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Probabilistic Seismic Hazard Assessment for a NPP in the Upper Rhine Graben, France

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The southern part of the Upper Rhine Graben (URG) straddling the border between eastern France and western Germany, presents a relatively important seismic activity for an intraplate area. A magnitude 5 or greater shakes the URG every 25 years and in 1356 a magnitude greater than 6.5 struck the city of Basel. Several potentially active faults have been identified in the area and documented in the French Active Fault Database (web site in construction). These faults are located along the Graben boundaries and also inside the Graben itself, beneath heavily populated areas and critical facilities (including the Fessenheim Nuclear Power Plant). These faults are prone to produce earthquakes with magnitude 6 and above. Published regional models and preliminary geomorphological investigations provided provisional assessment of slip rates for the individual faults (0.1-0.001 mm/a) resulting in recurrence time of 10 000 years or greater for magnitude 6+ earthquakes. Using a fault model, ground motion response spectra are calculated for annual frequencies of exceedance (AFE) ranging from 10-4 to 10-8 per year, typical for design basis and probabilistic safety analyses of NPPs. A logic tree is implemented to evaluate uncertainties in seismic hazard assessment. The choice of ground motion prediction equations (GMPEs) and range of slip rate uncertainty are the main sources of seismic hazard variability at the NPP site. In fact, the hazard for AFE lower than 10-4 is mostly controlled by the potentially active nearby Rhine River fault. Compared with areal source zone models, a fault model localizes the hazard around the active faults and changes the shape of the Uniform Hazard Spectrum at the site. Seismic hazard deaggregations are performed to identify the earthquake scenarios (including magnitude, distance and the number of standard deviations from the median ground motion as predicted by GMPEs) that contribute to the exceedance of spectral acceleration for the different AFE levels. These scenarios are finally examined with respect to the seismicity data available in paleoseismic, historic and instrumental catalogues.