for the NS model, and Y and Z for the EW model). The updated, hazard consistent, seismic ground surface input time histories shown in Figures F.1-9 through 12 were used in SASSI in conjunction with the Direct method of analysis. FRS for 5 percent damping were obtained at the ground surface for the Turbine Building First Bay (node 2951) and Annex Building (node 2942). FRS for 5 percent damping were also obtained at the six (6) key nodes of the NI to assess any influence of the adjacent structures updated seismic input on the key NI nodes.

Figures F.2-1 through F.2-2 presents the TPNP Turbine Building First Bay horizontal and vertical individual FRS for the initial Section 6.3 (TP2DBER5) and updated (TP2DBER6) BE soil cases compared to the previous TPNP FRS broadened envelope and the AP1000 Turbine Building First Bay FRS generic envelope at the ground surface.

As shown, the initial and updated FRS are very similar and the AP1000 Turbine Building First Bay FRS envelop both the TPNP site specific FRS and broadened FRS at the Turbine Building First Bay surface node 2951.

Similarly, Figures F.2-3 through F.2-4 present the TPNP Annex Building horizontal and vertical individual FRS for the initial Section 6.3 (TP2DBER5) and updated (TP2DBER6) BE case compared to the previous TPNP broadened FRS envelope and AP1000 Annex Building FRS generic envelope at the ground surface.

As shown, the initial and updated FRS are similar and the AP1000 Annex Building FRS envelop both the site specific FRS and broadened FRS at the Annex Building surface node 2942.

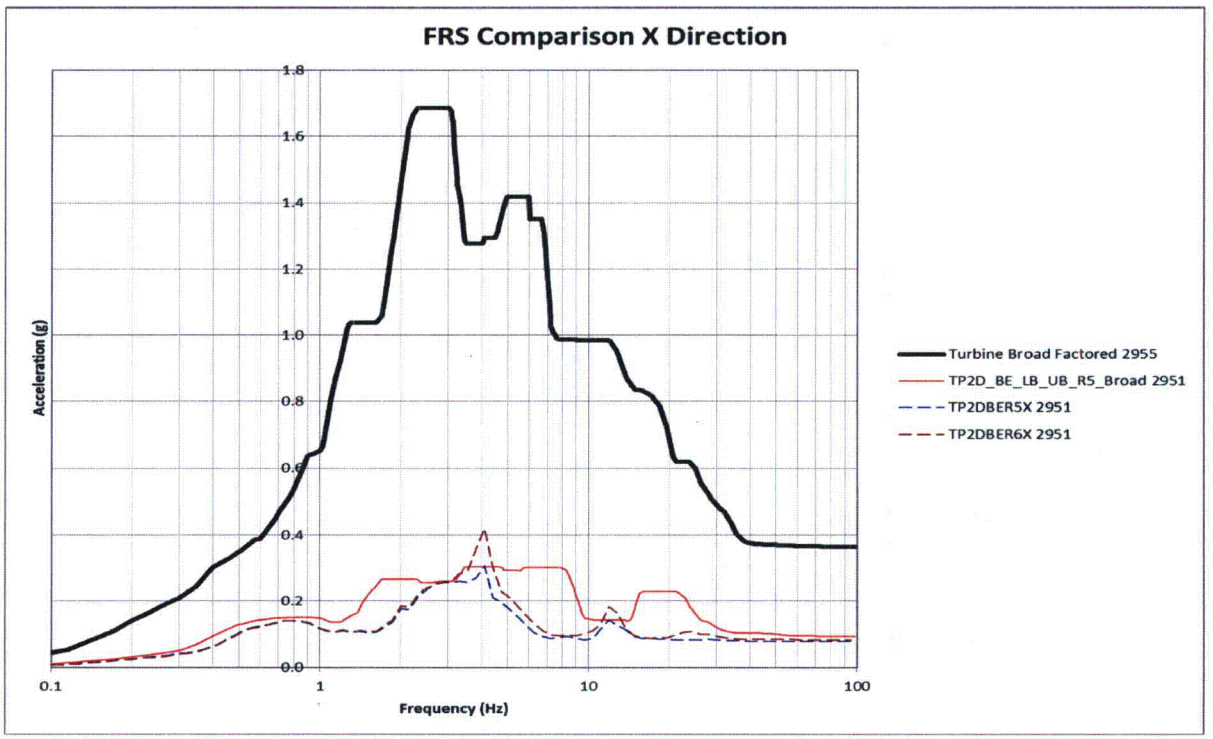

Figure F.2-1. TPNP TB 1st Bay BE Sensitivity FRS Comparison and FRS Envelope in X-Direction – Node 2951

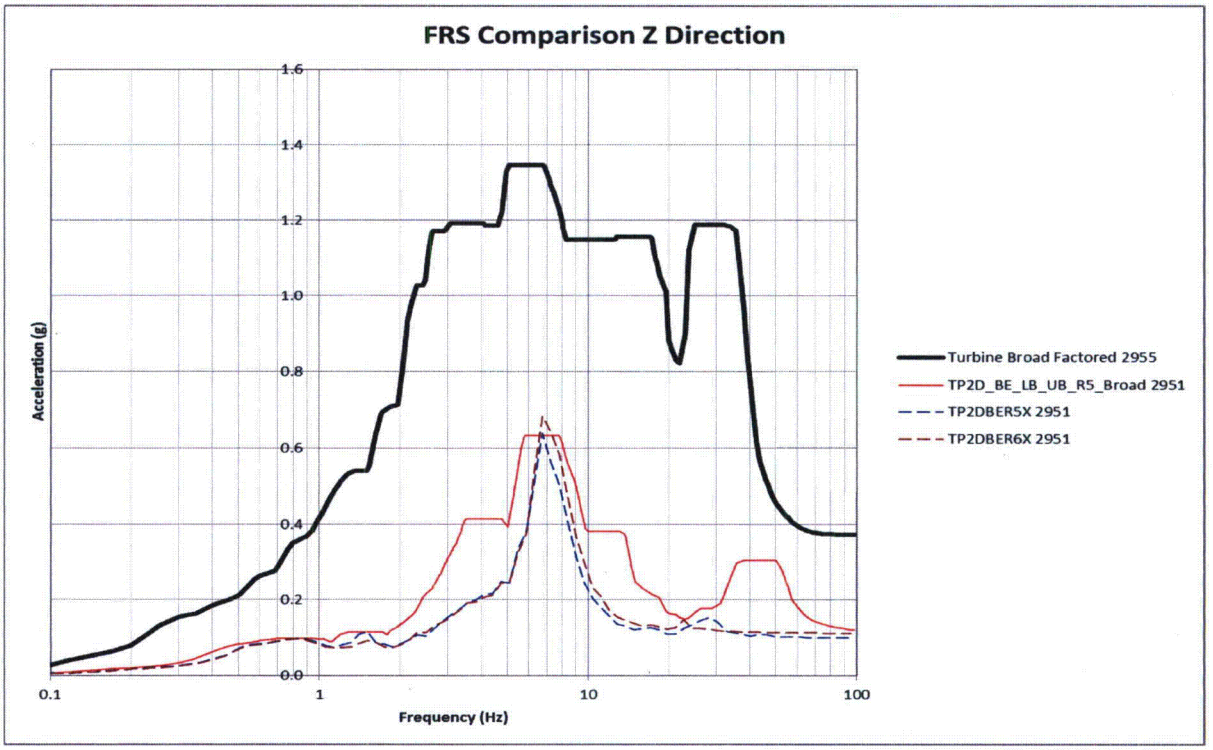

Figure F.2-2. TPNP TB 1st Bay BE Sensitivity FRS Comparison and FRS Envelope in Z-Direction – Node 2951

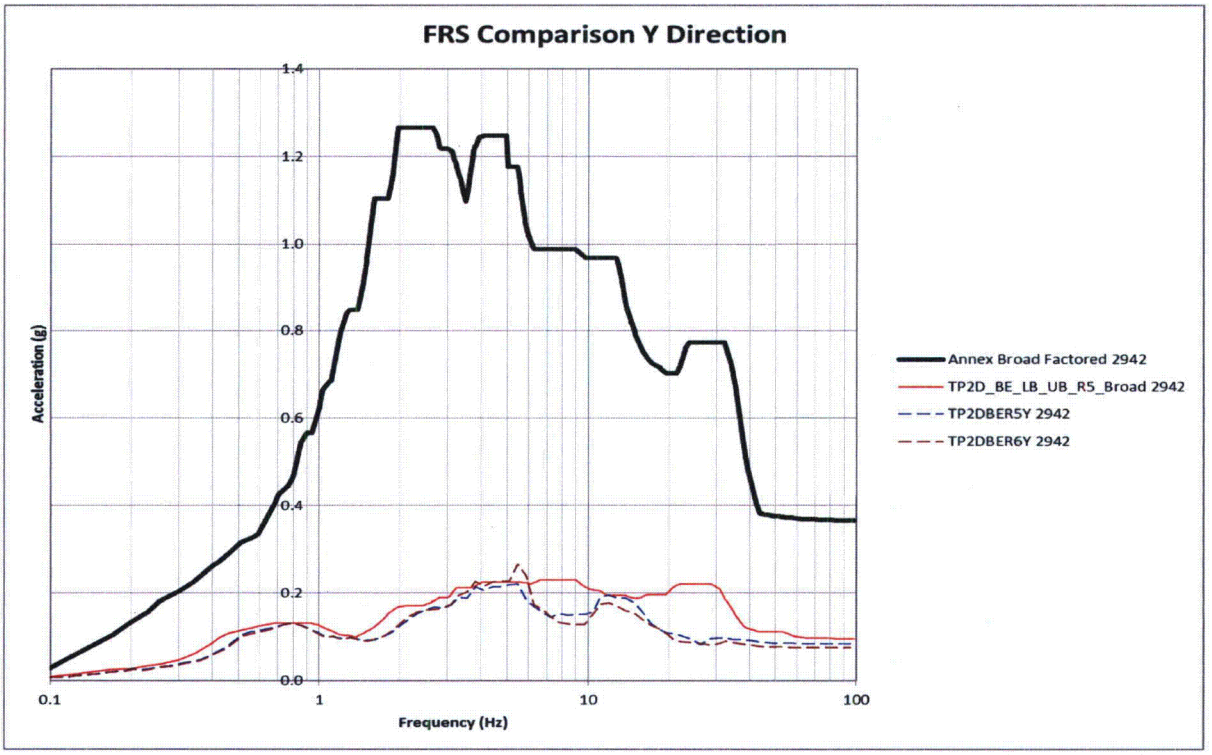

Figure F.2-3. TPNP AB BE Sensitivity FRS Comparison and FRS Envelope in Y-Direction – Node 2942

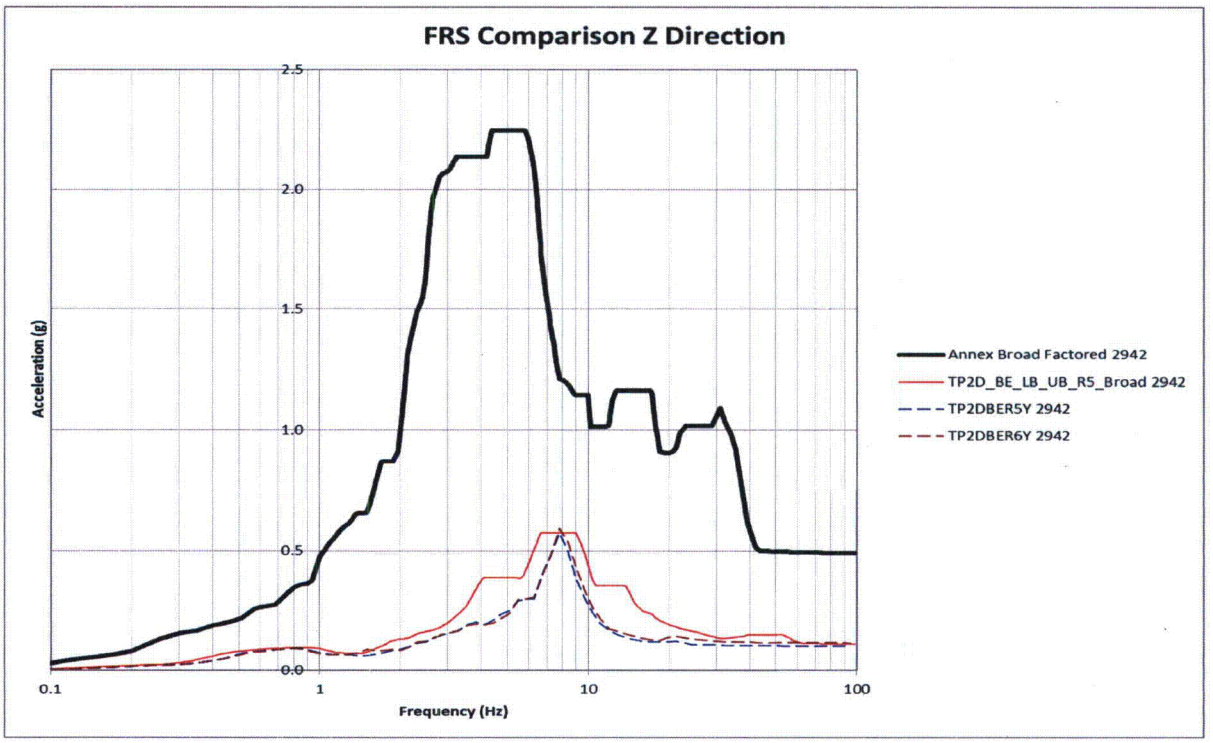

Figure F.2-4. TPNP AB BE Sensitivity FRS Comparison and FRS Envelope in Z-Direction – Node 2942

F.2.1 2D SSI Sensitivity Analysis Response Spectra of Nuclear Island

Figures F.2-5 through F.2-22 present the FRS comparisons at the six (6) key nodes of the NI due to the Turbine Building First Bay (North-South) and Annex Building (East-West) updated 2D BE response and corresponding previous (Appendix A) 2D NI BE response.

As shown, the previous and updated 2D FRS for the NI nodes are very similar indicating the NI FRS are negligibly influenced by the difference in the initial and updated BE seismic input, and all nodes are enveloped by the AP1000 FRS envelope.

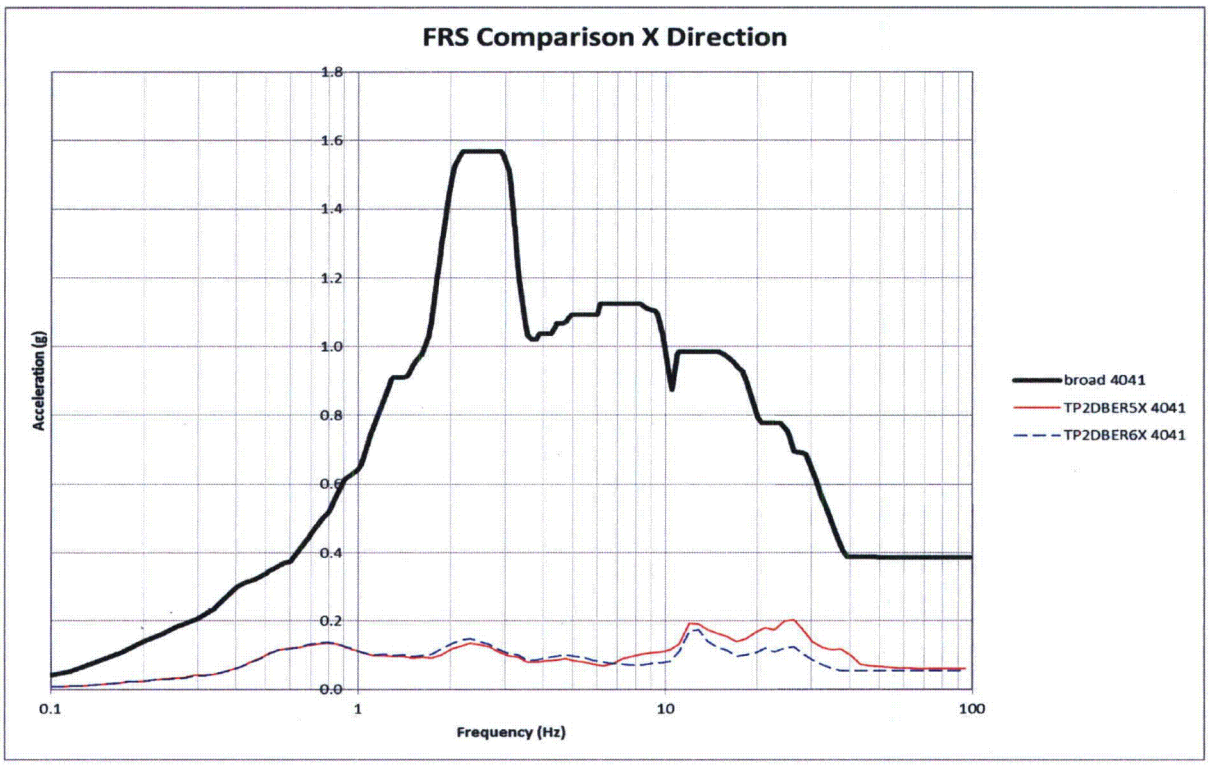

Figure F.2-5. TPNP 2D NI BE Sensitivity FRS Comparison, X Direction – Node 4041 (El. 99.0 ft)

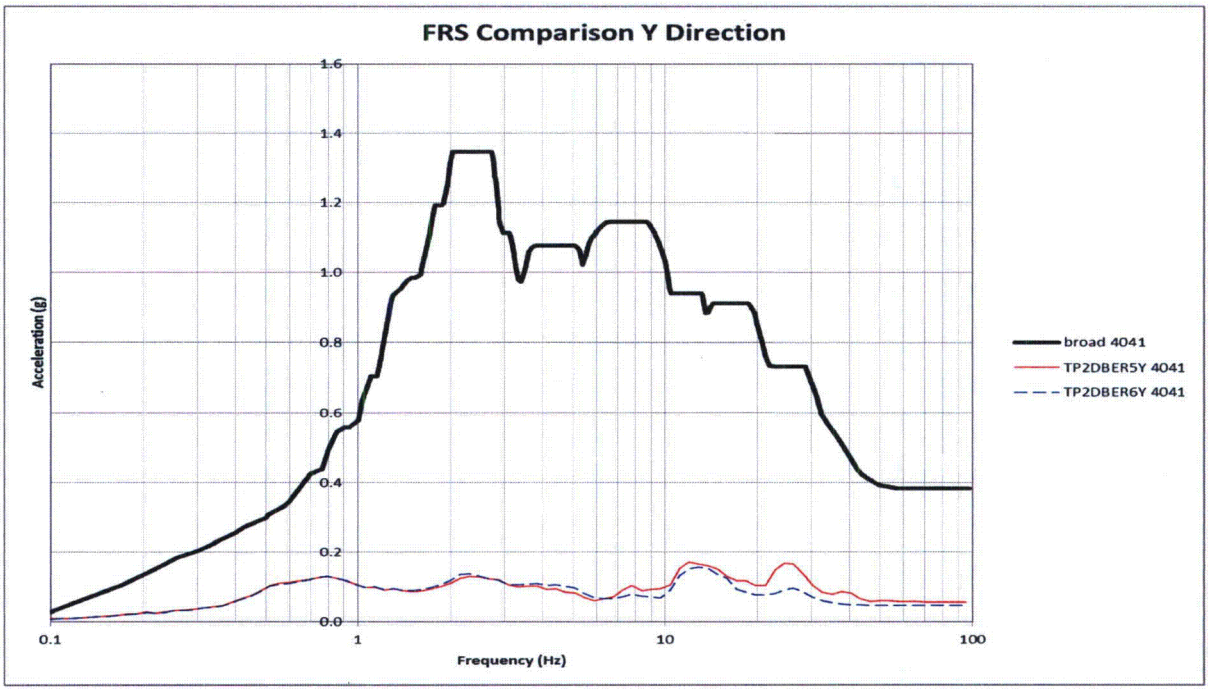

Figure F.2-6. TPNP 2D NI BE Sensitivity FRS Comparison, Y Direction – Node 4041 (El. 99.0 ft)

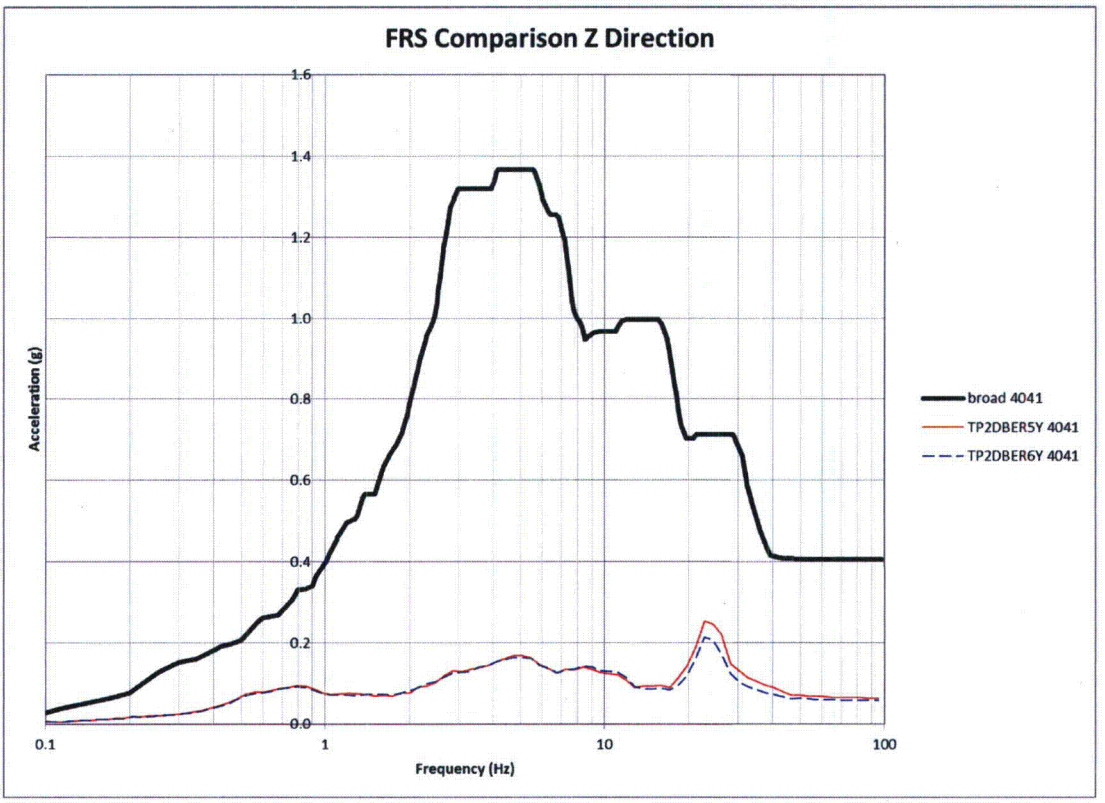

Figure F.2-7. TPNP 2D NI BE Sensitivity FRS Comparison, Z Direction – Node 4041 (El. 99.0 ft)

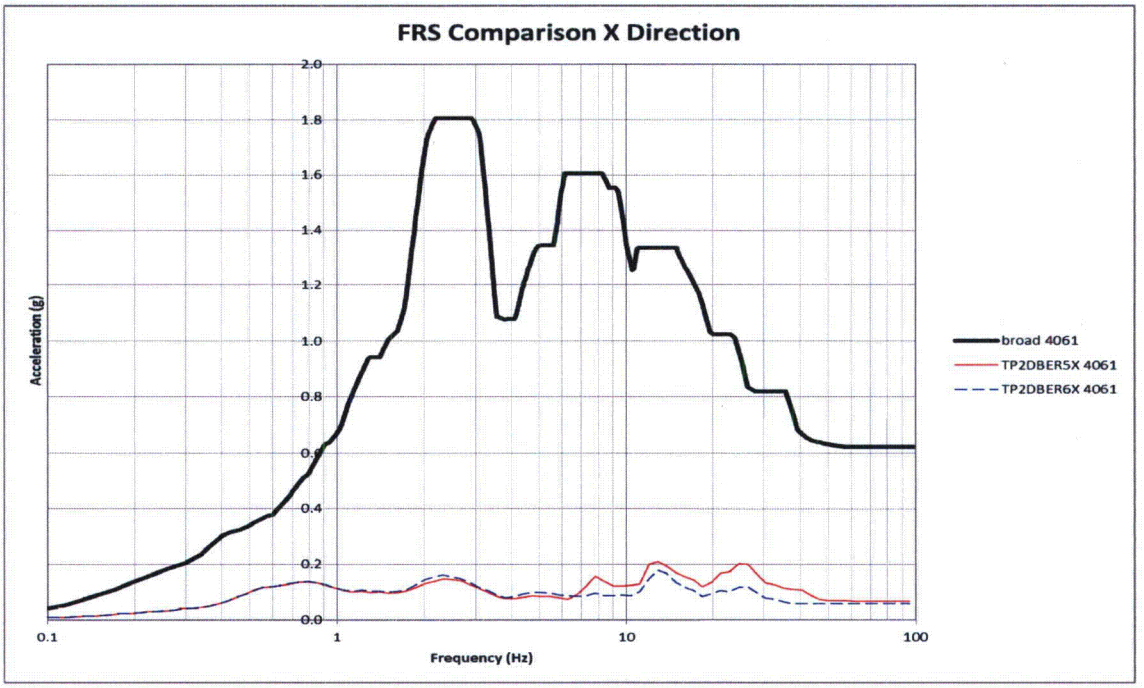

Figure F.2-8. TPNP 2D NI BE Sensitivity FRS Comparison, X Direction – Node 4061 (El. 116.5 ft)

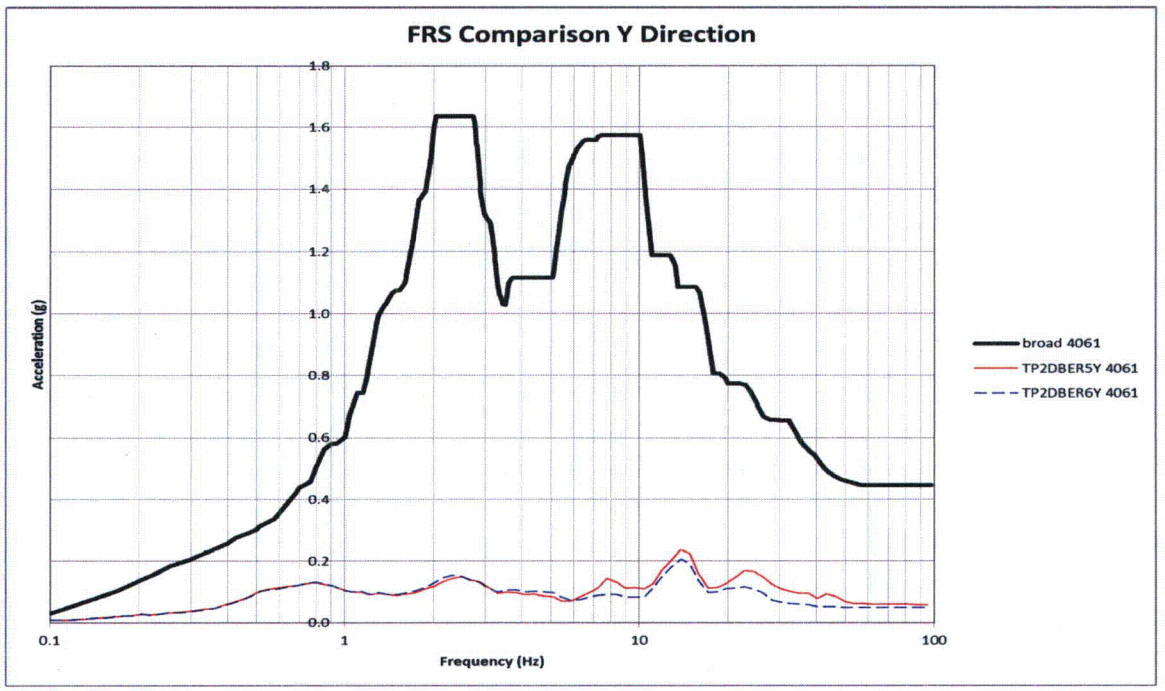

Figure F.2-9. TPNP 2D NI BE Sensitivity FRS Comparison, Y Direction – Node 4061 (El. 116.5 ft)

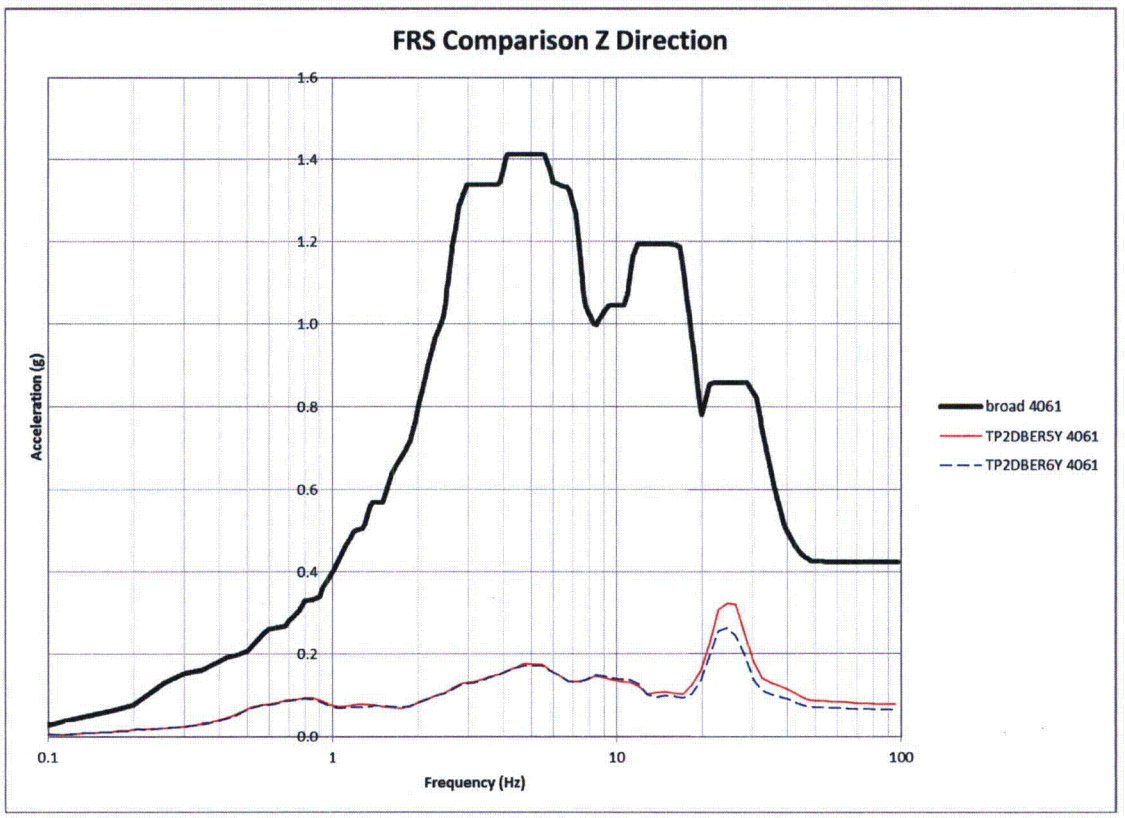

Figure F.2-10. TPNP 2D NI BE Sensitivity FRS Comparison, Z Direction – Node 4061 (El. 116.5 ft)

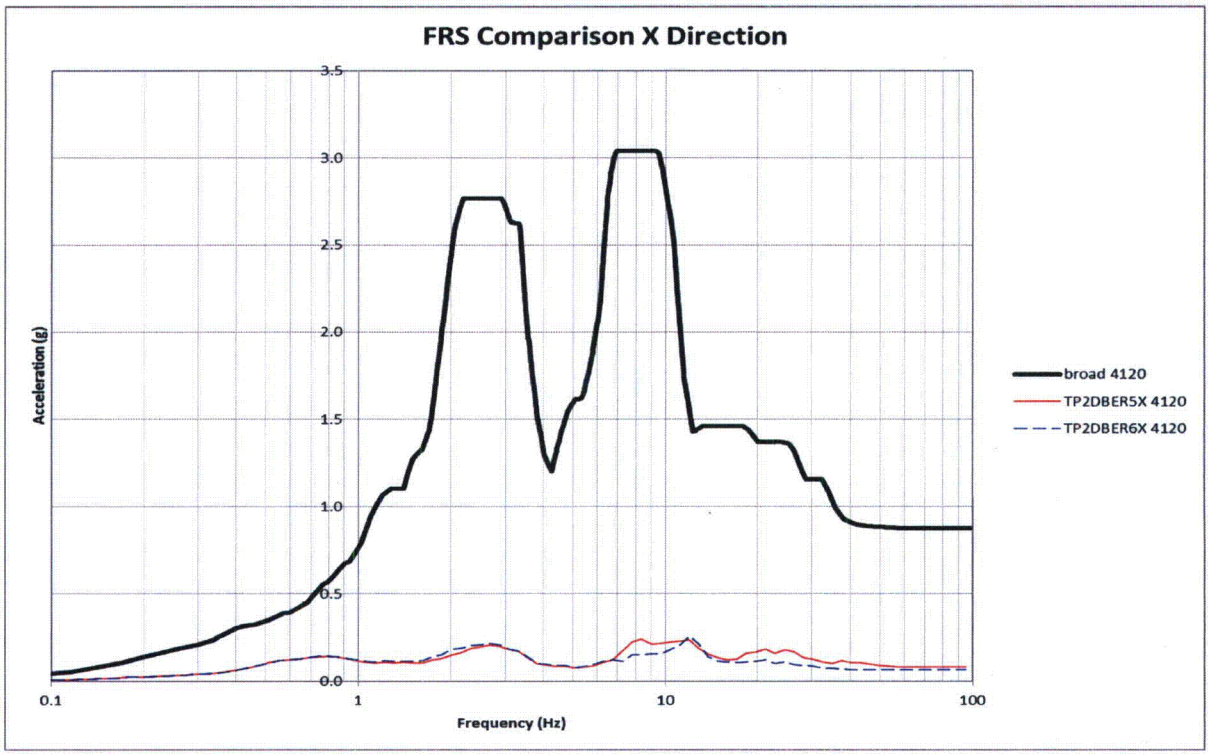

Figure F.2-11. TPNP 2D NI BE Sensitivity FRS Comparison, X Direction – Node 4120 (El. 179.56 ft)

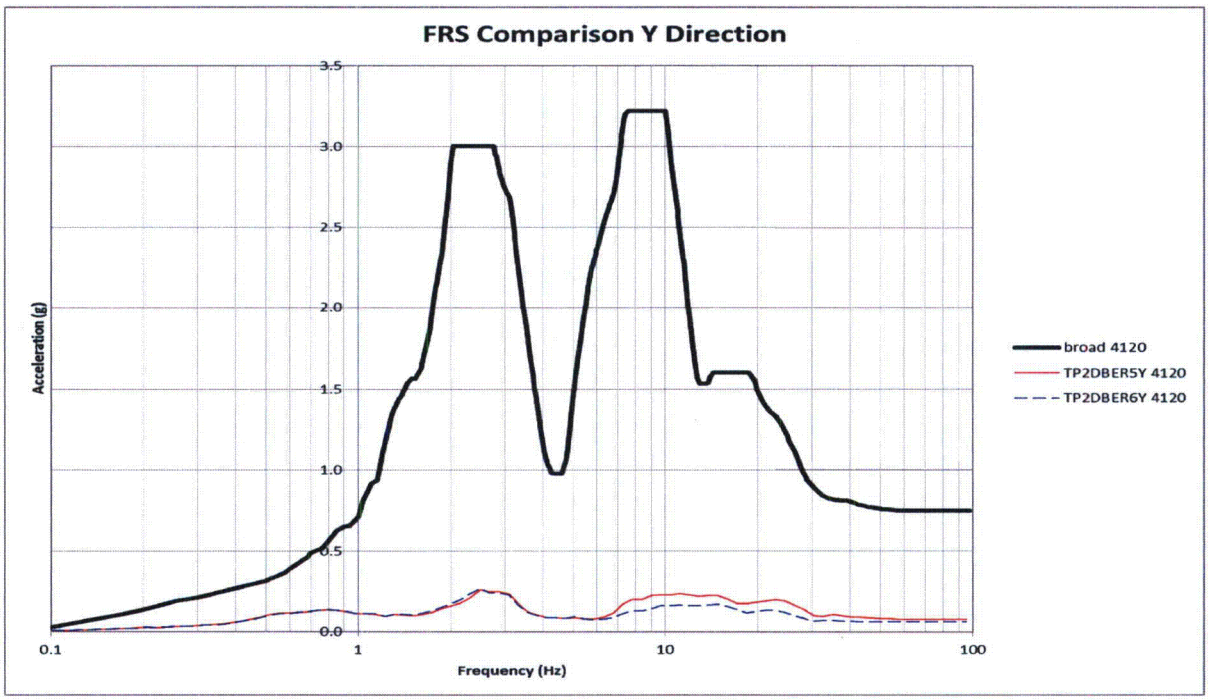

Figure F.2-12. TPNP 2D NI BE Sensitivity FRS Comparison, Y Direction – Node 4120 (El. 179.56 ft)

