

RAS 5641

72-22-ISFSI - State Exhibit 179-Recd 5/6/02

SUPPORTING INFORMATION FOR SIMULATIONS LISTED IN ANSWER 118 OF
KPS/AIS TESTIMONY

5/3/2002

CORRECTED VERSION OF SUMMARY TABLE

SUMMARY OF VISUALNASTRAN ANALYSES

| Case # - Description | Event | Stiffness | Damping | COF | Remarks |
|----------------------|-------|--|--|----------------------------|---|
| 1. - 8 casks | 2k | Lower Bound design basis | Lower bound design basis | .8 | Confirm Dynamo results. Stiffness values per Appendix D |
| 2. - 8 casks | 2k | Resonance @ 5 Hz | 1% | .8 | Evaluate effect of "tuning" soil springs and low damping |
| 3.-1 cask on pad | 10k | Based on mass of 1 cask + entire pad oscillating at 5Hz | 1% | .8 | Lowest stiffness that gives 5 Hz tuning |
| 4. - 1 cask on pad | 10k | Based on mass of 1 cask + entire pad oscillating at 5Hz | 5% | .8 | Check damping effect |
| 5.-3 casks on pad | 10k | Based on mass of 8 casks + pad @ 5 Hz | 1% | Random between 0.2 and 1.0 | Check real configuration |
| 6.-3 casks on pad | 10k | Based on mass of 1 cask + entire pad oscillating at 5Hz | 1% | .8 | Intermediate loading with lower bound tuned stiffness |
| 7.- 4 casks on pad | 10k | Based on mass of 8 casks + entire pad oscillating at 5Hz | 1% | .8 | Intermediate loading with upper bound tuned stiffness |
| 8.- 8 casks on pad | 10k | Based on mass of 8 casks + entire pad oscillating at 5Hz | 1% | .8 | Fully populated with tuned stiffness and damping per Appendix A. |
| 9.- 8 casks on pad | 10k | Based on mass of 8 casks + entire pad oscillating at 5Hz | 1% | 0.2 | Fully populated with upper bound tuned stiffness and damping |
| 10. - 8 casks on pad | 10k | Based on mass of 8 casks + entire pad oscillating at 5Hz | 1% | Random between 0.2 and 1.0 | Fully populated with tuned stiffness and damping - evaluation of the effect of real behavior of friction between casks and pads |
| 11. - 8 casks on pad | 10k | Geomatrix Lower Bound Values consistent with 10k | Geomatrix Lower Bound Values consistent with 10k | .8 | Design basis equivalent of 2k event. Stiffness values per Appendix C. |

NUCLEAR REGULATORY COMMISSION

Docket No. _____ Official Exh. No. 179
 In the matter of PFS
 Staff _____ IDENTIFIED
 Applicant _____ RECEIVED _____
 Intervenor _____ REJECTED _____
 Other _____ WITHDRAWN _____
 DATE 5-6-02 Witness _____
 Clerk D. Keut

