

Source: Appendix C, Table C-1

Figure 6.4.2-27. Average Geologic Columns for the SFA From Borehole Geologic Logs



Figure 6.4.2-28. Downhole V  $_{\rm S}$  Profiles and Average Geologic Column for Northeast of Exile Hill Fault Splay at the SFA



Figure 6.4.2-29. Suspension V  $_{\rm S}$  Profiles and Average Geologic Column for Northeast of Exile Hill Fault Splay at the SFA



Figure 6.4.2-30. SASW  $V_8$  Profiles and Average Geologic Column for Northeast of Exile Hill Fault Splay at the SFA



Figure 6.4.2-31. Downhole  $V_S$  Profiles and Average Geologic Column for South of Exile Hill Fault Splay at the SFA



Figure 6.4.2-32. Suspension V  $_{\rm S}$  Profiles and Average Geologic Column for South of Exile Hill Fault Splay at the SFA



Figure 6.4.2-33. V  $_{\rm S}$  Profiles and Average Geologic Column for South of Exile Hill Fault Splay at the SFA



Figure 6.4.2-34. Downhole V  $_{\rm S}$  Profiles and Average Geologic Column for Southwest of Exile Hill Fault Splay at the SFA



Figure 6.4.2-35. Suspension V  $_{\rm S}$  Profiles and Average Geologic Column for Southwest of Exile Hill Fault Splay at the SFA



Figure 6.4.2-36. SASW V  $_{\rm S}$  Profiles and Average Geologic Column for Southwest of Exile Hill Fault Splay at the SFA







Figure 6.4.2-37. Base Case V<sub>S</sub> Profile for Tuff Units at the SFA



Source: Appendix C, Table C-1

Figure 6.4.2-38. South Case A, B, and C for the SFA



Figure 6.4.2-39. V<sub>S</sub> Profiles for Each Technique for Northeast of Exile Hill Fault Splay at the SFA



Figure 6.4.2-40. V<sub>S</sub> Profiles for Each Technique for South of Exile Hill Fault Splay at the SFA



Note: Tuff refers to tuff of the Timber Mountain and Paintbrush Groups.

Figure 6.4.2-41. Sensitivity Case at the SFA South of Exile Hill Fault Splay Case C1: 100 Feet of Alluvium





Figure 6.4.2-42. Mean  $V_S$  Profile for Alluvium (without fill) at the SFA





Figure 6.4.2-43. Base Case V  $_{\rm S}$  Profiles for Alluvium for Northeast and South of the Exile Hill Fault Splay at the SFA



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-44. V <sub>S</sub> Base Case #1 Profile at the SFA Northeast of Exile Hill Fault Splay: 30 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-45. V <sub>S</sub> Base Case #2 Profile at the SFA Northeast of Exile Hill Fault Splay: 70 Feet of Alluvium



Source: Appendix C, Table C-1

Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-46. V <sub>S</sub> Base Case #3 Profile at the SFA Northeast of Exile Hill Fault Splay: 100 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-47. V <sub>S</sub> Base Case #4 Profile at the SFA Northeast of Exile Hill Fault Splay: 200 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-48. V <sub>S</sub> Base Case #5 Profile at the SFA South of Exile Hill Fault Splay Case A: 30 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-49. V <sub>S</sub> Base Case #6 Profile at the SFA South of Exile Hill Fault Splay Case A: 70 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-50. V <sub>S</sub> Base Case #7 Profile at the SFA South of Exile Hill Fault Splay Case A: 100 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-51. V <sub>S</sub> Base Case #8 Profile at the SFA South of Exile Hill Fault Splay Case B: 30 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-52. V <sub>S</sub> Base Case #9 Profile at the SFA South of Exile Hill Fault Splay Case B: 70 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-53. V <sub>S</sub> Base Case #10 Profile at the SFA South of Exile Hill Fault Splay Case B: 100 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-54. V <sub>s</sub> Base Case #11 Profile at the SFA South of Exile Hill Fault Splay Case C: 30 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-55. V <sub>S</sub> Base Case #12 Profile at the SFA South of Exile Hill Fault Splay Case C: 70 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-56. V <sub>S</sub> Base Case #13 Profile at the SFA South of Exile Hill Fault Splay Case C: 100 Feet of Alluvium



