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UCSB Borehole Array Monitoring Program

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Downhole array monitoring sites are designed to capture the infrequent but critically important *in situ* case histories of ground response, deformation, and liquefaction during significant earthquakes that generate high intensity ground shaking and large strains. The University of California at Santa Barbara has been monitoring densely instrumented geotechnical array field sites for almost three decades. These field sites, the Wildlife Liquefaction Array (WLA), the Borrego Valley Downhole Array (BVDA), the Garner Valley Downhole Array (GVDA), the Hollister Earthquake Observatory (HEO), the Seattle Liquefaction Array (SLA), and the Delaney Park Array (DPK), are geographically distributed throughout the most hazardous part of the United States, including three sites in southern California, one site in central California, one Pacific Northwest site in Seattle, and one site in Anchorage Alaska. The design objective of these sites was to capture the penultimate earthquake in each region and instrumental observations of the earthquake effects associated with such events. The broader objective is to capture a suite of earthquakes covering a range of ground motions and strain levels at each of these sites, to enable calibration of ground motion prediction models that include the effects of the near-surface geology from linear through nonlinear behavior. The California sites are operated solely by UCSB, while the Seattle and Anchorage sites are operated by the Pacific Northwest Seismic Network (PNSN) and the United States Geological Survey (USGS) respectively, with some assistance from UCSB.

UCSB provides access to the instrumental case histories generated by earthquake recordings at these sites, as well as co-located instrumented structures, through a web-based data dissemination portal (http://www.nees.ucsb.edu/data-portal). An update on these field site facilities will be presented, along with a summary of the current research activities and results. Highlights of the last decade include the newest liquefaction monitoring facility in Seattle Washington, and more than a dozen observations of excess pore pressure generation during earthquake shaking at two facilities in southern California, with PGA ranges from 0.05 to 0.33g and strains from 10^{-5} to $2x10^{-3}$. Enhancements to the facilities include long-term monitoring of an Induced Partial Saturation (IPS) test pad for liquefaction mitigation, and permanently deployed cross-hole hammer source and receivers for examining shear modulus degradation and recovery following earthquakes. Contributing these case histories for the development and validation of models that predict site response, liquefaction initiation, ground displacements and settlement, and soil-foundation-structure interaction effects, is the ultimate goal of this monitoring effort.