JD DOCKETED
 USNRC
 2003 JAN 31 PM 2:06
 OFFICE OF THE SECRETARY
 RULEMAKINGS AND
 ADJUDICATIONS STAFF

Template = SECY-028

SECY-02

| Input Value for Case 1 - Table accompanying Answer 118 of KPS/AIS testimony | | |
|---|------------------------|--|
| Item | Value | Reference (unless noted reference is to report HI-2022854) |
| Cask mass (lbm) | 360,000 | p.12,Figure 8 |
| Cask height (inch) | 231.5 | HI-STORM FSAR |
| Cask radius (inch) | 66.25 | HI-STORM FSAR |
| Pad length/width/thickness (ft) | 67/30/3 | Appendix C, p. C-1 |
| Pad mass (lbm) | 934700 | Figure 8 |
| Cask contact stiffness per facet (lbf/inch) | 1179030 | Figure 7 and Appendix A, p A-1 |
| Cask Contact damping per facet (lbf *sec/inch) | 4549.05 | Appendix A, p A-2 |
| Cask-Pad Coefficient of Friction | 0.8 | |
| Number of facets | 34 | Appendix A, p.A-1 |
| Cask Locations (confirming runs) | Per array considered | Appendix A, p. A-4 |
| Soil Spring and Damper Data | | |
| Kx(lbf/in) | 9,512,000 | Appendix D |
| Cx (lbm/sec) | 9.249×10^7 | " |
| Ky(lbf/in) | 9,037,000 | " |
| Cy (lbm/sec) | 8.789×10^7 | " |
| Kz(lbf/in) | 12,040,000 | " |
| Cz (lbm/sec) | 1.727×10^8 | " |
| Kxx(lbf-in/deg) | 2.423×10^{10} | " |
| Cxx (lbf in sec/deg) | 3.812×10^8 | " |
| Kyy(lbf-in/deg) | 8.137×10^9 | " |
| Cyy (lbf in sec/deg) | 8.427×10^7 | " |
| Kzz(lbf in/deg) | 2.226×10^{10} | " |
| Czz (lbf in sec/deg) | 1.556×10^8 | " |
| Seismic Input (2k) | 3 input files | Geomatrix |

| Input Value for Case 2 - Table accompanying Answer 118 of KPS/AIS testimony | | |
|---|-----------------------------|--|
| Item | Value | Reference (unless noted reference is to report HI-2022854) |
| Cask mass (lbm) | 360,000 | p.12,Figure 8 |
| Cask height (inch) | 231.5 | HI-STORM FSAR |
| Cask radius (inch) | 66.25 | HI-STORM FSAR |
| Pad length/width/thickness (ft) | 67/30/3 | Appendix C, p. C-1 |
| Pad mass (lbm) | 934700 | Figure 8 |
| Cask contact stiffness per facet (lbf/inch) | 1179030 | Figure 7 and Appendix A, p A-1 |
| Cask Contact damping per facet (lbf *sec/inch) | 4549.05 | Appendix A, p A-2 |
| Cask-Pad Coefficient of Friction | 0.8 | |
| Number of facets | 34 | Appendix A, p.A-1 |
| Cask Locations (confirming runs) | Per array considered | Appendix A, p. A-4 |
| Soil Data (1% tuned) | | Based on mass of 8 casks plus entire pad |
| Tuning frequency(Hz) | 5 | Appendix A, p.3 |
| Tuning damping % | 0.1(linear);1.0(rotational) | Appendix A, p.3 |
| Kx(lbf/in) | 9,796,000 | Figure 6 |
| Cx (lbm/sec) | 240,800 | " |
| Ky(lbf/in) | 9,796,000 | Figure 6 |
| Cy (lbm/sec) | 240,800 | " |
| Kz(lbf/in) | 9,796,000 | Figure 6 |
| Cz (lbm/sec) | 240,800 | " |
| Kxx(lbf-in/deg) | 1.385x10 ⁹ | Figure 6 |
| Cxx (lbf in sec/deg) | 881,620 | " |
| Kyy(lbf-in/deg) | 6.924x10 ⁹ | Figure 6 |
| Cyy (lbf in sec/deg) | 4,408,000 | " |
| Kzz(lbf-in/deg) | 8.309x10 ⁹ | Figure 6 |
| Czz (lbf in sec/deg) | 5,289,000 | " |
| Seismic Input (2k) | 3 input files | Geomatrix |