Source: Appendix C, Table C-1

Figure 6.4.2-57. Poisson's Ratio for Tuff of the Timber Mountain and Paintbrush Groups at the SFA From Average  $V_S$  and  $V_P$  Profiles for Northeast of Exile Hill Fault Splay



Source: Appendix C, Table C-1

Figure 6.4.2-58. Poisson's Ratio for Tuff of the Timber Mountain and Paintbrush Groups at the SFA From Mean  $V_S$  and  $V_P$  Profiles for South and Southwest of Exile Hill Fault Splay



Figure 6.4.2-59. Poisson's Ratio for Tuff of the Timber Mountain and Paintbrush Groups at the SFA From Mean  $V_S$  and  $V_P$  Profiles for All Boreholes on Either Side of Exile Hill Fault Splay



Source: Appendix C, Table C-1

Figure 6.4.2-60. V<sub>S</sub> and V<sub>P</sub> Profiles for Tuff at the SFA for Northeast of Exile Hill Fault Splay





Figure 6.4.2-61. V  $_{\rm S}$  and V<sub>P</sub> Profiles for Tuff of the Timber Mountain and Paintbrush Groups at the SFA for South of Exile Hill Fault Splay Case A





Figure 6.4.2-62. V  $_{\rm S}$  and V  $_{\rm P}$  Profiles for Tuff of the Timber Mountain and Paintbrush Groups at the SFA for South of Exile Hill Fault Splay Case B


Source: Appendix C, Table C-1

Figure 6.4.2-63. Poisson's Ratio for Alluvium at the SFA From Mean V  $_{\rm S}$  and V\_P Profiles for all Boreholes on Either Side of Exile Hill Fault Splay



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Figure 6.4.2-64. V<sub>P</sub> Base Case 1 at the SFA Northeast of Exile Hill Fault Splay: 30 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Figure 6.4.2-65. V<sub>P</sub> Base Case 2 at the SFA Northeast of Exile Hill Fault Splay: 70 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Figure 6.4.2-66. V<sub>P</sub> Base Case 3 at the SFA Northeast of Exile Hill Fault Splay: 100 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Figure 6.4.2-67. V<sub>P</sub> Base Case 4 at the SFA Northeast of Exile Hill Fault Splay: 200 Feet of Alluvium



- Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.
- Figure 6.4.2-68. V <sub>P</sub> Base Case 5 at the SFA South of Exile Hill Fault Splay Case A: 30 Feet of Alluvium



- Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.
- Figure 6.4.2-69. V <sub>P</sub> Base Case 6 at the SFA South of Exile Hill Fault Splay Case A: 70 Feet of Alluvium



- Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.
- Figure 6.4.2-70. V P Base Case 7 at the SFA South of Exile Hill Fault Splay Case A: 100 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Figure 6.4.2-71. V P Base Case 8 at the SFA South of Exile Hill Fault Splay Case B: 30 Feet of Alluvium



- Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.
- Figure 6.4.2-72. V <sub>P</sub> Base Case 9 at the SFA South of Exile Hill Fault Splay Case B: 70 Feet of Alluvium



- Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.
- Figure 6.4.2-73. V <sub>P</sub> Base Case 10 at the SFA South of Exile Hill Fault Splay Case B: 100 Feet of Alluvium



- Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.
  - Figure 6.4.2-74. V <sub>P</sub> Base Case 11 at the SFA South of Exile Hill Fault Splay Case C: 30 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Figure 6.4.2-75. V P Base Case 12 at the SFA South of Exile Hill Fault Splay Case C: 70 Feet of Alluvium



Note: For lithologic units, "Tuff" refers to tuffs for the Timber Mountain and Paintbrush Groups; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs for the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the SFA.

Figure 6.4.2-76. V <sub>P</sub> Base Case 13 at the SFA South of Exile Hill Fault Splay Case C: 100 Feet of Alluvium



Figure 6.4.2-77. SASW V<sub>S</sub> Profiles for RB





Figure 6.4.2-78. Average Geologic Columns for RB Zones from GFM



Source: Appendix C, Table C-1

Note: When the number of profiles being averaged is three or less, the resulting mean profile is dashed. Figure 6.4.2-79. Mean  $V_S$  Profiles for the Individual and All Soft Zones at the RB



Source: Appendix C, Table C-1

Note: When the number of profiles being averaged is three or less, the resulting mean profile is dashed. Figure 6.4.2-80. Comparison of Mean  $V_s$  at the RB Profiles for Stiff and Soft Zone



