

Seismic Directionality Effects on In-Structure Response Spectra in Seismic Probabilistic Risk Assessment

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Abstract : Currently, seismic probabilistic risk assessments (SPRA) for nuclear facilities use In-Structure Response Spectra (ISRS) in the calculation of fragilities for systems and components. ISRS are calculated via dynamic analyses of the host building subjected to two orthogonal components of horizontal ground motion. Each component is defined as the median motion in any horizontal direction. Structural engineers applied the components along selected X and Y Cartesian axes. The ISRS at different locations in the building are also calculated in the X and Y directions. The choice of the directions of X and Y are not specified by the ground motion model with respect to geographic coordinates, and are rather arbitrarily selected by the structural engineer. Normally, X and Y coincide with the "principal" axes of the building, in the understanding that this practice is generally conservative. For SPRA purposes, however, it is desirable to remove any conservatism in the estimates of median ISRS. This paper examines the effects of the direction of horizontal seismic motion on the ISRS on typical nuclear structure. We also evaluate the variability of ISRS calculated along different horizontal directions. Our results indicate that some central measures of the ISRS provide robust estimates that are practically independent of the selection of the directions of the horizontal Cartesian axes.

Keywords : seismic, directionality, in-structure response spectra, probabilistic risk assessment

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