| Input Value for Case 3 - Table accompanying Answer 118 of KPS/AIS testimony | | |
|---|-----------------------------|---|
| Item | Value | Reference (unless noted reference is to report HI-2022854) |
| Cask mass (lbm) | 360,000 | p.12,Figure 8 |
| Cask height (inch) | 231.5 | HI-STORM FSAR |
| Cask radius (inch) | 66.25 | HI-STORM FSAR |
| Pad length/width/thickness (ft) | 67/30/3 | Appendix C, p. C-1 |
| Pad mass (lbm) | 934700 | Figure 8 |
| Cask contact stiffness per facet (lbf/inch) | 1179030 | Figure 7 and Appendix A, p A-1 |
| CaskContact damping per facet (lbf *sec/inch) | 4549.05 | Appendix A, p A-2 |
| Cask-Pad Coefficient of Friction | 0.8 | |
| Number of facets | 34 | Appendix A, p.A-1 |
| Cask Locations (confirming runs) | Per array considered | Appendix A, p. A-4 |
| Soil Data (Tuned) | | Based on Mass of 1 cask plus entire pad |
| Tuning frequency(Hz) | 5 | |
| Tuning damping % | 0.1(linear);1.0(rotational) | |
| Kx(lbf/in) | 3,325,000 | Use values from case 2 multiplied by ratio = (mass of 1 cask plus entire pad)/(mass of 8 casks plus entire pad) |
| Cx (lbm/sec) | 81,730 | |
| Ky(lbf/in) | 3,325,000 | |
| Cy (lbm/sec) | 81,730 | |
| Kz(lbf/in) | 3,325,000 | |
| Cz (lbm/sec) | 81,730 | |
| Kxx(lbf-in/deg) | 4.701×10^8 | |
| Cxx (lbf in sec/deg) | 299,200 | |
| Kyy(lbf-in/deg) | 2.35×10^9 | |
| Cyy (lbf in sec/deg) | 1,496,000 | |
| Kzz(lbf-in/deg) | 2.82×10^9 | |
| Czz (lbf in sec/deg) | 1,795,000 | |
| Seismic Input (10k) | 3 input files | Geomatrix |

| Input Value for Case 4 - Table accompanying Answer 118 of KPS/AIS testimony | | |
|---|-----------------------------|--|
| Item | Value | Reference (unless noted reference is to report HI-2022854) |
| Cask mass (lbm) | 360,000 | p.12,Figure 8 |
| Cask height (inch) | 231.5 | HI-STORM FSAR |
| Cask radius (inch) | 66.25 | HI-STORM FSAR |
| Pad length/width/thickness (ft) | 67/30/3 | Appendix C, p. C-1 |
| Pad mass (lbm) | 934700 | Figure 8 |
| Cask contact stiffness per facet (lbf/inch) | 1179030 | Figure 7 and Appendix A, p A-1 |
| Cask Contact damping per facet (lbf *sec/inch) | 4549.05 | Appendix A, p A-2 |
| Cask-Pad Coefficient of Friction | 0.8 | |
| Number of facets | 34 | Appendix A, p.A-1 |
| Cask Locations (confirming runs) | Per array considered | Appendix A, p. A-4 |
| Soil Data (tuned) | | Based on Mass of 1 cask plus entire pad |
| Tuning frequency(Hz) | 5 | |
| Tuning damping % | 0.5(linear);5.0(rotational) | |
| Kx(lbf/in) | 3,325,000 | |
| Cx (lbm/sec) | 81,730 x 5 | All dampers multiplied by 5 |
| Ky(lbf/in) | 3,325,000 | |
| Cy (lbm/sec) | 81,730 x 5 | |
| Kz(lbf/in) | 3,325,000 | |
| Cz (lbm/sec) | 81,730 x 5 | |
| Kxx(lbf-in/deg) | 4.701×10^8 | |
| Cxx (lbf in sec/deg) | 299,200 x 5 | |
| Kyy(lbf-in/deg) | 2.35×10^9 | |
| Cyy (lbf in sec/deg) | 1,496,000 x 5 | |
| Kzz(lbf-in/deg) | 2.82×10^9 | |
| Czz (lbf in sec/deg) | 1,795,000 x 5 | |
| Seismic Input (10k) | 3 input files | Geomatrix |

