ABSTRACT

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Title: Non-linear soil structure interaction analysis for determination of seismic margins of nuclear power plants with an account of material and geometric nonlinearities

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Soil structure interaction plays a crucial role in the behavior, analysis and design of stocky structures of high importance such as power plants, processing facilities, hospitals, precision engineering facilities, hydraulic power infrastructure, etc. The change in frequency content of the ground motion as seismic waves propagate through the subsoil might result in the reduction or amplification of the response acceleration of seismically excited structures. SSI has a significant influence on the calculated in-structure response spectra (ISRS), and the calculated seismic design demand forces. The fundamental hypothesis is that nonlinearities at the soil-structure interface have the potential to influence the peak acceleration demands due to energy dissipation. The sources of the non-linearity include (i) non-linear structural behavior, (ii) non-linear soil behavior and (iii) geometric non-linearities across the interface such as gapping and sliding. The dissertation aims to establish a non-linear SSI analysis methodology in time domain to understand the response of structural basemat with respect to the free-field motion when subjected seismic excitation. The contribution of each source of nonlinearity on the basemat response is examined through an array of sensitivity studies. The numerical studies are carried out on the Fukushima Daichii nuclear power plant in Japan with ground motion history from the Tohoku earthquake.