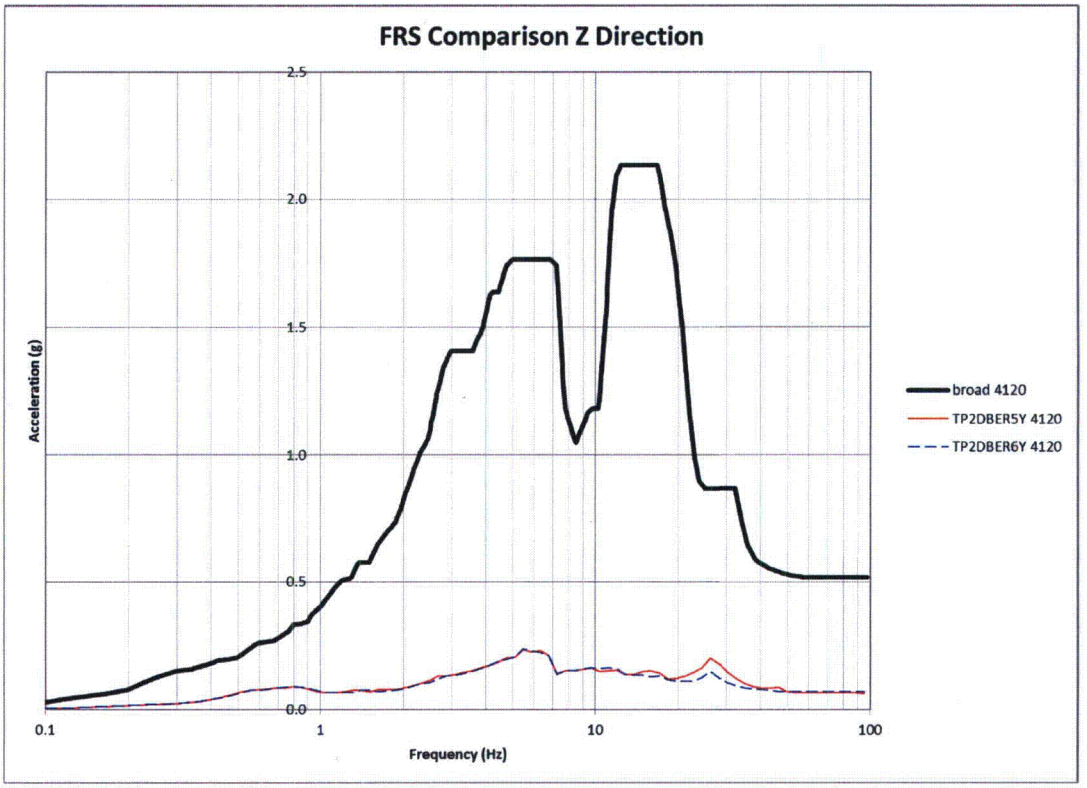

Figure F.2-13. TPNP 2D NI BE Sensitivity FRS Comparison, Z Direction – Node 4120 (El. 179.56 ft)

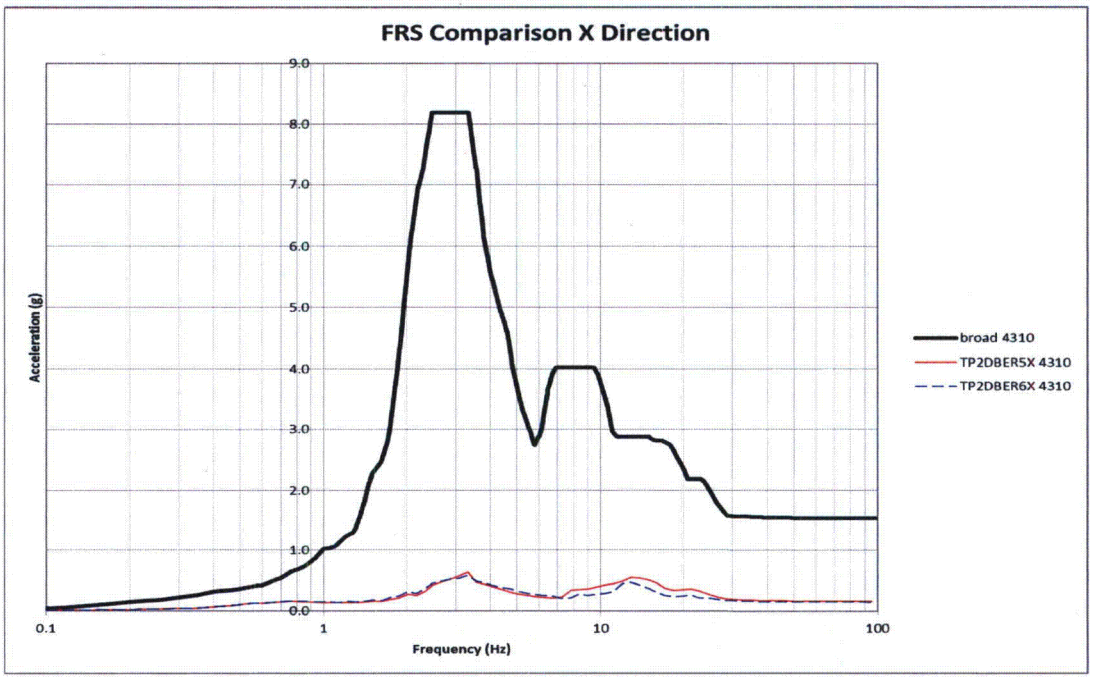

Figure F.2-14. TPNP 2D NI BE Sensitivity FRS Comparison, X Direction – Node 4310 (El. 327.41 ft)

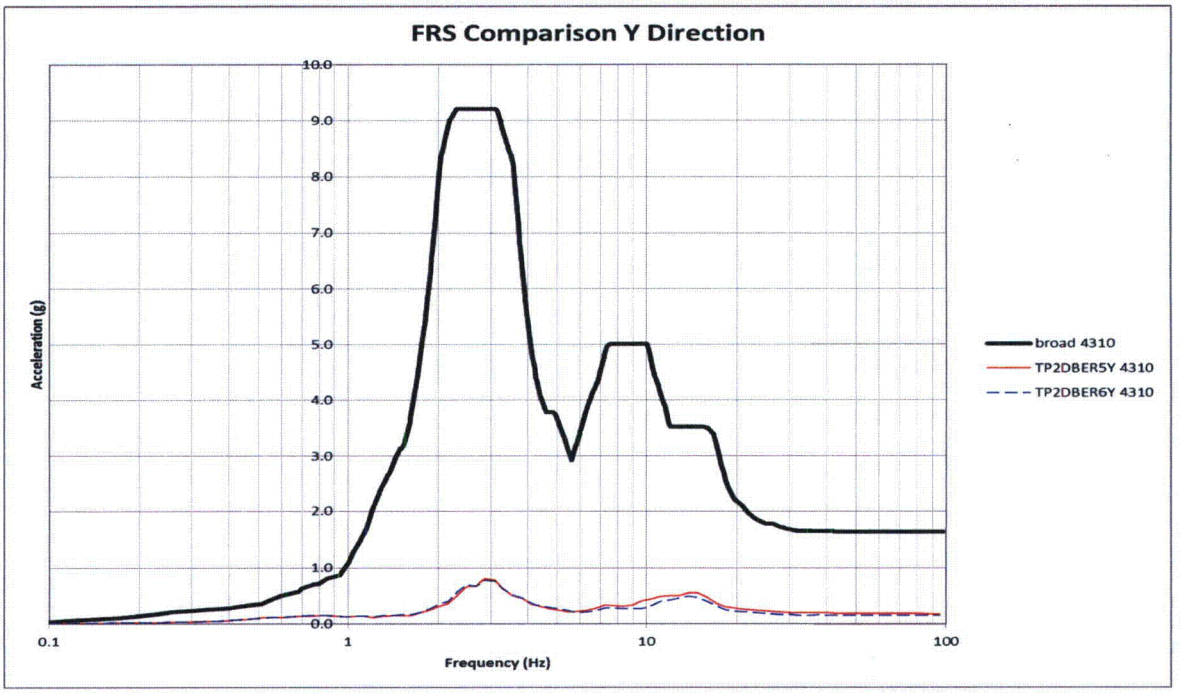

Figure F.2-15. TPNP 2D NI BE Sensitivity FRS Comparison, Y Direction – Node 4310 (El. 327.41 ft)

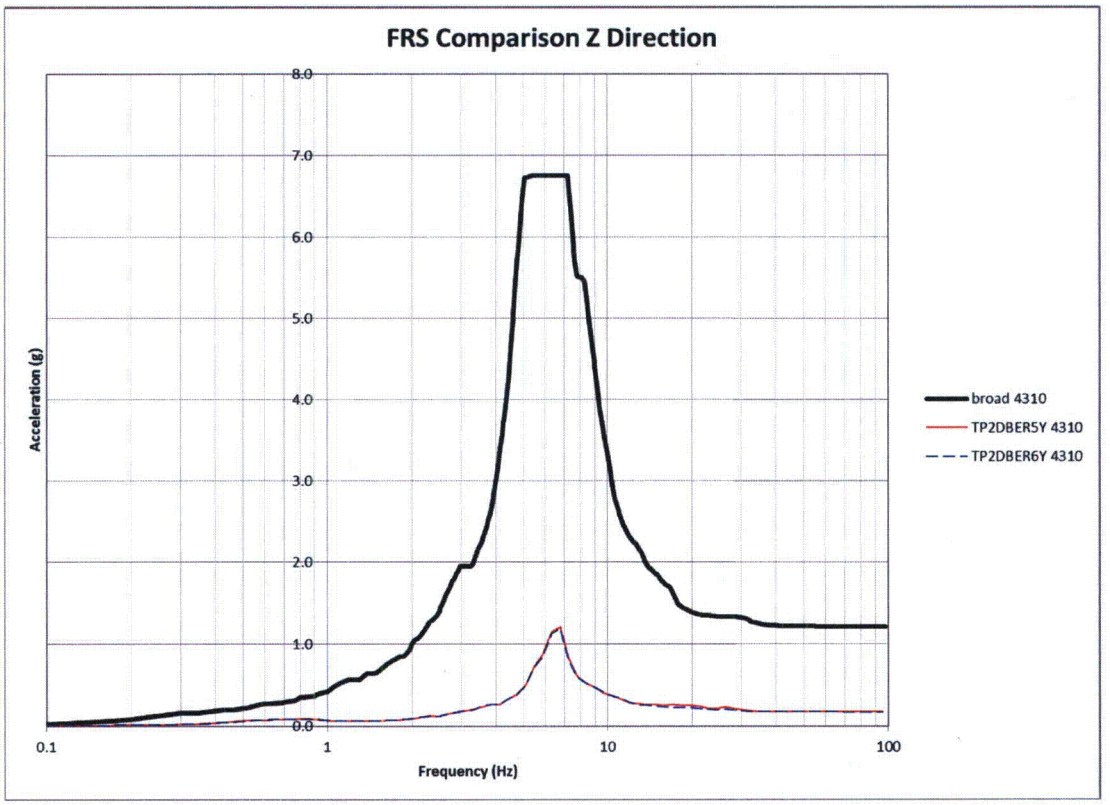

Figure F.2-16. TPNP 2D NI BE Sensitivity FRS Comparison, Z Direction – Node 4310 (El. 327.41 ft)

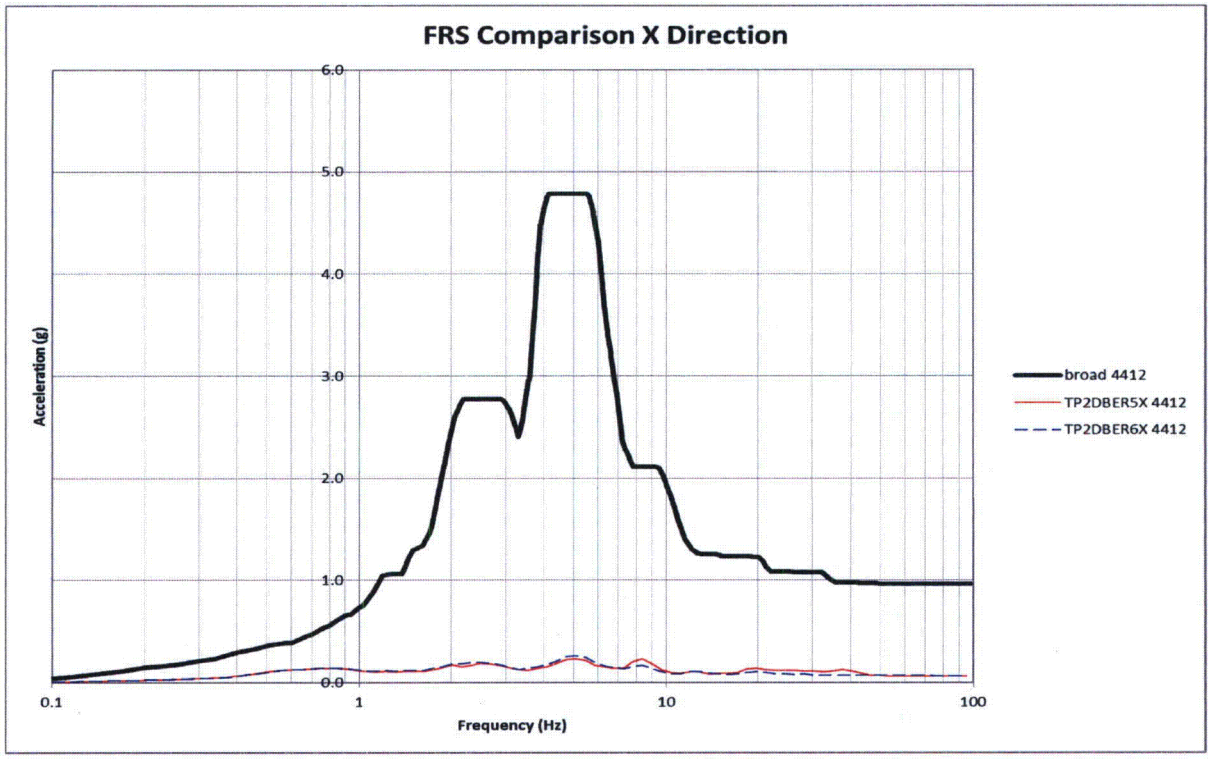

Figure F.2-17. TPNP 2D NI BE Sensitivity FRS Comparison, X Direction – Node 4412 (El. 224.0 ft)

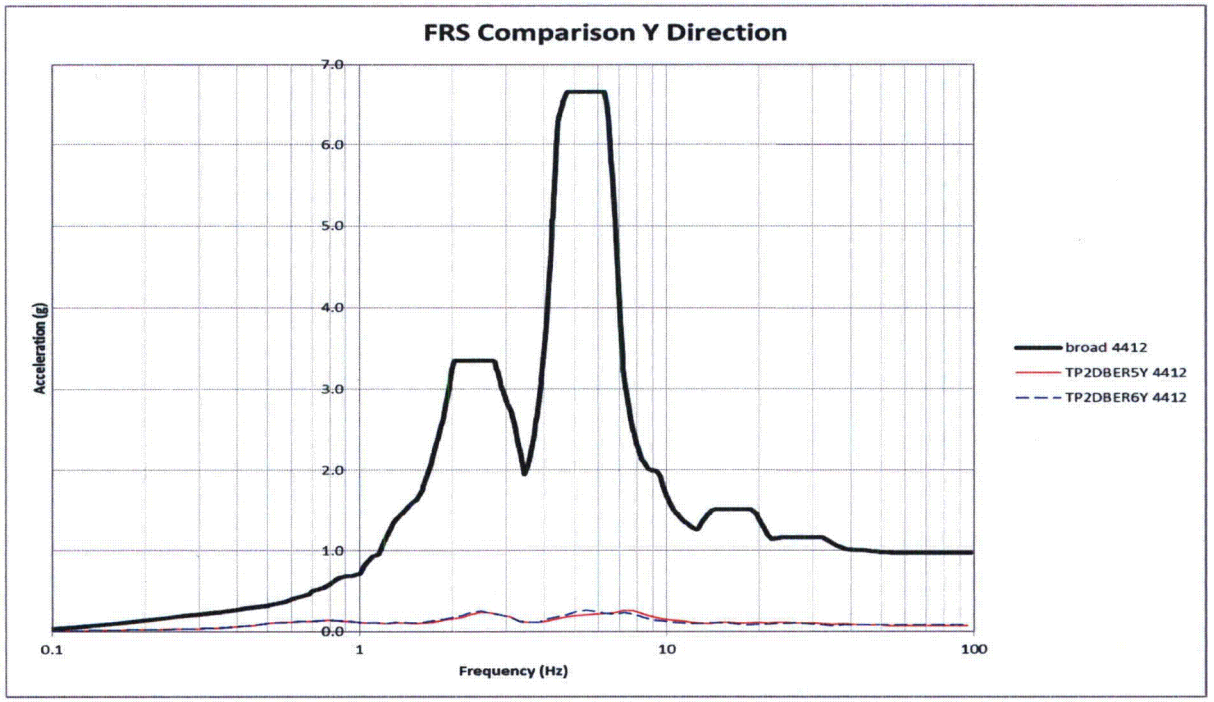

Figure F.2-18. TPNP 2D NI BE Sensitivity FRS Comparison, Y Direction – Node 4412 (El. 224.0 ft)

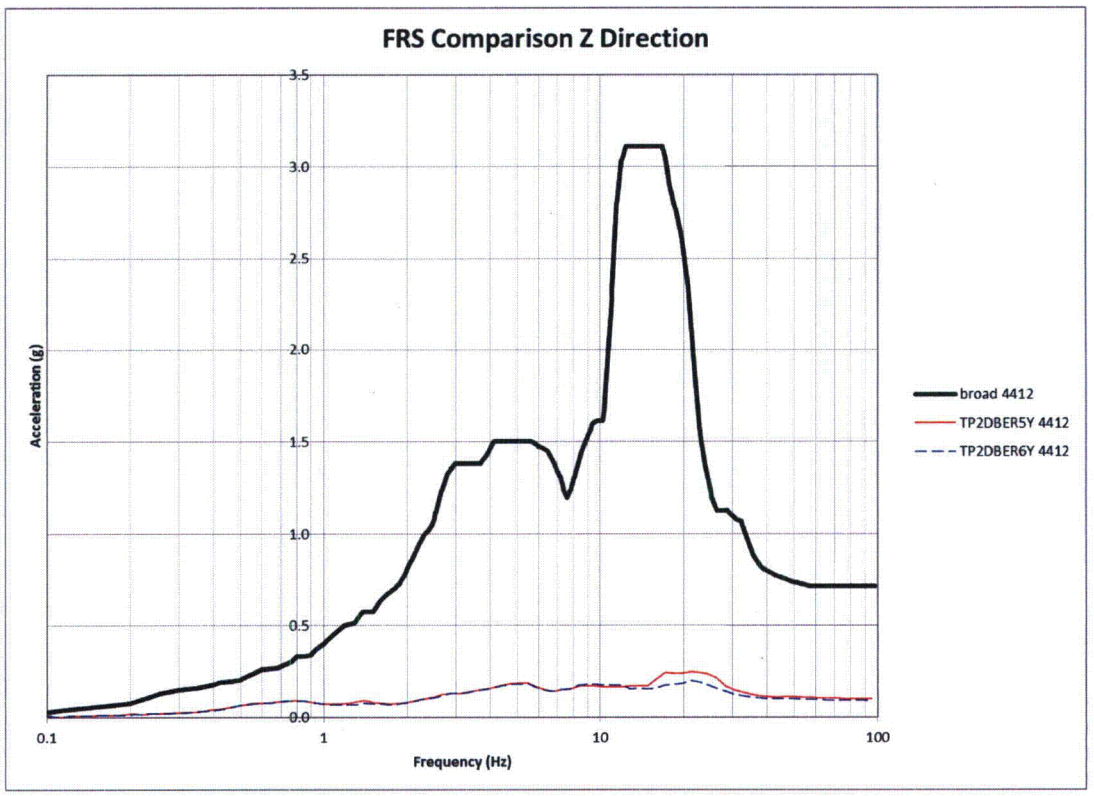

Figure F.2-19. TPNP 2D NI BE Sensitivity FRS Comparison, Z Direction – Node 4412 (El. 224.0 ft)

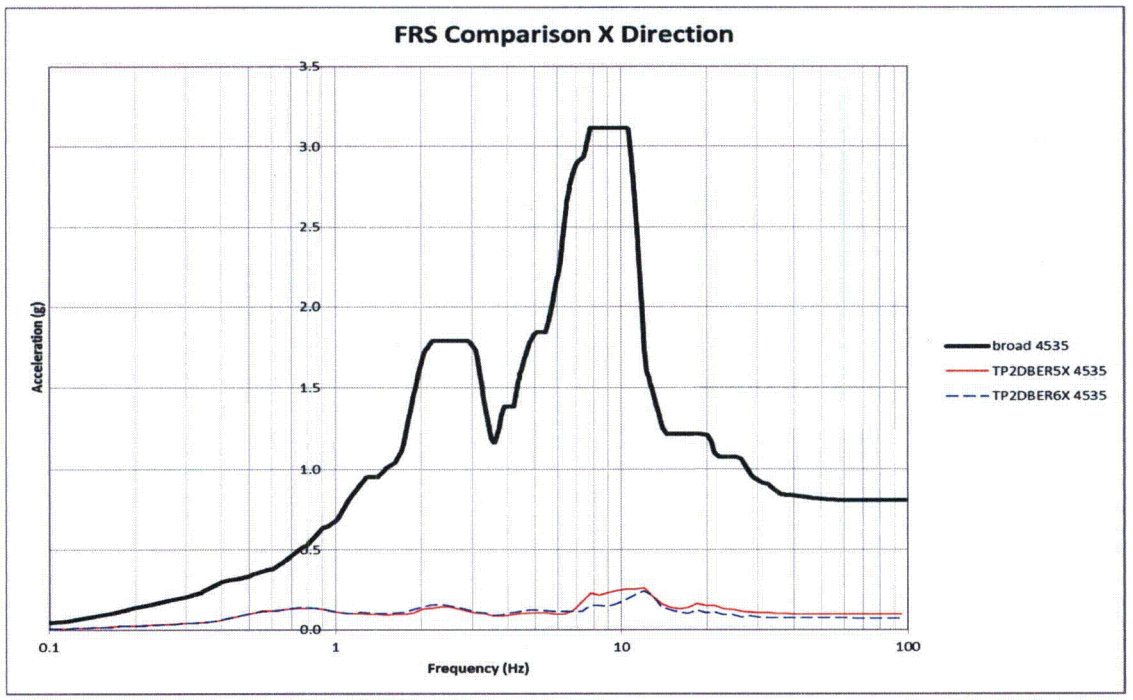

Figure F.2-20. TPNP 2D NI BE Sensitivity FRS Comparison, X Direction – Node 4535 (El. 134.25 ft)

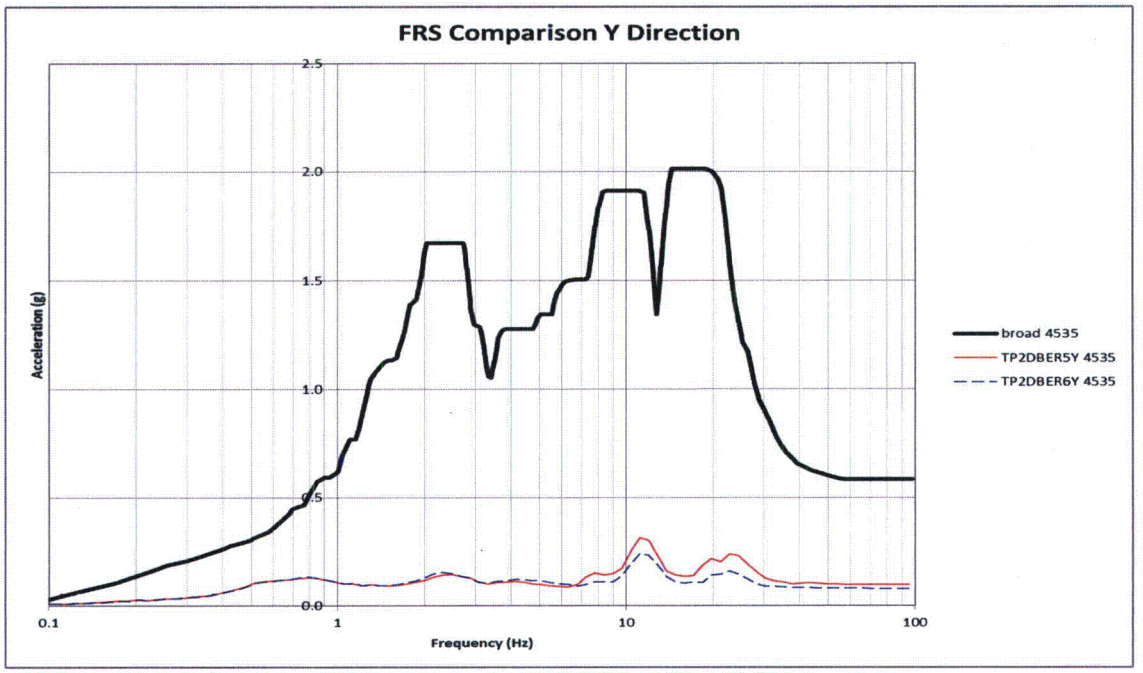

Figure F.2-21. TPNP 2D NI BE Sensitivity FRS Comparison, Y Direction – Node 4535 (El. 134.25 ft)

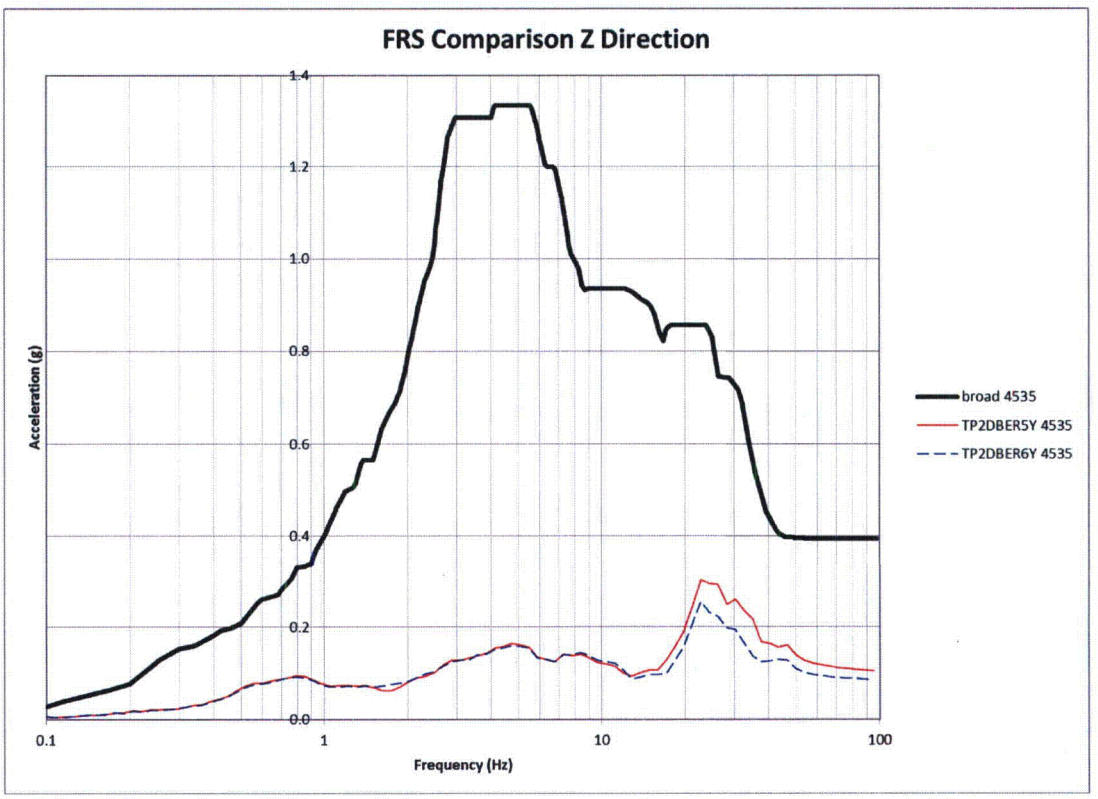

Figure F.2-22. TPNP 2D NI BE Sensitivity FRS Comparison, Z Direction – Node 4435 (El. 134.25 ft)

F.2.2 TPNP Adjacent Structure Relative Displacements

The TPNP 2D NS and EW models were used to obtain updated relative displacements at the locations listed below:

- Turbine Building Foundation to Nuclear Island
- Top of Turbine Building to Nuclear Island (El.170)
- Annex Building Foundation to Nuclear Island
- Top of Annex Building to Nuclear Island (El.180)

The relative displacements were calculated to ensure that there is no contact between the structures at the foundations or at the superstructure. To prevent contact, the relative displacements between the NI and the foundations of the adjacent buildings must be less than 2 inches. To avoid contact between the NI and the Top of the Turbine Building First Bay (elevation 170') and Top of the Annex Building (elevation 180'), the relative displacement between the superstructures must be less than 4 inches. The initial BE and updated BE Sensitivity relative displacements are shown in Table F.2-1. The relative displacements are similar, negligibly influenced by the updated BE seismic input, and are far less than the space allocated; therefore there is no contact between the NI and the adjacent structures.

Table F.2-1. SCII Adjacent Structures BE Sensitivity Relative Displacement Comparison

	North South Model		East West Model	
TPNP Soil Case	**Turbine Building Foundation to Nuclear Island (inches)**	**Top of Turbine Building to Nuclear Island (El.170±) (inches)**	**Annex Building Foundation to Nuclear Island (inches)**	**Top of Annex Building to Nuclear Island (El.180±) (inches)**
BE Sensitivity	0.049	0.174	0.020	0.091
BE	0.050	0.159	0.023	0.081

F.3 Summary of Results and Conclusions

F.3.1 Results

Seismic SSI sensitivity analyses of the SCII Turbine Building First Bay and Annex Building were performed to assess the effect of the updated TPNP BE soil/rock, grouted rock, lean concrete, and engineered fill properties (Reference 12) on the SCII adjacent structures FRS at the ground surface.

Figures F.2-1 through F.2-4 compare the individual BE seismic FRS and the updated SSI sensitivity analysis, and both are compared to the Section 6.3 broadened TPNP SCII FRS. All of the individual and broadened TPNP FRS results are compared to the corresponding AP1000 FRS envelopes.

As shown in Figures F.2-1 through F.2-4, the sensitivity analysis results indicate that the FRS due to the updated properties from supplemental geotechnical data are very similar (within about $\pm$ 10 percent) of the Section 6.3 FRS at the same SCII surface locations. Also, and most importantly, the individual TPNP site-specific FRS and TPNP broadened FRS are enveloped by the AP1000 FRS envelope at all locations.

TPNP floor response spectra at the 2D Nuclear Island key nodes are compared in Figures F.2-5 through F.2-22, which are shown to be negligibly influenced by the updated TPNP BE seismic input and are enveloped by the corresponding 2D AP1000 envelope FRS.

Relative displacements at the base and top of the adjacent structures are presented in Table F.2-1 and indicate that there is no contact between the structures at the foundation and superstructure.

F.3.2 Conclusions

Based on the results of the TPNP 2D SSI sensitivity analyses and comparisons with the initial design-basis SSI analysis results, the effect of the updated site characterization and site response data at Turkey Point Units 6&7 on the SCII Turbine Building First Bay and Annex Building adjacent structures FRS, the NI FRS, and relative displacement is considered negligible. Therefore, the previous design-basis SCII adjacent structures analysis results/conclusions presented in Section 6.3, Figures 6.3-1 through 6.3-4, Table 6.4-1 and described in Section 7.0 are considered still valid.

NRC RAI Letter No. PTN-RAI-LTR-061 Dated May 17, 2012

SRP Section: 03.07.01 – Seismic Design Parameters

Questions from Structural Engineering Branch 1

NRC RAI Number: 03.07.01-16 (eRAI 6432)

In Revision 3 of the applicant's FSAR, (aka. TPG-1000-S2R-802, "Turkey Point Site-Specific Seismic Evaluation Report") A Poisson's ratio of 0.48 is used in the SSI analyses, as indicated in the third paragraph in Section 3JJ.3, "Strain-Compatible Soil Property Profiles." History has shown that high levels of Poisson's ratio often lead to unreliable results when used in the SASSI Computer Program. As a result, staff is requesting that the applicant provide a verification problem that demonstrates the validity of the SASSI solution for Poisson's ratios that are as high as 0.48 for foundation sizes that are consistent with the NI. This should be part of the Software V&V package since the V&V problems should be applicable to the range of parameters for which the software is to be used.

INTRODUCTION:

The existing response to this RAI has not changed as a result of the site response sensitivity analysis that was performed. The conclusions of the site-specific soil structure interaction analysis (TPG-1000-S2R-802 Revision 5) performed for the Turkey Point Units 6 & 7 remain valid.

FPL RESPONSE:

As noted by the Staff in RAI 03.07.01-16, Poisson's ratio of 0.48 was used in the Turkey Point Units 6 & 7 soil-structure interaction (SSI) analyses, and history has shown that high levels of Poisson's ratio often lead to unreliable results when used in the System for Soil-Structure Interaction (SASSI) Computer Program. A Turkey Point specific verification-type problem was performed to evaluate the effect on in-structure response spectra (ISRS) due to a range of Poisson's ratios from 0.42 to maximum of 0.48. The problem response analysis demonstrates the validity of the SASSI solution and that the SASSI computer program results presented for the Turkey Point Unit Units 6 & 7 SSI analysis are considered reliable.

In Revision 5 of TPG-1000-S2R-802, "Turkey Point Site-Specific Seismic Evaluation Report") Table 4.2-3 presents the TPNP 2D Coarse Best-Estimate (BE) SITE profile, and Figure 4.3-3 presents the corresponding 2D model used in the parametric SSI analyses. As shown below, soil profile data from Table 4.3-3 for Layers 17 through 51 indicate Poisson's ratio ranges from 0.42 to 0.47, which generated the ISRS presented in Figures 6.1-3 through 6.1-14 in the TPG-1000-S2R-802 Rev. 5 report. The ISRS results correspond to the six (6) Nuclear Island (NI) locations shown in Table 3.4-1, and is considered the 'base-case' problem solution.

A total of three (3) subsequent SSI analyses were performed, which varied the compression wave velocity (Vp) values of Layers 15 through 49 to achieve Poisson's ratios of 0.42, 0.45 and 0.48, respectively. These SITE profiles are presented below in Tables 03.07.01-16-1, 03.07.01-16-2 and 03.07.01-16-3, respectively. The corresponding ISRS for each of the Poisson's ratio cases are compared to the Turkey Point Coarse BE base case ISRS, which are shown below in Figures 03.07.01-16-1 through 03.07.01-16-12. As shown, the parametric SSI analyses with Poisson's ratio varying from 0.42, 0.45 and 0.48 compared to the Turkey Point BE base case with a range of Poisson's ratio from 0.42 to 0.47 indicate that the effect of Poisson's ratio on ISRS is negligible. Consequently, based on these parametric analyses and corresponding ISRS comparison presented below, the Turkey Point Units 6 & 7 SASSI SSI results are considered reliable.