| Input Value for Case 5 - Table accompanying Answer 118 of KPS/AIS testimony | | |
|---|-----------------------------|--|
| Item | Value | Reference (unless noted reference is to report HI-2022854) |
| Cask mass (lbm) | 360,000 | p.12,Figure 8 |
| Cask height (inch) | 231.5 | HI-STORM FSAR |
| Cask radius (inch) | 66.25 | HI-STORM FSAR |
| Pad length/width/thickness (ft) | 67/30/3 | Appendix C, p. C-1 |
| Pad mass (lbm) | 934700 | Figure 8 |
| Cask contact stiffness per facet (lbf/inch) | 1179030 | Figure 7 and Appendix A, p A-1 |
| Cask Contact damping per facet (lbf *sec/inch) | 4549.05 | Appendix A, p A-2 |
| Cask-Pad Coefficient of Friction | Random | See Figure 7 formula |
| Number of facets | 34 | Appendix A, p.A-1 |
| Cask Locations (confirming runs) | Per array considered | Appendix A, p. A-4 |
| Soil Data (Tuned) | | Based on Mass of 8 casks plus entire pad |
| Tuning frequency(Hz) | 5 | |
| Tuning damping % | 0.1(linear);1.0(rotational) | |
| Kx(lbf/in) | 9,796,000 | Figure 6 |
| Cx (lbm/sec) | 240,800 | " |
| Ky(lbf/in) | 9,796,000 | Figure 6 |
| Cy (lbm/sec) | 240,800 | " |
| Kz(lbf/in) | 9,796,000 | Figure 6 |
| Cz (lbm/sec) | 240,800 | " |
| Kxx(lbf-in/deg) | 1.385×10^9 | Figure 6 |
| Cxx (lbf in sec/deg) | 881,620 | " |
| Kyy(lbf-in/deg) | 6.924×10^9 | Figure 6 |
| Cyy (lbf in sec/deg) | 4,408,000 | " |
| Kzz(lbf-in/deg) | 8.309×10^9 | Figure 6 |
| Czz (lbf in sec/deg) | 5,289,000 | " |
| Seismic Input (10k) | 3 input files | Geomatrix |

| Input Value for Case 6 - Table accompanying Answer 118 of KPS/AIS testimony | | |
|---|-----------------------------|---|
| Item | Value | Reference (unless noted reference is to report HI-2022854) |
| Cask mass (lbm) | 360,000 | p.12,Figure 8 |
| Cask height (inch) | 231.5 | HI-STORM FSAR |
| Cask radius (inch) | 66.25 | HI-STORM FSAR |
| Pad length/width/thickness (ft) | 67/30/3 | Appendix C, p. C-1 |
| Pad mass (lbm) | 934700 | Figure 8 |
| Cask contact stiffness per facet (lbf/inch) | 1179030 | Figure 7 and Appendix A, p A-1 |
| Cask Contact damping per facet (lbf *sec/inch) | 4549.05 | Appendix A, p A-2 |
| Cask-Pad Coefficient of Friction | 0.8 | |
| Number of facets | 34 | Appendix A, p.A-1 |
| Cask Locations (confirming runs) | Per array considered | Appendix A, p. A-4 |
| Soil Data (Tuned) | | Based on Mass of 1 casks plus entire pad |
| Tuning frequency(Hz) | 5 | |
| Tuning damping % | 0.1(linear);1.0(rotational) | |
| Kx(lbf/in) | 3,325,000 | Use values from case 2 multiplied by ratio = (mass of 1 cask plus entire pad)/(mass of 8 casks plus entire pad) |
| Cx (lbm/sec) | 81,730 | |
| Ky(lbf/in) | 3,325,000 | |
| Cy (lbm/sec) | 81,730 | |
| Kz(lbf/in) | 3,325,000 | |
| Cz (lbm/sec) | 81,730 | |
| Kxx(lbf-in/deg) | 4.701×10^8 | |
| Cxx (lbf in sec/deg) | 299,200 | |
| Kyy(lbf-in/deg) | 2.35×10^9 | |
| Cyy (lbf in sec/deg) | 1,496,000 | |
| Kzz(lbf-in/deg) | 2.82×10^9 | |
| Czz (lbf in sec/deg) | 1,795,000 | |
| Seismic Input (10k) | 3 input files | Geomatrix |