Source: Appendix C, Table C-1

Figure 6.4.2-81. V<sub>S</sub> Data for the Northern Soft Zone and Average Geologic Column







Source: Appendix C, Table C-1

Figure 6.4.2-83. V<sub>S</sub> Data for the Southern Soft Zone and Average Geologic Column



Source: Appendix C, Table C-1

Figure 6.4.2-84. V<sub>S</sub> Data for the Central Stiff Zone and Average Geologic Column



Note: For lithologic units, "Tuff Units" refers to tuffs for the Paintbrush Group; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs of the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the RB.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-85. V<sub>S</sub> Base Case 1 Profile of the RB Average Soft Zone



Source: Appendix C, Table C-1

Note: For lithologic units, "Tuff Units" refers to tuffs for the Paintbrush Group; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs of the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the RB.

Average profiles from data are shown as dashed where based on 3 or less than 3 profiles.

Figure 6.4.2-86. V<sub>S</sub> Base Case 2 Profile of the RB Central Stiff Zone



Note: For lithologic units, "Tuff Units" refers to tuffs for the Paintbrush Group; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs of the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the RB.

Figure 6.4.2-87. V<sub>S</sub> Sensitivity Case #1 Profile of the RB Northern Soft Zone



Source: Appendix C, Table C-1

Note: For lithologic units, "Tuff Units" refers to tuffs for the Paintbrush Group; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs of the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the RB.

Figure 6.4.2-88. V<sub>S</sub> Sensitivity Case #2 Profile of the RB Southern Soft Zone



NOTE: Tuff velocities truncated to 5600 ft/sec below 995 ft to 1300 ft

For lithologic units, "Tuff Units" refers to tuffs for the Paintbrush Group; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs of the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the RB.

Figure 6.4.2-89. V<sub>S</sub> Sensitivity Case #3 Profile of the RB Central Stiff Zone



Source: Appendix C, Table C-1





Note: For lithologic units, "Tuff Units" refers to tuffs for the Paintbrush Group; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs of the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the RB.

Figure 6.4.2-91. V<sub>P</sub> Base Case 1 at the RB Average Soft Zone



Note: For lithologic units, "Tuff Units" refers to tuffs for the Paintbrush Group; "Calico Hills" refers to tuffs of the Calico Hills Formation, and "ProwPass" refers to tuffs of the Prow Pass Tuff. This nomenclature is used in all figures showing base case velocity profiles for the RB.

Figure 6.4.2-92. V<sub>P</sub> Base Case 2 at the RB Central Stiff Zone



Figure 6.4.2-93. Comparison of 2004 and 2007 Smoothed RB Base Case  $V_S$  Profiles



Source: Appendix C, Table C-1

Figure 6.4.2-94. Comparison of 2004 and 2007 Smoothed SFA Base Case  $V_{\rm S}$  Profiles for Tuff



Source: Appendix D, Y06.C\RASCALS\AMPS.02\AM1P01P5.D1





Source: Appendix D, Y06.C\RASCALS\AMPS.02\AM1P02P5.B1

Figure 6.4.2-96. Sample of Randomized  $V_S$  Velocity Profiles for RB



DTN: MO0203DHRSSWHB.001 [DIRS 158082], MO9905LABDYNRS.000 [DIRS 103792]

Note:Only data obtained from SFA borehole samples are shown. Data from ESF samples are not plotted.Figure 6.4.4-1.Laboratory Test Results on Tuff Specimens Grouped by Stratigraphic Unit



DTN: MO0203DHRSSWHB.001 [DIRS 158082], MO9905LABDYNRS.000 [DIRS 103792]

Note: Only data obtained from SFA borehole samples are shown. Data from ESF samples are not plotted. Figure 6.4.4-2. Laboratory Test Results on Welded Tuff Specimens


DTN: MO0203DHRSSWHB.001 [DIRS 158082], MO9905LABDYNRS.000 [DIRS 103792]

Note: Only data obtained from SFA borehole samples are shown. Data from ESF samples are not plotted. Figure 6.4.4-3. Laboratory Test Results on Nonwelded Tuff Specimens



DTN: MO0203DHRSSWHB.001 [DIRS 158082]

Note: Only data obtained from SFA borehole samples are shown. Data from ESF samples are not plotted.