Data Derived from Table 3.2-1 in TPG-1000-S2R-807 Rev. 2
TPNP 2D Coarse BE POISSON'S RATIO BASE CASE SOIL PROFILE

Layer	Thickness	Unit Wt.	Vs	Vp	Damping	Poisson's Ratio
	(ft)	(kcf)	(ft/sec)	(ft/sec)	(dim)	(hz)
1	17.5	0.130	769	1439	0.037	0.30
2	16	0.128	1100	3313	0.050	0.44
3	6	0.128	3708	8772	0.006	0.39
4	2.0	0.125	4735	10086	0.006	0.36
5	5.00	0.125	4735	10086	0.006	0.36
6	10.00	0.125	5053	9999	0.006	0.33
7	4.00	0.150	5519	8600	0.011	0.15
8	6.00	0.155	5674	8843	0.010	0.15
9	10.00	0.155	5781	10816	0.010	0.30
10	10.00	0.155	5450	10016	0.010	0.29
11	10.00	0.136	4858	9007	0.010	0.29
12	10.00	0.136	4769	9623	0.010	0.34
13	10.00	0.136	4712	9446	0.010	0.33
14	10.00	0.136	4671	9224	0.010	0.33
15	10.00	0.136	4559	9080	0.010	0.33
16	10.00	0.136	1847	5000	0.010	0.42
17	10.00	0.120	1470	5000	0.019	0.45
18	10.00	0.120	1532	6388	0.018	0.47
19	10.00	0.120	1532	5079	0.018	0.45
20	10.00	0.120	1596	6309	0.017	0.47
21	10.00	0.120	1607	5861	0.017	0.46
22	10.00	0.120	1622	5640	0.017	0.45
23	10.00	0.120	1626	5820	0.017	0.46
24	10.00	0.120	1647	5981	0.017	0.46
25	10.00	0.120	1735	6060	0.016	0.46
26	10.00	0.120	1941	6303	0.014	0.45
27	10.00	0.120	1959	5564	0.014	0.43
28	10.00	0.120	1886	5086	0.014	0.42
29	10.00	0.120	1839	5699	0.015	0.44
30	10.00	0.120	1754	5082	0.016	0.43
31	10.00	0.120	1679	5411	0.017	0.45
32	10.00	0.120	1675	5880	0.017	0.46
33	10.00	0.120	1609	5534	0.017	0.45
34	10.00	0.120	1559	5022	0.018	0.45

Data Derived from Table 3.2-1 in TPG-1000-S2R-807 Rev. 2
TPNP 2D Coarse BE POISSON'S RATIO BASE CASE SOIL PROFILE

(continued)

Layer	Thickness	Unit Wt.	Vs	Vp	Damping	Poisson's Ratio
35	10.00	0.120	1555	5327	0.018	0.45
36	10.00	0.120	1518	5164	0.019	0.45
37	10.00	0.120	1445	5000	0.020	0.45
38	10.00	0.120	1440	5650	0.020	0.47
39	10.00	0.120	1440	5745	0.020	0.47
40	10.00	0.120	1438	5682	0.020	0.47
41	10.00	0.120	1438	5616	0.020	0.46
42	10.00	0.120	1425	5630	0.021	0.47
43	10.00	0.120	1416	5707	0.021	0.47
44	10.00	0.120	1407	5360	0.021	0.46
45	10.00	0.120	1399	5599	0.021	0.47
46	10.00	0.120	1395	5438	0.022	0.46
47	10.00	0.120	1395	5587	0.022	0.47
48	10.00	0.120	1391	5588	0.022	0.47
49	10.00	0.120	1390	5582	0.022	0.47
50	10.00	0.130	3911	15710	0.008	0.47
51	10.00	0.130	3911	15710	0.008	0.47
52	10.00	0.130	3911	8543	0.008	0.37
53	10.00	0.130	3910	7714	0.008	0.33
54	10.00	0.130	3897	7895	0.008	0.34
55	10.00	0.130	3886	7881	0.008	0.34
56	10.00	0.130	3867	8006	0.009	0.35
57	10.00	0.130	3840	8012	0.009	0.35
58	10.00	0.130	3789	7637	0.009	0.34
59	10.00	0.130	3779	7914	0.009	0.35
60	10.00	0.130	3569	7861	0.009	0.37
61	10.00	0.130	3407	7719	0.010	0.38
62	10.00	0.130	3151	7437	0.010	0.39
63	10.00	0.130	3159	7683	0.010	0.40
64	10.00	0.130	3189	7487	0.010	0.39
65	10.00	0.130	3382	7493	0.010	0.37
66	10.00	0.130	3529	7346	0.010	0.35
67	64.00	0.130	4308	8968	0.003	0.35
68	100.00	0.130	4304	8960	0.003	0.35
Halfspace	0.170	9200	17212	0.010		

Table 03.07.01-16-1 LAYERS 17 – 51
TPNP 2D Coarse BE POISSON'S RATIO = 0.42

Layer	Thickness (ft)	Unit Wt. (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping (dim)	Poisson's Ratio (hz)
1	17.5	0.130	769	1439	0.037	0.30
2	16	0.128	1100	3313	0.050	0.44
3	6	0.128	3708	8772	0.006	0.39
4	2.0	0.125	4735	10086	0.006	0.36
5	5.00	0.125	4735	10086	0.006	0.36
6	10.00	0.125	5053	9999	0.006	0.33
7	4.00	0.150	5519	8600	0.011	0.15
8	6.00	0.155	5674	8843	0.010	0.15
9	10.00	0.155	5781	10816	0.010	0.30
10	10.00	0.155	5450	10016	0.010	0.29
11	10.00	0.136	4858	9007	0.010	0.29
12	10.00	0.136	4769	9623	0.010	0.34
13	10.00	0.136	4712	9446	0.010	0.33
14	10.00	0.136	4671	9224	0.010	0.33
15	10.00	0.136	4559	9080	0.010	0.33
16	10.00	0.136	1847	5000	0.010	0.42
17	10.00	0.120	1470	3900	0.019	0.42
18	10.00	0.120	1532	4200	0.018	0.42
19	10.00	0.120	1532	4200	0.018	0.42
20	10.00	0.120	1596	4250	0.017	0.42
21	10.00	0.120	1607	4300	0.017	0.42
22	10.00	0.120	1622	4300	0.017	0.42
23	10.00	0.120	1626	4300	0.017	0.42
24	10.00	0.120	1647	4400	0.017	0.42
25	10.00	0.120	1735	4600	0.016	0.42
26	10.00	0.120	1941	5100	0.014	0.42
27	10.00	0.120	1959	5200	0.014	0.42
28	10.00	0.120	1886	5100	0.014	0.42
29	10.00	0.120	1839	5050	0.015	0.42
30	10.00	0.120	1754	4700	0.016	0.42
31	10.00	0.120	1679	4500	0.017	0.42
32	10.00	0.120	1675	4500	0.017	0.42
33	10.00	0.120	1609	4400	0.017	0.42
34	10.00	0.120	1559	4300	0.018	0.42

Table 03.07.01-16-1 LAYERS 17 – 51
TPNP 2D Coarse BE POISSON'S RATIO = 0.42
(continued)

Layer	Thickness (ft)	Unit Wt. (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping (dim)	Poisson's Ratio (hz)
35	10.00	0.120	1555	4300	0.018	0.42
36	10.00	0.120	1518	4150	0.019	0.42
37	10.00	0.120	1445	4000	0.020	0.42
38	10.00	0.120	1440	3950	0.020	0.42
39	10.00	0.120	1440	3950	0.020	0.42
40	10.00	0.120	1438	3950	0.020	0.42
41	10.00	0.120	1438	3950	0.020	0.42
42	10.00	0.120	1425	3900	0.021	0.42
43	10.00	0.120	1416	3900	0.021	0.42
44	10.00	0.120	1407	3850	0.021	0.42
45	10.00	0.120	1399	3850	0.021	0.42
46	10.00	0.120	1395	3850	0.022	0.42
47	10.00	0.120	1395	3850	0.022	0.42
48	10.00	0.120	1391	3850	0.022	0.42
49	10.00	0.120	1390	3800	0.022	0.42
50	10.00	0.130	3911	10500	0.008	0.42
51	10.00	0.130	3911	10500	0.008	0.42
52	10.00	0.130	3911	8543	0.008	0.37
53	10.00	0.130	3910	7714	0.008	0.33
54	10.00	0.130	3897	7895	0.008	0.34
55	10.00	0.130	3886	7881	0.008	0.34
56	10.00	0.130	3867	8006	0.009	0.35
57	10.00	0.130	3840	8012	0.009	0.35
58	10.00	0.130	3789	7637	0.009	0.34
59	10.00	0.130	3779	7914	0.009	0.35
60	10.00	0.130	3569	7861	0.009	0.37
61	10.00	0.130	3407	7719	0.010	0.38
62	10.00	0.130	3151	7437	0.010	0.39
63	10.00	0.130	3159	7683	0.010	0.40
64	10.00	0.130	3189	7487	0.010	0.39
65	10.00	0.130	3382	7493	0.010	0.37
66	10.00	0.130	3529	7346	0.010	0.35
67	64.00	0.130	4308	8968	0.003	0.35
68	100.00	0.130	4304	8960	0.003	0.35
Halfspace	0.170	9200	17212	0.010		

Table 03.07.01-16-2 LAYERS 17 – 51
TPNP 2D Coarse BE POISSON'S RATIO = 0.45

Layer	Thickness (ft)	Unit Wt. (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping (dim)	Poisson's Ratio (hz)
1	17.5	0.130	769	1439	0.037	0.30
2	16	0.128	1100	3313	0.050	0.44
3	6	0.128	3708	8772	0.006	0.39
4	2.0	0.125	4735	10086	0.006	0.36
5	5.00	0.125	4735	10086	0.006	0.36
6	10.00	0.125	5053	9999	0.006	0.33
7	4.00	0.150	5519	8600	0.011	0.15
8	6.00	0.155	5674	8843	0.010	0.15
9	10.00	0.155	5781	10816	0.010	0.30
10	10.00	0.155	5450	10016	0.010	0.29
11	10.00	0.136	4858	9007	0.010	0.29
12	10.00	0.136	4769	9623	0.010	0.34
13	10.00	0.136	4712	9446	0.010	0.33
14	10.00	0.136	4671	9224	0.010	0.33
15	10.00	0.136	4559	9080	0.010	0.33
16	10.00	0.136	1847	5000	0.010	0.42
17	10.00	0.120	1470	5000	0.019	0.45
18	10.00	0.120	1532	5300	0.018	0.45
19	10.00	0.120	1532	5300	0.018	0.45
20	10.00	0.120	1596	5350	0.017	0.45
21	10.00	0.120	1607	5400	0.017	0.45
22	10.00	0.120	1622	5400	0.017	0.45
23	10.00	0.120	1626	5400	0.017	0.45
24	10.00	0.120	1647	5500	0.017	0.45
25	10.00	0.120	1735	5700	0.016	0.45
26	10.00	0.120	1941	6200	0.014	0.45
27	10.00	0.120	1959	6300	0.014	0.45
28	10.00	0.120	1886	6200	0.014	0.45
29	10.00	0.120	1839	6150	0.015	0.45
30	10.00	0.120	1754	5800	0.016	0.45
31	10.00	0.120	1679	5600	0.017	0.45
32	10.00	0.120	1675	5600	0.017	0.45
33	10.00	0.120	1609	5500	0.017	0.45
34	10.00	0.120	1559	5400	0.018	0.45

Table 03.07.01-16-2 LAYERS 17 – 51
TPNP 2D Coarse BE POISSON'S RATIO = 0.45
(continued)

Layer	Thickness (ft)	Unit Wt. (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping (dim)	Poisson's Ratio (hz)
35	10.00	0.120	1555	5400	0.018	0.45
36	10.00	0.120	1518	5250	0.019	0.45
37	10.00	0.120	1445	5000	0.020	0.45
38	10.00	0.120	1440	4950	0.020	0.45
39	10.00	0.120	1440	4950	0.020	0.45
40	10.00	0.120	1438	4950	0.020	0.45
41	10.00	0.120	1438	4950	0.020	0.45
42	10.00	0.120	1425	4900	0.021	0.45
43	10.00	0.120	1416	4900	0.021	0.45
44	10.00	0.120	1407	4850	0.021	0.45
45	10.00	0.120	1399	4850	0.021	0.45
46	10.00	0.120	1395	4850	0.022	0.45
47	10.00	0.120	1395	4850	0.022	0.45
48	10.00	0.120	1391	4750	0.022	0.45
49	10.00	0.120	1390	4700	0.022	0.45
50	10.00	0.130	3911	12500	0.008	0.45
51	10.00	0.130	3911	12500	0.008	0.45
52	10.00	0.130	3911	8543	0.008	0.37
53	10.00	0.130	3910	7714	0.008	0.33
54	10.00	0.130	3897	7895	0.008	0.34
55	10.00	0.130	3886	7881	0.008	0.34
56	10.00	0.130	3867	8006	0.009	0.35
57	10.00	0.130	3840	8012	0.009	0.35
58	10.00	0.130	3789	7637	0.009	0.34
59	10.00	0.130	3779	7914	0.009	0.35
60	10.00	0.130	3569	7861	0.009	0.37
61	10.00	0.130	3407	7719	0.010	0.38
62	10.00	0.130	3151	7437	0.010	0.39
63	10.00	0.130	3159	7683	0.010	0.40
64	10.00	0.130	3189	7487	0.010	0.39
65	10.00	0.130	3382	7493	0.010	0.37
66	10.00	0.130	3529	7346	0.010	0.35
67	64.00	0.130	4308	8968	0.003	0.35
68	100.00	0.130	4304	8960	0.003	0.35
Halfspace	0.170	9200	17212	0.010		

Table 03.07.01-16-3 LAYERS 17 – 51
TPNP 2D Coarse BE POISSON'S RATIO = 0.48

Layer	Thickness (ft)	Unit Wt. (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping (dim)	Poisson's Ratio (hz)
1	17.5	0.130	769	1439	0.037	0.30
2	16	0.128	1100	3313	0.050	0.44
3	6	0.128	3708	8772	0.006	0.39
4	2.0	0.125	4735	10086	0.006	0.36
5	5.00	0.125	4735	10086	0.006	0.36
6	10.00	0.125	5053	9999	0.006	0.33
7	4.00	0.150	5519	8600	0.011	0.15
8	6.00	0.155	5674	8843	0.010	0.15
9	10.00	0.155	5781	10816	0.010	0.30
10	10.00	0.155	5450	10016	0.010	0.29
11	10.00	0.136	4858	9007	0.010	0.29
12	10.00	0.136	4769	9623	0.010	0.34
13	10.00	0.136	4712	9446	0.010	0.33
14	10.00	0.136	4671	9224	0.010	0.33
15	10.00	0.136	4559	9080	0.010	0.33
16	10.00	0.136	1847	5000	0.010	0.42
17	10.00	0.120	1470	7000	0.019	0.48
18	10.00	0.120	1532	7300	0.018	0.48
19	10.00	0.120	1532	7300	0.018	0.48
20	10.00	0.120	1596	7350	0.017	0.48
21	10.00	0.120	1607	7400	0.017	0.48
22	10.00	0.120	1622	7900	0.017	0.48
23	10.00	0.120	1626	7900	0.017	0.48
24	10.00	0.120	1647	8000	0.017	0.48
25	10.00	0.120	1735	8200	0.016	0.48
26	10.00	0.120	1941	9200	0.014	0.48
27	10.00	0.120	1959	9300	0.014	0.48
28	10.00	0.120	1886	8700	0.014	0.48
29	10.00	0.120	1839	8650	0.015	0.48
30	10.00	0.120	1754	8300	0.016	0.48
31	10.00	0.120	1679	8100	0.017	0.48
32	10.00	0.120	1675	8100	0.017	0.48
33	10.00	0.120	1609	7500	0.017	0.48
34	10.00	0.120	1559	7400	0.018	0.48

Table 03.07.01-16-3 LAYERS 17 – 51
TPNP 2D Coarse BE POISSON'S RATIO = 0.48
(continued)

Layer	Thickness (ft)	Unit Wt. (kcf)	Vs (ft/sec)	Vp (ft/sec)	Damping (dim)	Poisson's Ratio (hz)
35	10.00	0.120	1555	7400	0.018	0.48
36	10.00	0.120	1518	7250	0.019	0.48
37	10.00	0.120	1445	7000	0.020	0.48
38	10.00	0.120	1440	6950	0.020	0.48
39	10.00	0.120	1440	6950	0.020	0.48
40	10.00	0.120	1438	6950	0.020	0.48
41	10.00	0.120	1438	6950	0.020	0.48
42	10.00	0.120	1425	6900	0.021	0.48
43	10.00	0.120	1416	6900	0.021	0.48
44	10.00	0.120	1407	6850	0.021	0.48
45	10.00	0.120	1399	6850	0.021	0.48
46	10.00	0.120	1395	6850	0.022	0.48
47	10.00	0.120	1395	6850	0.022	0.48
48	10.00	0.120	1391	6750	0.022	0.48
49	10.00	0.120	1390	6700	0.022	0.48
50	10.00	0.130	3911	18500	0.008	0.48
51	10.00	0.130	3911	18500	0.008	0.48
52	10.00	0.130	3911	8543	0.008	0.37
53	10.00	0.130	3910	7714	0.008	0.33
54	10.00	0.130	3897	7895	0.008	0.34
55	10.00	0.130	3886	7881	0.008	0.34
56	10.00	0.130	3867	8006	0.009	0.35
57	10.00	0.130	3840	8012	0.009	0.35
58	10.00	0.130	3789	7637	0.009	0.34
59	10.00	0.130	3779	7914	0.009	0.35
60	10.00	0.130	3569	7861	0.009	0.37
61	10.00	0.130	3407	7719	0.010	0.38
62	10.00	0.130	3151	7437	0.010	0.39
63	10.00	0.130	3159	7683	0.010	0.40
64	10.00	0.130	3189	7487	0.010	0.39
65	10.00	0.130	3382	7493	0.010	0.37
66	10.00	0.130	3529	7346	0.010	0.35
67	64.00	0.130	4308	8968	0.003	0.35
68	100.00	0.130	4304	8960	0.003	0.35
Halfspace	0.170	9200	17212	0.010		