| Input Value for Case 7 - Table accompanying Answer 118 of KPS/AIS testimony | | |
|---|-----------------------------|--|
| Item | Value | Reference (unless noted reference is to report HI-2022854) |
| Cask mass (lbm) | 360,000 | p.12,Figure 8 |
| Cask height (inch) | 231.5 | HI-STORM FSAR |
| Cask radius (inch) | 66.25 | HI-STORM FSAR |
| Pad length/width/thickness (ft) | 67/30/3 | Appendix C, p. C-1 |
| Pad mass (lbm) | 934700 | Figure 8 |
| Cask contact stiffness per facet (lbf/inch) | 1179030 | Figure 7 and Appendix A, p A-1 |
| Cask Contact damping per facet (lbf *sec/inch) | 4549.05 | Appendix A, p A-2 |
| Cask-Pad Coefficient of Friction | .8 | |
| Number of facets | 34 | Appendix A, p.A-1 |
| Cask Locations (confirming runs) | Per array considered | Appendix A, p. A-4 |
| Soil Data (Tuned) | | Based on Mass of 8 casks plus entire pad |
| Tuning frequency(Hz) | 5 | |
| Tuning damping % | 0.1(linear);1.0(rotational) | |
| Kx(lbf/in) | 9,796,000 | Figure 6 |
| Cx (lbm/sec) | 240,800 | " |
| Ky(lbf/in) | 9,796,000 | Figure 6 |
| Cy (lbm/sec) | 240,800 | " |
| Kz(lbf/in) | 9,796,000 | Figure 6 |
| Cz (lbm/sec) | 240,800 | " |
| Kxx(lbf-in/deg) | 1.385x10 ⁹ | Figure 6 |
| Cxx (lbf in sec/deg) | 881,620 | " |
| Kyy(lbf-in/deg) | 6.924x10 ⁹ | Figure 6 |
| Cyy (lbf in sec/deg) | 4,408,000 | " |
| Kzz(lbf-in/deg) | 8.309x10 ⁹ | Figure 6 |
| Czz (lbf in sec/deg) | 5,289,000 | " |
| Seismic Input (10k) | 3 input files | Geomatrix |

| Input Value for Case 8 - Table accompanying Answer 118 of KPS/AIS testimony | | |
|---|-----------------------------|--|
| Item | Value | Reference (unless noted reference is to report HI-2022854) |
| Cask mass (lbm) | 360,000 | p.12,Figure 8 |
| Cask height (inch) | 231.5 | HI-STORM FSAR |
| Cask radius (inch) | 66.25 | HI-STORM FSAR |
| Pad length/width/thickness (ft) | 67/30/3 | Appendix C, p. C-1 |
| Pad mass (lbm) | 934700 | Figure 8 |
| Cask contact stiffness per facet (lbf/inch) | 1179030 | Figure 7 and Appendix A, p A-1 |
| Cask Contact damping per facet (lbf *sec/inch) | 4549.05 | Appendix A, p A-2 |
| Cask-Pad Coefficient of Friction | .8 | |
| Number of facets | 34 | Appendix A, p.A-1 |
| Cask Locations (confirming runs) | Per array considered | Appendix A, p. A-4 |
| Soil Data (1% tuned) | | |
| Tuning frequency(Hz) | 5 | Appendix A, p.3 |
| Tuning damping % | 0.1(linear);1.0(rotational) | Appendix A, p.3 |
| Kx(lbf/in) | 9,796,000 | Figure 6 |
| Cx (lbm/sec) | 240,800 | “ |
| Ky(lbf/in) | 9,796,000 | Figure 6 |
| Cy (lbm/sec) | 240,800 | “ |
| Kz(lbf/in) | 9,796,000 | Figure 6 |
| Cz (lbm/sec) | 240,800 | “ |
| Kxx(lbf-in/deg) | 1.385x10 ⁹ | Figure 6 |
| Cxx (lbf in sec/deg) | 881,620 | “ |
| Kyy(lbf-in/deg) | 6.924x10 ⁹ | Figure 6 |
| Cyy (lbf in sec/deg) | 4,408,000 | “ |
| Kzz(lbf-in/deg) | 8.309x10 ⁹ | Figure 6 |
| Czz (lbf in sec/deg) | 5,289,000 | “ |
| Seismic Input (10k) | 3 input files | Geomatrix |