Figure 6.4.4-4. Variation of V<sub>S</sub> Measured in the Laboratory at In-Situ Mean Total Stress with Dry Unit Weight of Intact Tuff Specimens



DTN: MO0203DHRSSWHB.001 [DIRS 158082]

Note: Only data obtained from SFA borehole samples are shown. Data from ESF samples are not plotted.

Figure 6.4.4-5. Variation in Normalized Shear Modulus with Shearing Strain of Intact Tuff Specimens for Groups Based on Dry Unit Weight







Figure 6.4.4-6. Variation in Material Damping Ratio with Shearing Strain of Intact Tuff Specimens for Groups Based on Dry Unit Weight



Source: BSC (2004) [DIRS 170027], Figure 6.2-137

Note: Lines between symbols indicate possible ranges in V<sub>S</sub>. Each set of data points represents a single sample whose V<sub>S</sub> was measured in the laboratory.

Figure 6.4.4-7. Comparison of V <sub>S</sub> Measured in the Laboratory and in the Field with Three Different Seismic Methods: Tuff Materials in the Surface Facilities Area



Source: BSC (2004) [DIRS 170027], Figure 6.2-138 Figure 6.4.4-8. Comparison of  $V_S$  Measured in the Laboratory: Large and Small Tuff Specimens



DTN: MO0403SDIAWHBC.003 [DIRS 170434] (CURVES), MO0203DHRSSWHB.001 [DIRS 158082] (DATA), MO9905LABDYNRS.000 [DIRS 103792] (DATA)

## Figure 6.4.4-9. Mean Normalized Shear Modulus and Material Damping Curves for Tuff Used in BSC (2004 [DIRS 170027])



DTN: MO0708DYNPRP07.000 [DIRS 182579]

Figure 6.4.4-10. Comparison of Original and Updated G/G  $_{\rm max}$  and Hysteretic Damping Curves for Tuff



Source: BSC (2004) [DIRS 170027], Figure 6.2-140

Figure 6.4.4-11. Laboratory Test Results on Tuff Specimens from WHB Area (SFA) and Repository Block





Figure 6.4.4-12. Comparison of V <sub>S</sub> Measured in the Laboratory and V<sub>S</sub> Measured in the Field with Three Different Seismic Methods: Reconstituted Alluvium Specimen from a Depth of 59 ft in Borehole UE-25 RF#17



DTN: GS020783114233.005 [DIRS 159542]

Figure 6.4.4-13. Gradation Curves from WHB Test Pit Bag Samples



Source: Stokoe and Valle 2003 [DIRS 164689], Figure 10

Figure 6.4.4-14. Comparison of the Normalized Shear Modulus with Shearing Strain for Naturally Cemented Sand with and without Cementation



**(b) Loose Sand** Source: Van Hoff 1993 [DIRS 163890], Figures 7.16 and 7.17

Figure 6.4.4-15. Normalized Shear Modulus with Shearing Strain for Artificially Cemented Sands





Figure 6.4.4-16. Low Strain Shear Wave Velocity Versus Cement Content for Artificially Cemented Sands





Figure 6.4.4-17. Effect of Uniformity Coefficient, C <sub>u</sub>, on Nonlinear Shear Modulus and Material Damping Curves of Dense to Very Dense Specimens



DTN: MO0403SDIAWHBC.003 [DIRS 170434] (CURVES), MO0203DHRSSWHB.001 [DIRS 158082] (DATA), MO9905LABDYNRS.000 [DIRS 103792] (DATA)

Figure 6.4.4-18. Mean Normalized Shear Modulus and Material Damping Curves for Alluvium Used in BSC (2004 [DIRS 170027])



DTN: MO0708DYNPRP07.000 [DIRS 182579]

Figure 6.4.4-19. Comparison of original and updated G/G <sub>max</sub> and hysteretic damping curves for desert alluvium



Point A PGV Mean Hazard Curve versus Strain Conditioned Hazard Curves

NOTE: Shear strain sigma for the base-case is determined from site-response modeling. Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-1. Shear-Strain-Threshold-Conditioned and Unconditioned Reference Rock Outcrop PGV Mean Hazard Curves for a Range of Shear Strain Sigmas





NOTE: Shear strain sigma for the base-case is determined from site-response modeling. Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-2. Shear-Strain-Threshold-Conditioned and Unconditioned Reference Rock Outcrop PGA Mean Hazard Curves for a Range of Shear Strain Sigmas