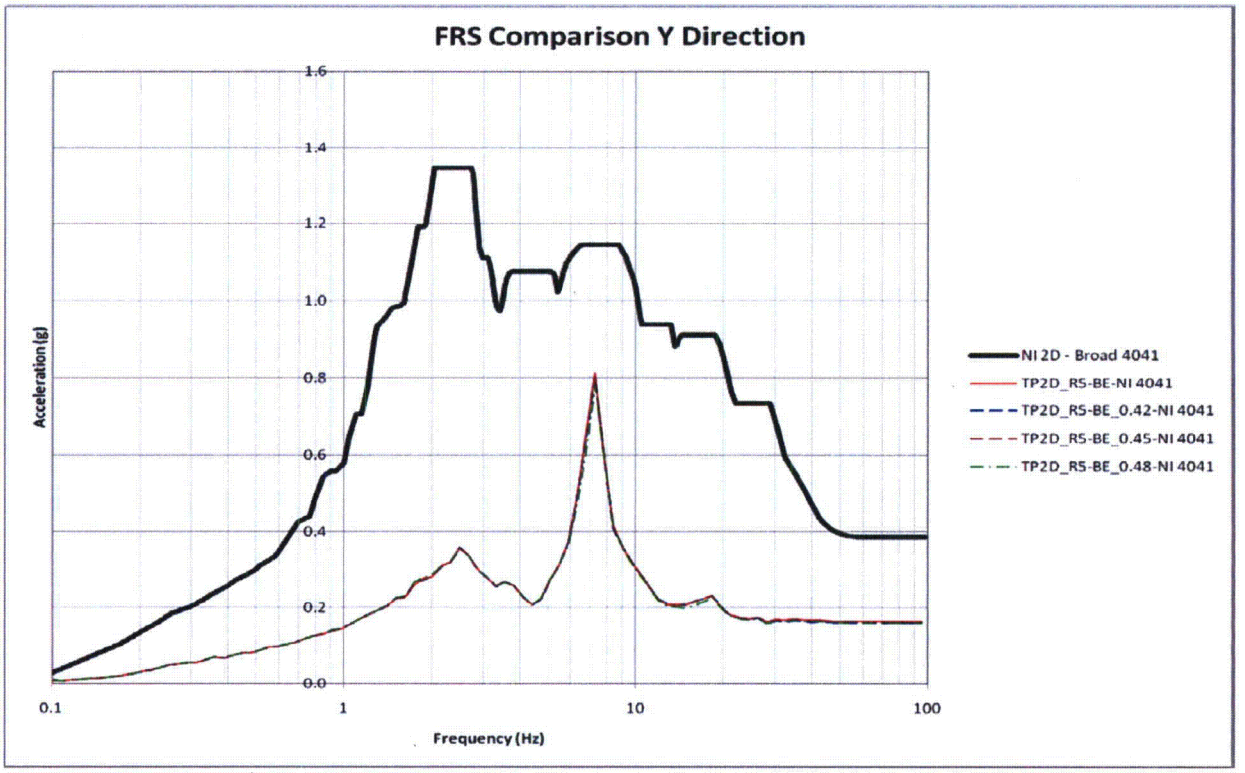

Figure 03.07.01-16-1

TPNP 2D BE FRS with Poisson's Ratio of 0.42, 0.45 and 0.48 – Node 4041Y

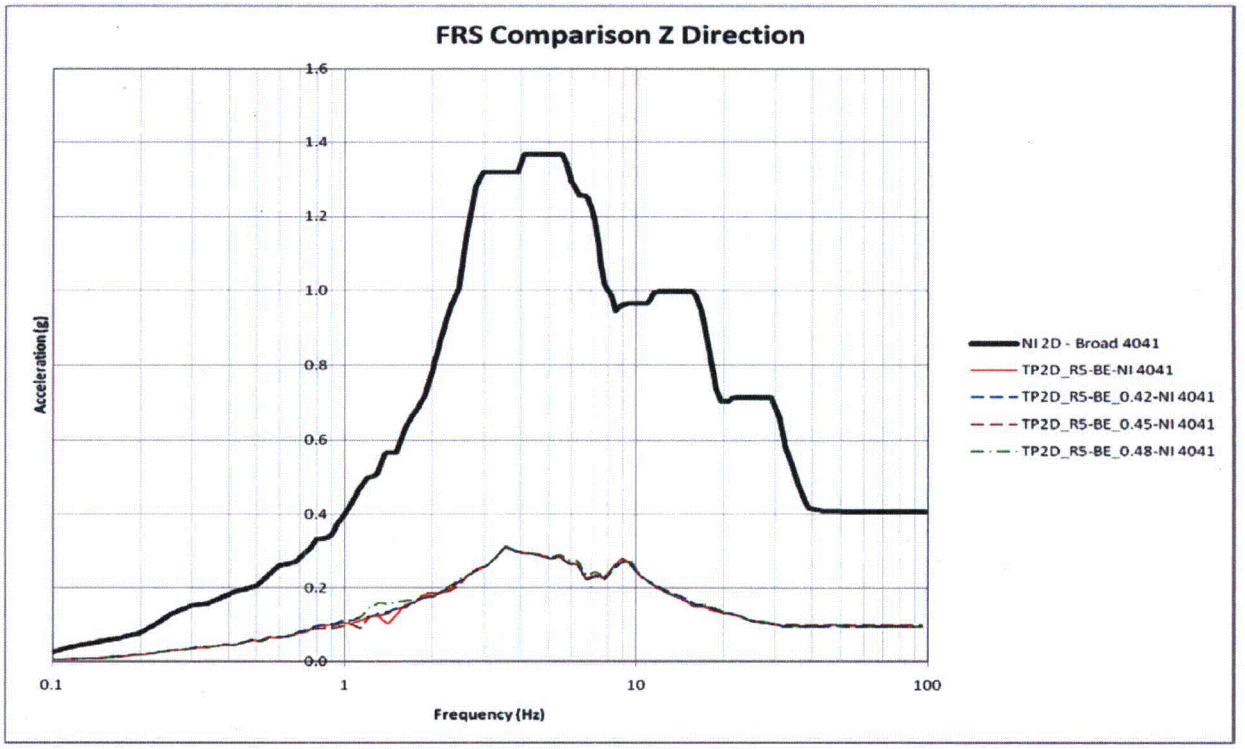

Figure 03.07.01-16-2

TPNP 2D BE FRS with Poisson's Ratio of 0.42, 0.45 and 0.48 – Node 4041Z

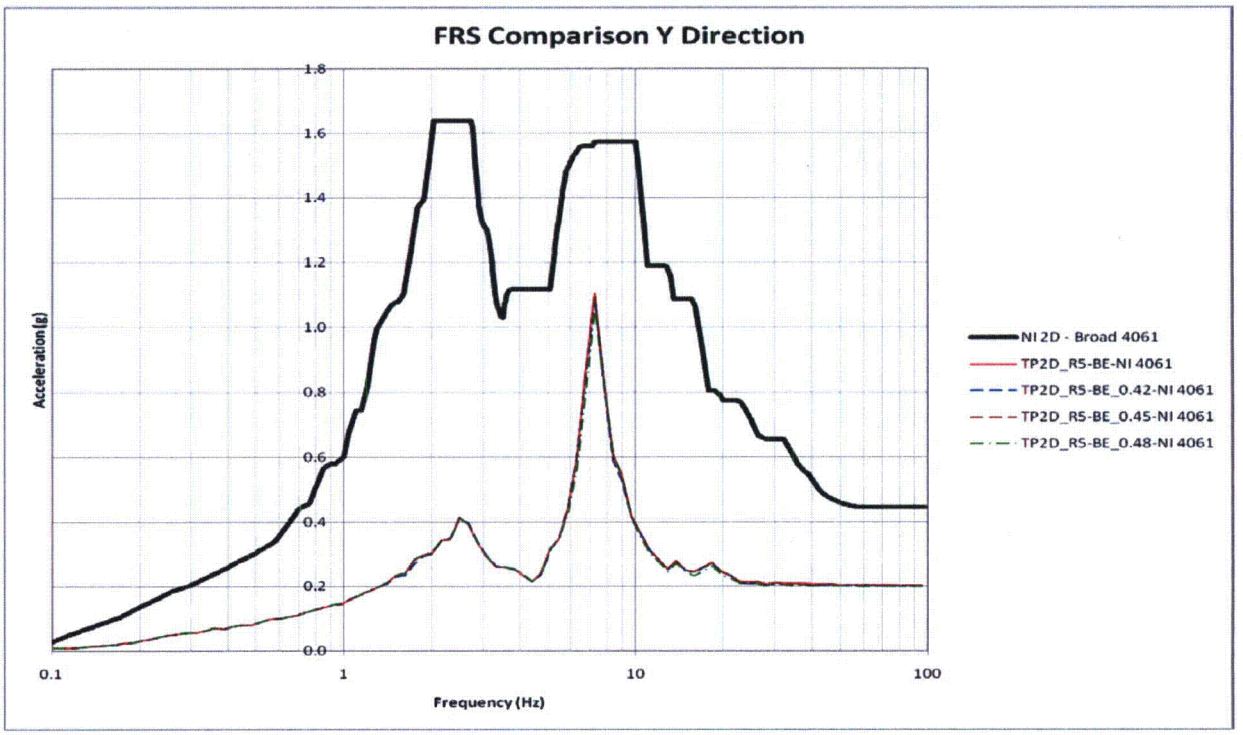

Figure 03.07.01-16-3

TPNP 2D BE FRS with Poisson's Ratio of 0.42, 0.45 and 0.48 – Node 4061Y

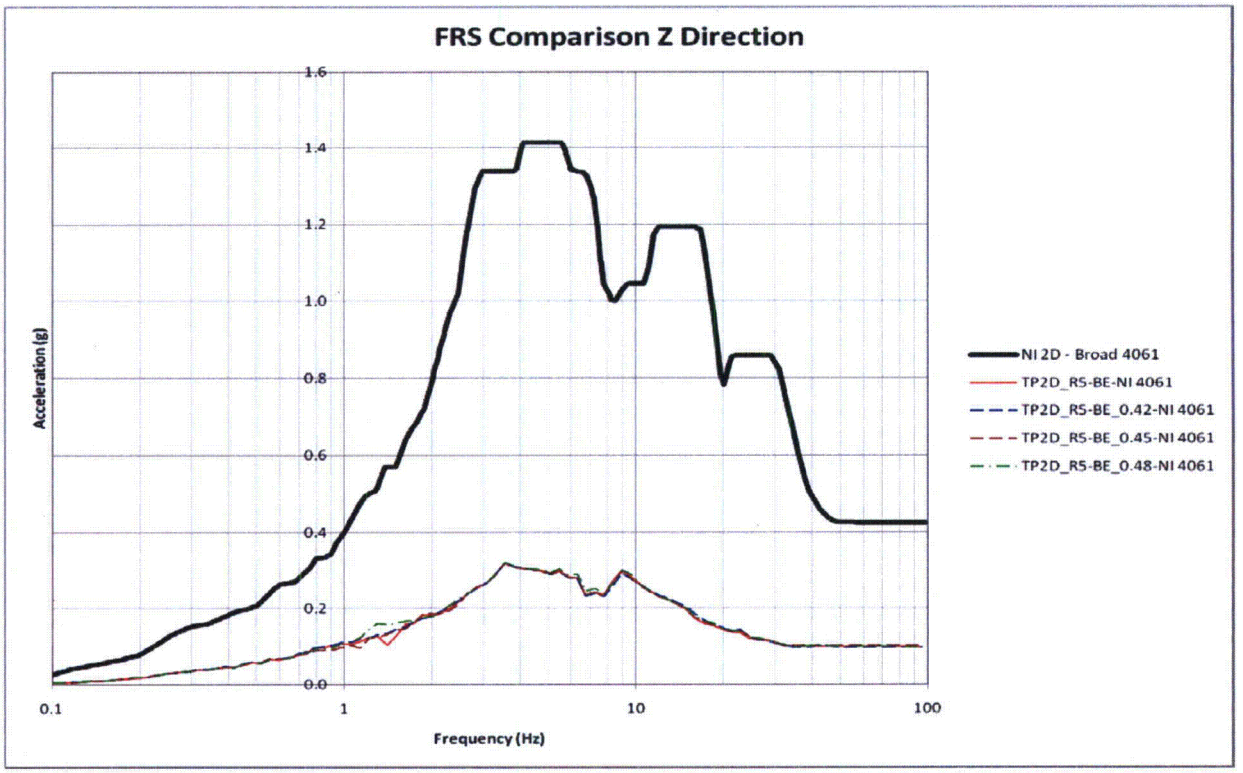

Figure 03.07.01-16-4

TPNP 2D BE FRS with Poisson's Ratio of 0.42, 0.45 and 0.48 – Node 4061Z

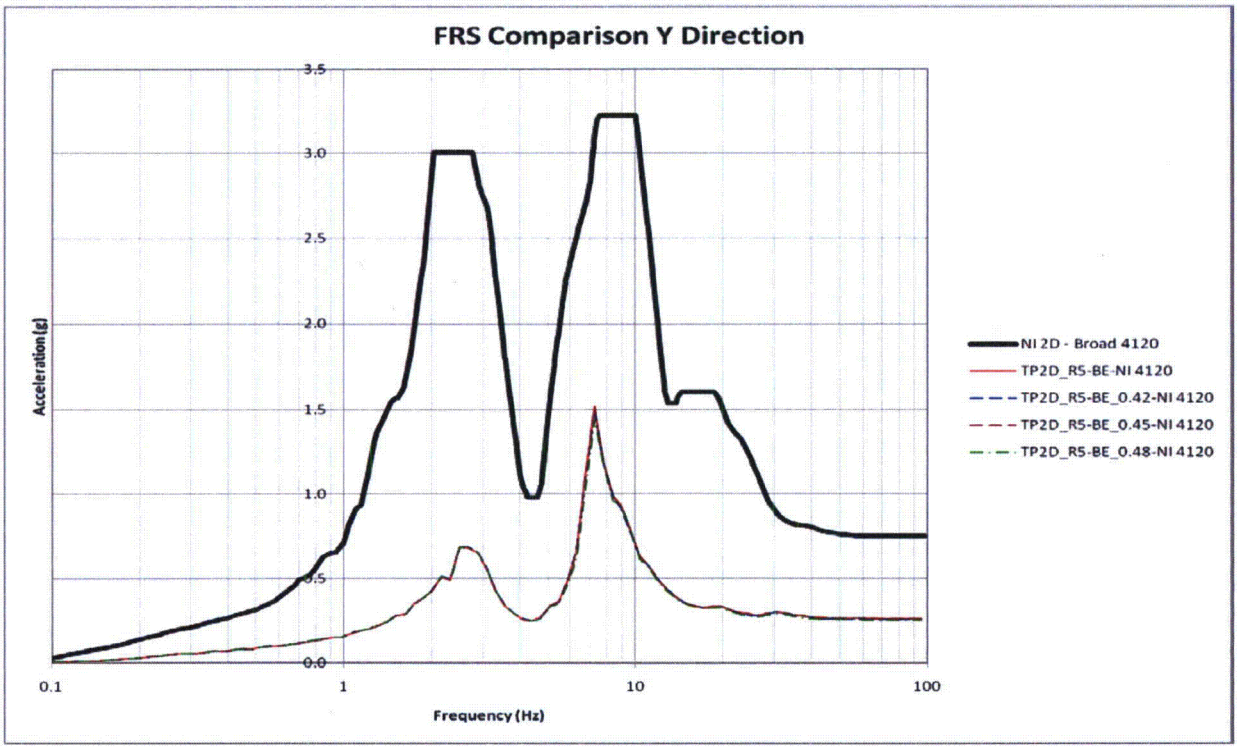

Figure 03.07.01-16-5

TPNP 2D BE FRS with Poisson's Ratio of 0.42, 0.45 and 0.48 – Node 4120Y

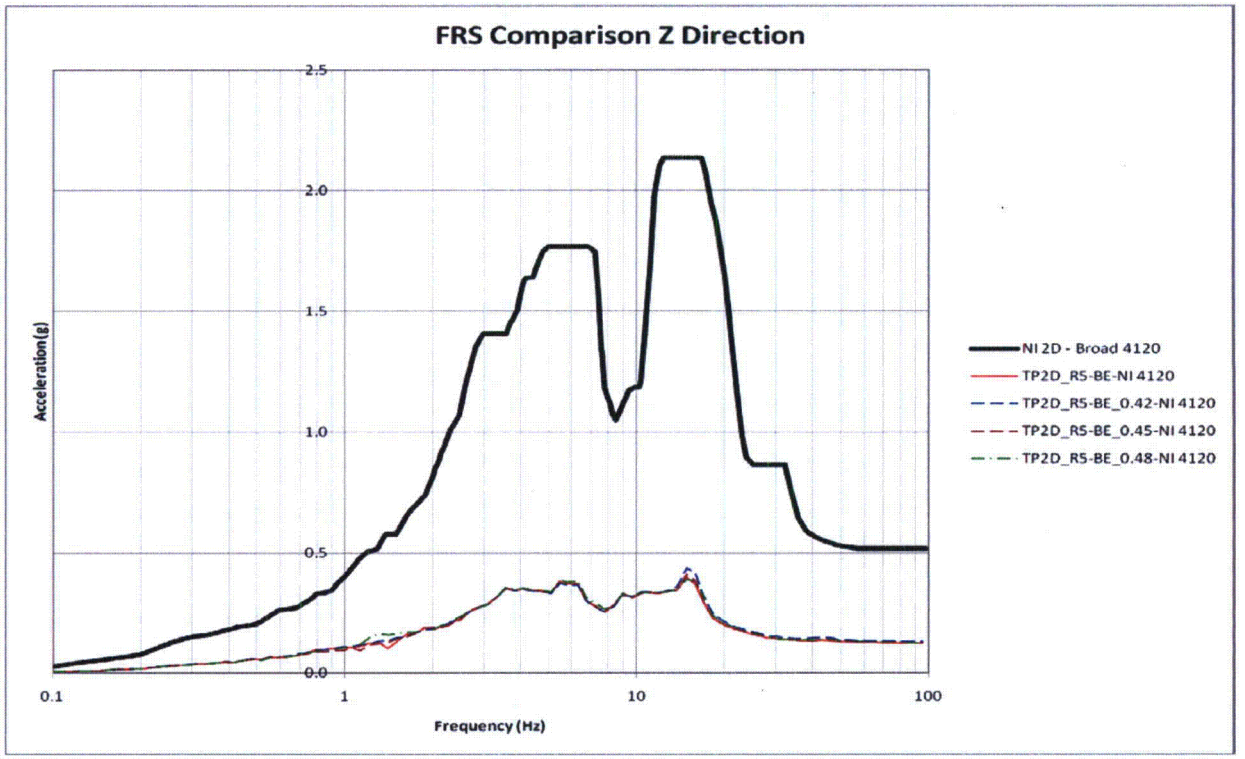

Figure 03.07.01-16-6

TPNP 2D BE FRS with Poisson's Ratio of 0.42, 0.45 and 0.48 – Node 4120Z

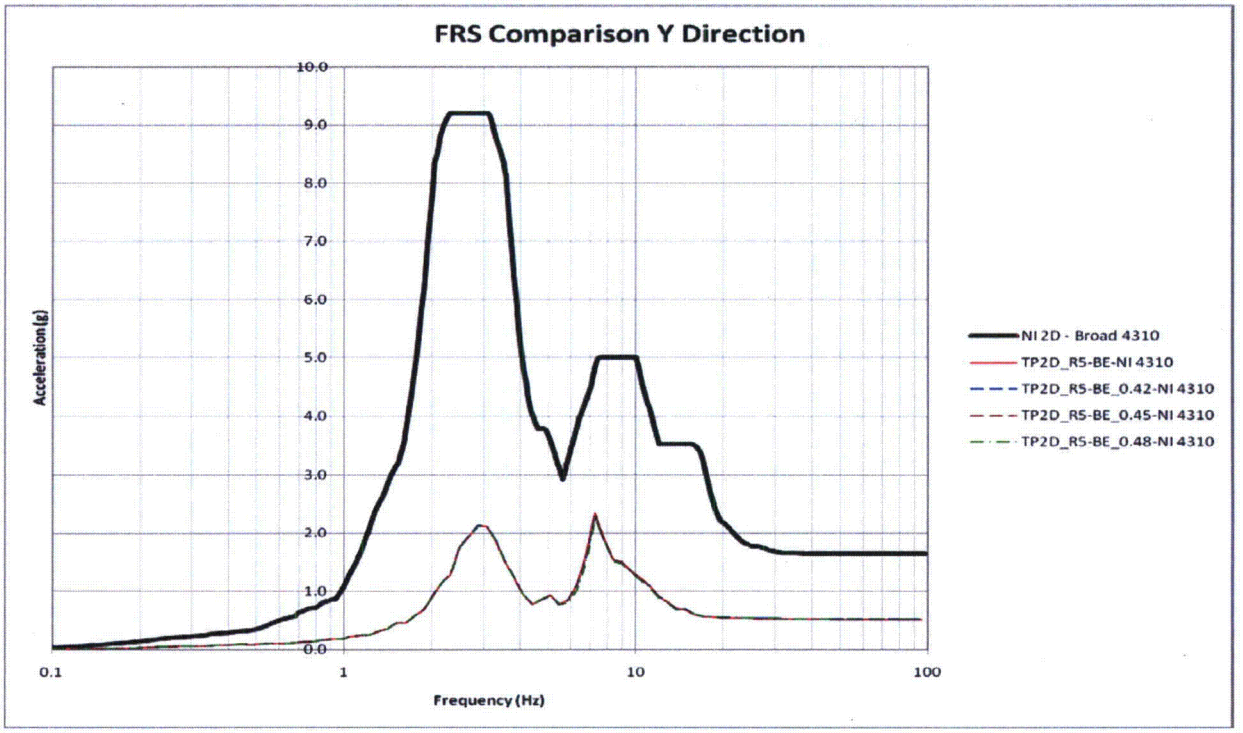

Figure 03.07.01-16-7

TPNP 2D BE FRS with Poisson's Ratio of 0.42, 0.45 and 0.48 – Node 4310Y

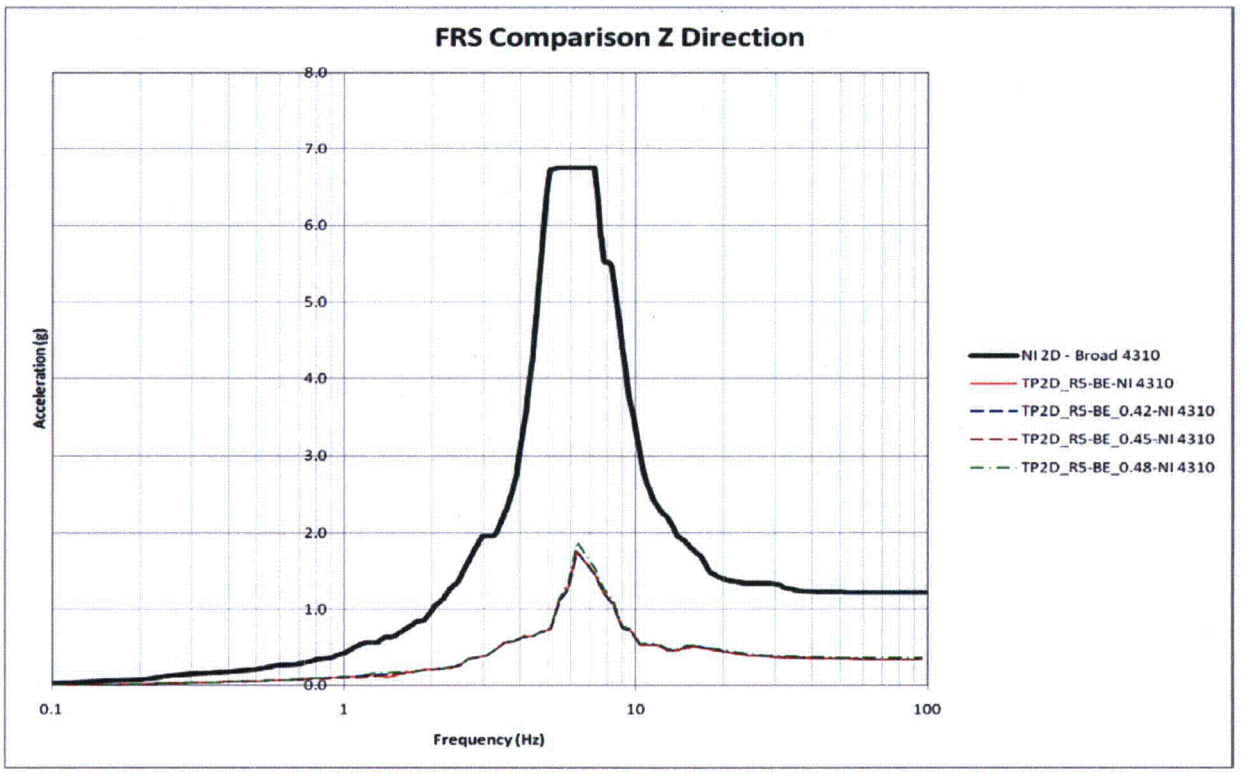

Figure 03.07.01-16-8

TPNP 2D BE FRS with Poisson's Ratio of 0.42, 0.45 and 0.48 – Node 4310Z

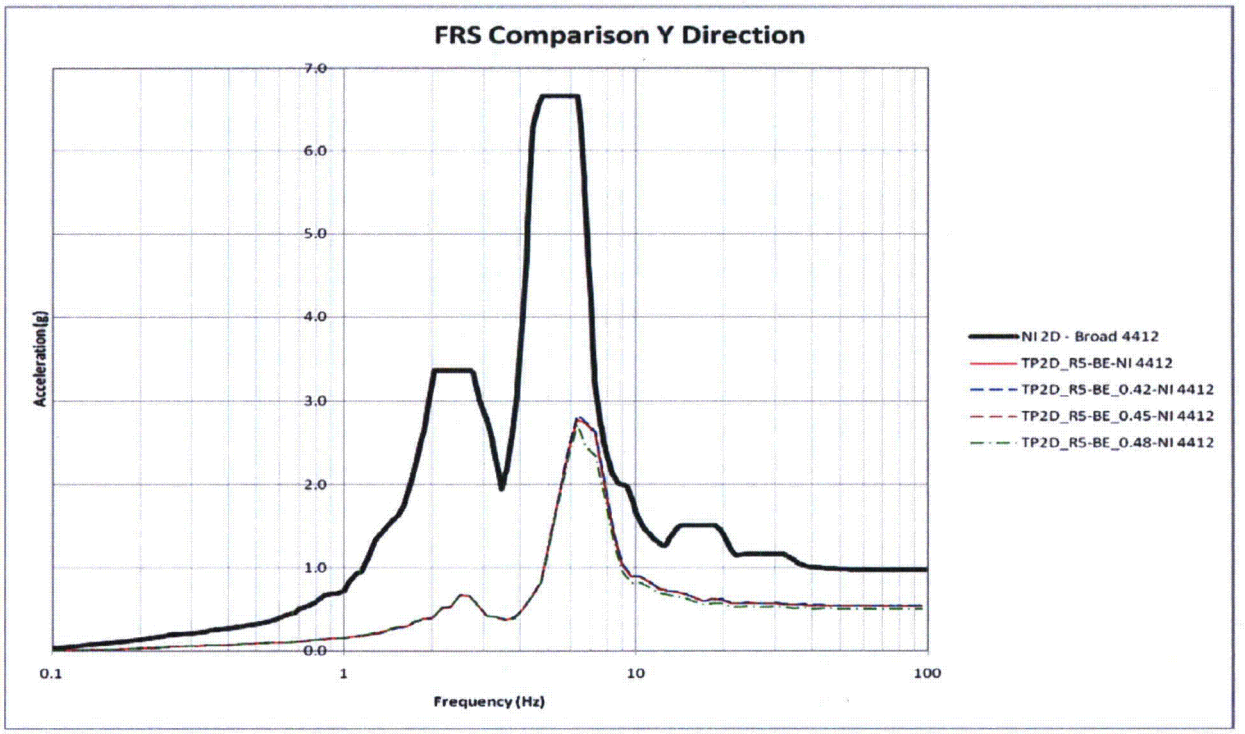

Figure 03.07.01-16-9

TPNP 2D BE FRS with Poisson's Ratio of 0.42, 0.45 and 0.48 – Node 4412Y

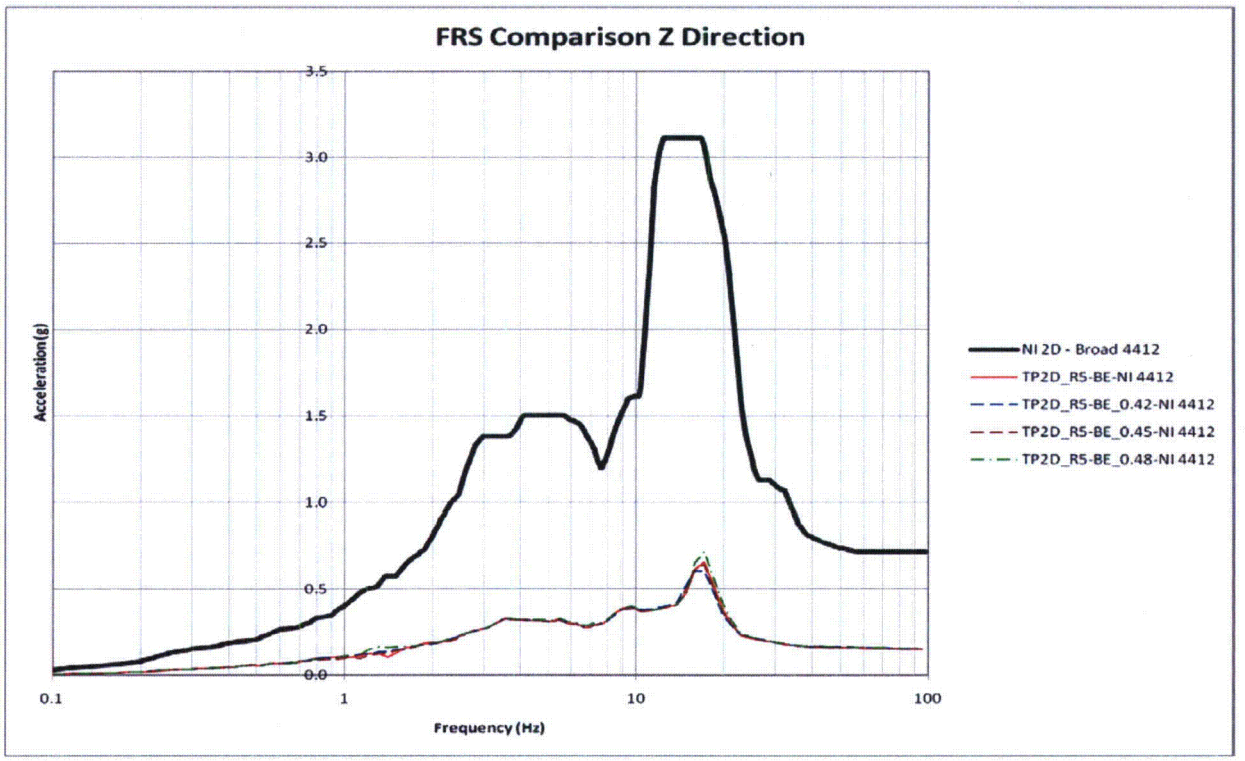

Figure 03.07.01-16-10

TPNP 2D BE FRS with Poisson's Ratio of 0.42, 0.45 and 0.48 – Node 4412Z

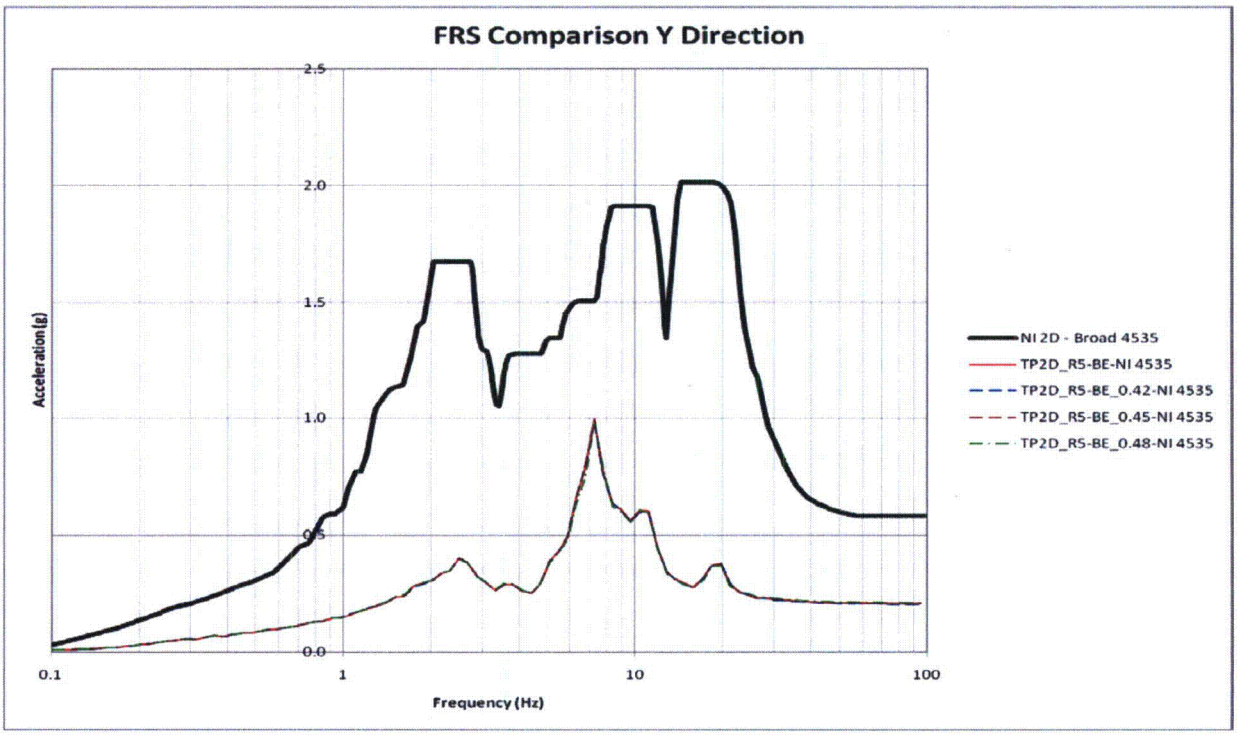

Figure 03.07.01-16-11

TPNP 2D BE FRS with Poisson's Ratio of 0.42, 0.45 and 0.48 – Node 4535Y

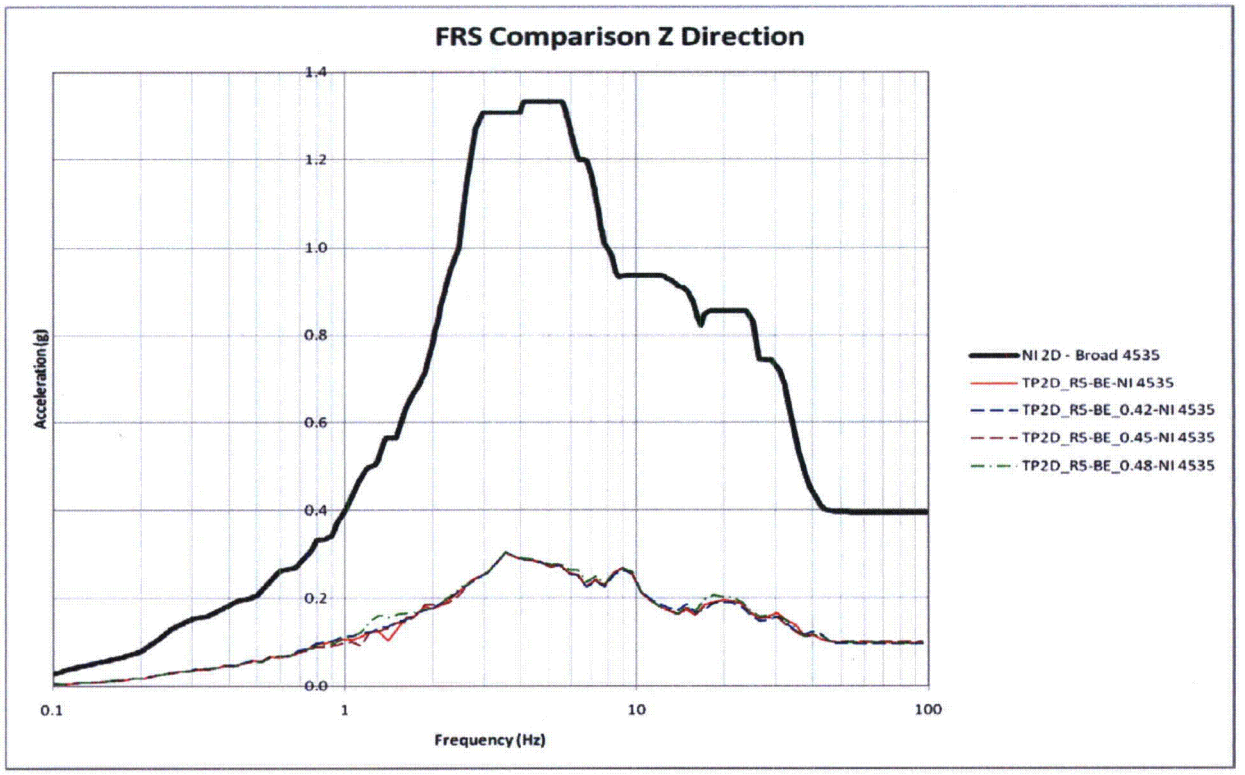

Figure 03.07.01-16-12

TPNP 2D BE FRS with Poisson's Ratio of 0.42, 0.45 and 0.48 – Node 4535Z

This response is PLANT SPECIFIC.

References:

1. Westinghouse Report No. TPG-1000-S2R-802, Rev.6, "Turkey Point Site Specific Seismic Evaluation Report," dated March 2015.
2. Westinghouse Report No. TPG-1000-S2R-807, Rev.3, "Turkey Point Site Specific Seismic Evaluation Report," dated March 2015.
3. SASSI2000, User's Manual, A System for Analysis of Soil-Structure-Interaction, Rev. 1, November 1999, Geotechnical Engineering Division Civil Engineering Department, University of California, Berkeley, CA 94720.
4. ACS SASSI NQA Version 2.3.0 Verification & Quality Assurance Plan.

ASSOCIATED COLA REVISIONS:

No additional changes to COLA Revision 6 have been identified as a result of this revised RAI response.

ASSOCIATED ENCLOSURES:

None

NRC RAI Letter No. PTN-RAI-LTR-061 Dated May 17, 2012

SRP Section: 03.07.01 – Seismic Design Parameters

Questions from Structural Engineering Branch 1

NRC RAI Number: 03.07.01-18 (eRAI 6432)

There are no transfer functions of the AP1000 six key locations in Revision 3 of the applicant's FSAR, (aka. TPG-1000-S2R-802, "Turkey Point Site-Specific Seismic Evaluation Report."). Transfer functions are needed for the staff to determine the technical adequacy of the SSI analyses presented in the FSAR. The applicant is requested to provide the transfer functions for the six key locations

INTRODUCTION:

The existing response to this RAI has not changed as a result of the site response sensitivity analysis that was performed. The conclusions of the site-specific soil structure interaction analysis (TPG-1000-S2R-802 Revision 5) performed for the Turkey Point Units 6 & 7 remain valid.

FPL RESPONSE:

In Revision 5 of TPG-1000-S2R-802, "Turkey Point Site-Specific Seismic Evaluation Report") Appendixes B, C and D present the Turkey Point Units 6 & 7 site-specific, 3D NI20r soil-structure interaction (SSI)-derived transfer functions for the best-estimate (BE), lower bound (LB) and upper bound (UB) soil cases, respectively. Comparisons of the un-interpolated (red circle) and interpolated (solid blue line) transfer functions from the Turkey Point Units 6 & 7 SSI analyses are presented in each of the appendixes of the Revision 5 report, and shown below, for the six (6) key 3D Nuclear Island (NI) NI20r model nodes shown in Table 3.4-1 of the report.

From TPG-1000-S2R-802 Rev. 5:

Appendix B: TPNP 3D BE SSI Analysis Transfer Functions – NI Key Nodes

The interpolation function for the NI20r model was manually checked to ensure the proper initiation point for the transfer functions. The TPNP 3D BE SSI analysis transfer functions for the NI six key locations, defined in Table 3.4-1, are shown in Figures B-1 through B-18.