| Input Value for Case 9 - Table accompanying Answer 118 of KPS/AIS testimony | | |
|---|-----------------------------|--|
| Item | Value | Reference (unless noted reference is to report HI-2022854) |
| Cask mass (lbm) | 360,000 | p.12, Figure 8 |
| Cask height (inch) | 231.5 | HI-STORM FSAR |
| Cask radius (inch) | 66.25 | HI-STORM FSAR |
| Pad length/width/thickness (ft) | 67/30/3 | Appendix C, p. C-1 |
| Pad mass (lbm) | 934700 | Figure 8 |
| Cask contact stiffness per facet (lbf/inch) | 1179030 | Figure 7 and Appendix A, p A-1 |
| Cask Contact damping per facet (lbf *sec/inch) | 4549.05 | Appendix A, p A-2 |
| Cask-Pad Coefficient of Friction | 0.2 | |
| Number of facets | 34 | Appendix A, p.A-1 |
| Cask Locations (confirming runs) | Per array considered | Appendix A, p. A-4 |
| Soil Data (1% tuned) | | |
| Tuning frequency(Hz) | 5 | Appendix A, p.3 |
| Tuning damping % | 0.1(linear);1.0(rotational) | Appendix A, p.3 |
| Kx(lbf/in) | 9,796,000 | Figure 6 |
| Cx (lbm/sec) | 240,800 | " |
| Ky(lbf/in) | 9,796,000 | Figure 6 |
| Cy (lbm/sec) | 240,800 | " |
| Kz(lbf/in) | 9,796,000 | Figure 6 |
| Cz (lbm/sec) | 240,800 | " |
| Kxx(lbf-in/deg) | 1.385x10 ⁹ | Figure 6 |
| Cxx (lbf in sec/deg) | 881,620 | " |
| Kyy(lbf-in/deg) | 6.924x10 ⁹ | Figure 6 |
| Cyy (lbf in sec/deg) | 4,408,000 | " |
| Kzz(lbf-in/deg) | 8.309x10 ⁹ | Figure 6 |
| Czz (lbf in sec/deg) | 5,289,000 | " |
| Seismic Input (10k) | 3 input files | Geomatrix |

| Input Value for Case 10 - Table accompanying Answer 118 of KPS/AIS testimony | | |
|--|-----------------------------|--|
| Item | Value | Reference (unless noted reference is to report HI-2022854) |
| Cask mass (lbm) | 360,000 | p.12,Figure 8 |
| Cask height (inch) | 231.5 | HI-STORM FSAR |
| Cask radius (inch) | 66.25 | HI-STORM FSAR |
| Pad length/width/thickness (ft) | 67/30/3 | Appendix C, p. C-1 |
| Pad mass (lbm) | 934700 | Figure 8 |
| Cask contact stiffness per facet (lbf/inch) | 1179030 | Figure 7 and Appendix A, p A-1 |
| Cask Contact damping per facet (lbf *sec/inch) | 4549.05 | Appendix A, p A-2 |
| Cask-Pad Coefficient of Friction | Random | See Figure 7 |
| Number of facets | 34 | Appendix A, p.A-1 |
| Cask Locations (confirming runs) | Per array considered | Appendix A, p. A-4 |
| Soil Data (1% tuned) | | |
| Tuning frequency(Hz) | 5 | Appendix A, p.3 |
| Tuning damping % | 0.1(linear);1.0(rotational) | Appendix A, p.3 |
| Kx(lbf/in) | 9,796,000 | Figure 6 |
| Cx (lbm/sec) | 240,800 | “ |
| Ky(lbf/in) | 9,796,000 | Figure 6 |
| Cy (lbm/sec) | 240,800 | “ |
| Kz(lbf/in) | 9,796,000 | Figure 6 |
| Cz (lbm/sec) | 240,800 | “ |
| Kxx(lbf-in/deg) | 1.385x10 ⁹ | Figure 6 |
| Cxx (lbf in sec/deg) | 881,620 | “ |
| Kyy(lbf-in/deg) | 6.924x10 ⁹ | Figure 6 |
| Cyy (lbf in sec/deg) | 4,408,000 | “ |
| Kzz(lbf-in/deg) | 8.309x10 ⁹ | Figure 6 |
| Czz (lbf in sec/deg) | 5,289,000 | “ |
| Seismic Input (10k) | 3 input files | Geomatrix |

