Calculation of impedance functions of the CTB mat
Using the method in SC-21, PFS Ex. MM

Storage Pad per SC-21	Assumptions	*cf* CTB Mat
67 ft x 30 ft.	Length (L) x Width (B)	240 ft x 280 ft
450,000 ksf for 3000 psi concrete	E - Youngs modulus of mat	~450,000 ksf for 3000 psi concrete
3 ft.	t - thickness of mat	5 ft
$(.100\ ksf/32.17)(750\ fps)^2 =$ 1749 ksf	$\mu = \rho V_s^2$	$(.100\ ksf/32.17)(*2327\ fps)^2 =$ 16,832 ksf
sqrt((67 ft x 30 ft)/4) = 22.4 ft.	a = sqrt((L x B)/4)	sqrt((240 ft x 280 ft)/4) = 129.6ft
0.1 ksf	unit weight of soil	0.1 ksf

$$\delta = (Et^3)/(\mu a^3(1-\nu^2)) = \text{relative stiffness}$$

Storage Pad

$$\frac{(450{,}000\ ksf)\ (3\ ft)^3}{(1749\ ksf)(22.4\ ft)^3(1 - 0.40^2)}$$

$\delta = 0.735$

CTB Mat

$$\frac{(450{,}000\ ksf)(5ft)^3}{(16{,}832\ ksf)(129.6ft)^3(1 - 0.40^2)}$$

$\delta = 0.0018$

$$a_0 = \Omega\ a/V_s = \text{dimensionless parameter}$$

$a_0 = 0.19$ to 0.94 for frequencies between 1Hz - 5 Hz

$a_0 = 1.75$ for frequency of 5 Hz

$$\frac{(5\ cycles/sec)\ (2\pi\ radians/cycle)(129\ 6ft)}{2327\ ft/sec}$$

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*
Soil shear wave velocity using the average velocity over the depth of 260 ft
Depth of 260 ft = (240'x280')/2
V_s^2 for the CTB mat = weighted average of Best Estimate Properties from G(PO17)-2, ICEC, p.8
V_{sav} = (5/260)(1497) + (5/260)(415) + 2/260(622) + (6/260)(779) + (8/260)(760) + (9/260)(818) + (15/260)(956) + (40/260)(1716) + (35/260)(2900)+ (135/260)(2900) = 2327 fps

Table 1

Dynamic Soil Properties for SASSI Model

(Source: Reference 5)

Upper-Bound Properties

SHAKE Layers	Depth Top (ft)	Depth Bottom (ft)	Wave Velocity			Damping Ratio		Poisson's Ratio
			Density (pcf)	Vs (fps)	Vp (fps)	Shear (%)	Compression (%)	
1-2	0	5	100	2120	3380	0.91	0.91	0.176
3-4	5	10	80	557	1385	3.48	3.48	0.403
5	10	12	80	807	1543	2.69	2.69	0.312
6-7	12	18	100	983	1803	1.82	1.82	0.289
8-9	18	26	94	973	1764	2.31	2.31	0.281
10-12	26	35	115	1053	2042	5.07	5.07	0.319
13-15	35	50	115	1488	2949	4.04	4.04	0.329
16-23	50	90	120	2481	4808	1.21	1.21	0.318
24-26	90	125	135	4101	7104	4.28	4.28	0.250
27-35	125	300	145	4101	7104	4.28	4.28	0.250
36-39	300	500	145	5657	9798	3.10	3.10	0.250
40-41	500	700	145	6398	11155	2.53	2.53	0.255
	700		170	6398	11155	2.16	1.00	0.255

Best Estimate Properties

SHAKE Layers	Depth Top (ft)	Depth Bottom (ft)	Wave Velocity			Damping Ratio		Poisson's Ratio
			Density (pcf)	Vs (fps)	Vp (fps)	Shear (%)	Compression (%)	
1-2	0	5	100	1497	2390	0.94	0.94	0.177
3-4	5	10	80	415	1131	4.78	4.78	0.422
5	10	12	80	622	1260	3.60	3.60	0.339
6-7	12	18	100	779	1472	2.29	2.29	0.306
8-9	18	26	94	760	1440	3.01	3.01	0.307
10-12	26	35	115	818	1667	6.21	6.21	0.341
13-15	35	50	115	956	2085	6.13	6.13	0.367
16-23	50	90	120	1716	3400	1.74	1.74	0.329
24-26	90	125	135	2900	5023	4.32	4.32	0.250
27-35	125	300	145	2900	5023	4.32	4.32	0.250
36-39	300	500	145	3450	5975.5	3.67	3.67	0.250
40-41	500	700	145	3950	6841.5	3.33	3.33	0.250
	700		170	6398	11155	1.76	1.00	0.255

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RULEMAKINGS AND
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NUCLEAR REGULATORY COMMISSION

Docket No. ____________ Official Exh. No. 177

In the matter of PFS

Staff ____________ IDENTIFIED ✓

Applicant ____________ RECEIVED ____________

Intervenor ✓ REJECTED ____________

Other ____________ WITHDRAWN ____________

DATE 5-2-02 Witness ____________

Clerk [signature]

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