NOTE: Shear strain sigma for the base-case is determined from site-response modeling. Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-3. Shear-Strain-Threshold-Conditioned and Unconditioned Reference Rock Outcrop 1.0 Sec Spectral Acceleration Mean Hazard Curves for a Range of Shear Strain Sigmas





NOTE: Base-case ground motion sigma is 0.15. Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-4. Extreme-Stress Drop-Conditioned and Unconditioned PGV Mean Hazard Curves for a Range of Ground Motion Sigmas





NOTE: Base-case ground motion sigma is 0.15. Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-5. Extreme–Stress-Drop-Conditioned and Unconditioned PGA Mean Hazard Curves for a Range of Ground Motion Sigmas





NOTE: Base-case ground motion sigma is 0.15. Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-6. Extreme–Stress-Drop-Conditioned and Unconditioned 1.0 Hz Spectral Acceleration Mean Hazard Curves for a Range of Ground Motion Sigmas





- Note: Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.
  - Figure 6.5.1-7. Conditioned and Unconditioned Reference Rock Outcrop Mean Horizontal PGV Hazard Curves



Point A PGA Mean Hazard Curve versus Base Conditioned Hazard Curves used in 2007 Analyses

Note: Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-8. Conditioned and Unconditioned Reference Rock Outcrop Mean Horizontal PGA Hazard Curves





Note: Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-9. Conditioned and Unconditioned Reference Rock Outcrop Mean Horizontal 1.0 Sec Spectral Acceleration Hazard Curves



- NOTE: Periods of 0.01, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0 and 3.3 seconds (100, 20, 10, 5, 2, 1, .5, and 0.3- Hz). Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.
  - Figure 6.5.1-10. Reference Rock Outcrop UHS Based on the Extreme-Stress-Drop and Shear-Strain-Threshold Conditioned and Unconditioned Hazard for an AFE of 10<sup>-3</sup>



NOTE: Periods of 0.01, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0 and 3.3 seconds (100, 20, 10, 5, 2, 1, .5, and 0.3- Hz). Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-11. Reference Rock Outcrop UHS Based on the Extreme-Stress-Drop and Shear-Strain– Threshold Conditioned and Unconditioned Hazard for an AFE of 10<sup>-4</sup>



NOTE: Periods of 0.01, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0 and 3.3 seconds (100, 20, 10, 5, 2, 1, .5, and 0.3- Hz). Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-12. Reference Rock Outcrop UHS Based on the Extreme-Stress-Drop and Shear-Strain– Threshold Conditioned and Unconditioned Hazard for an AFE of 10<sup>-5</sup>



NOTE: Periods of 0.01, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0 and 3.3 seconds (100, 20, 10, 5, 2, 1, .5, and 0.3- Hz). Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-13. Reference Rock Outcrop UHS Based on the Extreme-Stress-Drop and Shear-Strain-Threshold Conditioned and Unconditioned Hazard for an AFE of 10<sup>-6</sup>



NOTE: Periods of 0.01, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0 and 3.3 seconds (100, 20, 10, 5, 2, 1, .5, and 0.3- Hz). Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-14. Reference Rock Outcrop UHS Based on the Extreme-Stress-Drop and Shear-Strain-Threshold Conditioned and Unconditioned Hazard for an AFE of 10<sup>-7</sup>



NOTE: Periods of 0.01, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0 and 3.3 seconds (100, 20, 10, 5, 2, 1, .5, and 0.3- Hz). Point A is the PSHA reference rock outcrop used as the control point for site-response modeling.

Figure 6.5.1-15. Reference Rock Outcrop UHS Based on the Extreme-Stress-Drop and Shear-Strain– Threshold Conditioned and Unconditioned Hazard for an AFE of 10<sup>-8</sup>



Note: Transfer functions are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves; 1 to 2 Hz RE control motions: median and <u>+</u> 1 sigma estimates

Figure 6.5.2-1a. Example of horizontal transfer functions (amplification factors): 1 to 2 Hz RE.



- Note: Transfer functions are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves; 1 to 2 Hz RE control motions: median and <u>+</u> 1 sigma estimates
- Figure 6.5.2-1b. Example of horizontal transfer functions (amplification factors): 1 to 2 Hz RE (continued).



