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Effect of Sampling Technique on Estimation of Clearance-to-stop in Seismically Isolated Nuclear Facilities

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Introduction

ASCE 4 requires that a hard stop to be built around the seismic isolation system in nuclear power plants. In order to maintain the function of the isolation system, the hard stop should have enough clearance-to-stop, which should be no less than 90th-percentile displacement for 150% Design Basis Earthquake (DBE) shaking.

Huang et al. (2009) calculated the clearance-to-stop by using a Latin Hypercube Sampling (LHS) technique. This sampling technique fits well near the median (or mean) of lognormal (or normal) distribution, but not well enough at the tails of distributions. In order to more accurately estimate percentile responses of the isolated structure at the tail of distribution, a weighted Latin Hypercube Sampling (WLHS) technique is proposed in this paper. This technique is applied to consider the uncertainties in the isolation system and input ground motion. The effects of using different sampling techniques on estimation of clearance-to-stop is investigated. It is found that the WLHS technique more accurately approximates the distribution tail of the responses than the Latin Hypercube Sampling technique. Based on this study, several recommendations in probabilistic seismic-performance evaluation are suggested.