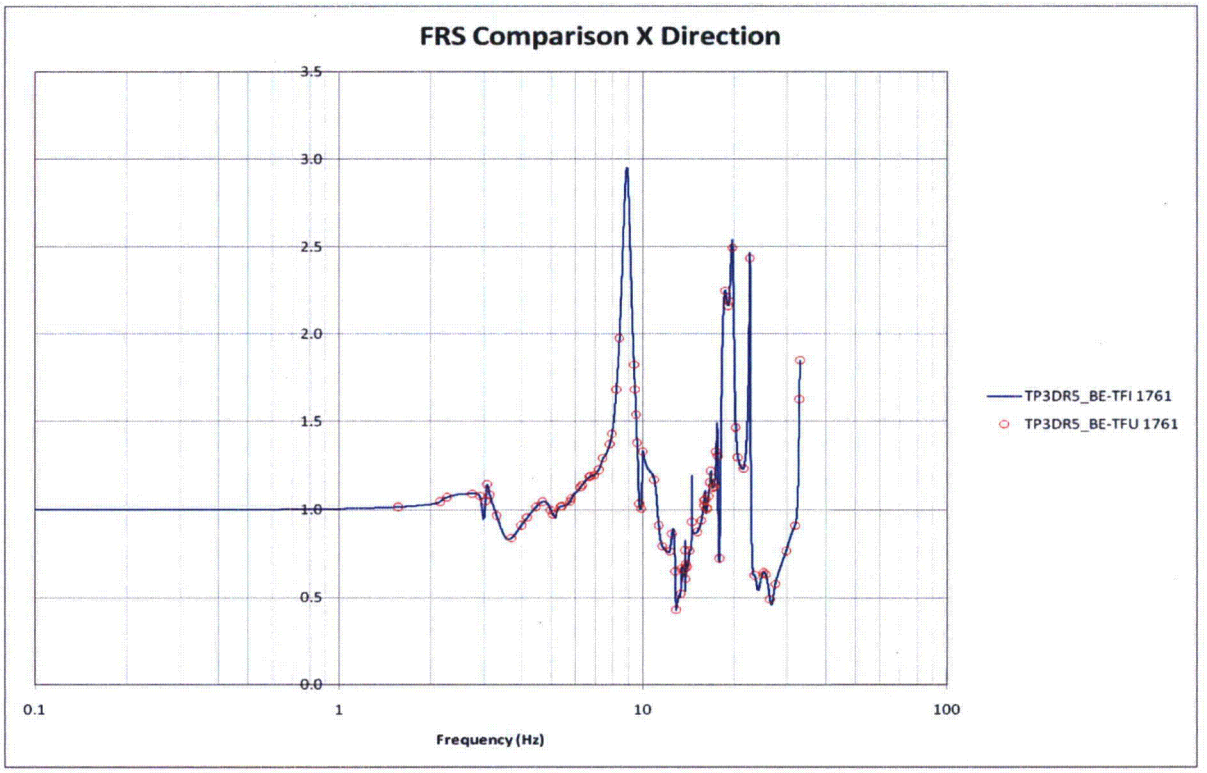

Figure B-1

TPNP 3D NI SSI BE Transfer Function in X-Direction – Node 1761

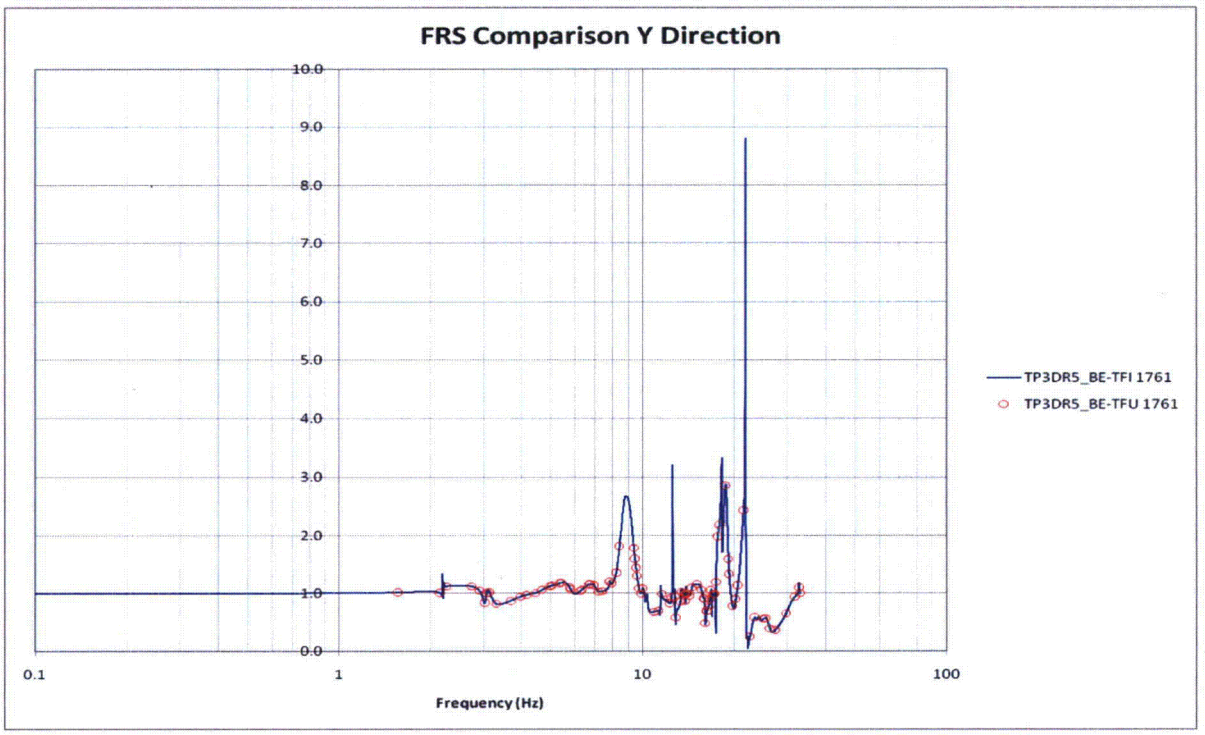

Figure B-2

TPNP 3D NI SSI BE Transfer Function in Y-Direction – Node 1761

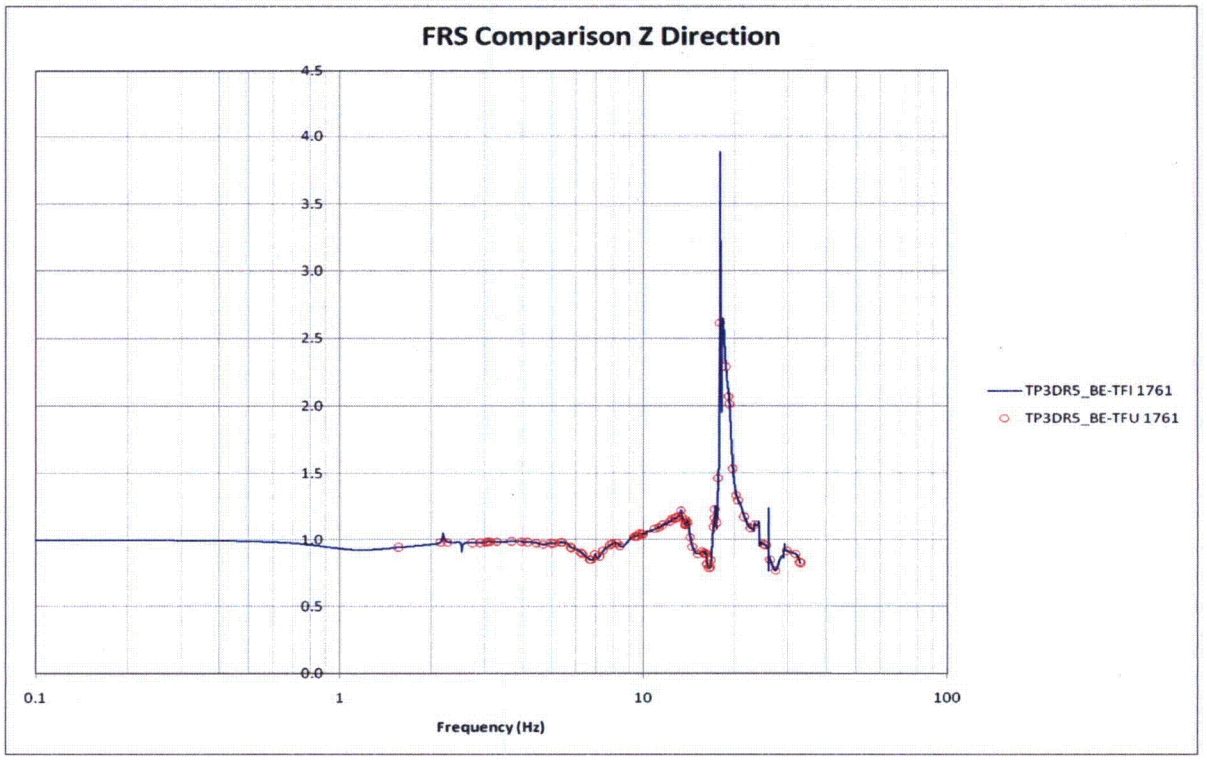

Figure B-3

TPNP 3D NI SSI BE Transfer Function in Z-Direction – Node 1761

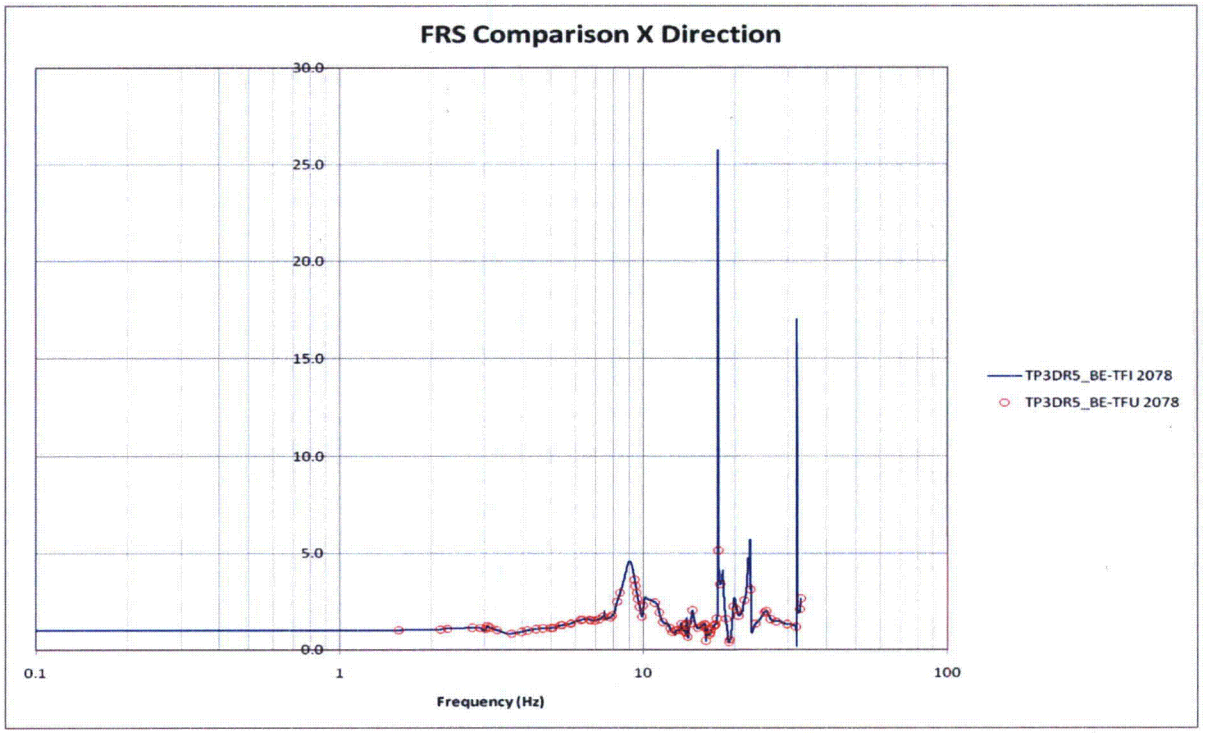

Figure B-4

TPNP 3D NI SSI BE Transfer Function in X-Direction – Node 2078

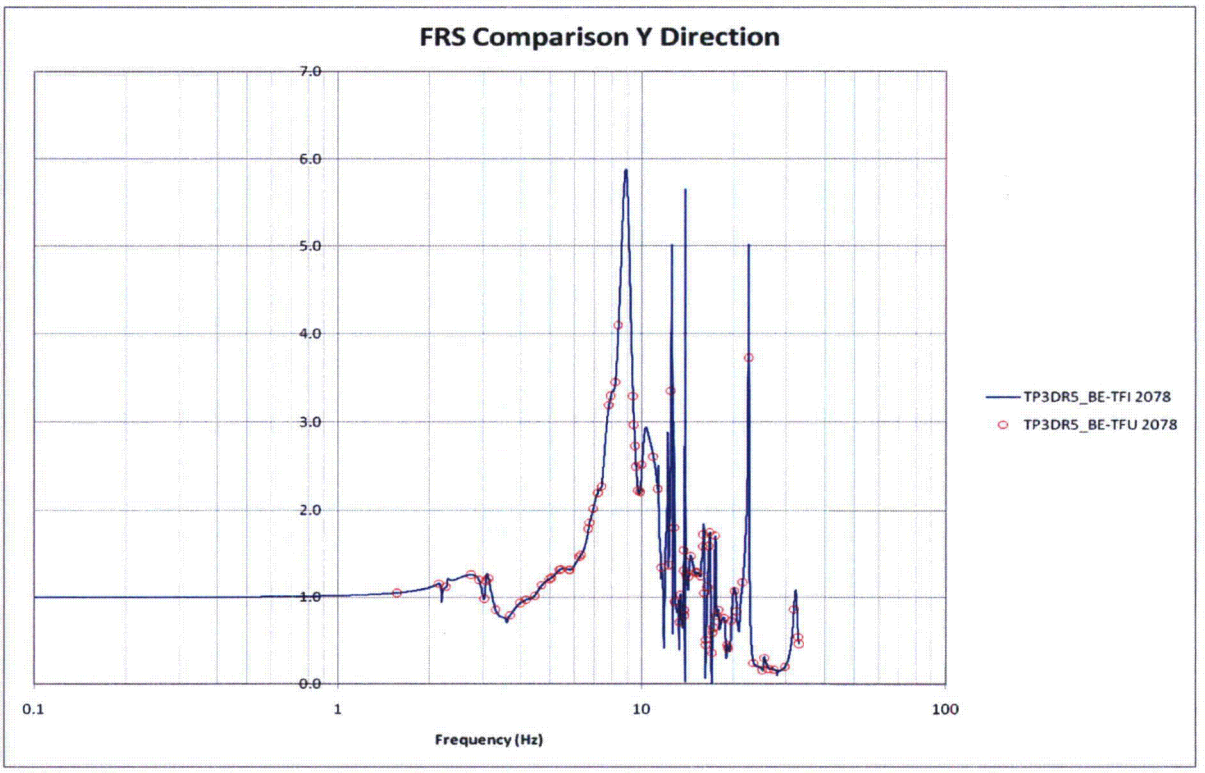

Figure B-5

TPNP 3D NI SSI BE Transfer Function in Y-Direction – Node 2078

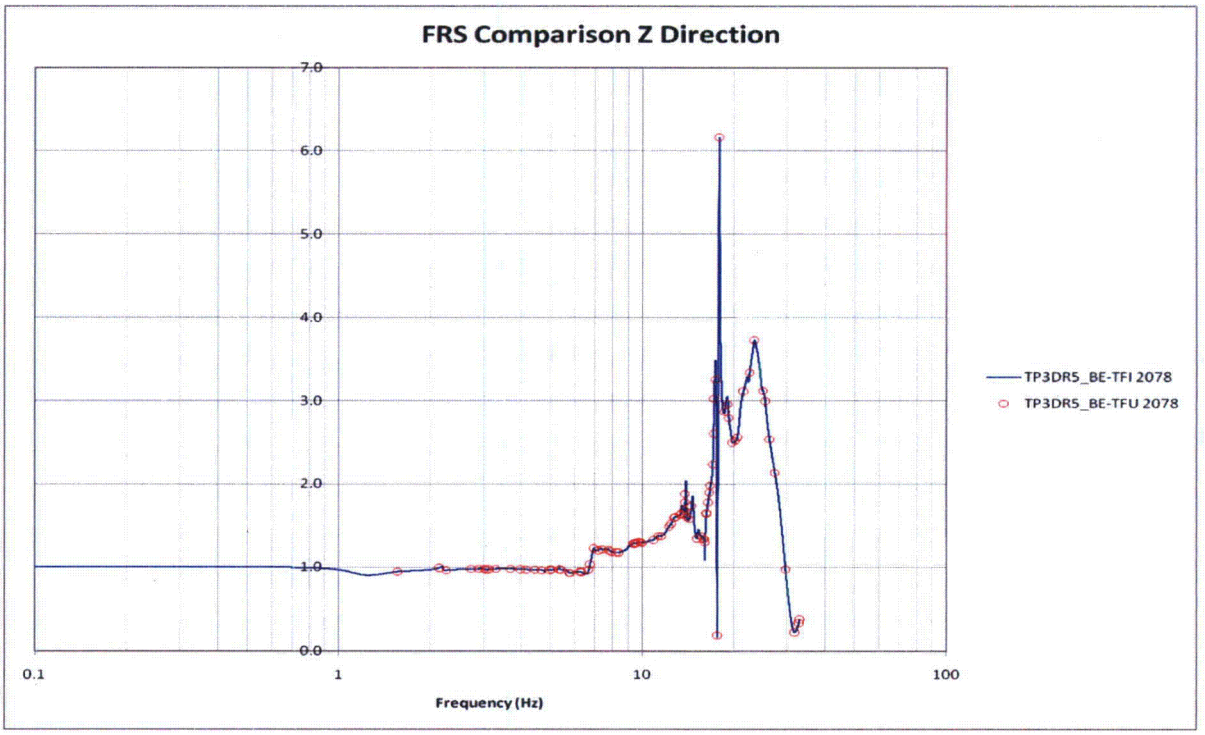

Figure B-6

TPNP 3D NI SSI BE Transfer Function in Z-Direction – Node 2078

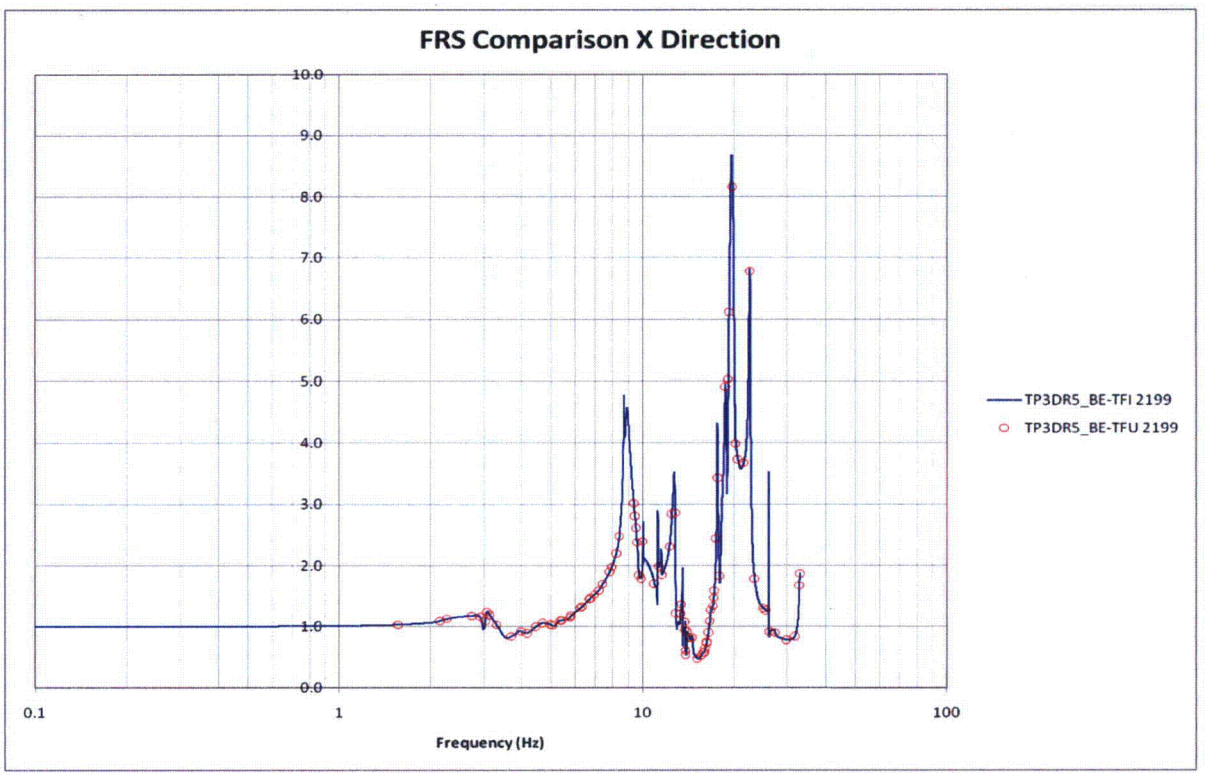

Figure B-7

TPNP 3D NI SSI BE Transfer Function in X-Direction – Node 2199

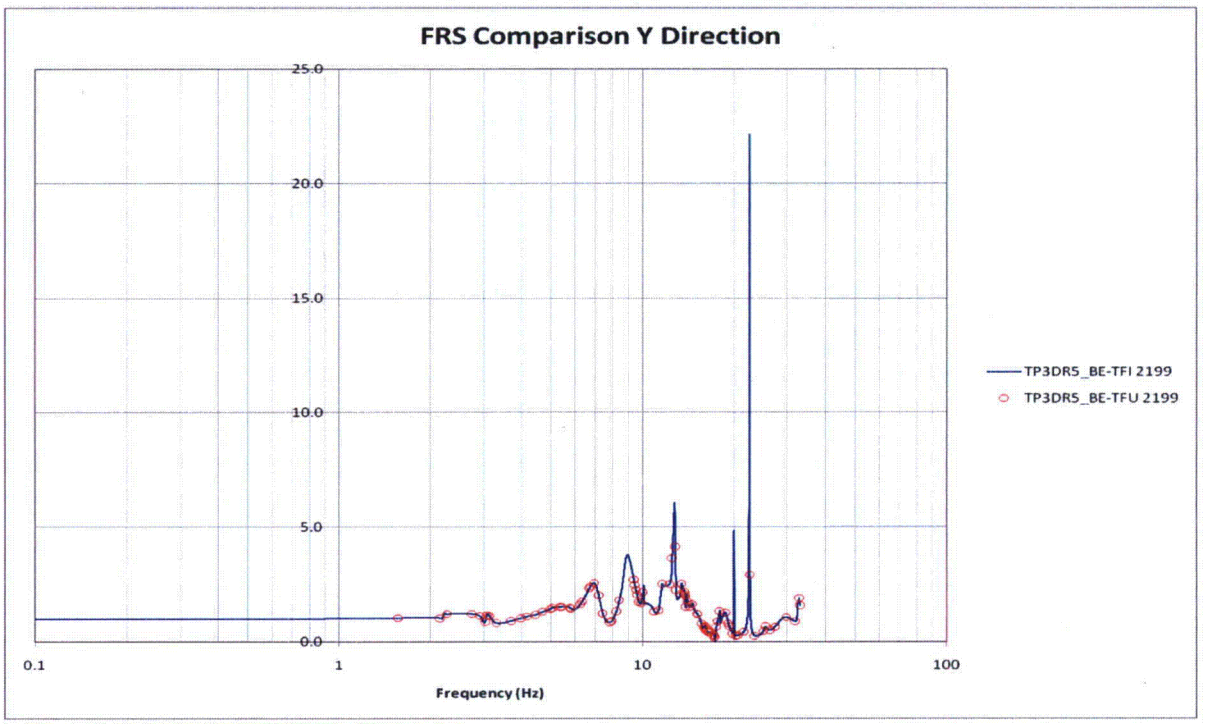

Figure B-8

TPNP 3D NI SSI BE Transfer Function in Y-Direction – Node 2199

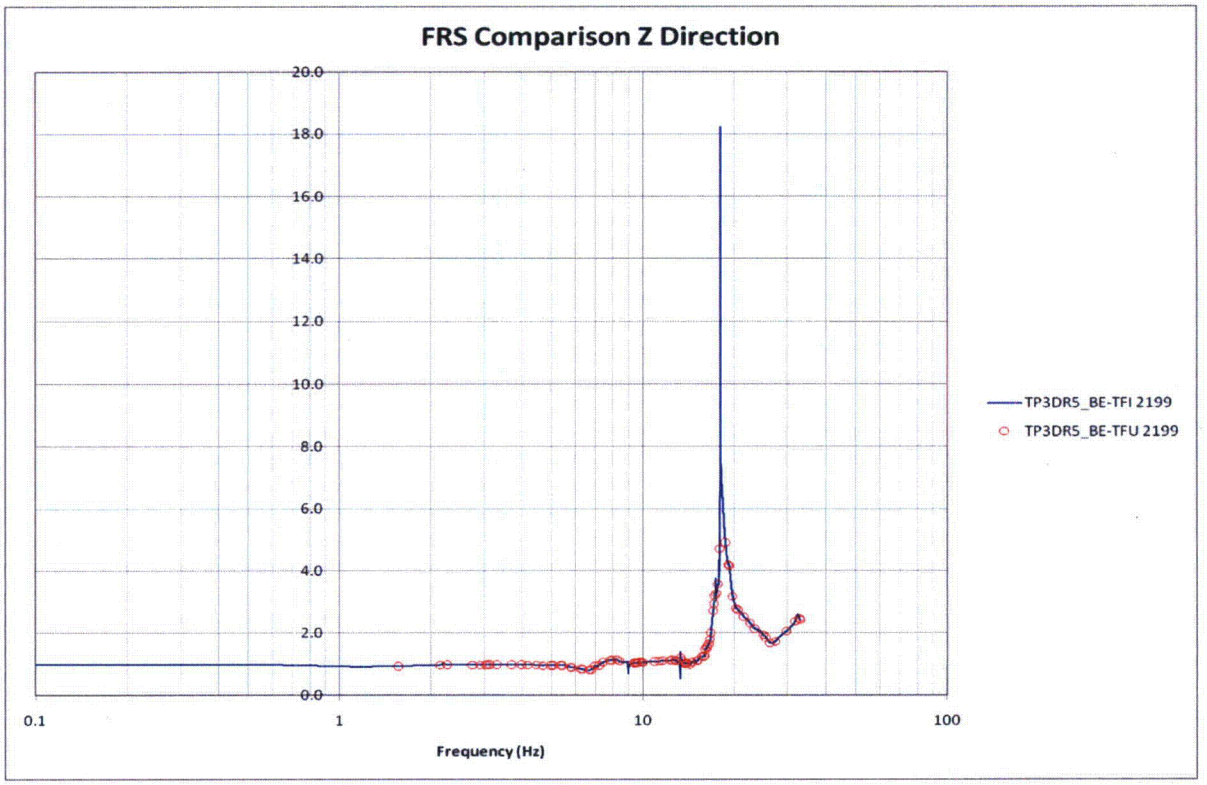

Figure B-9

TPNP 3D NI SSI BE Transfer Function in Z-Direction – Node 2199

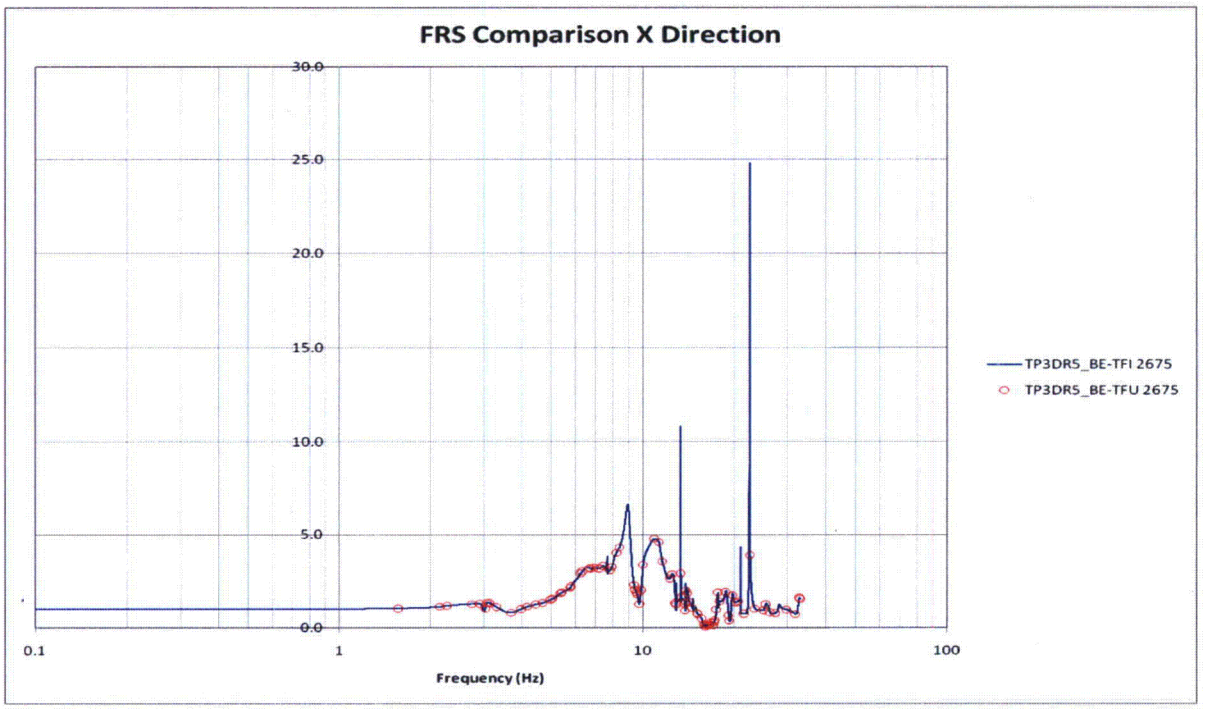

Figure B-10

TPNP 3D NI SSI BE Transfer Function in X-Direction – Node 2675

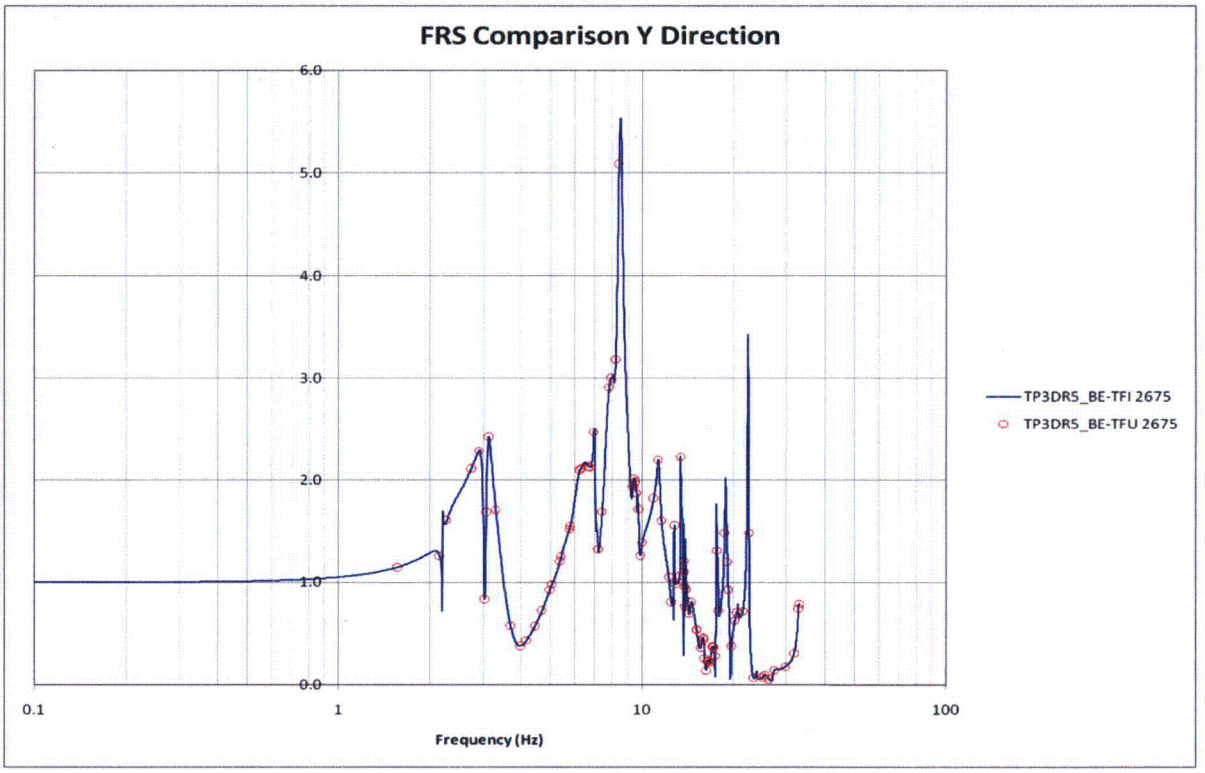

Figure B-11