- Note: Transfer functions are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves; 1 to 2 Hz RE control motions: median and <u>+</u> 1 sigma estimates
- Figure 6.5.2-1c. Example of horizontal transfer functions (amplification factors): 1 to 2 Hz RE (continued).



Source: Appendix D, Table D-1

- Note: Transfer functions are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves; 1 to 2 Hz RE control motions: median and <u>+</u> 1 sigma estimates
- Figure 6.5.2-1d. Example of horizontal transfer functions (amplification factors): 1 to 2 Hz RE (continued).


Note: Transfer functions are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves; 5 to 10 Hz RE control motions: median and <u>+</u> 1 sigma estimates

Figure 6.5.2-2a. Example of horizontal transfer functions (amplification factors): 5 to 10 Hz RE.



Note: Transfer functions are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves; 5 to 10 Hz RE control motions: median and <u>+</u> 1 sigma estimates

Figure 6.5.2-2b. Example of horizontal transfer functions (amplification factors): 5 to 10 Hz RE (continued).



- Note: Transfer functions are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves; 5 to 10 Hz RE control motions: median and <u>+</u>1 sigma estimates
- Figure 6.5.2-2c. Example of horizontal transfer functions (amplification factors): 5 to 10 Hz RE (continued).



Source: Appendix D, Table D-1

- Note: Transfer functions are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves; 5 to 10 Hz RE control motions: median and <u>+</u> 1 sigma estimates
- Figure 6.5.2-2d. Example of horizontal transfer functions (amplification factors): 5 to 10 Hz RE (continued).



- Note: Transfer functions are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves;  $\mathbf{M} = 7.0$  point source control motions: median and <u>+</u> 1 sigma estimates
- Figure 6.5.2-3a. Example of horizontal transfer functions (amplification factors): **M** = 7.0 point source.



- Note: Transfer functions are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves;  $\mathbf{M} = 7.0$  point source control motions: median and  $\pm 1$  sigma estimates
- Figure 6.5.2-3b. Example of horizontal transfer functions (amplification factors):  $\mathbf{M} = 7.0$  point source (continued).



- Note: Transfer functions are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves;  $\mathbf{M} = 7.0$  point source control motions: median and  $\pm 1$  sigma estimates
- Figure 6.5.2-3c. Example of horizontal transfer functions (amplification factors): **M** = 7.0 point source (continued).



Source: Appendix D, Table D-1

- Note: Transfer functions are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves;  $\mathbf{M} = 7.0$  point source control motions: median and  $\pm 1$  sigma estimates
- Figure 6.5.2-3d. Example of horizontal transfer functions (amplification factors):  $\mathbf{M} = 7.0$  point source (continued).



NOTE: Campbell and Bozorgnia (200 3) provide results for PGA to 0.25 Hz. For plotting purposes, values obtained for spectral acceleration at 0.25 Hz are also used for 0.1 Hz.

Figure 6.5.2-4. Example of empirical V/H ratios (Campbell and Bozorgnia, 2003) Computed for soft rock;  $\mathbf{M} = 6.0$ ; ratios of median estimates.



NOTE: Campbell and Bozorgnia (2003) provide results for PGA to 0.25 Hz. For plotting purposes, values obtained for spectral acceleration at 0.25 Hz are also used for 0.1 Hz.

Figure 6.5.2-5. Example of empirical V/H ratios (Campbell and Bozorgnia, 2003) Computed for deep firm soil;  $\mathbf{M} = 6.0$ ; ratios of median estimates.



Note: V/H ratios are computed for South of Fault velocity profile A, 100 ft of alluvium, and upper mean tuff and alluvium dynamic property curves; point source  $\mathbf{M} = 6.0$ : median estimates

Figure 6.5.2-6. Example of analytical V/H ratios.



