2.5.4.8.4 Earthquake Induced Cyclic Stress

Earthquake-induced cyclic stresses within soils considered for liquefaction analysis were computed from the site response analyses used to develop the site amplification functions for the PBSRS profiles described in Subsection 2.5.2.5. The site response analyses were performed using 60 randomized soil profiles representing each PBSRS shear wave velocity profile and 30 acceleration time histories representing each deaggregation earthquake (DE) listed in Table 2.5.2-225. In each individual site response analysis effective cyclic shear strains and iterated shear modulus were computed for each layer of the profile. The effective cyclic shear stress for each layer was then taken as the product of the effective cyclic shear strain and the iterated shear modulus. The results of the 180 analyses (60 randomized profiles times three deaggregation earthquakes) were then used to compute a weighted mean effective cyclic shear stress for each layer within each of the three PBSRS soil profiles and for the 10^{-4} and 10^{-5} exceedance level input motions. The weights used were the relative weights assigned to the DEs that are listed in Table 2.5.2-225.

The results of the site response analyses were used to produce peak ground acceleration (PGA) seismic hazard results at the finished graded elevation computed without CAV for the 10^{-4} and 10^{-5} exceedance levels. These values were used to compute a performance based PGA at the finished grade elevation using Equations 2.5.2-215 through 2.5.2-217. The resulting acceleration value is 0.118g. The corresponding PGA at the base of the excavation (-24 ft. NAVD88) is 0.071g. These values along with the site class and the value of F_a based on the International Building Code (2006) are shown in Table 2.5.4.8-201.

The development of the cyclic shear stress complies with the guidance in Regulatory Position 3.3.2 of Regulatory Guide 1.198 because an ensemble of time histories was used that represent the earthquakes contributing to the hazard at the LNP site. The development of the ensemble of time histories is described in Subsection 2.5.2.5.2. The time histories used to represent the DE were taken from NUREG/CR-6728 (Reference 2.5.2-263). The weighted mean magnitude for the earthquake time histories representing the high frequency (HF) 10^{-4} and 10^{-5} DEs are 6.8 and 6.1, respectively. Thus, these time histories also satisfy the acceptance criteria in SRP Section 2.5.2 in that weighted mean magnitudes for the ensembles of time histories exceed magnitude 6. The associated number of equivalent cycles of loading was estimated using the relationship between earthquake magnitude and number of loading cycles provided in Reference 2.5.4.8-203. The m_b magnitudes listed in Table 2.5.2-225 for the HF DEs were converted to moment magnitudes using the relationships given in Subsection 2.5.2.4.2.3 and the resulting average moment magnitude was used to estimate the number of cycles for each DE using Figure 12 in Reference 2.5.4.8-203. The resulting weighted mean values are 9.4 cycles and 6.5 cycles for the HF 10^{-4} and 10^{-5} hazard levels, respectively.

Deleted: the mean of the cyclic stress for each soil layer from the randomized set of soil profiles used to develop the PBSRS using the SHAKE program. The rock peak ground acceleration,

Deleted: , and the horizontal peak ground surface acceleration for the North and the South reactor

Deleted: o

Deleted: estimated based on the seismic ground motions, specifically horizontal ground accelerations versus time as identified on Table 2.5.4.8-201. These ground motions are based on the SHAKE analyses used to develop the GMRS, including the soil profile randomization procedure. The ground motions were scaled up to 0.10 g.

Table 2.5.4.8-201
Summary of Peak Ground Acceleration Used for Liquefaction Analysis

Structure	Rock Peak Ground Acceleration (g)	Site Class	F_a	a_{max} (g)
North Reactor	0.071	C	1.2	0.118
South Reactor	0.071	C	1.2	0.118

Notes:

Site Class and F_a were estimated based on International Building Code (IBC) (2006).

a_{max} = Horizontal peak acceleration at ground surface for the PBSRS profile with no CAV or scaling
g = gravity acceleration

Deleted: A minimum value of 0.1 g was used, per 10 CFR 50.