NRC Staff Confirmatory Calculations for the Hanford Probabilistic Seismic Hazard and the Columbia Generating Station Site Response Analyses

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In response to the accident at the Fukushima Daiichi nuclear power plant resulting from the March 11, 2011, Great Tohoku earthquake and subsequent tsunami, the U.S. Nuclear Regulatory Commission (NRC) issued a 50.54(f) letter requesting that licensees reevaluate the seismic hazards at their sites against present-day NRC requirements. For the seismic hazard re-evaluations, the 50.54(f) letter requested that licensees perform a Probabilistic Seismic Hazard Analysis (PSHA) together with a site response analysis in order to develop site-specific seismic hazard curves and a Ground Motion Response Spectrum (GMRS). For the Columbia Generating Station (CGS), the licensee used the 2014 PSHA performed for the Hanford site by the Pacific Northwest National Laboratory (PNNL) using the Senior Seismic Hazard Analysis Committee (SSHAC) Level 3 process. This paper presents an overview of the NRC staff's confirmatory analyses of the seismic source characterization (SSC) and ground motion characterization (GMC) models developed by the Hanford SSHAC Level 3 PSHA and the licensee's site response analysis for the CGS site. Specifically, the NRC staff performed a confirmatory PSHA for several of the seismic sources that are dominant contributors to the overall hazard at the site. For each of the seismic sources considered, the staff first confirmed the reproducibility of mean hazard results and then evaluated the sensitivity of the mean hazard results to a range of fault geometries, slip rates, and magnitudes. This review included both specific fault-sources as well as the background source zones encompassing the site. In addition, the staff evaluated the implementation of site (Vs-kappa) adjustments to the ground motion prediction equations (GMPEs) and the use of partially non-ergodic sigma for the baserock motions. The licensee's site response analysis for the CGS site considered multiple base case profiles, nonlinear dynamic material properties, damping, and used a wide range of input motions in order to develop a suite of site amplification factors, which were then used to develop the final site hazard curves and GMRS. In particular, the presence of multiple basalt layers with thin sedimentary interbeds in the subsurface beneath the Hanford site significantly affects the calculated site amplification. The NRC staff's confirmatory analyses considered the effect of alternative interbed dynamic material properties and the potential for interbeds to be absent from the subsurface profile. The NRC staff anticipate using results of the confirmatory analyses to help determine if the Hanford Level 3 SSHAC met the fundamental goal of the SSHAC process to evaluate available data, models and methods in order to develop models that captured the center, body, and range of technically defensible interpretations for both the SSC and GMC models. DISCLAIMER: Any opinions, findings, and conclusions expressed in this abstract are those of the author and do not necessarily reflect the views of the United States Nuclear Regulatory Commission or licensees.