TPNP 3D NI SSI BE Transfer Function in Y-Direction – Node 2675

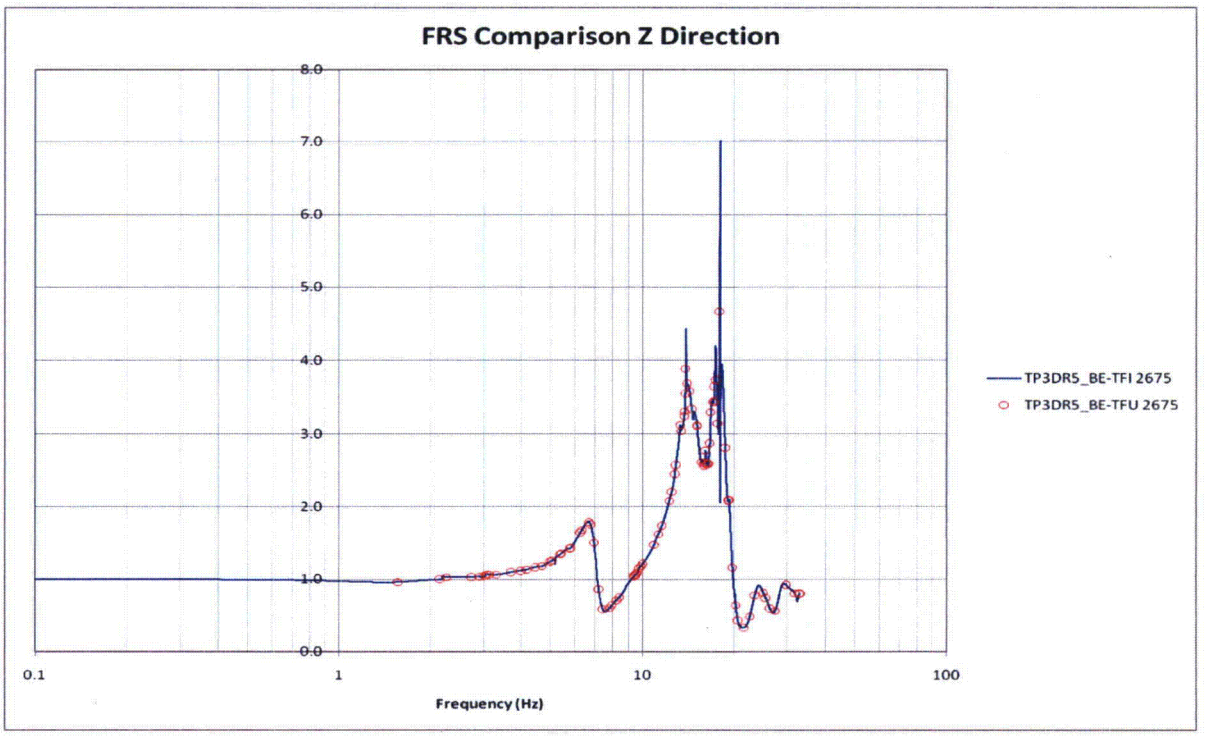

Figure B-12

TPNP 3D NI SSI BE Transfer Function in Z-Direction – Node 2675

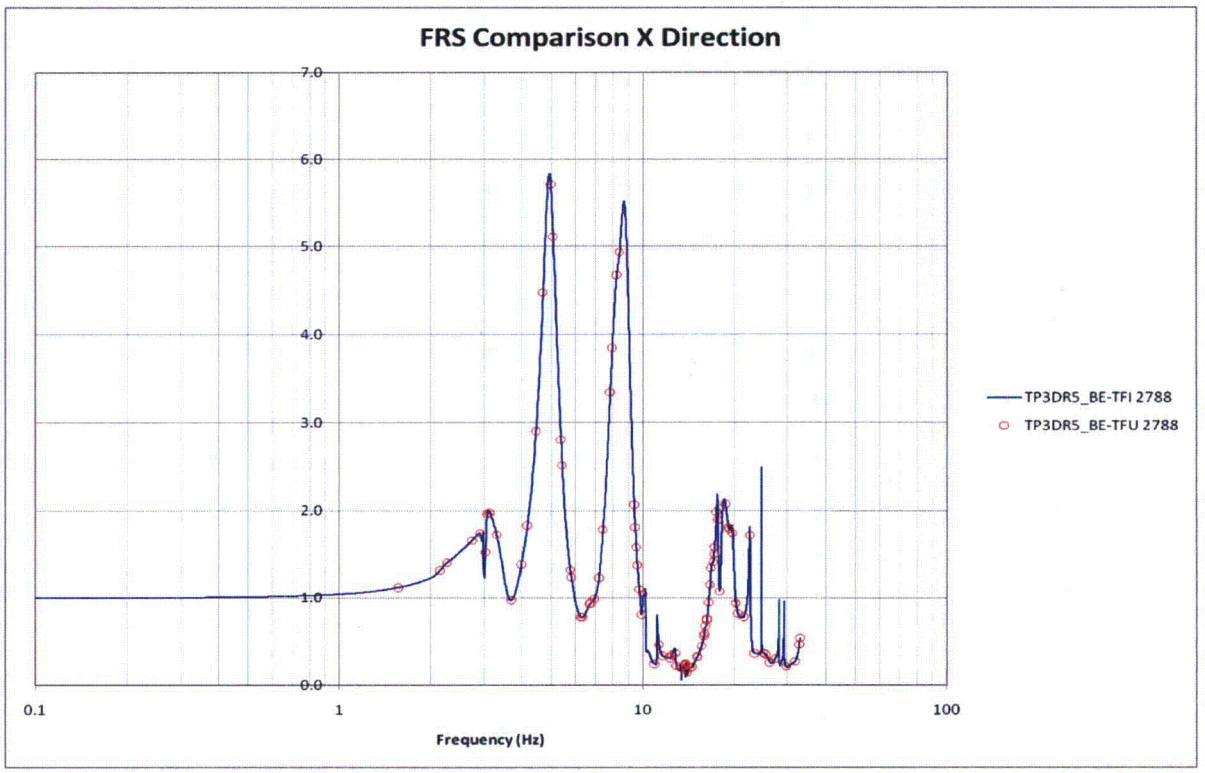

Figure B-13

TPNP 3D NI SSI BE Transfer Function in X-Direction – Node 2788

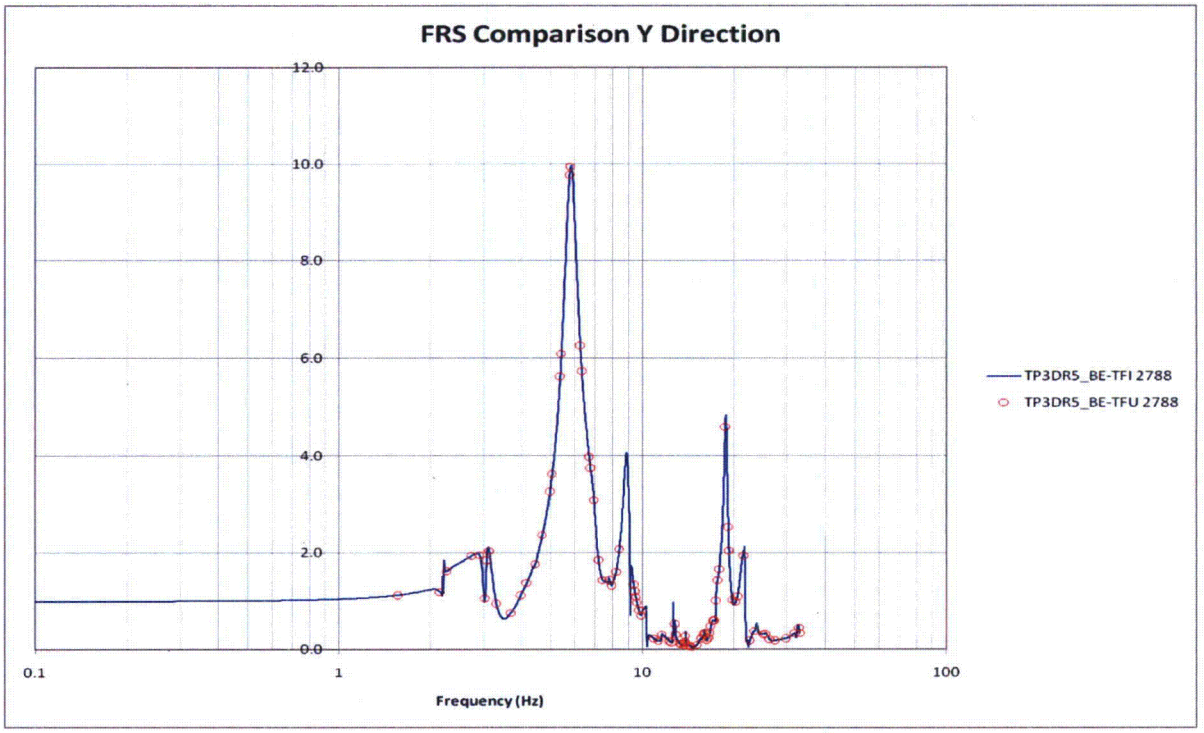

Figure B-14

TPNP 3D NI SSI BE Transfer Function in Y-Direction – Node 2788

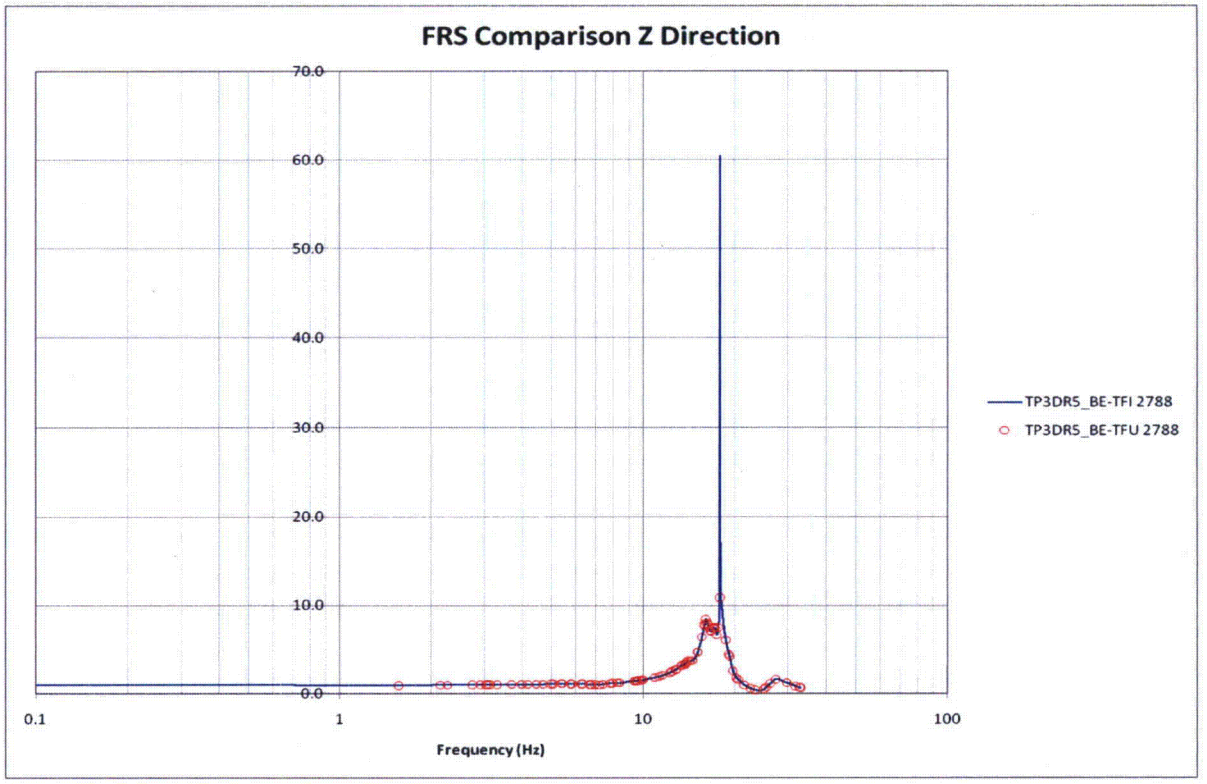

Figure B-15

TPNP 3D NI SSI BE Transfer Function in Z-Direction – Node 2788

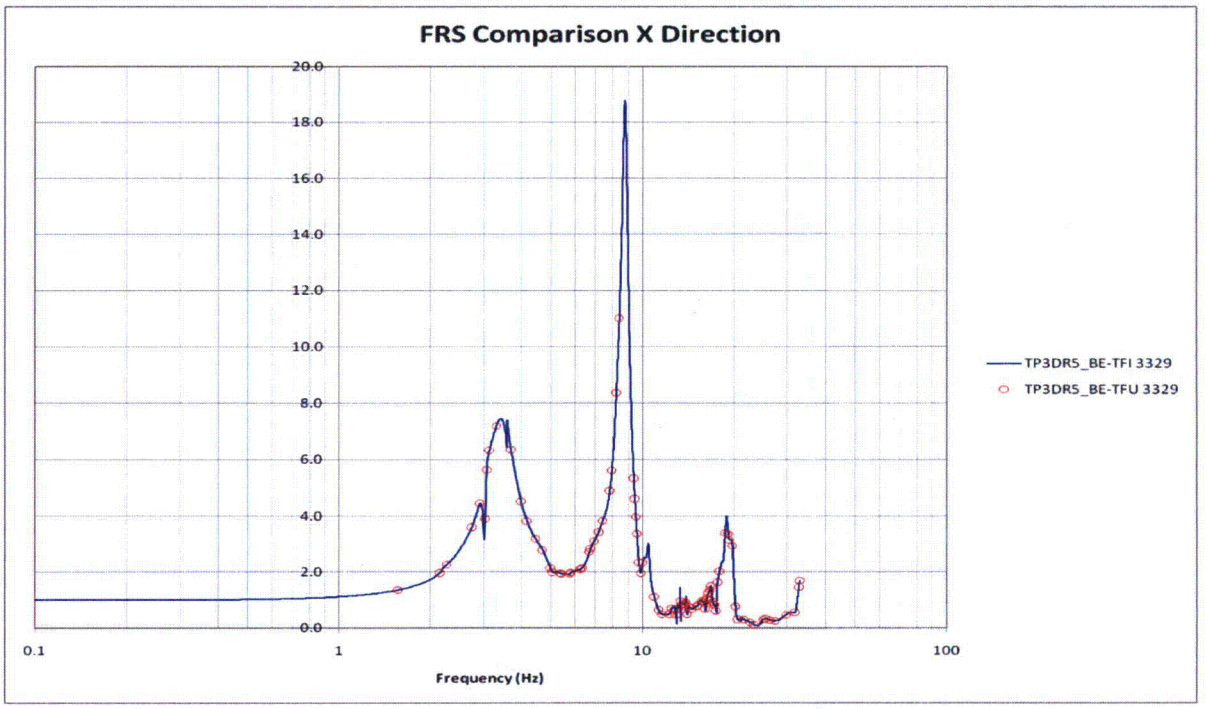

Figure B-16

TPNP 3D NI SSI BE Transfer Function in X-Direction – Node 3329

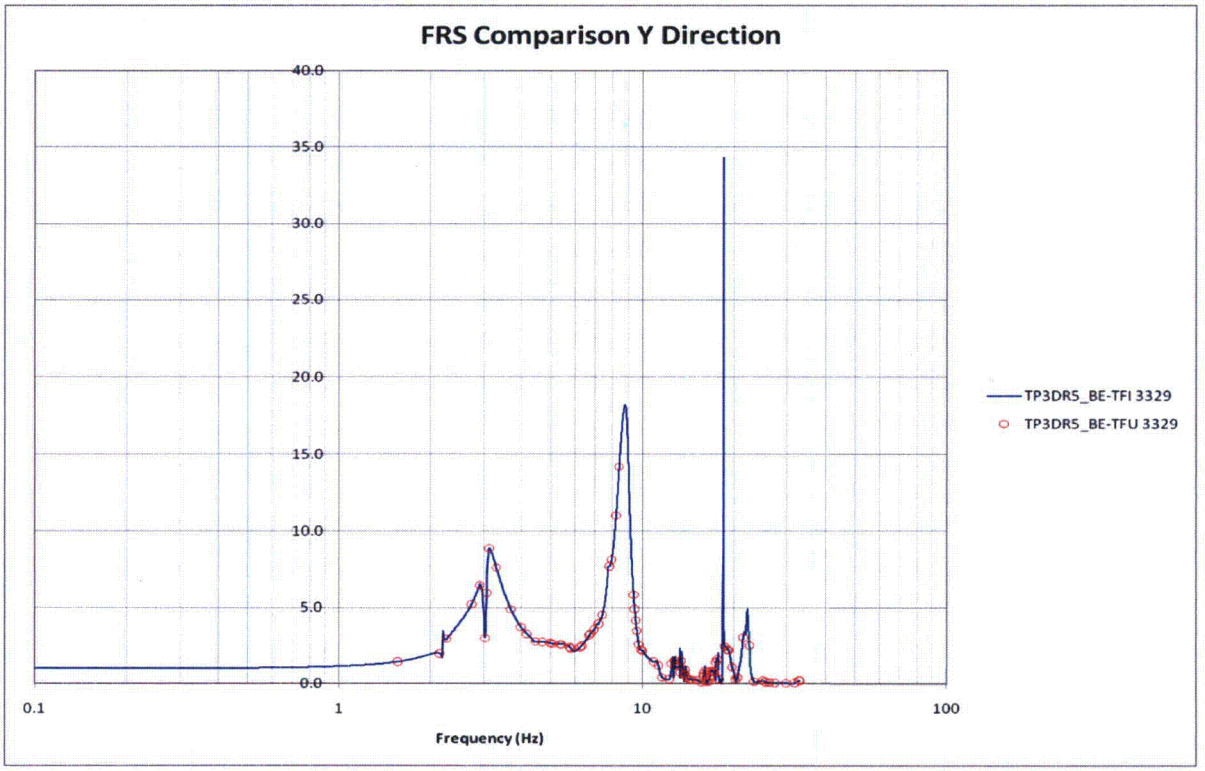

Figure B-17

TPNP 3D NI SSI BE Transfer Function in Y-Direction – Node 3329

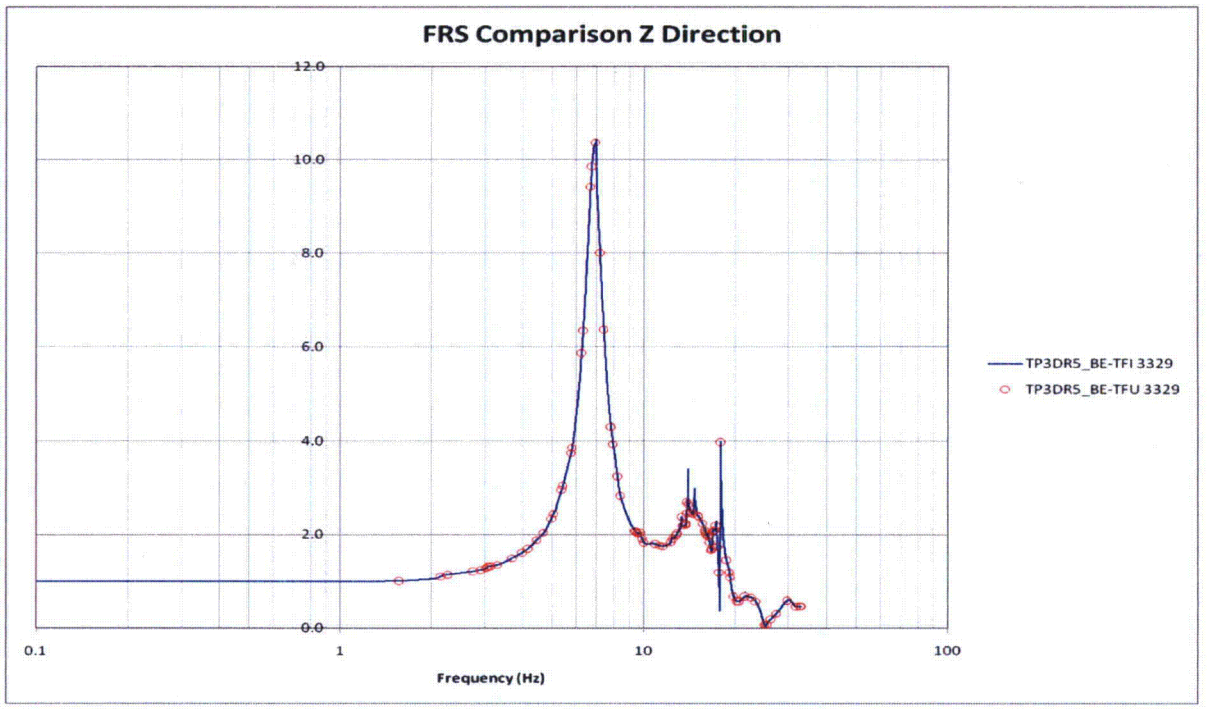

Figure B-18

TPNP 3D NI SSI BE Transfer Function in Z-Direction – Node 3329

From TPG-1000-S2R-802 Rev. 5:

Appendix C: TPNP 3D LB SSI Analysis Transfer Functions – NI Key Nodes

The interpolation function for the NI20r model was manually checked to ensure the correct starting point for the transfer functions. The TPNP 3D LB SSI analysis transfer functions for the NI six key locations, defined in Table 3.4-1, are shown in Figures C-1 through C-18.

