SEISMIC ANALYSIS AND DESIGN OF A PIPELINE ARCH BRIDGE OF A NUCLEAR POWER PLANT

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Abstract

The pipeline arch bridge in a nuclear power plant mainly serves to connect different nuclear power units via pipelines and provide access for vehicles and pedestrians. As a critical infrastructure for island-based nuclear power plants, its seismic performance is directly related to the safety and reliability of the entire nuclear power plant. The pipeline arch bridge adopts a through-type tied arch structure with full steel construction and a main span of 210 m. Its seismic performance objective is that the structural response remains within the elastic range under the SL-2 level earthquake. In this paper, a refined three-dimensional finite element model of the “bridge-pile-foundation soil” system is established, and an artificial boundary modeling method that can approximately simulate the free-field response of soil is proposed. The nonlinear seismic responses of the bridge under the SL-2 level earthquake are analyzed, and the seismic performances of different seismic isolation bearings are compared. Based on the numerical results,

a seismic isolation scheme using friction pendulum bearings is finally adopted, which effectively controls the peak internal force responses of piers and pile foundations, as well as the relative displacement responses of expansion joints, meeting the requirements of pipeline process design. With the optimized reinforcement scheme, key components such as piers and pile foundations remain in elastic working conditions under the SL-2 level earthquake, satisfying the seismic fortification objective of basically no damage. This study provides a reference for the seismic design of similar pipeline arch bridges in nuclear power plants.

Keywords: *Pipeline arch bridge; Bridge-pile-soil interaction; Artificial boundary; Nonlinear time-history analysis; Friction pendulum bearing*