PEER "Research Nuggets"

Title: An International Workshop on Large-Scale Shake Table Testing for the Assessment of Soil-Foundation-Structure System Response for Seismic Safety of DOE Nuclear Facilities

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Motivation: Aging infrastructure within the US Department of Energy (DOE) and the National Nuclear Security Administration (NNSA) nuclear facilities poses a major challenge to their resiliency against natural phenomenon hazards. Examples of mission-critical facilities located in regions of high seismicity can be found at a number of NNSA sites including Lawrence Livermore National Laboratory, Los Alamos National Laboratory, and the Nevada National Security Site. Most of the nation's currently operating nuclear facilities have already reached their operating lifetime, and most currently operating nuclear power plants (NPPs) have already reached the extent of their operating license period. While the domestic demand for electrical energy is expected to grow, if currently operating NPPs do not extend their operations and additional plants are not built quickly enough to replace them, the total fraction of electrical energy generated from carbon-free nuclear power will rapidly decline. The decision to extend operation is ultimately an economic one; however, economics can often be improved through technical advancements (McCarthy et al. 2015) and research and development (R&D) activities.

Similarly, the operating lifetime of the current DOE- and NNSA-owned critical infrastructure can be extended using the Probabilistic Risk Assessment (PRA) framework to systematically identify the risk associated with designing and operating existing facilities and building new ones. Using this framework consists of several steps, including (1) system analysis considering the interaction between components, such as evaluating the soil-foundation-structure system response; and (2) assessment of areas of uncertainty. Both of these steps are essential to assessing and reducing risks to the DOE and NNSA nuclear facilities.

While the risks to the DOE's facilities are primarily due to natural hazard phenomena, data from large-scale tests of the soil-foundation-structural system response to seismic shaking is currently lacking. This workshop aimed to address these key areas by organizing an international workshop focused on advancing the seismic safety of nuclear facilities using large-scale shake table testing.

Objectives: The ultimate objective of the workshop was to develop a "road map" for the future experimental campaign and innovative instrumentations using the newly constructed DOE-funded large-scale shake table facility at the University of Nevada, Reno (UNR) as well as other large-scale shake table testing facilities. This new facility resulted from a collaborative project engagement between UNR and Lawrence Berkeley National Laboratory. (LBNL) The workshop was planned for two days, May 17-18 2021, and included a virtual tour of the large-scale shake table facility at UNR. On both days, we saw cutting-edge research in experimental research, numerical modeling, and applied engineering through presentations and Q&A discussions.

Methodology: The workshop was held virtually in Spring 2021 through the Zoom online webinar platform. We opted to hold it virtually consistent with the format of some of the other

major conferences in 2021 rather than postponing it to a later date. This report summarizes the proceedings of the workshop and highlights the key outcomes from presentations and discussions.

Results: Workshop recommendation are listed in Chapter 4.

Conclusions: Workshop conclusions are listed in Chapter 4.

Future directions/References: Workshop recommendation are listed in Chapter 4.

Keywords: Large-Scale; Shake Table Testing; Soil-Foundation-Structure Interaction; Seismic Safety of Nuclear Facilities; Virtual Workshop