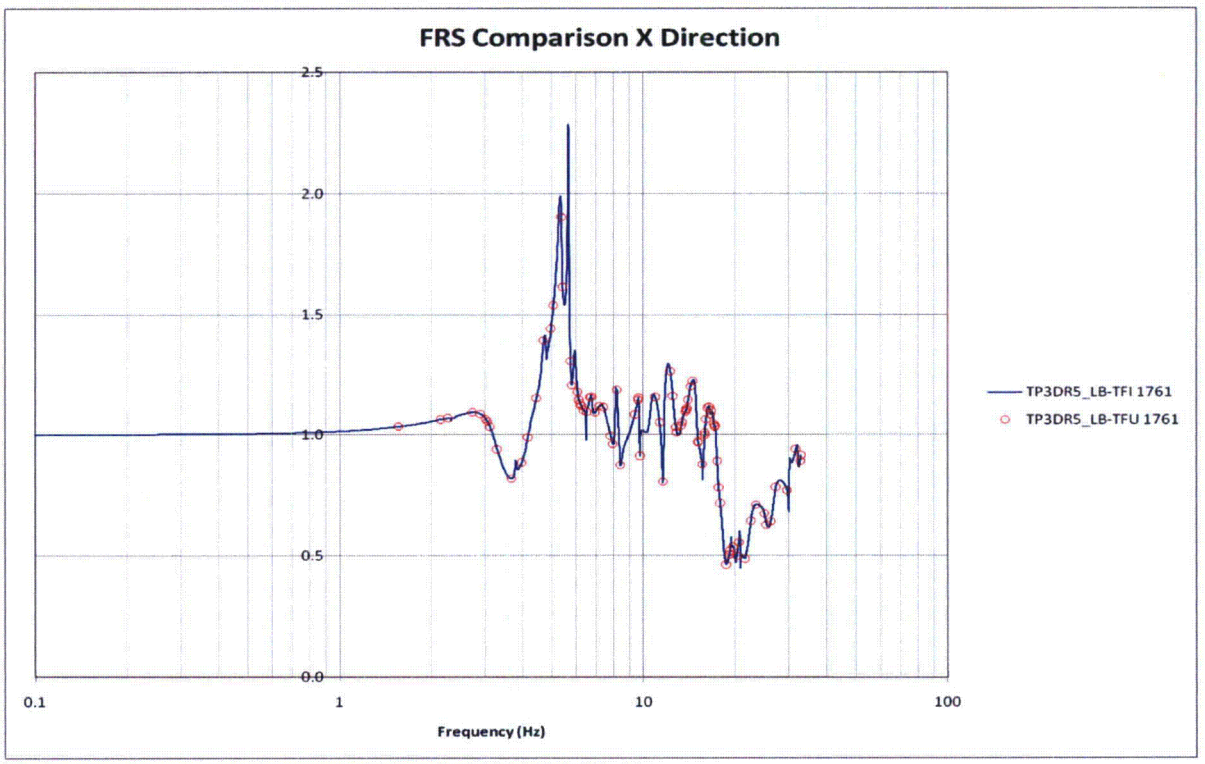

Figure C-1

TPNP 3D NI SSI LB Transfer Function in X-Direction – Node 1761

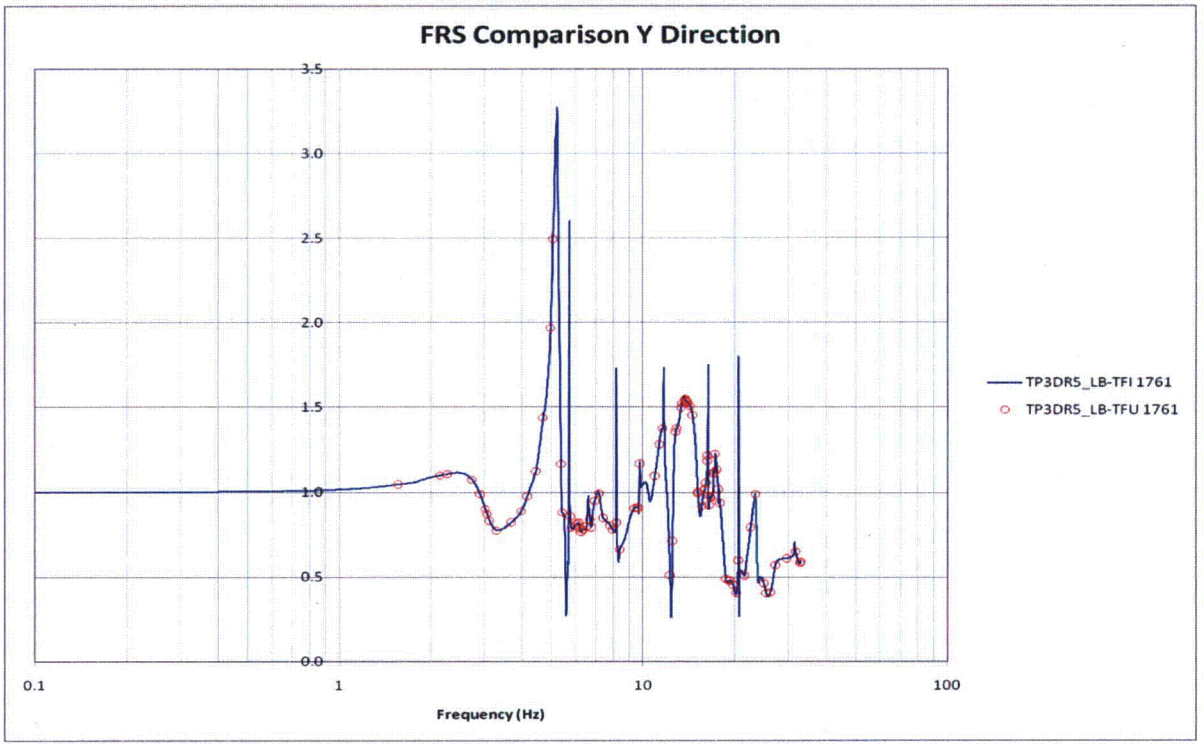

Figure C-2

TPNP 3D NI SSI LB Transfer Function in Y-Direction – Node 1761

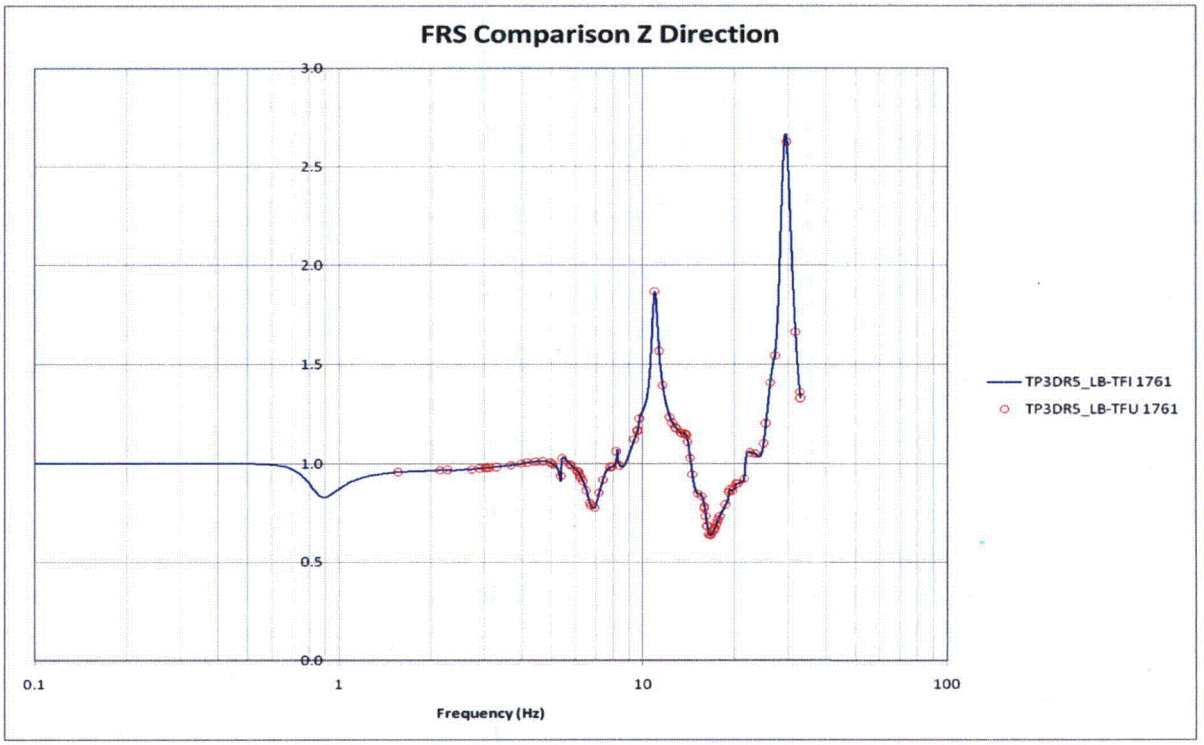

Figure C-3

TPNP 3D NI SSI LB Transfer Function in Z-Direction – Node 1761

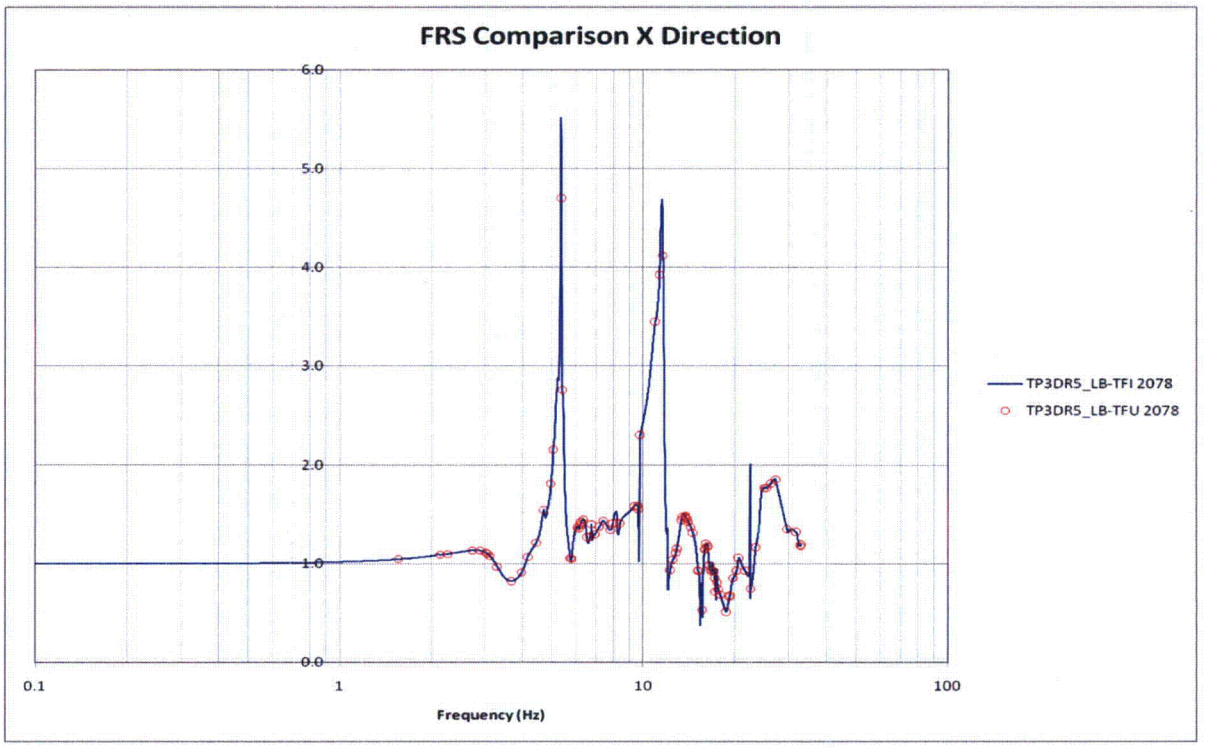

Figure C-4

TPNP 3D NI SSI LB Transfer Function in X-Direction – Node 2078

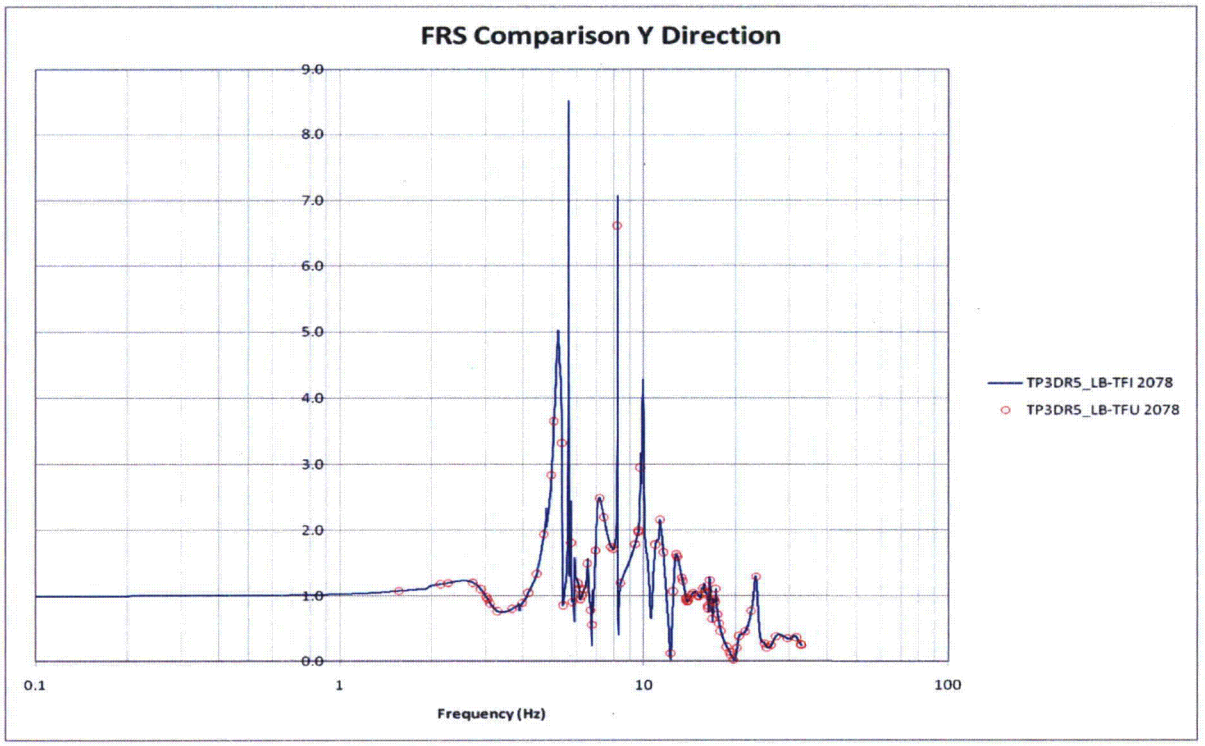

Figure C-5

TPNP 3D NI SSI LB Transfer Function in Y-Direction – Node 2078

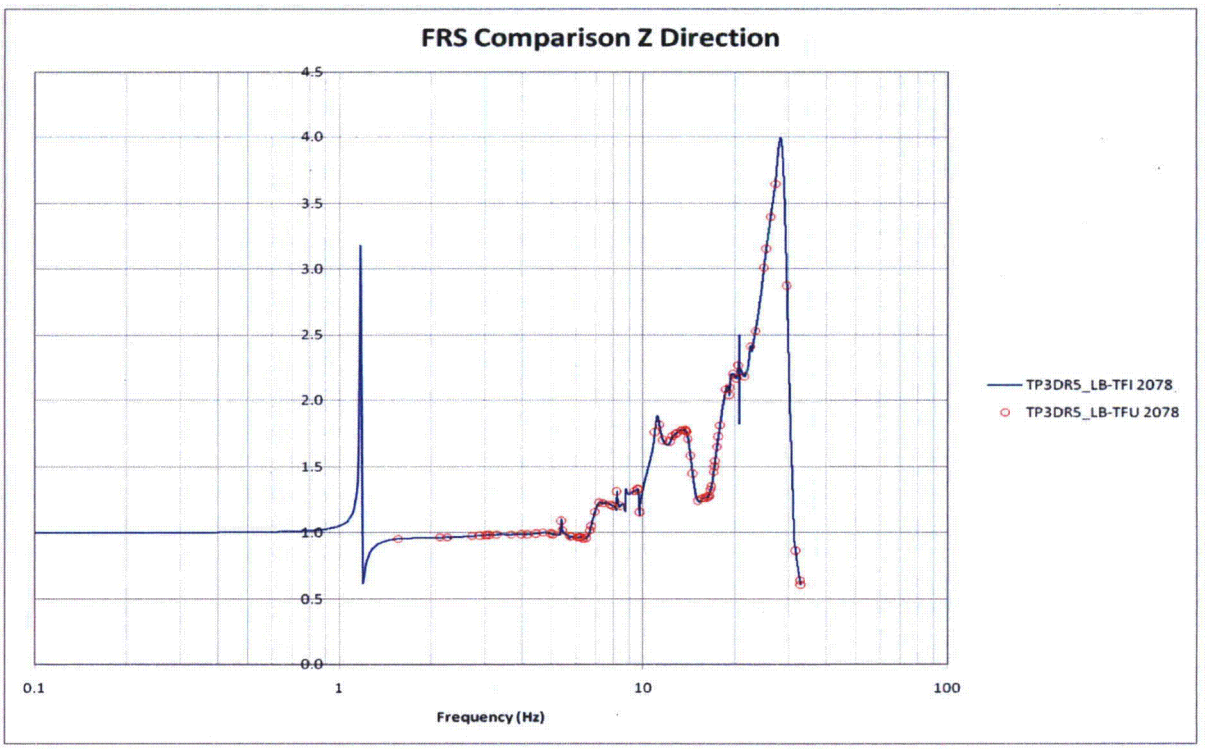

Figure C-6

TPNP 3D NI SSI LB Transfer Function in Z-Direction – Node 2078

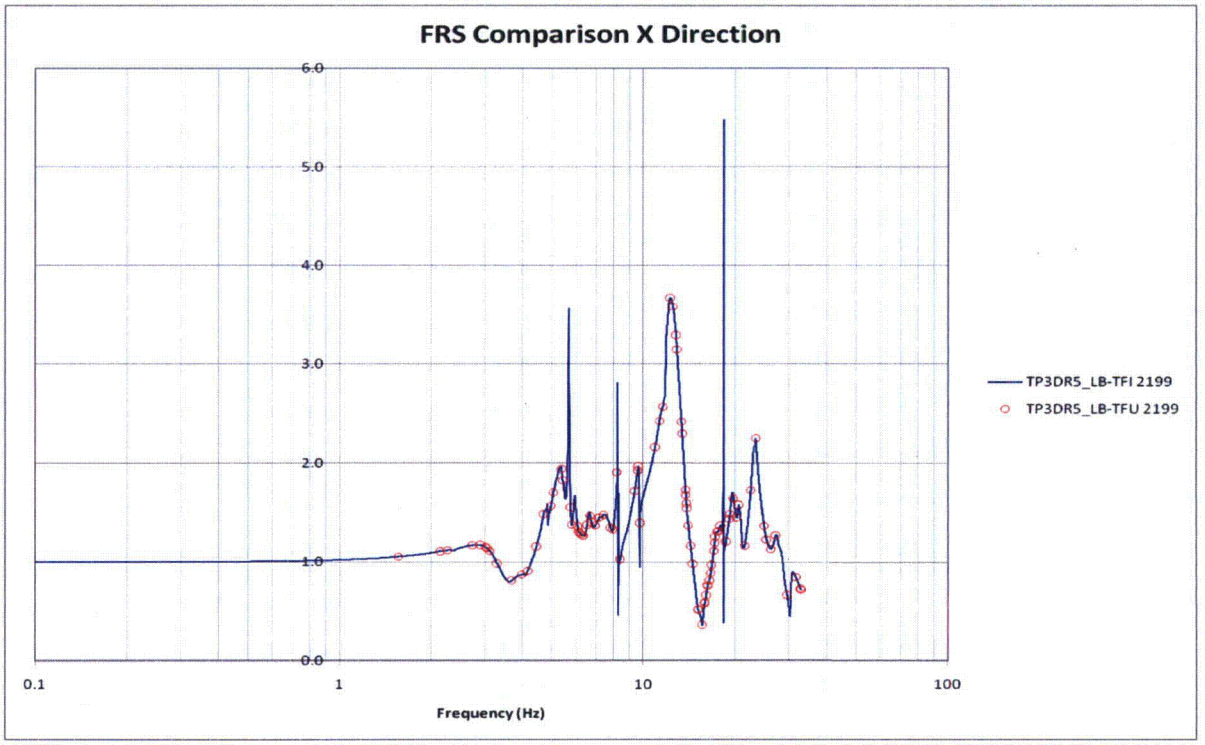

Figure C-7

TPNP 3D NI SSI LB Transfer Function in X-Direction – Node 2199

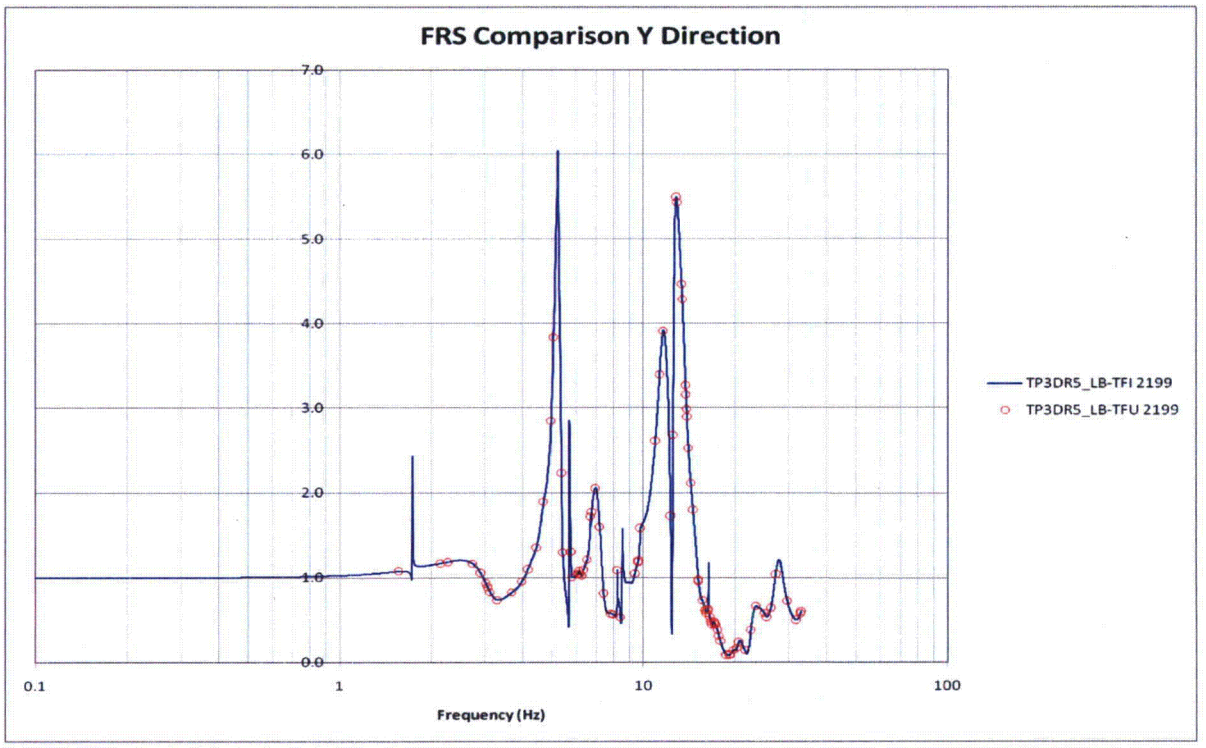

Figure C-8

TPNP 3D NI SSI LB Transfer Function in Y-Direction – Node 2199

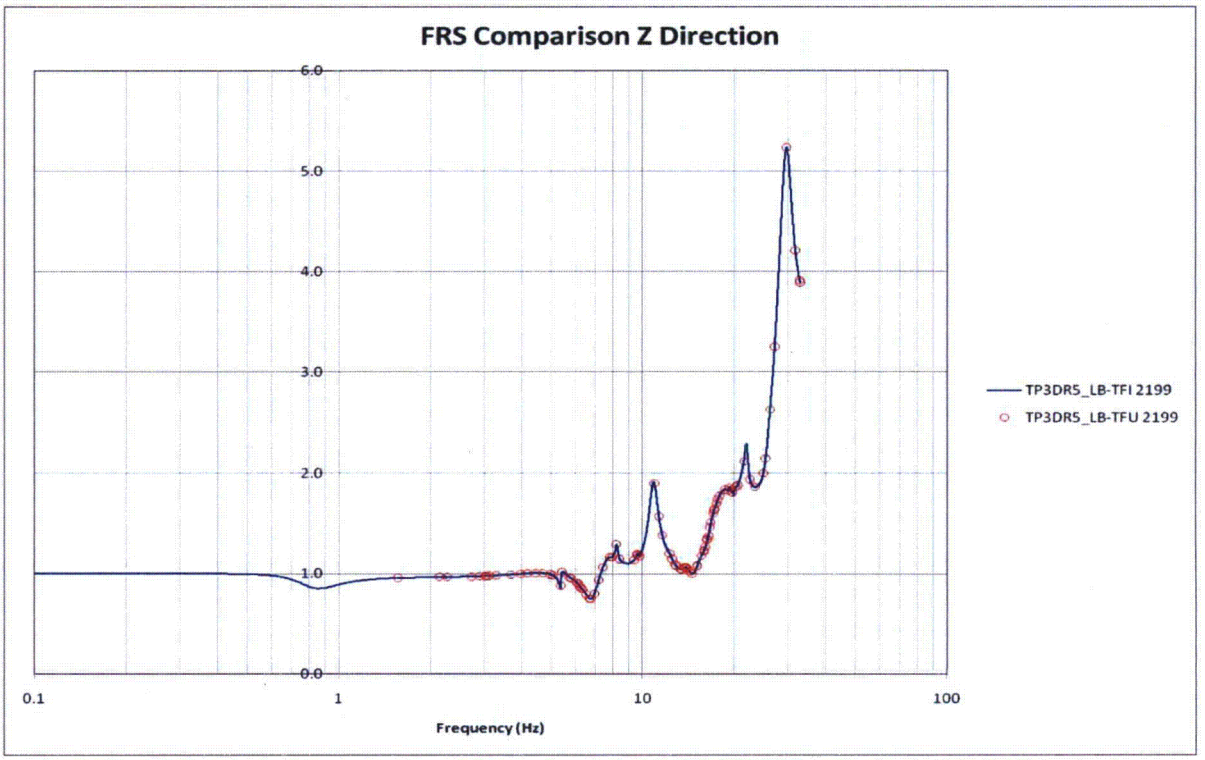

Figure C-9

TPNP 3D NI SSI LB Transfer Function in Z-Direction – Node 2199

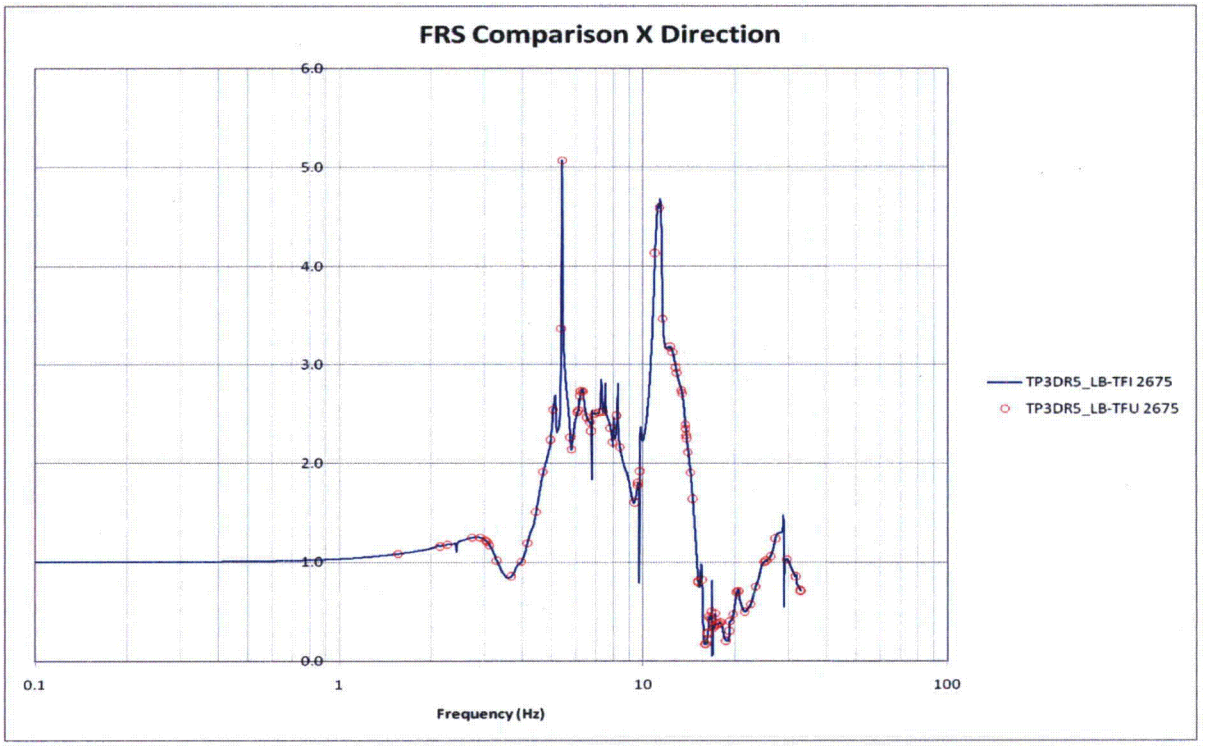

Figure C-10

TPNP 3D NI SSI LB Transfer Function in X-Direction – Node 2675

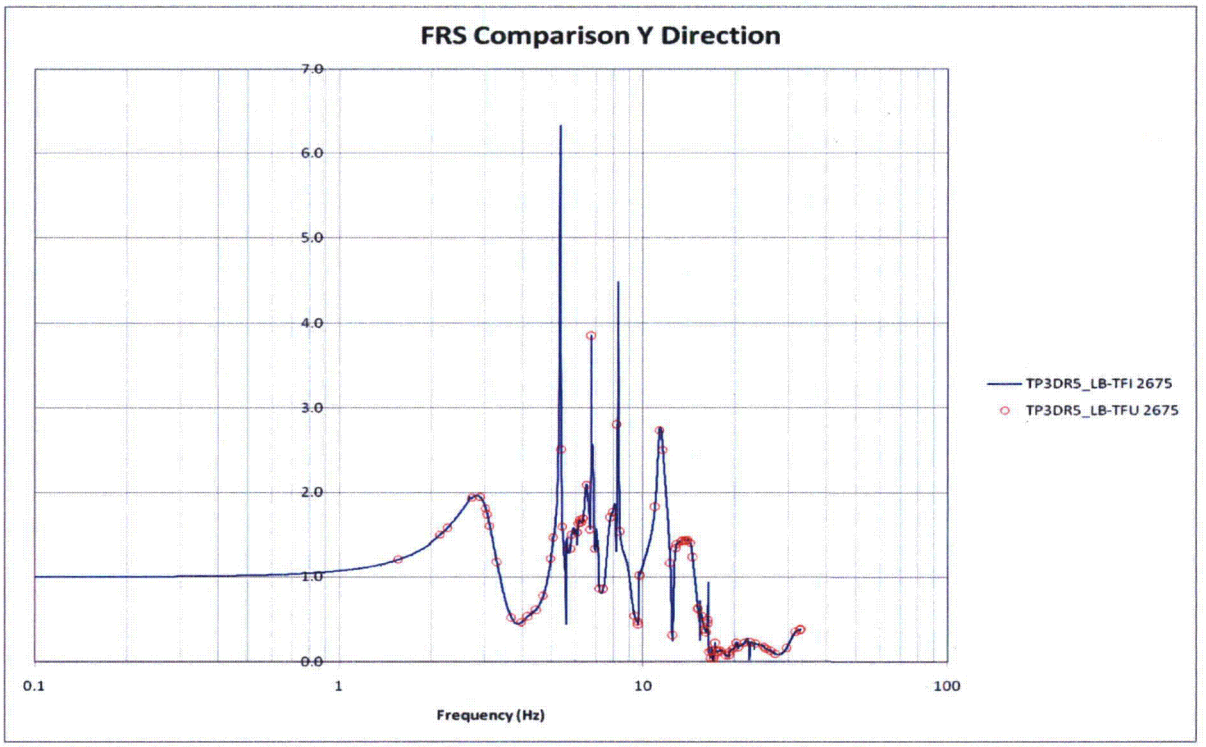

Figure C-11

TPNP 3D NI SSI LB Transfer Function in Y-Direction – Node 2675

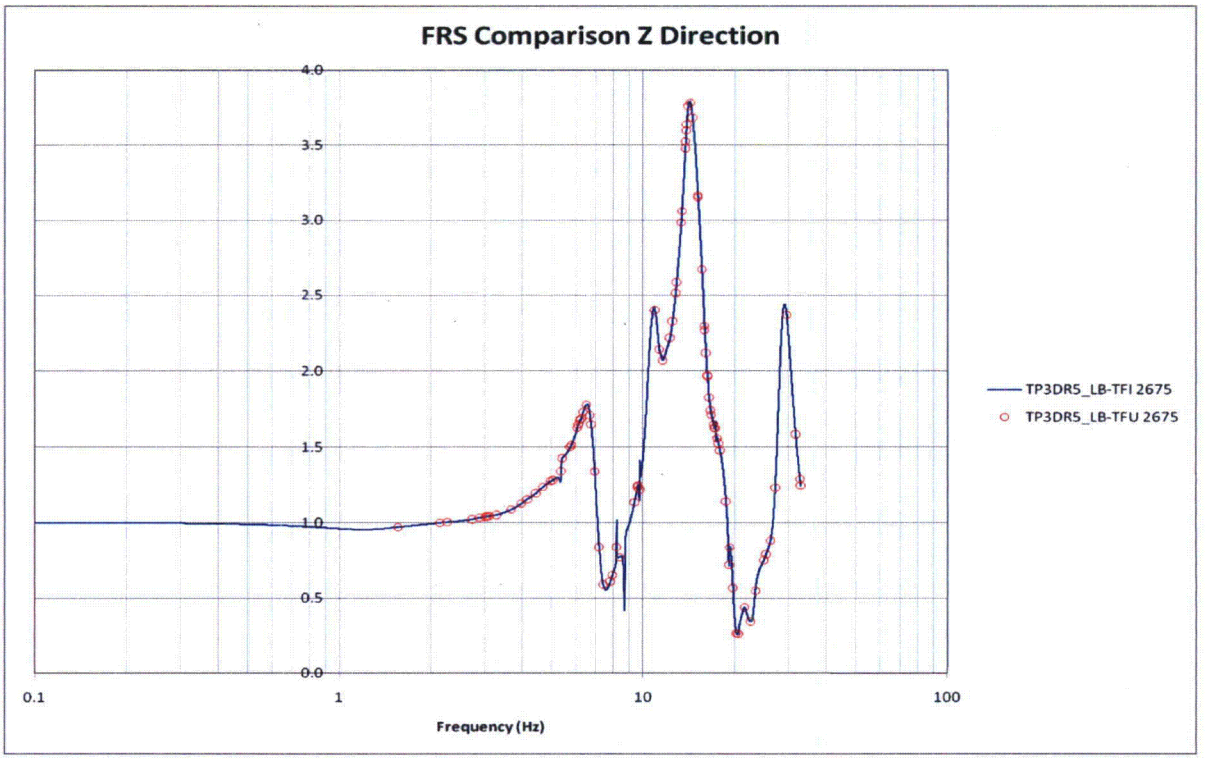

Figure C-12

TPNP 3D NI SSI LB Transfer Function in Z-Direction – Node 2675

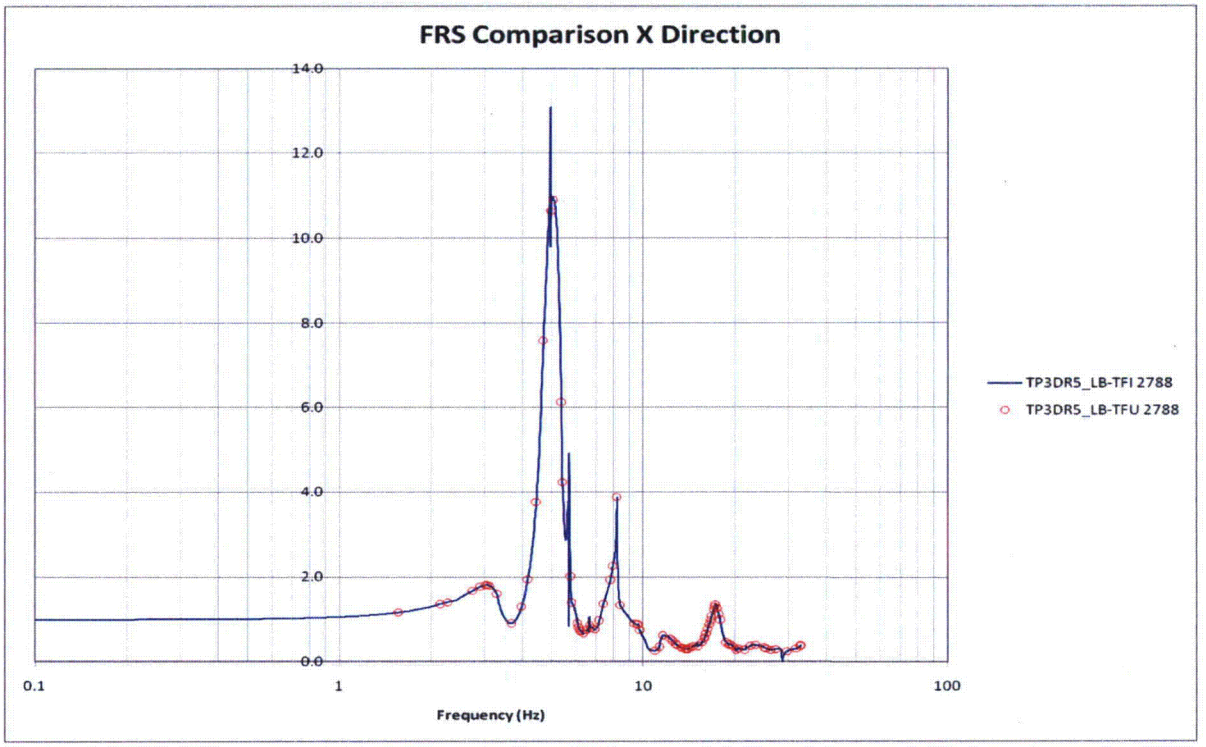

Figure C-13

TPNP 3D NI SSI LB Transfer Function in X-Direction – Node 2788

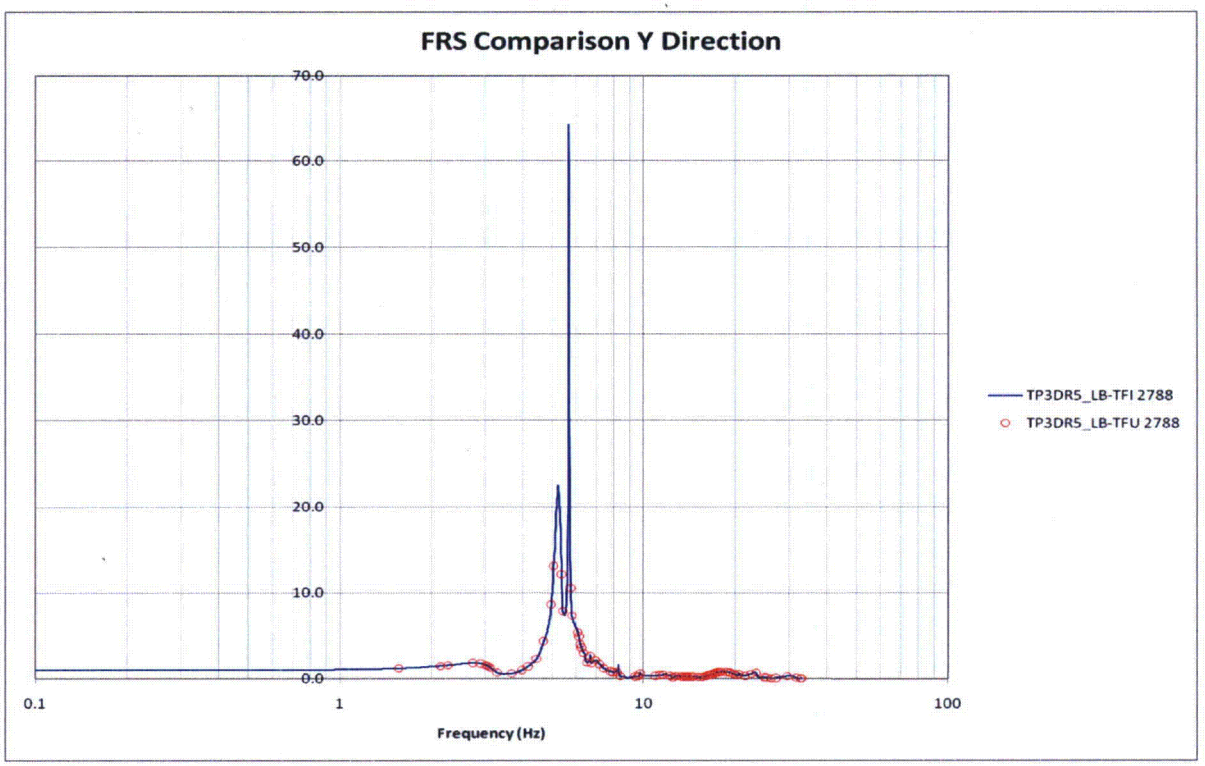

Figure C-14

TPNP 3D NI SSI LB Transfer Function in Y-Direction – Node 2788

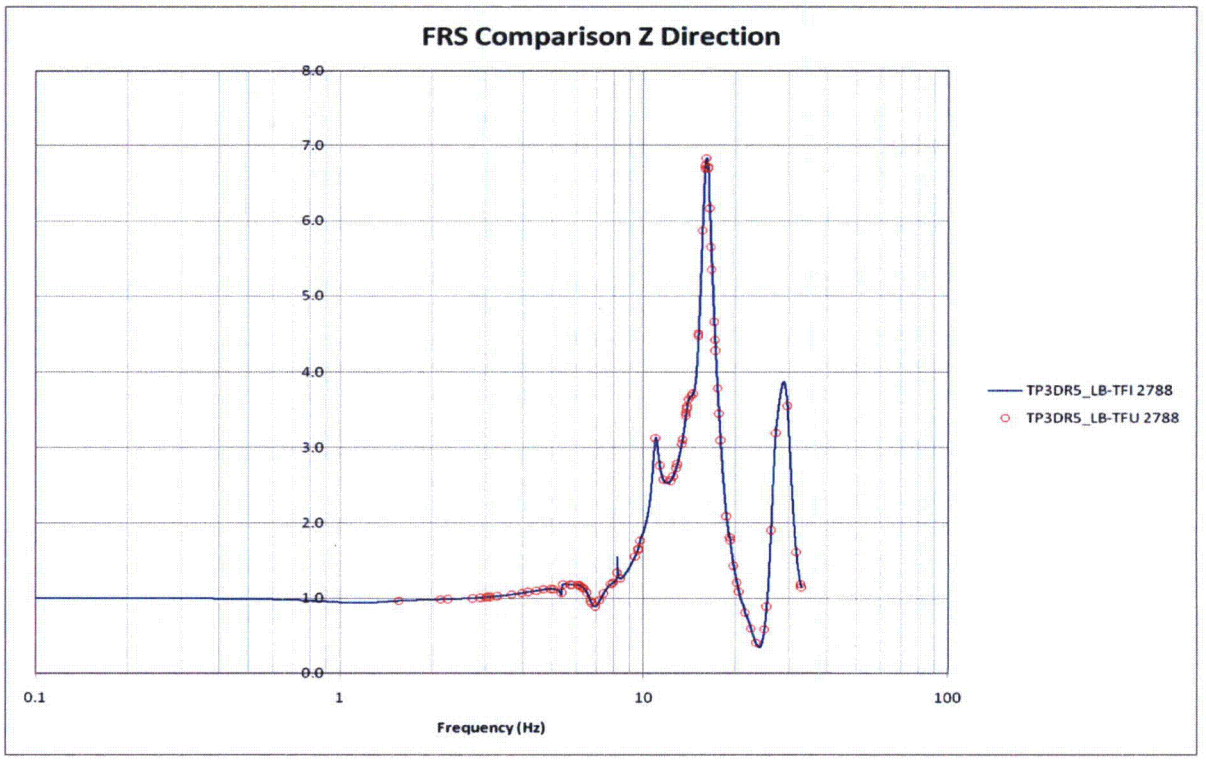

Figure C-15

TPNP 3D NI SSI LB Transfer Function in Z-Direction – Node 2788

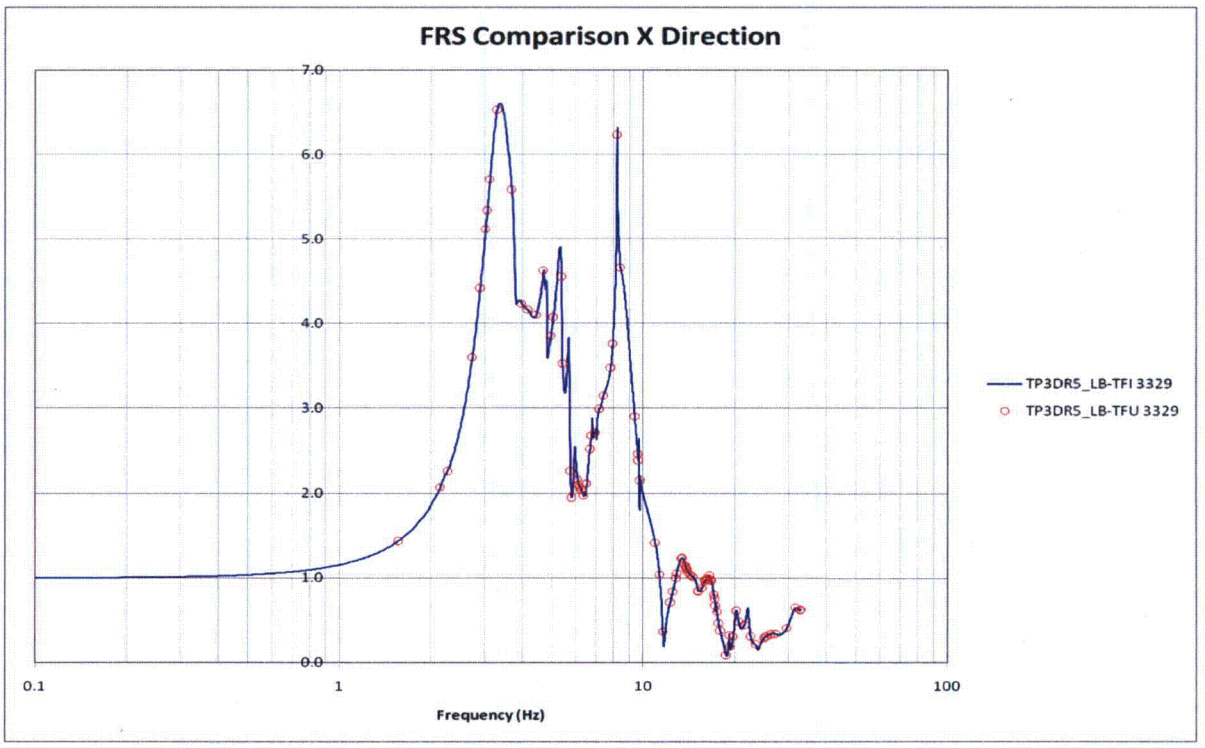

Figure C-16

TPNP 3D NI SSI LB Transfer Function in X-Direction – Node 3329

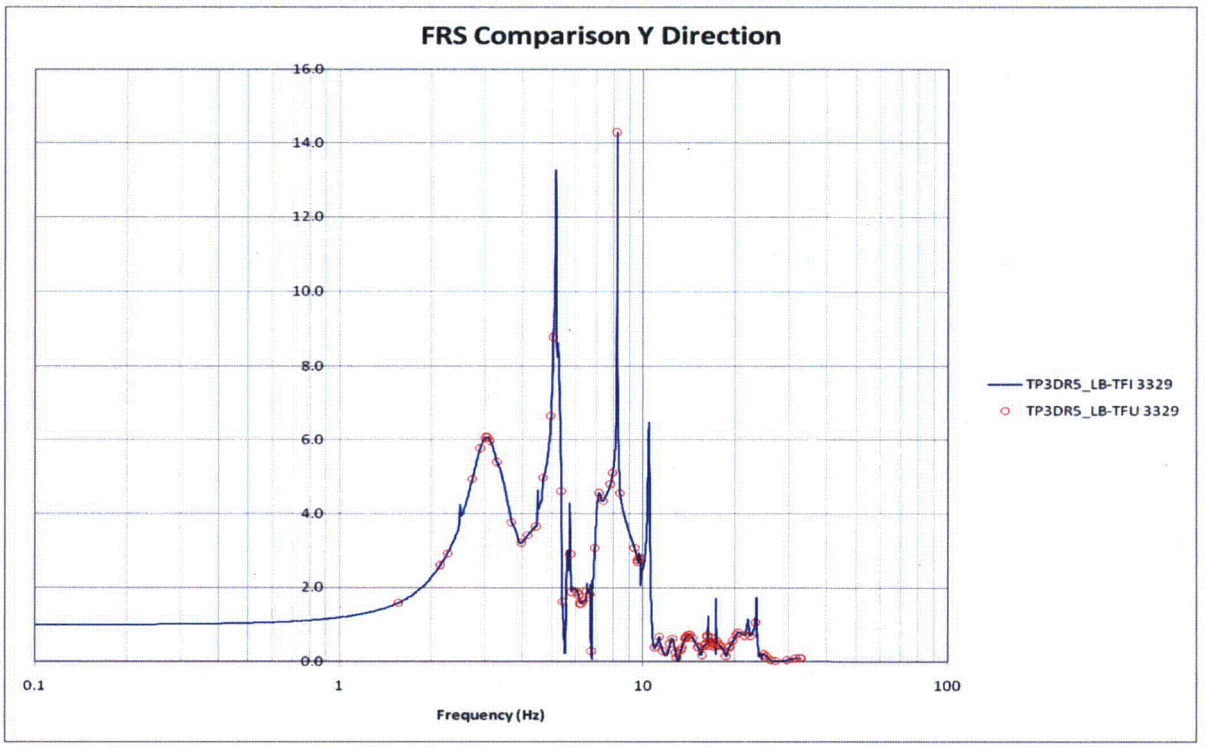

Figure C-17

TPNP 3D NI SSI LB Transfer Function in Y-Direction – Node 3329

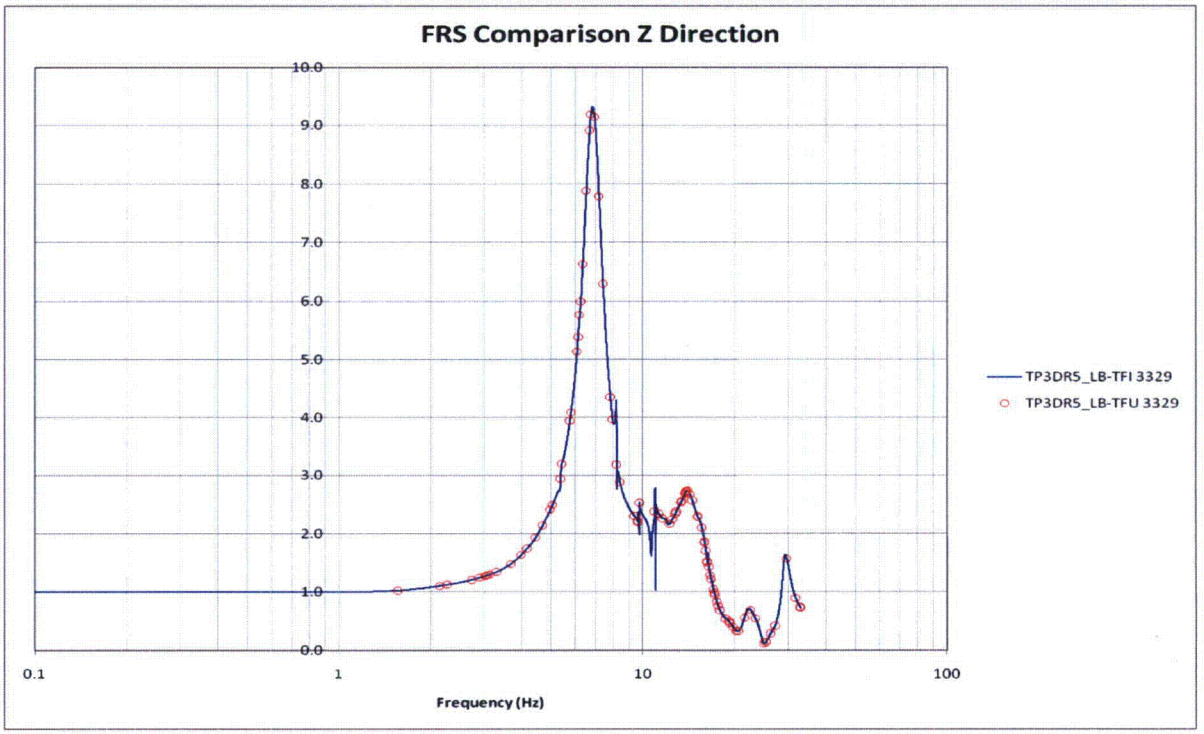

Figure C-18

TPNP 3D NI SSI LB Transfer Function in Z-Direction – Node 3329

From TPG-1000-S2R-802 Rev. 5:

Appendix D: TPNP 3D UB SSI Analysis Transfer Functions – NI Key Nodes

The interpolation function for the NI20r model was manually checked to ensure the correct starting point for the transfer functions. The TPNP 3D UB SSI analysis transfer functions for the NI six key locations, defined in Table 3.4-1, are shown in Figures D-1 through D-18.