Figure 6.5.2-7. Mean Horizontal and Vertical Seismic Hazard Curves for 30 ft of Alluvium over Tuff, Northeast of the Fault, for PGA at SFA



Figure 6.5.2-8. Mean Horizontal and Vertical Seismic Hazard Curves for 30 ft of Alluvium over Tuff, Northeast of the Fault, for 0.2 Sec SA at SFA



Figure 6.5.2-9. Mean Horizontal and Vertical Seismic Hazard Curves for 30 ft of Alluvium over Tuff, Northeast of the Fault, for 1.0 Sec SA at SFA



Figure 6.5.2-10. Mean Horizontal and Vertical Seismic Hazard Curves for 70 ft of Alluvium over Tuff, Northeast of the Fault, for PGA at SFA



Figure 6.5.2-11. Mean Horizontal and Vertical Seismic Hazard Curves for 70 ft of Alluvium over Tuff, Northeast of the Fault, for 0.2 Sec SA at SFA



Figure 6.5.2-12. Mean Horizontal and Vertical Seismic Hazard Curves for 70 ft of Alluvium over Tuff, Northeast of the Fault, for 1.0 Sec SA at SFA



Figure 6.5.2-13. Mean Horizontal and Vertical Seismic Hazard Curves for 100 ft of Alluvium over Tuff, Northeast of the Fault, for PGA at SFA



Figure 6.5.2-14. Mean Horizontal and Vertical Seismic Hazard Curves for 100 ft of Alluvium over Tuff, Northeast of the Fault, for 0.2 Sec SA at SFA



Figure 6.5.2-15. Mean Horizontal and Vertical Seismic Hazard Curves for 100 ft of Alluvium over Tuff, Northeast of the Fault, for 1.0 Sec SA at SFA



Figure 6.5.2-16. Mean Horizontal and Vertical Seismic Hazard Curves for 200 ft of Alluvium over Tuff, Northeast of the Fault, for PGA at SFA



Figure 6.5.2-17. Mean Horizontal and Vertical Seismic Hazard Curves for 200 ft of Alluvium over Tuff, Northeast of the Fault, for 0.2 Sec SA at SFA



Figure 6.5.2-18. Mean Horizontal and Vertical Seismic Hazard Curves for 200 ft of Alluvium over Tuff, Northeast of the Fault, for 1.0 Sec SA at SFA



Figure 6.5.2-19. Mean Horizontal and Vertical Seismic Hazard Curves for 30 ft of Alluvium over Tuff, South of the Fault, for PGA at SFA



Source: Appendix D, Table D-1

Figure 6.5.2-20. Mean Horizontal and Vertical Seismic Hazard Curves for 30 ft of Alluvium over Tuff, South of the Fault, for 0.2 Sec SA at SFA



Figure 6.5.2-21. Mean Horizontal and Vertical Seismic Hazard Curves for 30 ft of Alluvium over Tuff, South of the Fault, for 1.0 Sec SA at SFA



Figure 6.5.2-22. Mean Horizontal and Vertical Seismic Hazard Curves for 70 ft of Alluvium over Tuff, South of the Fault, for PGA at SFA



Figure 6.5.2-23. Mean Horizontal and Vertical Seismic Hazard Curves for 70 ft of Alluvium over Tuff, South of the Fault, for 0.2 Sec SA at SFA



Figure 6.5.2-24. Mean Horizontal and Vertical Seismic Hazard Curves for 70 ft of Alluvium over Tuff, South of the Fault, for 1.0 Sec SA at SFA



Figure 6.5.2-25. Mean Horizontal and Vertical Seismic Hazard Curves for 100 ft of Alluvium over Tuff, South of the Fault, for PGA at SFA



Figure 6.5.2-26. Mean Horizontal and Vertical Seismic Hazard Curves for 100 ft of Alluvium over Tuff, South of the Fault, for 0.2 Sec SA at SFA



Figure 6.5.2-27. Mean Horizontal and Vertical Seismic Hazard Curves for 100 ft of Alluvium over Tuff, South of the Fault, for 1.0 Sec SA at SFA



Figure 6.5.2-28. Mean Horizontal and Vertical Seismic Hazard Curves for Northeast of the Fault, for PGA at SFA



Figure 6.5.2-29. Mean Horizontal and Vertical Seismic Hazard Curves for Northeast of the Fault, for 0.2 Sec SA at SFA



Figure 6.5.2-30. Mean Horizontal and Vertical Seismic Hazard Curves for Northeast of the Fault, for 1.0 Sec SA at SFA



Figure 6.5.2-31. Mean Horizontal and Vertical Seismic Hazard Curves for South of the Fault, for PGA at SFA


Source: Appendix D, Table D-1

Figure 6.5.2-32. Mean Horizontal and Vertical Seismic Hazard Curves for South of the Fault, for 0.2 Sec SA at SFA



