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Seismic risk assessment of the Ignalina Nuclear Power Plant, a low seismicity cratonic area

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The assessment of the seismic potential and related risk level remains a highly complex problem in low seismicity areas. The Ignalina NPP (Lithuania), located in the the East European Craton, was originally built for the lowest seismic risk conditions. Throughout two decades of operation the plant was reinforced several times due to realization of possibly higher seismic risk with increaseing seismitectonic knowledge of the region. Still, the seismic potential of the basin was seemingly underestimated, as evidenced by the recent Kaliningrad earthquake (2004, M=5.0). The Design Basis Earthquake was re-evaluated for the Ignalina NPP site. The deterministic approach was applied instead of probabilistic methods due to scarceness of seismic records. Morevore, the applicability of the Guttenberg-Richter law is under question. The estimated Design Basis Earthquake of the site is ML=5.0 and hypocentral depth 10 km that is based on the fact of presence of the neotectonically active large-scale shear zone close to the nuclear power plant. This tectonic feature is compatible to other fault zones identified within the radius of 150 km that show historical earthquake activity up to M=4.6-4.8 (Io=6-7). The free-field ground response spectra were claculated using attenuation relationship derived from Japanese near-field seismic records, taking into account the site-specific amplification effects. The estimated design peak ground acceleration is of 0.166g. The maximum spectral acceleration is defined within 7-10 Hz frequency range. The in-structure response spectra were calculated for the Unit 2 Rector Building using FEM techniques. New spectra differ considerably from previous estimates by higher load in the high-frequency range, whereas much lower values are estimated for the low-frequency range, as the far-field strong-motion data collected in other regions were scaled for the Ignalina NPP site during previous studies that bears systematic overestimation of the load in the low-frequency range.