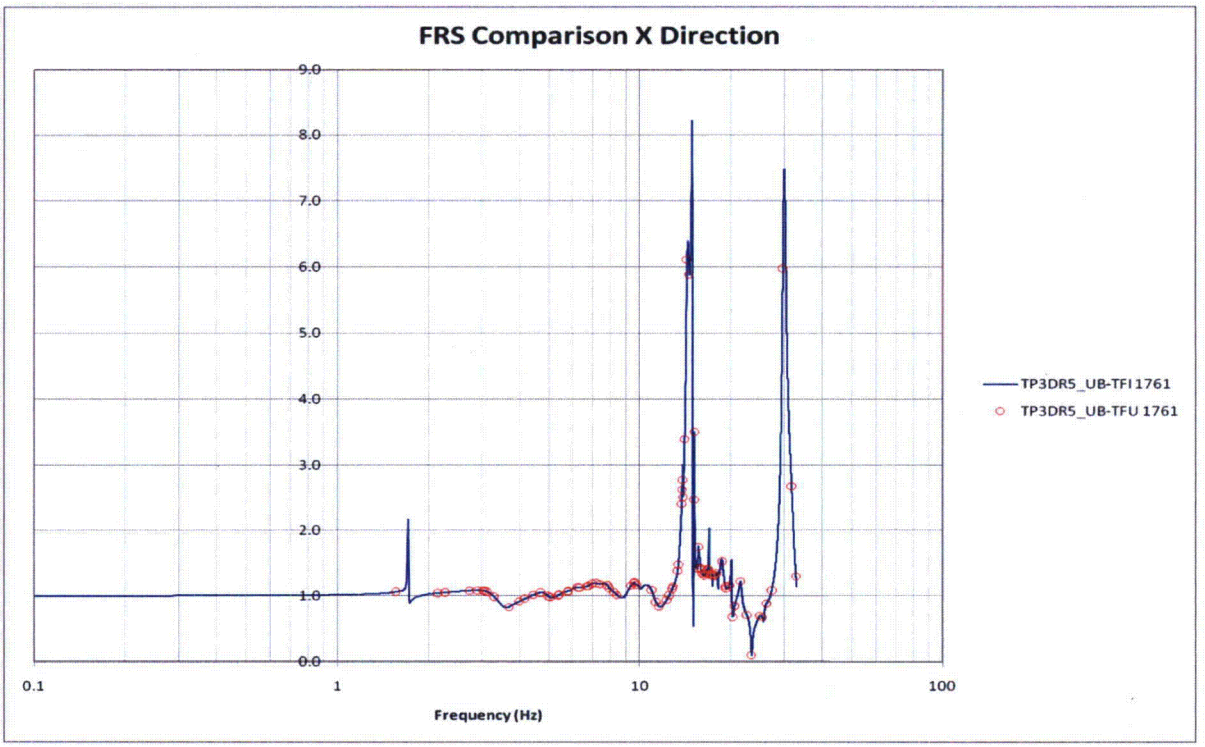

Figure D-1

TPNP 3D NI SSI UB Transfer Function in X-Direction – Node 1761

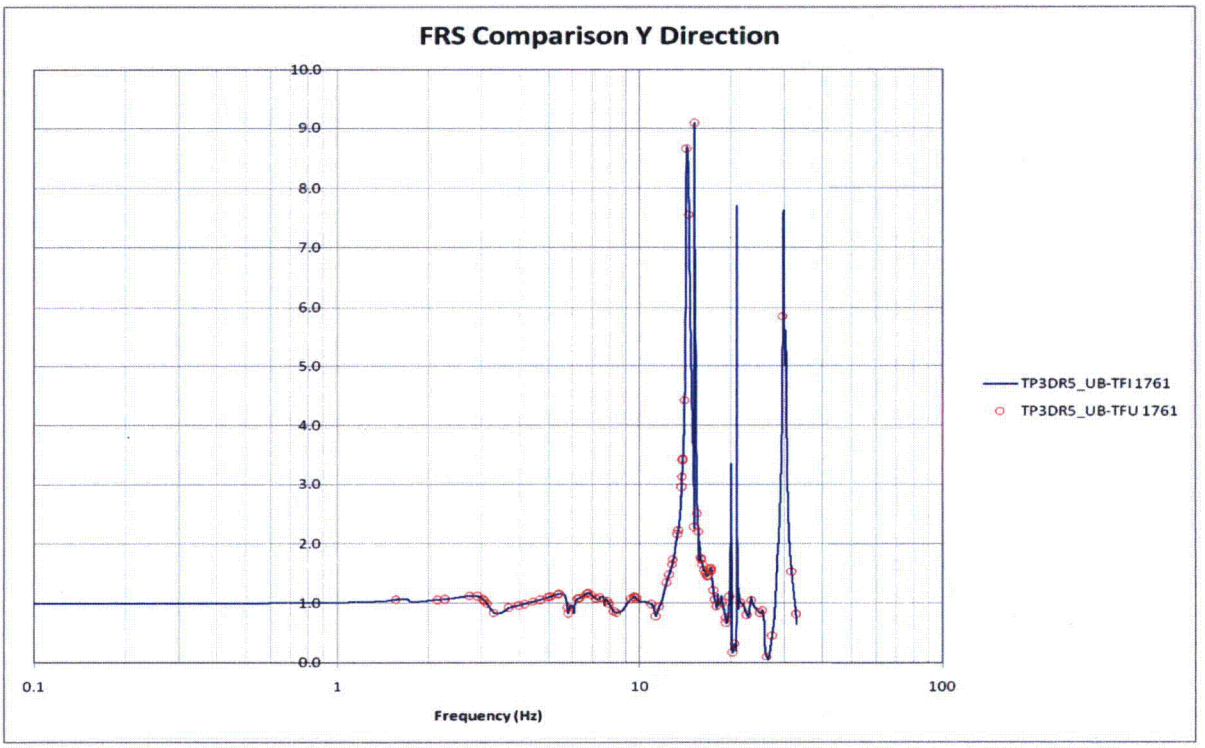

Figure D-2

TPNP 3D NI SSI UB Transfer Function in Y-Direction – Node 1761

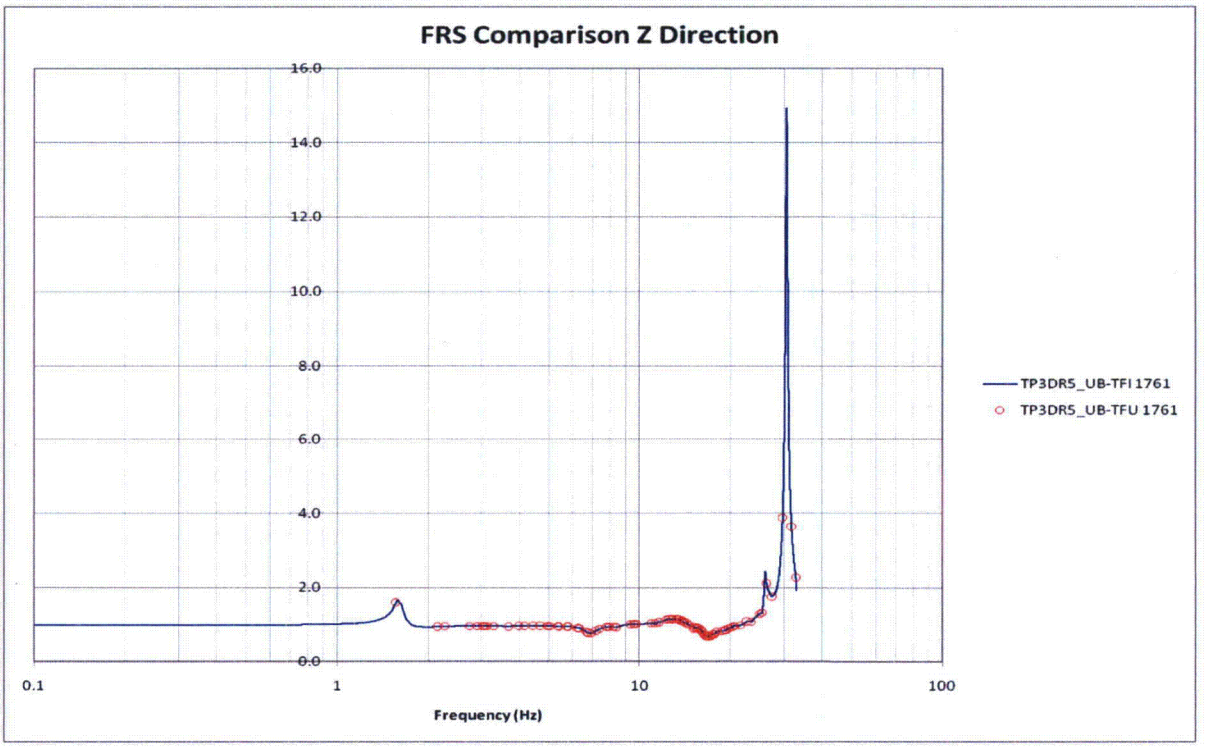

Figure D-3

TPNP 3D NI SSI UB Transfer Function in Z-Direction – Node 1761

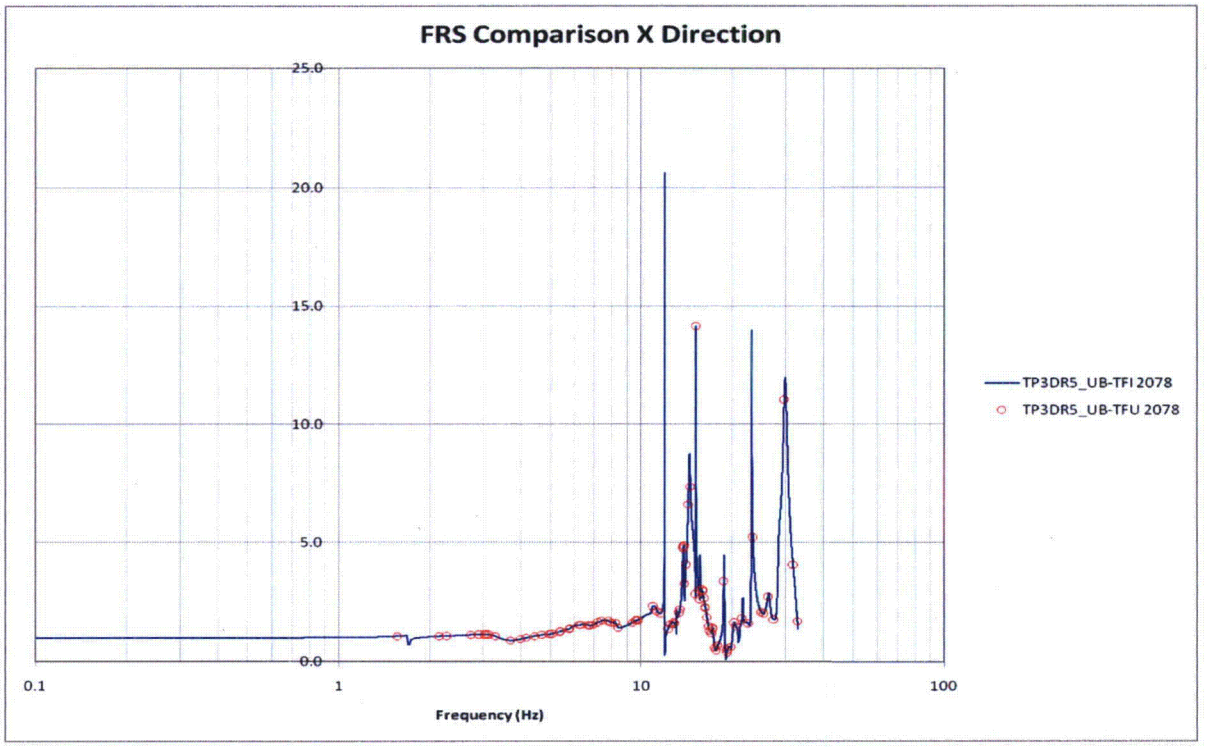

Figure D-4

TPNP 3D NI SSI UB Transfer Function in X-Direction – Node 2078

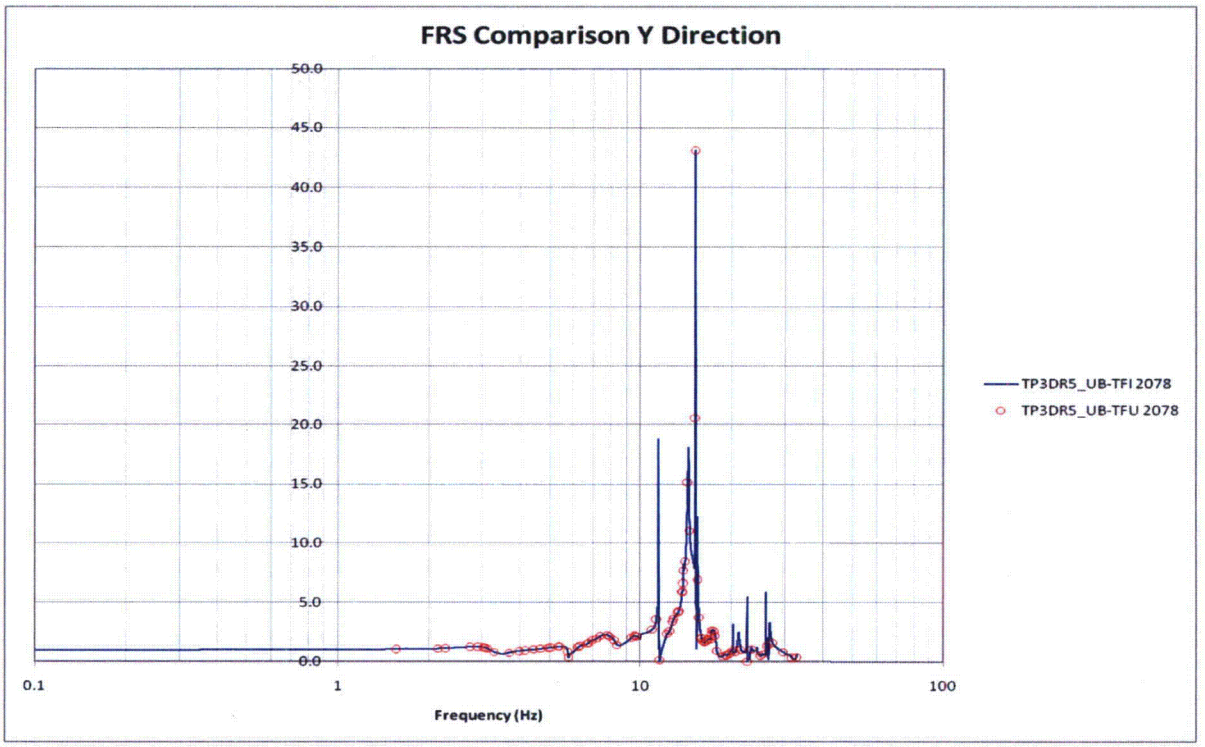

Figure D-5

TPNP 3D NI SSI UB Transfer Function in Y-Direction – Node 2078

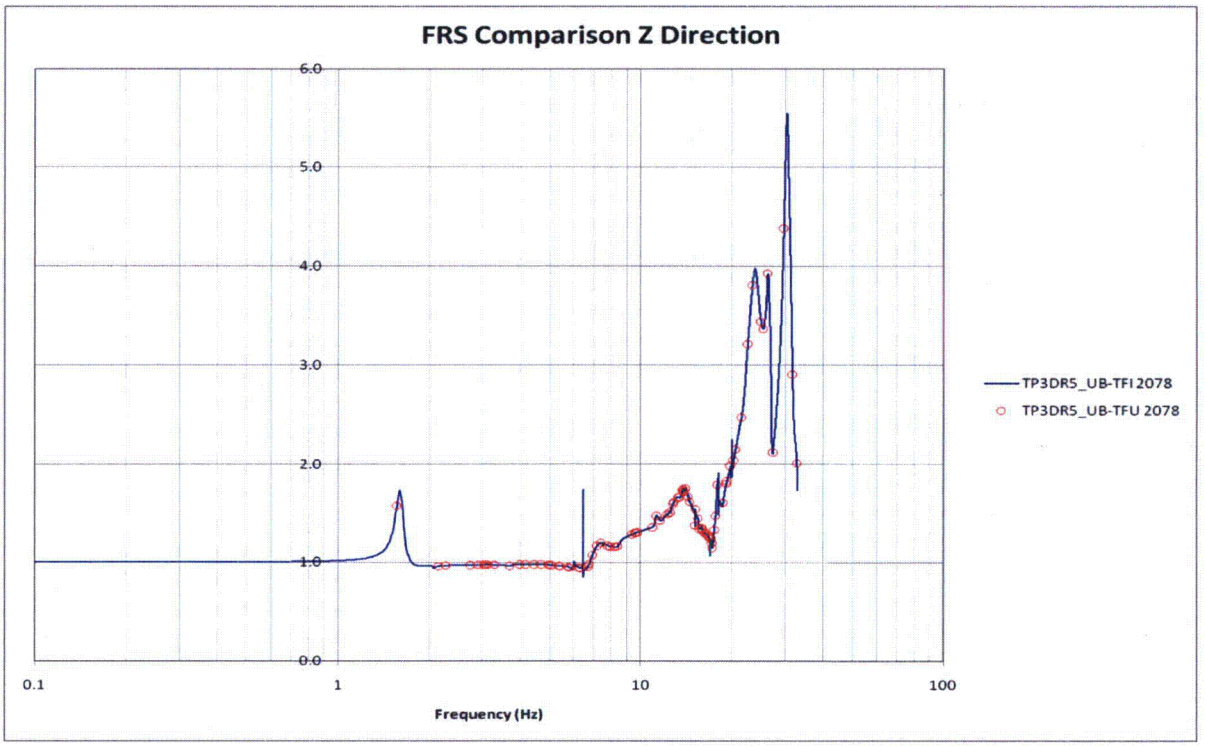

Figure D-6

TPNP 3D NI SSI UB Transfer Function in Z-Direction – Node 2078

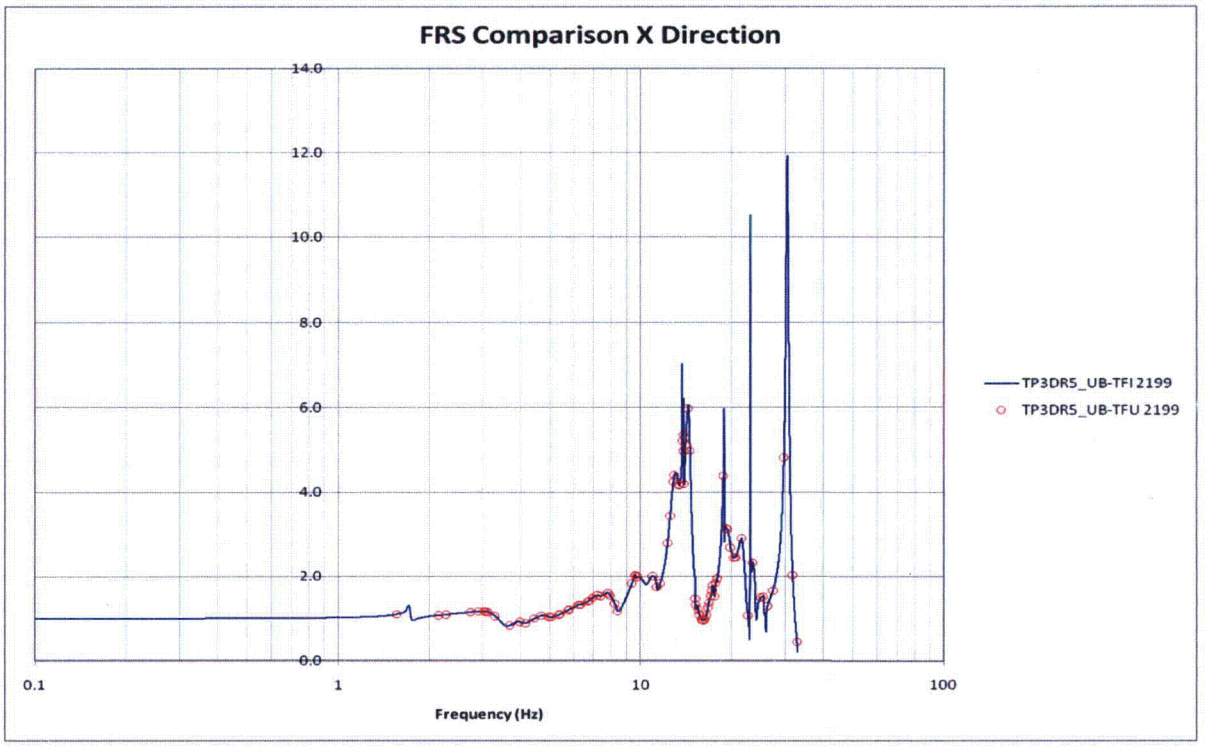

Figure D-7

TPNP 3D NI SSI UB Transfer Function in X-Direction – Node 2199

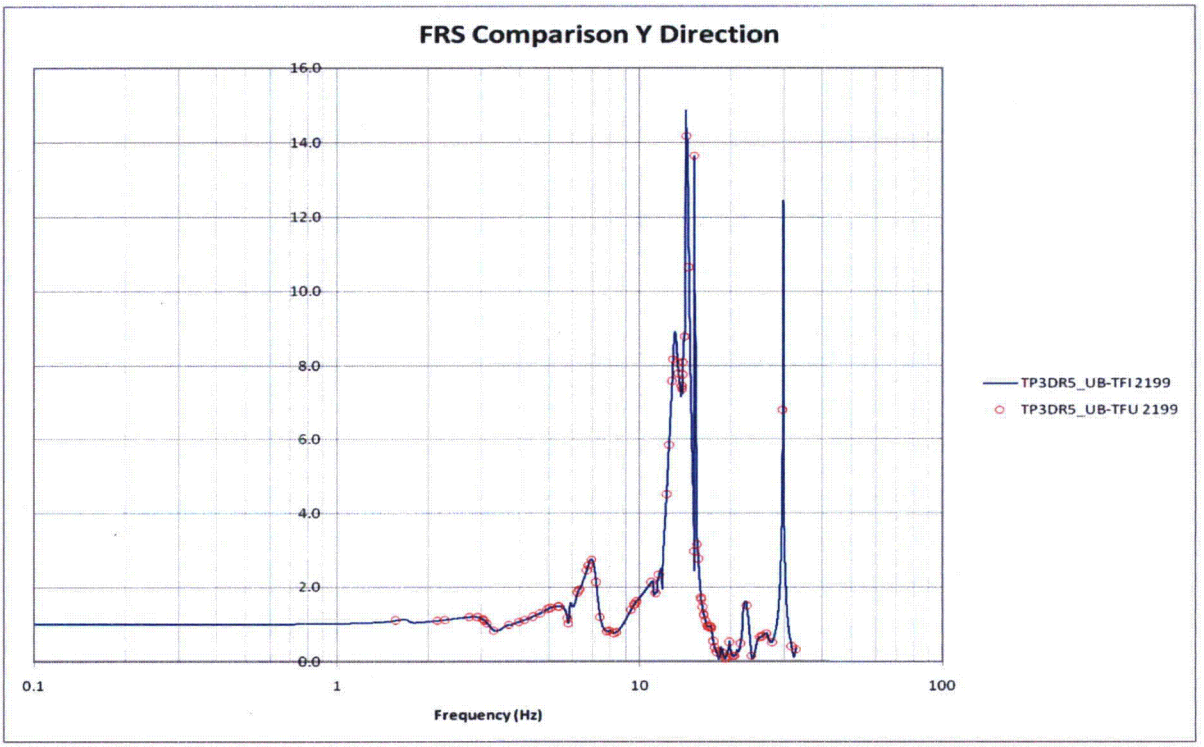

Figure D-8

TPNP 3D NI SSI UB Transfer Function in Y-Direction – Node 2199

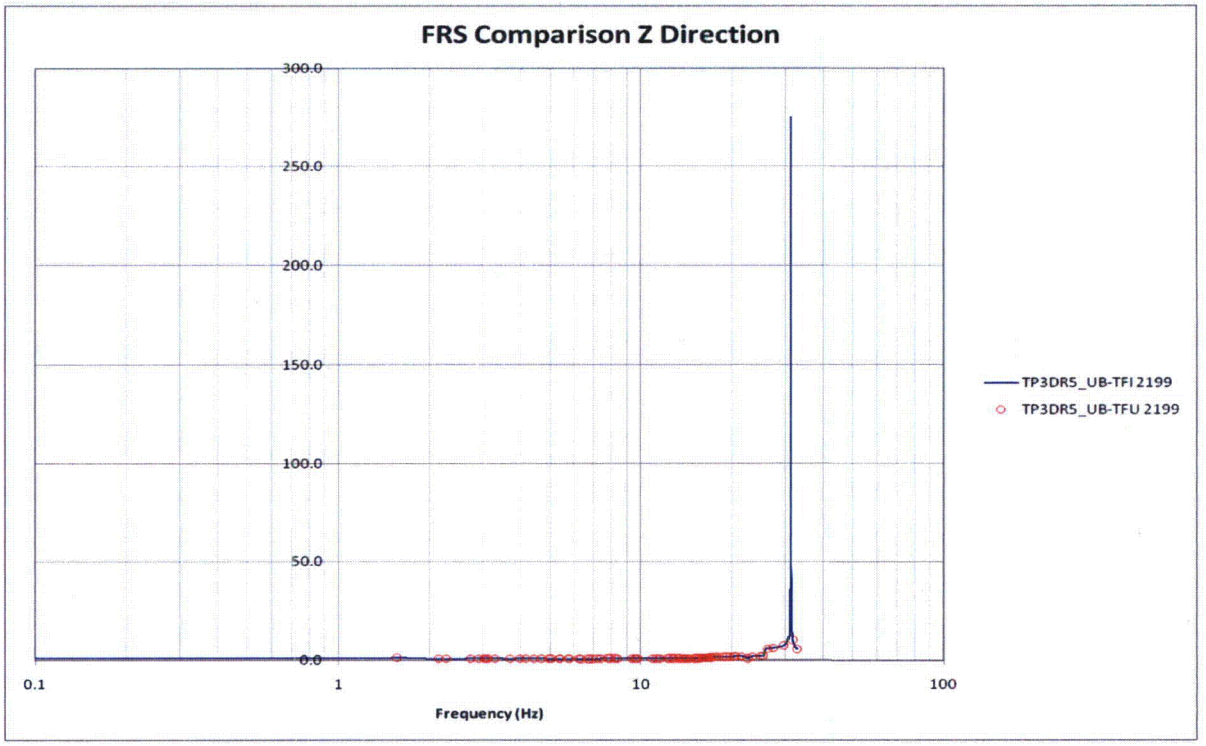

Figure D-9

TPNP 3D NI SSI UB Transfer Function in Z-Direction – Node 2199

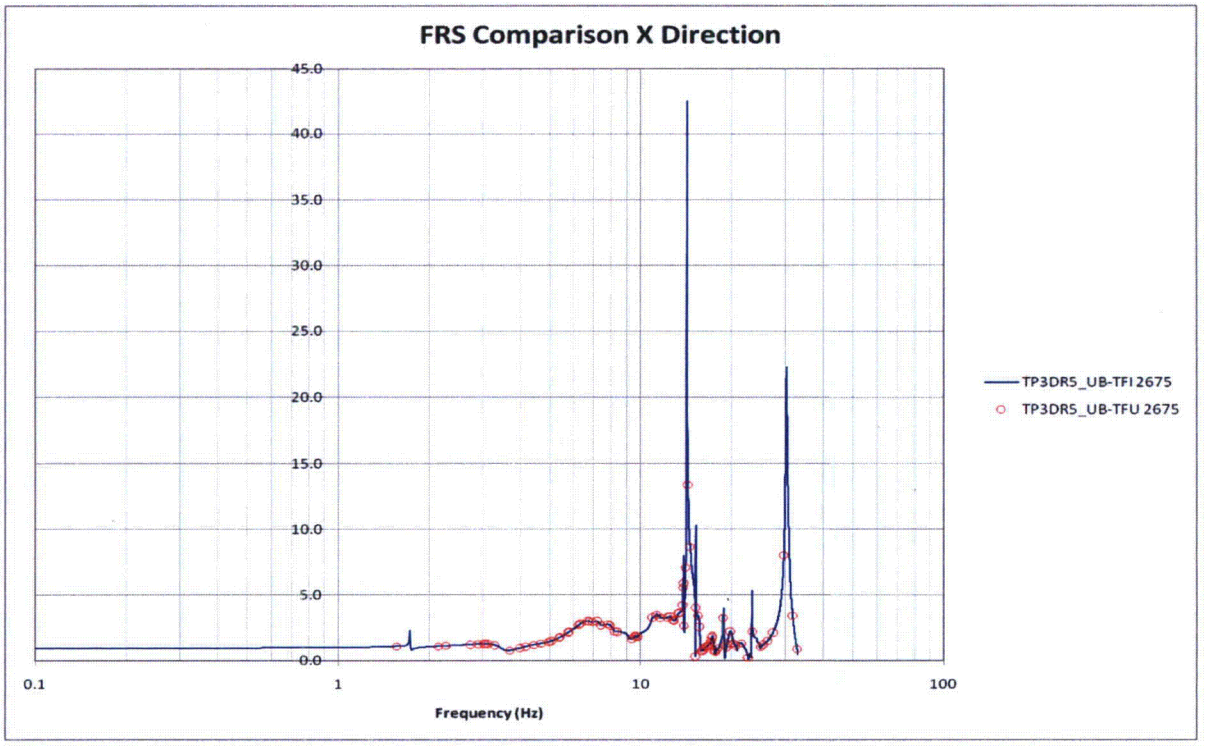

Figure D-10

TPNP 3D NI SSI UB Transfer Function in X-Direction – Node 2675

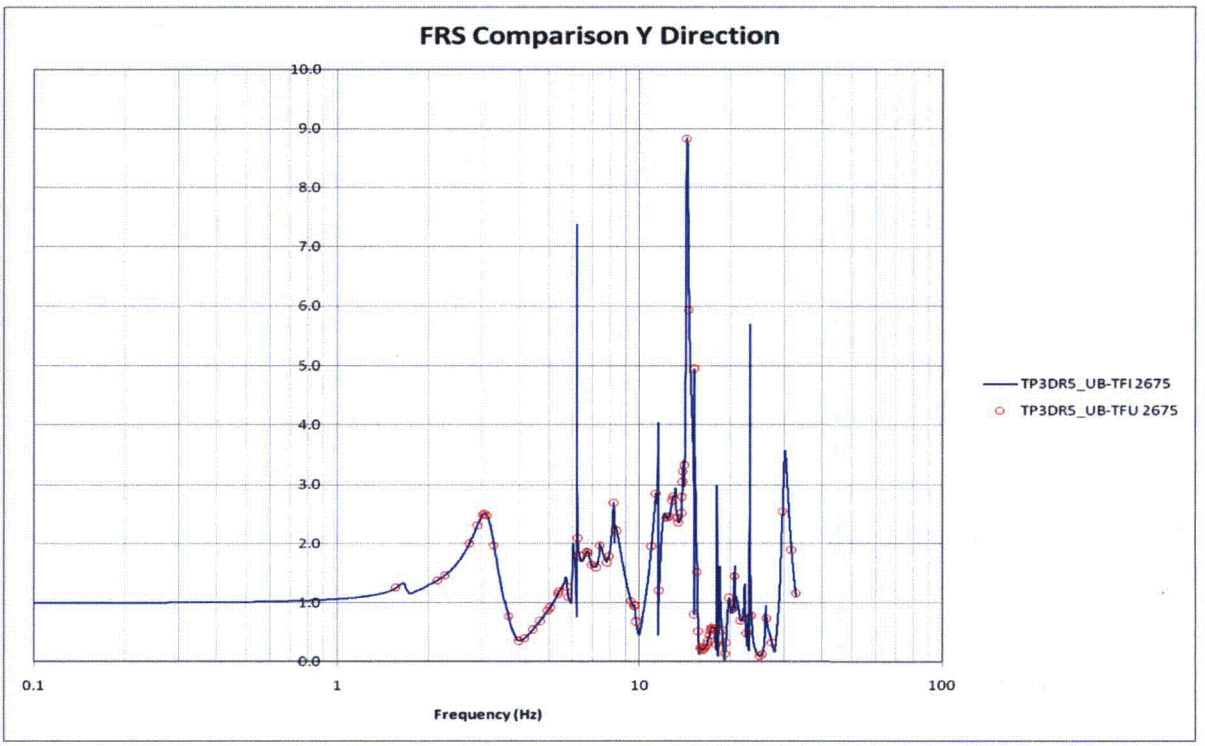

Figure D-11

TPNP 3D NI SSI UB Transfer Function in Y-Direction – Node 2675

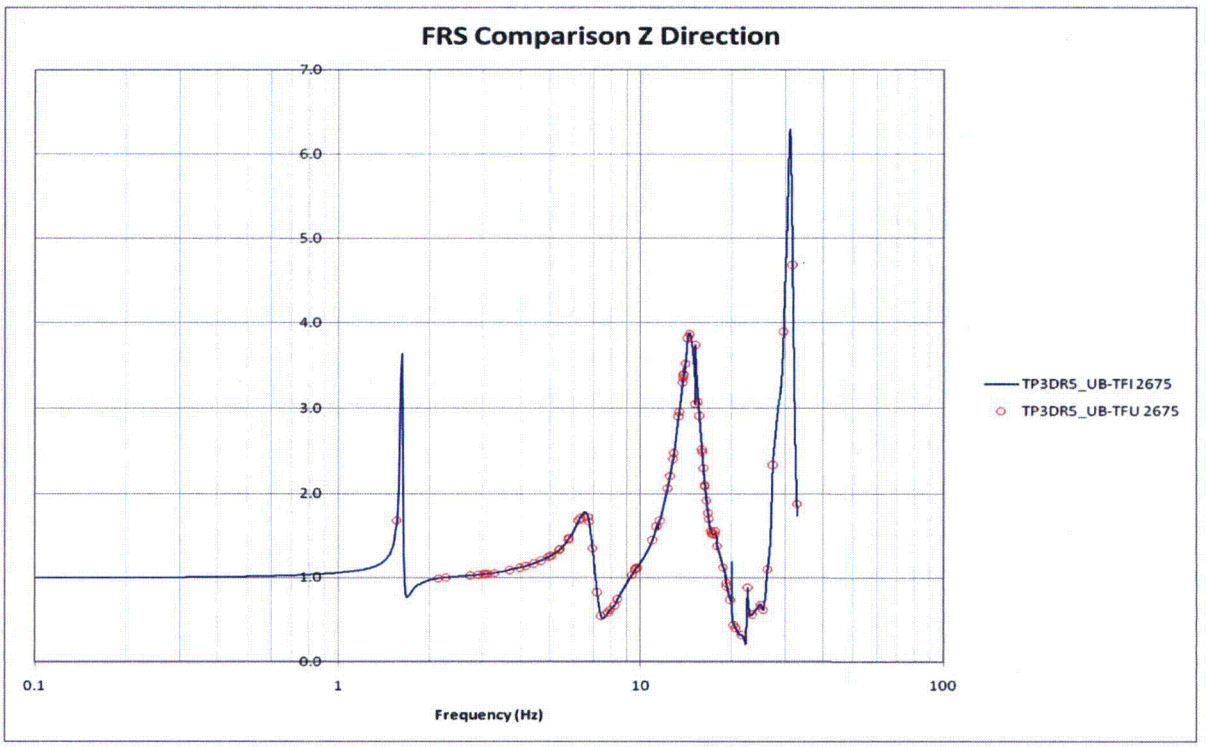

Figure D-12

TPNP 3D NI SSI UB Transfer Function in Z-Direction – Node 2675

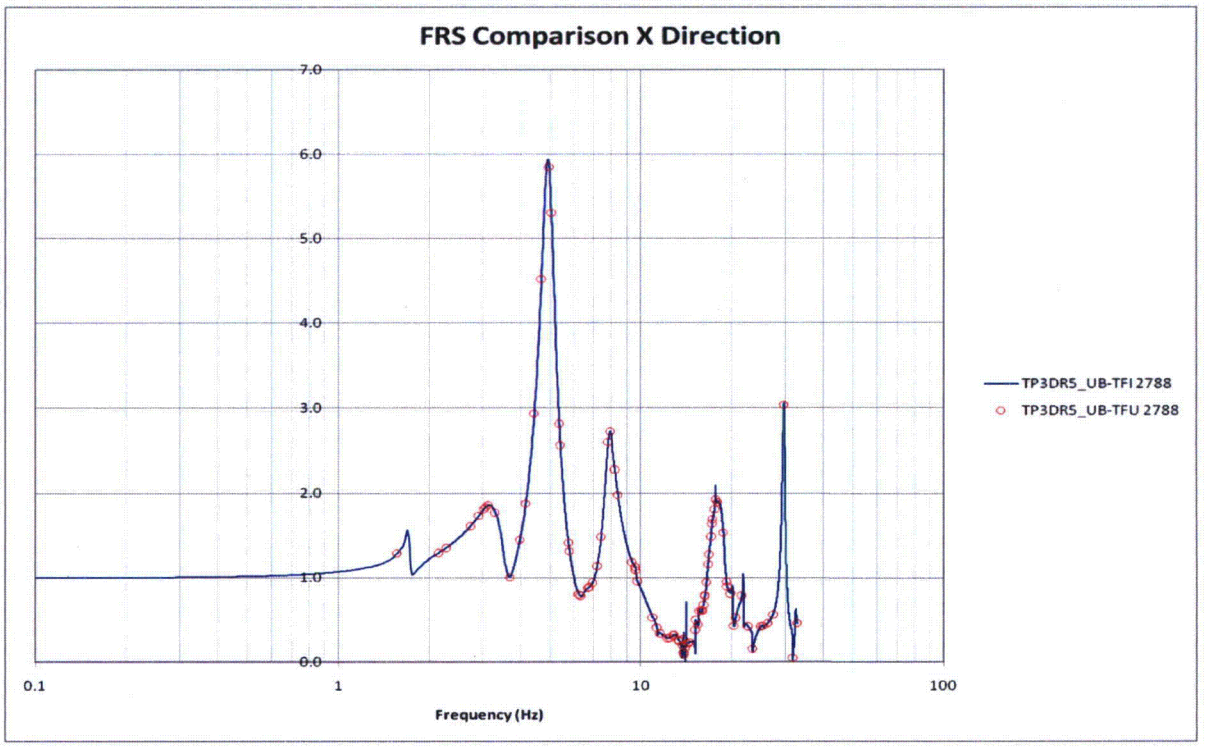

Figure D-13

TPNP 3D NI SSI UB Transfer Function in X-Direction – Node 2788

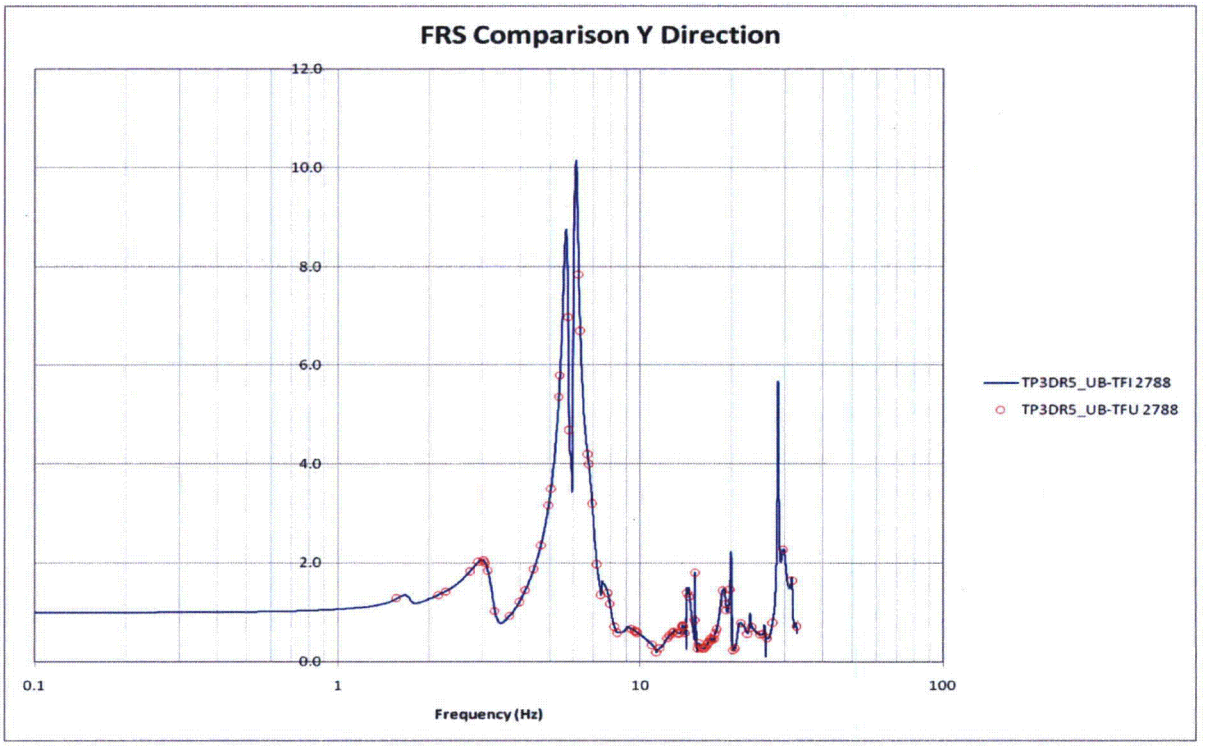

Figure D-14

TPNP 3D NI SSI UB Transfer Function in Y-Direction – Node 2788

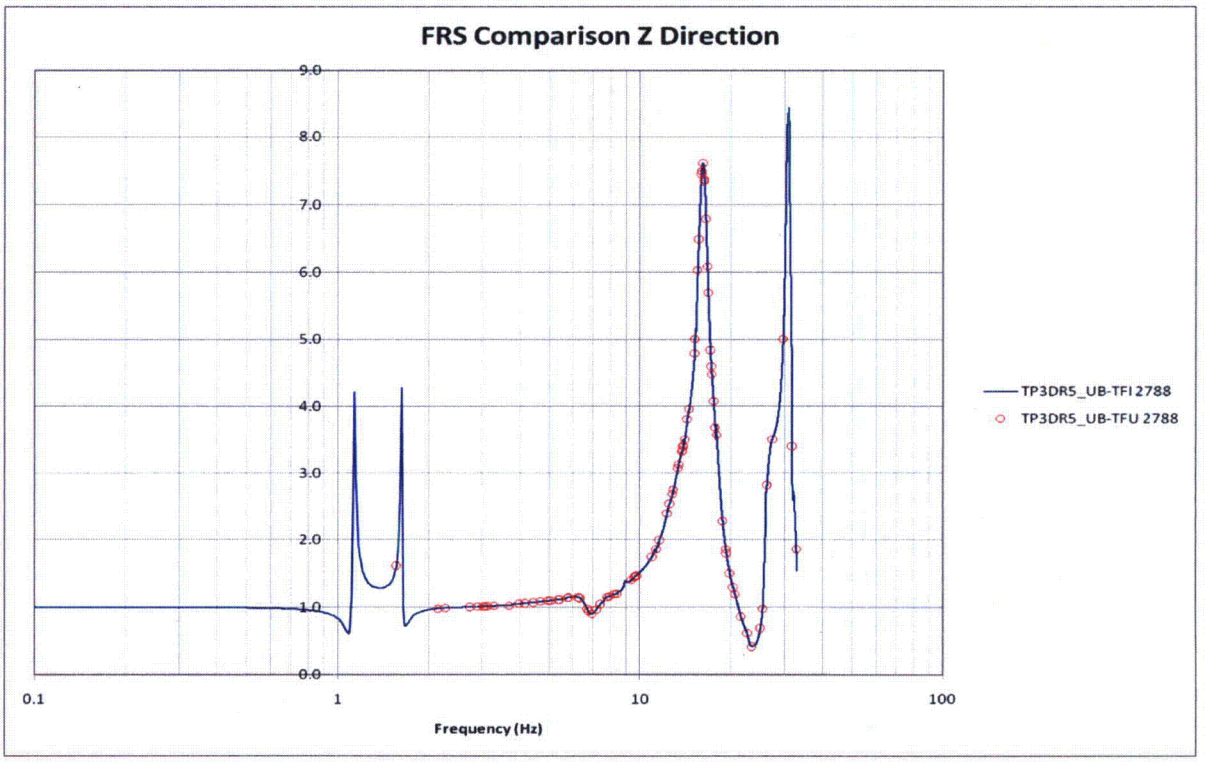

Figure D-15

TPNP 3D NI SSI UB Transfer Function in Z-Direction – Node 2788

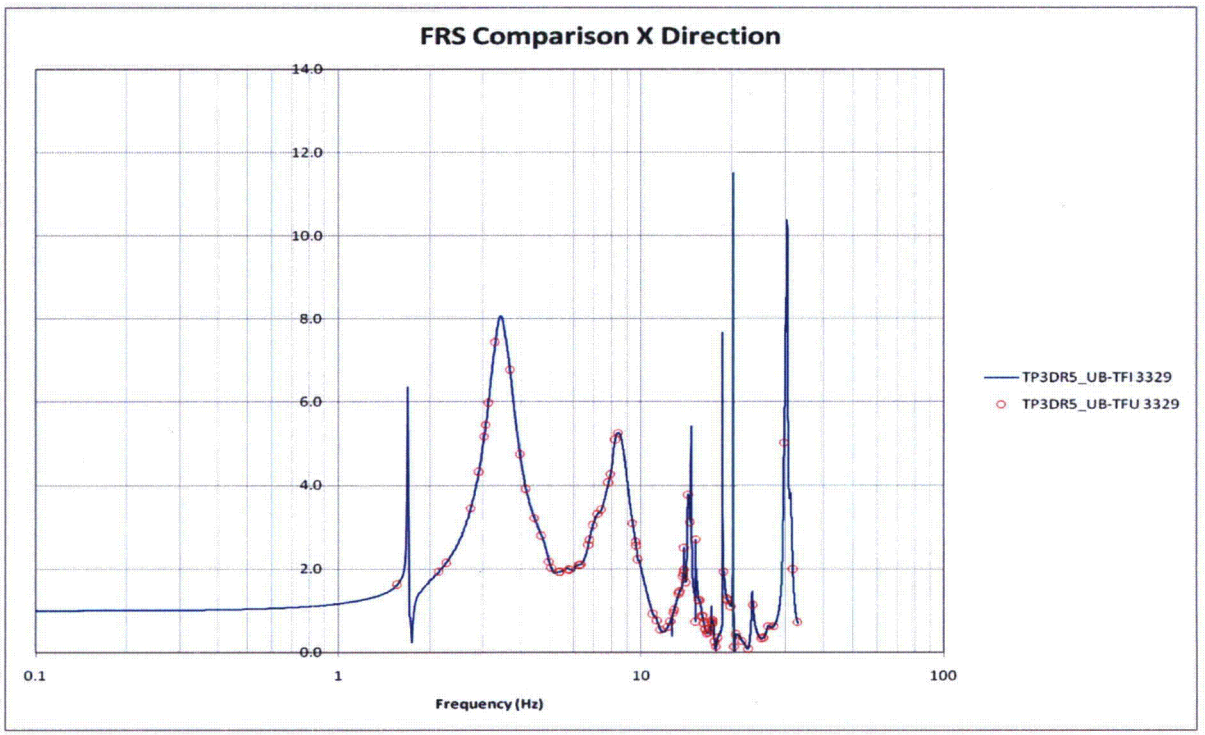

Figure D-16

TPNP 3D NI SSI UB Transfer Function in X-Direction – Node 3329

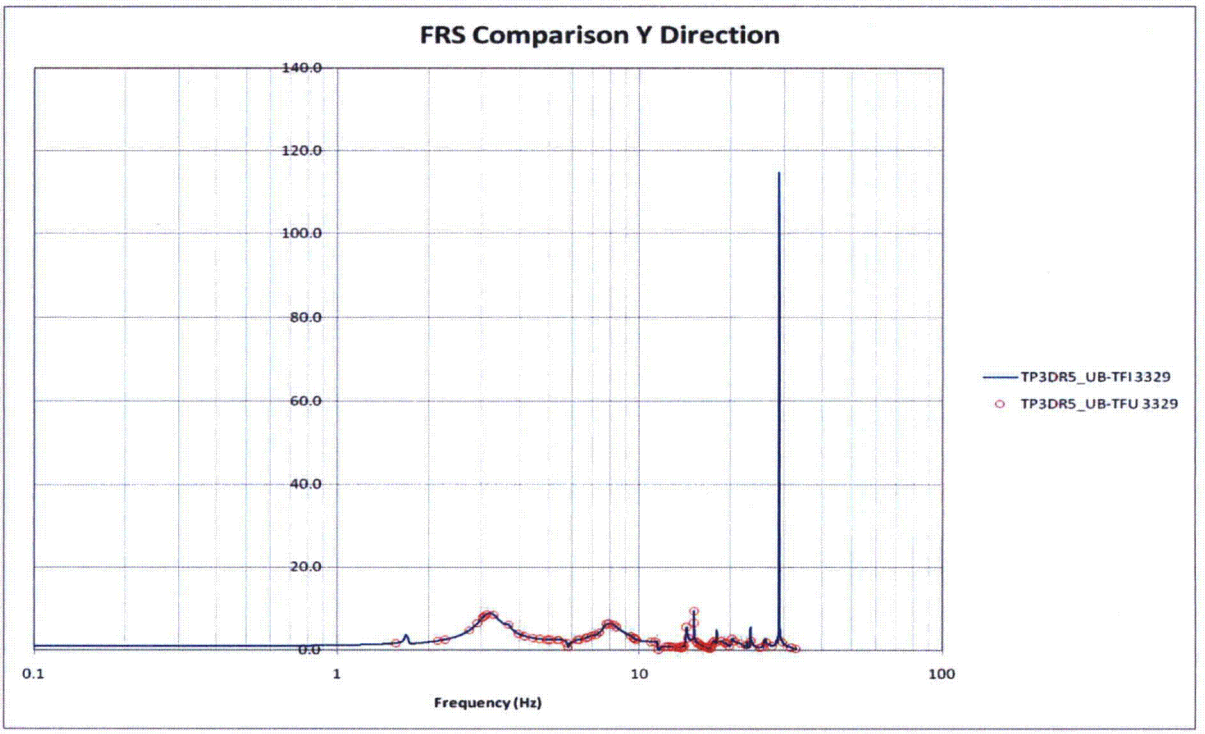

Figure D-17

TPNP 3D NI SSI UB Transfer Function in Y-Direction – Node 3329

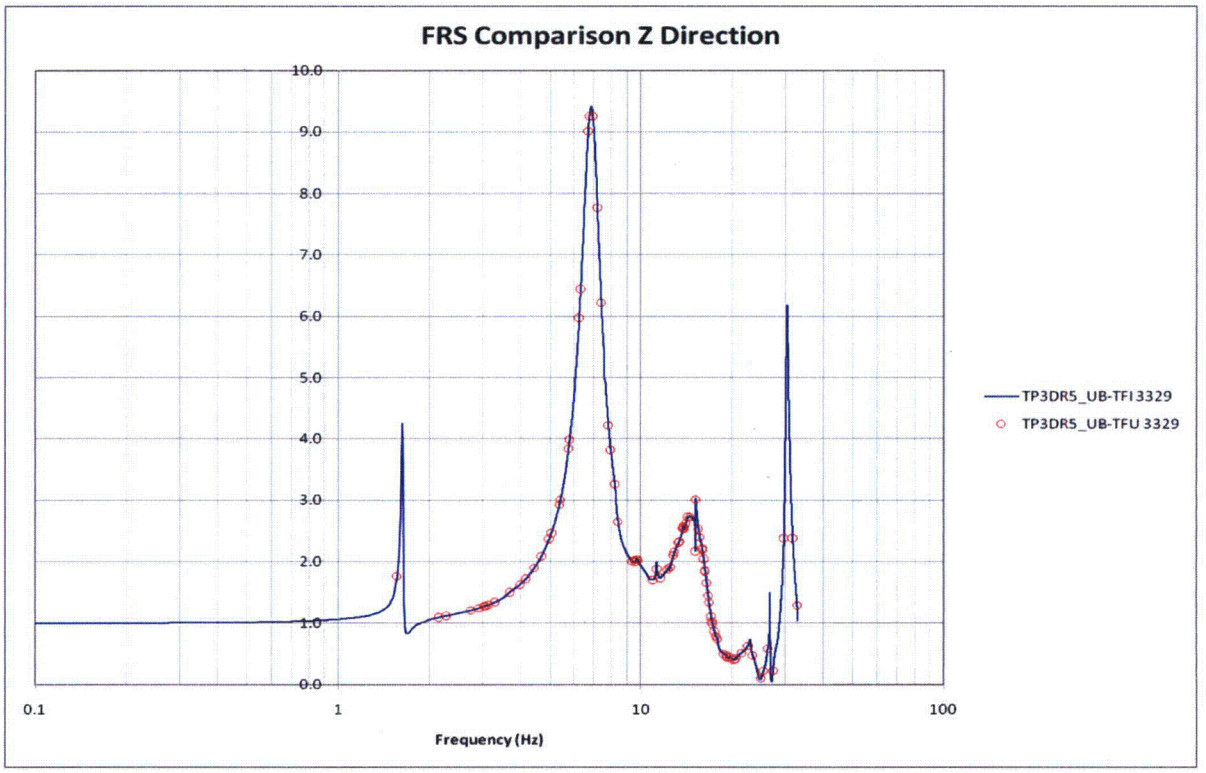

Figure D-18

TPNP 3D NI SSI UB Transfer Function in Z-Direction – Node 3329

This response is PLANT SPECIFIC.

References:

1. Westinghouse Report No. TPG-1000-S2R-802, Rev.6, "Turkey Point Site Specific Seismic Evaluation Report," dated March 2015.
2. Westinghouse Report No. TPG-1000-S2R-807, Rev.2, "Turkey Point Site Specific Seismic Evaluation Report," dated January 2013.

ASSOCIATED COLA REVISIONS:

No additional changes to COLA Revision 6 have been identified as a result of this revised RAI response.

ASSOCIATED ENCLOSURES:

None