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Idaho National Engineering Laboratory

Site-Specific Probabilistic Seismic Hazard Analyses for the Idaho National Engineering Laboratory

Volume 1 Final Report

The peak accelerations and acceleration response spectra presented in this report are not to be used for the seismic design of facilities. The intent of this study is to provide supporting documentation for development of design response spectra and peak accelerations for the INEL Architectural and Engineering Standards.

Lockheed Idaho Technologies Company

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Woodward-Clyde Federal Services
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and
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(Table 5-1). Lower and upper-bound values of 100 and 660, respectively, were also considered to incorporate the uncertainty in Q_o. The latter is a typical central U.S. value. These estimates are based on earthquakes to the north, east, and south of the INEL. A half-space shear wave velocity of 3.55 km/sec and density of 2.7 g/cm^3 were assumed appropriate for the path between the bottom of the site profiles (see following discussion) and the earthquake source.

5.2.2.3 Site Parameters

The subsurface geology at a site influences the ground motions in two ways. A gradient of increasing velocity with depth amplifies motions, while material damping reduces the motions. In our model, the near-surface damping is parameterized by kappa and the amplification is modeled by propagation through a site-specific velocity profile. The inversion of regional earthquakes and Borah Peak aftershocks described in Appendix B provided estimates of kappa at several seismograph stations at the INEL. These values were used for sites ANL, PBF, and RWMC, where instruments were actually located. For ATR, kappa from the nearest station TRAW was used, and for TAN, kappa was derived from the nearby LOFT. There were no seismic recordings near CPP or NRF so the log-average kappa (over the INEL) of 0.024 sec was assigned to these sites (Table 5-2). The κ values ranged from a low value of 0.012 at ANL to 0.033 at PBF. The log-average κ for the INEL is at the slightly lower end of typical western U.S. rock values (Section 5.2.1.4).

κ, as previously stated, is inversely proportional to the shear wave velocities and Q_s beneath each site. The lower the κ, the more efficient the transmission of seismic energy up through the geologic profile. The presence of relatively dense, high-velocity basalts probably accounts for the generally lower than typical western U.S. κ values at the INEL sites.

This effect, however, is probably offset by the low velocity sedimentary interbeds within the basalt section. An evaluation of borehole data at the INEL suggests that the number and thicknesses of interbeds generally increases towards the Big Lost River, their probable source (Woodward-Clyde Consultants, 1992a). ANL which is quite distant from the Big Lost River has few interbeds (Bartholomay, 1990), consistent with the lowest κ value (Table 5-2). PBF, which is located near the floodplain, probably has numerous interbeds and thus a higher κ value. ATR, TAN, and RWMC are also located within the floodplain.

Lithologic and velocity profiles were developed at each site for the stochastic site-specific modeling (Appendix D). The deepest drill hole or well at each site was used to develop the lithologic profiles. The profile at each site was estimated to depths below the bottom of each site's deepest drill hole by appending the lithology of several deep exploration drill holes to the deepest site drill hole. The deep exploration drill holes used for this purpose are INEL-1 in west-central INEL, Corehole 2-2A in north-central INEL, and WO-2 in central INEL. The deep parts of these holes were appended singly or in combination, depending on the proximity of the sites to various of the deep holes. Based on several different data sets, a shear wave velocity and density profile were estimated for each hole. The data include cross-hole compressional and shear wave velocity measurements at the NPR site and at CPP; borehole sonic logs and density logs from INEL-1, Corehole 2-2A, and WO-2; laboratory determinations of velocity and density for samples from INEL-1 and Corehole 2-2A; and detailed surface-to-borehole and suspension logs of compressional and shear wave velocities in corehole ANL-1 (Appendix D). The velocities with greatest uncertainties are those for the sediment interbeds. The velocity profiles for sediment interbeds are constrained by near-surface cross-hole logs and refraction surveys, by some sonic logs from Corehole 2-2A, by measured velocities in core samples, and by analogy to density and velocity profiles developed for sediments which have lithologies similar to ESRP sediment interbeds in young geologic basins. The compressional wave velocity profiles developed with these constraints were then used in conjunction with an estimated Poisson's ratio of 0.35 for the interbed sediments to estimate the shear wave velocity profiles.

5.2.3 Site-Specific Relationships

Based on the BLWN-RVT methodology and the input parameters previously described, site-specific relationships were developed for use in the hazard analysis. Point-source ground motions were simulated for a range of magnitudes and source-to-site distances using the