Source: Appendix D, Table D-1

Figure 6.5.2-33. Mean Horizontal and Vertical Seismic Hazard Curves for South of the Fault, for 1.0 Sec SA at SFA



Source:Appendix D, Table D-1; MO0801HCUHSSFA.001 [DIRS 184802]

Figure 6.5.2-34. Mean Horizontal and Vertical Seismic Hazard Curves for PGA at SFA



Source: Appendix D, Table D-1; MO0801HCUHSSFA.001 [DIRS 184802] Figure 6.5.2-35. Mean Horizontal and Vertical Seismic Hazard Curves for 0.05 Sec SA at SFA



Source: Appendix D, Table D-1; MO0801HCUHSSFA.001 [DIRS 184802]

Figure 6.5.2-36. Mean Horizontal and Vertical Seismic Hazard Curves for 0.1 Sec SA at SFA







Source: Appendix D, Table D-1; MO0801HCUHSSFA.001 [DIRS 184802]

Figure 6.5.2-38. Mean Horizontal and Vertical Seismic Hazard Curves for 0.5 Sec SA at SFA



Source: Appendix D, Table D-1; MO0801HCUHSSFA.001 [DIRS 184802] Figure 6.5.2-39. Mean Horizontal Seismic Hazard Curve for 1.0 Sec SA at SFA



Source: Appendix D, Table D-1; MO0801HCUHSSFA.001 [DIRS 184802] Figure 6.5.2-40. Mean Horizontal and Vertical Seismic Hazard Curves for 2.0 Sec SA at SFA



Source: Appendix D, Table D-1; MO0801HCUHSSFA.001 [DIRS 184802]

Figure 6.5.2-41. Mean Horizontal and Vertical Seismic Hazard Curves for 3.3 Sec SA at SFA







Source: Appendix D, Table D-1; MO0801HCUHSSFA.001 [DIRS 184802] Figure 6.5.2-43. Horizontal and Vertical UHS at 10<sup>-3</sup> AFE at SFA















Source: Appendix D, Table D-1; MO0801HCUHSSFA.001 [DIRS 184802] Figure 6.5.2-47. Horizontal and Vertical UHS at 2x10<sup>-6</sup> AFE at SFA



Source: Appendix D, Table D-1; MO0801HCUHSSFA.001 [DIRS 184802] Figure 6.5.2-48. Horizontal and Vertical UHS at 10<sup>-6</sup> AFE at SFA







DTN: MO0410SDSDE103002. [DIRS 172236]

Source: Appendix D, Table D-1

Figure 6.5.2-50. Comparison of 2004 and 2007 SFA Horizontal Design Spectra at 10<sup>-3</sup> AFE



DTN: MO0410SDSTMHIS.005. [DIRS 172237]

Source: Appendix D, Table D-1

Figure 6.5.2-51. Comparison of 2004 and 2007 SFA Horizontal Design Spectra at 5x10<sup>-4</sup> AFE



DTN: MO0410WHBDF104.002. [DIRS 172238]

Source: Appendix D, Table D-1

Figure 6.5.2-52. Comparison of 2004 and 2007 SFA Horizontal Design Spectra at 10<sup>-4</sup> AFE



DTN: MO0410SDSDE103.002. [DIRS 172236]

Source: Appendix D, Table D-1

Figure 6.5.2-53. Comparison of 2004 and 2007 SFA Vertical Design Spectra at 10<sup>-3</sup> AFE



DTN: MO0410SDSTMHIS.005. [DIRS 172237]

Source: Appendix D, Table D-1

Figure 6.5.2-54. Comparison of 2004 and 2007 SFA Vertical Design Spectra at 5x10<sup>-4</sup> AFE



DTN: MO0410WHBDF104.002. [DIRS 172238]



Figure 6.5.2-55. Comparison of 2004 and 2007 SFA Vertical Design Spectra at 10<sup>-4</sup> AFE



Source: Appendix D, Table D-1 Figure 6.5.2-56. 5%-Damped Horizontal Design Spectra for 10<sup>-3</sup>, 5x10<sup>-4</sup>, and 10<sup>-4</sup> AFEs



Source: Appendix D, Table D-1 Figure 6.5.2-57. 5%-Damped Vertical Design Spectra for 10<sup>-3</sup>, 5x10<sup>-4</sup>, and 10<sup>-4</sup> AFEs