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Seismic Response Analysis of Piping System in Emergency Diesel Generator with Base-Isolated System

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1. Introduction

In this study, seismic response analysis of piping system in Emergency Diesel Generator (EDG) with base-isolated system was performed. The base-isolated system was modeled by referring to previous studies [1]. The piping system were modeled through field surveys of nuclear power plants. The parametric analysis was performed for various seismic motions. The damage index was calculated based on the stress-strain relationship of the pipe elbow, which is the vulnerable part of the piping system, and compared with results of previous studies [2].

2. Methods and Results

Fig. 1 shows the details of the finite element model. Referring to the previous study, EDG was modeled as a rigid body, which is a beam element (B31). The base-isolated system was modeled as a spring element in two horizontal directions (nonlinear) and in a vertical direction (linear). The stiffness of base-isolated system was defined so that the natural frequencies in the horizontal and vertical directions were 0.5Hz, 1Hz, and 20Hz, respectively. The damping ratio of the base-isolated system was defined as 5%, and the damping coefficient was calculated by logarithmic decrement. The piping system is a shell element (S4R) and is connected to the EDG by kinematic coupling. Five artificial seismic motions were applied in the range of 0.1g-0.5g at intervals of 0.1g according to the Peak Ground Acceleration (PGA) level. Fig. 2 shows the results of the Banon Damage Index (DI) for the stress-strain response to the hoop direction in the crown of the pipe elbow. In the previous studies, the DI for leakage by through a cracks in the carbon steel pipe elbow

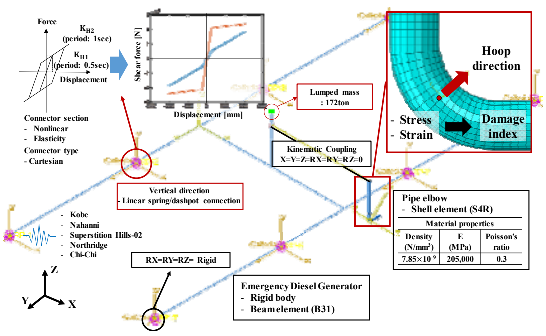

Fig. 1. Finite element model of piping system in EDG with base-isolated system.

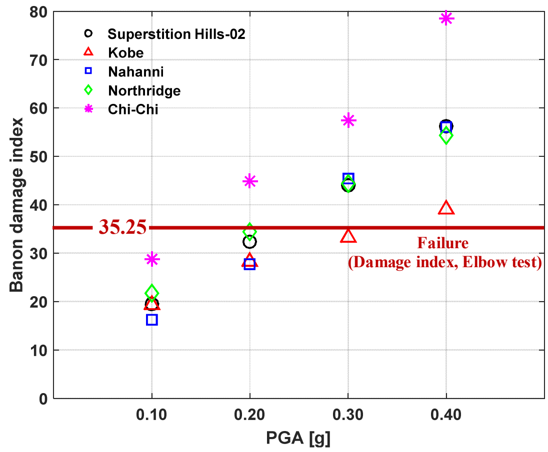

Fig. 2. Banon Damage Index based on finite element analysis results.

according to the stress-strain relationship was defined as 35.25. Therefore, it can be seen leakage by through a crack could occur when the PGA level is 0.2g–0.3g.

3. Conclusions

A seismic response analysis was performed on the piping system in EDG with base-isolated system, and the results of previous studies were compared. It was estimated that leakage by a through a crack could occur when the PGA level of the artificial seismic motion was in the range of 0.2g~0.3g. In the future, seismic fragility analysis will be performed with more various seismic response analysis.

Acknowledgment

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