| Input Value for Case 11 - Table accompanying Answer 118 of KPS/AIS testimony | | |
|--|------------------------|--|
| Item | Value | Reference (unless noted reference is to report HI-2022854) |
| Cask mass (lbm) | 360,000 | p.12,Figure 8 |
| Cask height (inch) | 231.5 | HI-STORM FSAR |
| Cask radius (inch) | 66.25 | HI-STORM FSAR |
| Pad length/width/thickness (ft) | 67/30/3 | Appendix C, p. C-1 |
| Pad mass (lbm) | 934700 | Figure 8 |
| Cask contact stiffness per facet (lbf/inch) | 1179030 | Figure 7 and Appendix A, p A-1 |
| Cask Contact damping per facet (lbf *sec/inch) | 4549.05 | Appendix A, p A-2 |
| Cask-Pad Coefficient of Friction | .8 | |
| Number of facets | 34 | Appendix A, p.A-1 |
| Cask Locations (confirming runs) | Per array considered | Appendix A, p. A-4 |
| Soil Spring and Damper Data | | |
| Kx(lbf/in) | 7,849,520 | Appendix C |
| Cx (lbm/sec) | 8.533×10^7 | " |
| Ky(lbf/in) | 7,457,040 | " |
| Cy (lbm/sec) | 8.106×10^7 | " |
| Kz(lbf/in) | 10,280,000 | " |
| Cz (lbm/sec) | 1.648×10^8 | " |
| Kxx(lbf-in/deg) | 2.069×10^{10} | " |
| Cxx (lbf in sec/deg) | 3.646×10^8 | " |
| Kyy(lbf-in/deg) | 6.947×10^9 | " |
| Cyy (lbf in sec/deg) | 8.068×10^7 | " |
| Kzz(lbf in/deg) | 1.781×10^{10} | " |
| Czz (lbf in sec/deg) | 1.392×10^8 | " |
| Seismic Input (10k) | 3 input files | Geomatrix |

