A COMPARATIVE SEISMIC SSI STUDY FOR A NUCLEAR ISLAND SITTING ON DIFFERENT BASE-ISOLATION SYSTEMS

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ABSTRACT

The paper investigates the seismic SSI effects for a base-isolated nuclear island subjected to coherent and incoherent motions. Two types of base-isolators are considered: 1) Lead-Rubber Bearing (LRB) isolators (Shimizu et al., 2015) that act efficiently in the 2D horizontal plane and 2) Base Control System (BCS) isolators (Nawrotzki et al, 2018) including a combination of spring units and high-viscosity damper (HVD) units that act efficiently in all 3D space directions.

The paper also investigates the effects of motion incoherency on the structure SSI responses. Both rock and soil sites are considered. In accordance with the ASCE 4-16 standard Section 12 that requires a set of at least 30 randomized SSI inputs (at least 10 deterministic seismic inputs and 3 deterministic soil profiles), in the present study a number of 60 probabilistic simulations of the seismic input motion and the soil profile were used.

The LRB isolators are modelled as hysteretic systems, while the HVD isolators are modelled as frequency-dependent dissipative systems. The SSI responses are compared in terms of structural displacements and ISRS.

To perform the probabilistic nonlinear seismic SSI analyses, the ACS SASSI V4 software (Ghiocel, 2019) with Options PRO (probabilistic SSI) and NON (nonlinear structure for hysteretic isolators) was used. The paper provides important insights on the SSI effects for seismically base-isolated nuclear structures. The paper also shows the limitation of the 2D LRB isolators in comparison with the 3D HVD-based isolators.

The paper provides a variety of comparative SSI results for the base-isolated nuclear RB complex using LRB isolators and BCS/HVD isolators. The main conclusions are that i) the RB complex base-isolation is highly effective for both the rock and soil sites, ii) the motion incoherency largely amplifies the horizontal ISRS and relative displacements within the RB complex, and iii) the 3D BCS/HVD isolators are more effective than the 2D LRB isolators especially for the vertical motions.

REFERENCES

Ghiocel, D.M. (2019) “Probabilistic Seismic SSI Analysis Sensitivity Studies for Base-Isolated Nuclear Structures Subjected to Coherent and Incoherent Motions”, the SMiRT25 Conference Proceedings, Division III, Charlotte, NC, August 4-9

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