Preliminary Probabilistic Seismic Hazard Assessment for KAERI site

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1. Introduction

The Korea Atomic Energy Research Institute (KAERI), located in the center of Korea peninsular, operates various nuclear research facilities, including a small research reactor. Since some facilities deal with radioactive materials, KAERI is striving to ensure safety through continuous management. However, after the accident at the Fukushima nuclear power plant in 2011, the expanded public anxiety over nuclear facilities has required advanced risk assessments for various hazard scenarios.

The Probabilistic Seismic Hazard Assessment (PSHA) is a crucial input for risk assessment as it derives the intensity of earthquake that can potentially occur on the target site. The seismic load potential appears differently depending on the earthquake records, geological and geotechnical conditions, etc., but there have been no results of PSHA on the KAERI site. Hence, in this study, a PSHA was performed on the KAERI site. Through this, the seismic hazard curves and uniform hazard spectrum were derived.

2. Target site and seismic source model

The inputs for PSHA are composed of the seismic source, the seismic parameters of sources, the attenuation equation, and the uncertainty value of each input values. This analysis determined input variables through the expert advice based on fault survey and PSHA study near the Wolseong carried out by Korea Hydro & Nuclear Power [1].

Seismic source models are largely divided into the area- and line- source. The area source model was derived by dividing the geometric zone based on the earthquake records, and we used a total of 4 different area model candidates. The line source was decided as faults with distinct seismic characteristics. In Korea, the Z fault and the Eupcheon fault located in the southeastern part have proven to be the fault sources. Figure 1 shows the location of the target site and the fault geometry used as line sources. The relatively small seismic potential can be expected by the long distance between the target site and the fault seismic source.

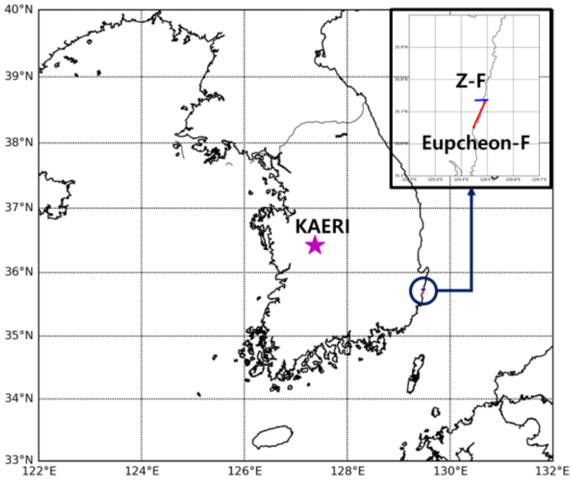

Fig. 1. Location of KAERI site and geometry of two fault source

3. Ground motion attenuation equation

The path characteristics of earthquakes transmitted from the seismic source to the site can be expressed through the ground motion attenuation equation. The attenuation equation varies by the magnitude and distance of the earthquake and the target frequency, and several attenuation equations have been suggested [2]. In Figure 2, the suggested attenuation equation (Mw= 5.4) compared with the records observed during the 2016 Gyeongju earthquake for the peak ground acceleration. Considering the similarity and variability, three equations developed by the domestic researcher were selected and applied to the analysis.

4. Probabilistic Seismic Hazard Assessment

The PSHA was performed using the HAZ45 program, and the uncertainty of the input variables was considered using the logical tree method with the weight of each variable. PSHA was implemented for ten specified frequencies, including the peak ground acceleration, to understand seismic loads according to frequencies.

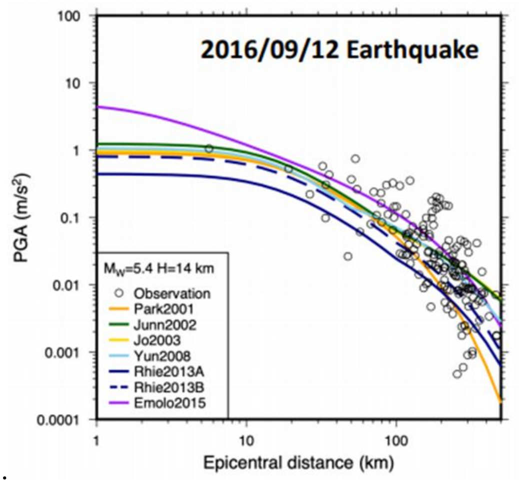

Fig. 2. Comparison of attenuation equations

The seismic hazard curve, expressed as the annual exceedance probability of the seismic motion intensity, is given as a distribution including uncertainty, and Figure 3 shows the seismic hazard curve for the mean value. The peak ground acceleration corresponding to the 10,000-year was about 0.136g, which was significantly smaller than the target acceleration in the research reactor's seismic design, 0.2g.

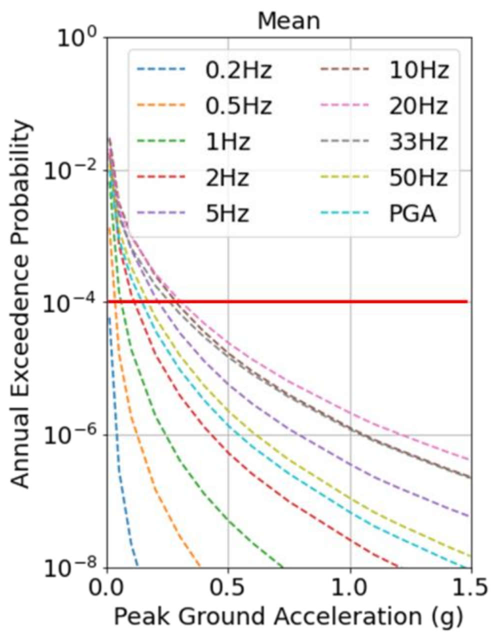

Fig. 3. Seismic hazard curves for KAERI site

5. Uniform Hazard Spectrum

The uniform hazard spectrum is generated by listing each frequency's spectral acceleration for the same probability as the red line in Figure 3. Figure 4 shows the uniform hazard spectrum for the 10000-year return period. And the standard spectrums of the US NRC RG 1.60 [3] and the uniform hazard spectrum for the Uljin site are also presented. The derived spectrum shape is similar to the Uljin site spectrum, where high frequencies of more than 10 Hz dominate. Still, the intensity of the spectral acceleration is significantly smaller. As mentioned in the location of target site and line source, this is judged to be due to the long distance from the fault source.

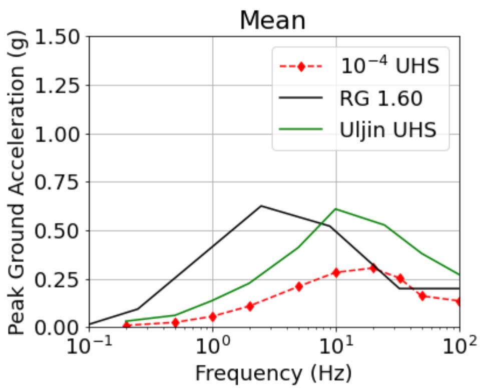

Fig. 4. Uniform Hazard Spectrum for KAERI site

6. Summary and Conclusion

A probabilistic seismic hazard assessment was performed for the KAERI site, and the seismic hazard curve and the uniform hazard spectrum were derived. The analysis result showed a relatively small intensity of potential seismic motion at the KAERI site. However, this interpretation is the result of a preliminary assessment performed under limited consideration. It needs to be continuously supplemented through numerous expert reviews and sensitivity analyses of input variables.

Acknowledgement

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