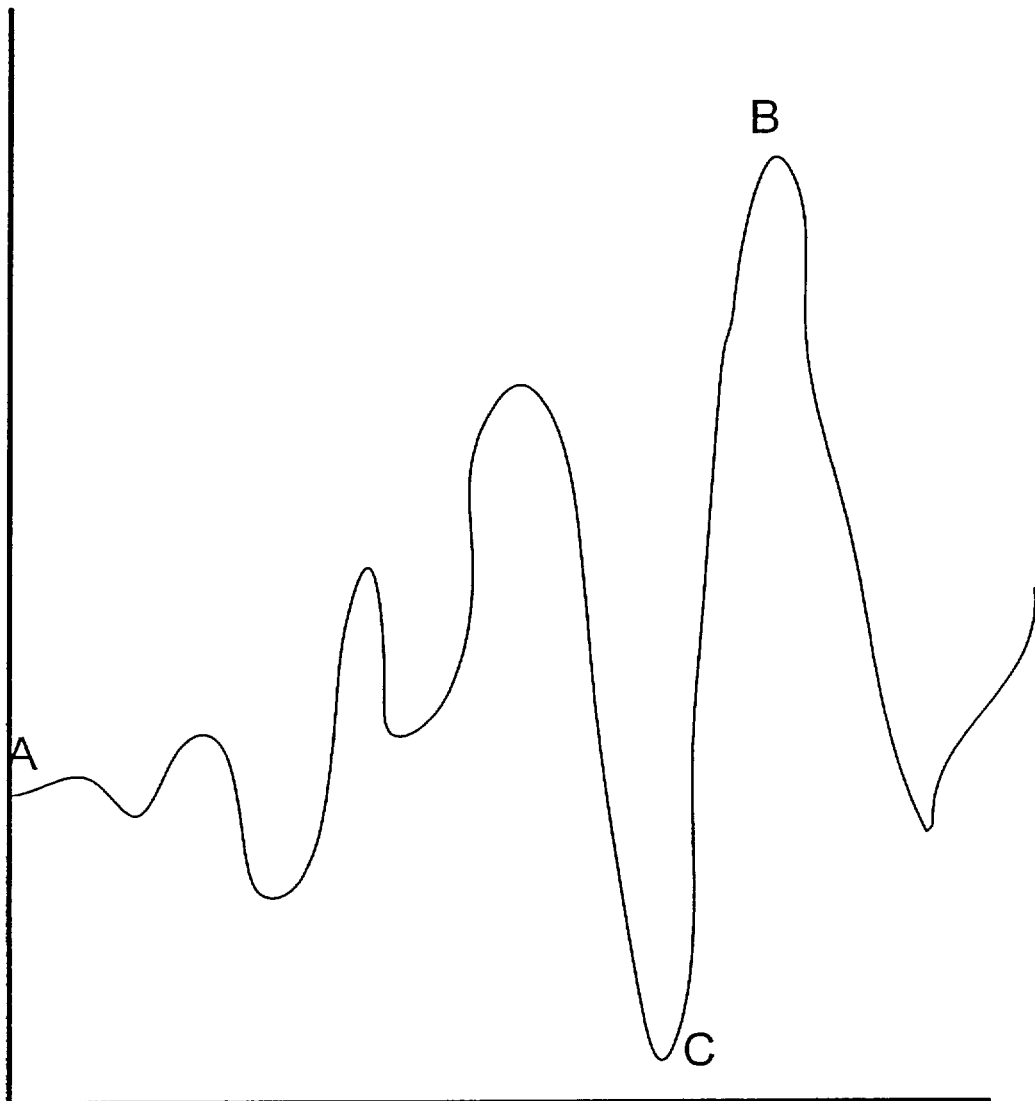
Displacement Response for Simulations

(All results are for cask #1)

| Displacement/Rotation Results From 11 Simulations | | | |
|---|--|--|--|
| Case Number | Max. Excursion of Top of Cask From Location at Start of Run (inch) | Max. Peak-to-Peak Excursion in a Single Cycle (inch) | Rotation Angle From Vertical (degrees) |
| 1 | 3.7 | 6.1 | 0.75 |
| 2 | 4.65 | 5.75 | 0.71 |
| 3 | 60.0 | 26.0 | 3.21 |
| 4 | 56.0 | 43.5 | 5.37 |
| 5 | 17.5 | 22.2 | 2.74 |
| 6 | 18.6 | 36.2 | 4.47 |
| 7 | 52.5 | 82.8 | 10.13 |
| 8 | 39.0 | 71.0 | 8.72 |
| 9 | 14.8 | 18.0 | ** |
| 10 | 12.5 | 13.7 | 1.70 |
| 11 | 22.7 | 36.5 | 4.51 |

** Essentially Pure Sliding – Base of cask mirrors motion of top of cask – maximum difference in lateral position bounded by 1”

See illustration below that describes how each column computed



Max. Excursion = greater of absolute value of (value at B-value at A) or (value at A-value at C)
Peak-to-Peak Swing = absolute value of (value at B-value at C) (for largest amplitude cycle)
Rotation angle is $\arctan(0.5 \times (\text{value at B-value at C})/\text{cask height})$