

A Review on Investigation Ranges Used in Geological and Seismological Standards for Nuclear Power Plant Siting

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1. Introduction

This paper reviews regulatory standards of geological and seismological investigations applied to nuclear power plant (NPP hereafter) siting in U.S., Japan, China and IAEA, and considers a possible guideline to the ranges and depth of the investigation for NPP siting in Korea, considering geological characteristics revealed from recently performed multidisciplinary researches at and around Korean NPP sites (W.C. Chwae et al., 1998a [1], 1998b [2]; C.B. Im et al., 2003 [3]; Y.P. Seo et al., 2003 [4]).

2. Review: NPP regulatory standards for geological and seismological investigations

Regulatory standards of the range in geological and seismological investigations for NPP siting used in representative countries and organization are summarized in the table 1.

10 CFR 100, APP. A (NARA, 1997 [5]), Regulatory Guide 1.165 (U.S. NRC, 1997a [6]) and Standard Review Plan (U.S. NRC, 1997b [7]) define ranges and depths of geological and seismological investigations for NPP siting in the United States. The investigations for determining seismic sources should be carried out at three levels, with areas described by radii of 320 km (200 mi), 40 km (25 mi), and 8 km (5 mi) from the site. The level of detail increases closer to the site. The specific site, to a distance of at least 1 km (0.6 mi), should be investigated in more detail than the other levels [4].

Japan has Safety Review Plan on geological and ground features (Expert Review Association on Nuclear Reactor, 1978 [8]) that describes investigation ranges of geological features for NPP sites in Japan (Table 1).

National Nuclear Safety Bureau (1994) defines four levels of investigation with the degree of their detail based on distance from the site – 150km, 25km, 5km and 1km, in China [9].

International Atomic Energy Agency (IAEA) applies regulatory standards to the geological and seismological investigation for NPP siting that is rather general and qualitative like “considerations.” IAEA describes four steps of investigation ranges regarding distance from the site and the degree of their detail in the Safety Series – “Earthquake and Associated Topics in Relation to Nuclear Power Plant Siting (1991)” [10].

Table 1. Summary of ranges for geological and seismological investigations used in representative countries and IAEA

Country or Institute	Ranges and Depths of Investigations (Map Scale)
United States	<ul style="list-style-type: none"> • Regional : 320km (1:500,000) • Site <ul style="list-style-type: none"> · 40km (1:50,000) · 8km (1:5,000) · 1km (1:500)
Japan	<ul style="list-style-type: none"> • Nearby Site : 30km (1:200,000) • Site Area : 1km (1:5,000) • NPPs : 200m (1:1,000) • Bottom Base after Excavation : 1km (1:100)
China	<ul style="list-style-type: none"> • Regional : 150km (1:1,000,000) • Near Regional : 25km (1:100,000) • Nearby Site : 5km (1:25,000) • Site Area : 1km (1:1,000)
IAEA	<ul style="list-style-type: none"> • Regional : 150km (1:500,000) • Near Regional : 25km (1:50,000) • Site Vicinity : 5km (1:5,000) • Site Area : 1km (1:500)

3. Discussion: a possible guideline to the ranges and depth of the investigation

The ranges and depths of geological and seismological investigation for NPP siting are basically similar in terms of performing several levels of investigation with the degree of their detail. The site investigation can be categorized in to four levels - ‘regional’, ‘near regional’, ‘site vicinity’, and ‘the site’, based on distance from the site and the degree of the detail.

With the ‘regional’ level of investigation, it is expected to define tectonic provinces and environments around the site region. This level of investigation should define all the regional tectonic structures and prospective seismogenic sources that might have an effect on the safety of the projected NPP. Regarding the distance of the investigation from the site, it is noteworthy to consider ‘how far’ is reasonably far enough to detect all the possible seismogenic sources that could generate a considerable vibratory ground motion to the existing or projected NPP sites (Fig. 1).

‘Near regional’ level of investigation is to verify all the details of geological and seismological aspects of the region surrounding the site region. Size of the area for the investigation should be large enough to define all the geological and structural units that may include or be related to the site in space or time.

‘Site vicinity’ level of investigation is to ‘scan’ any possible sources of permanent surface deformation at the

site and the vicinity and define their distributions and characteristics in 3-D. This level of investigation should involve more detailed exploration than those obtained by regional and near regional investigations and may have to include equally-spaced drilling operations, trench works and/or geophysical explorations.

'The site' level of investigation is to assure that the foundation of the site is sound and acceptable for the NPP facilities. This level of investigation should provide engineering information of the foundation, and sufficient data to clearly justify that surface faulting need not be taken into account at the site.

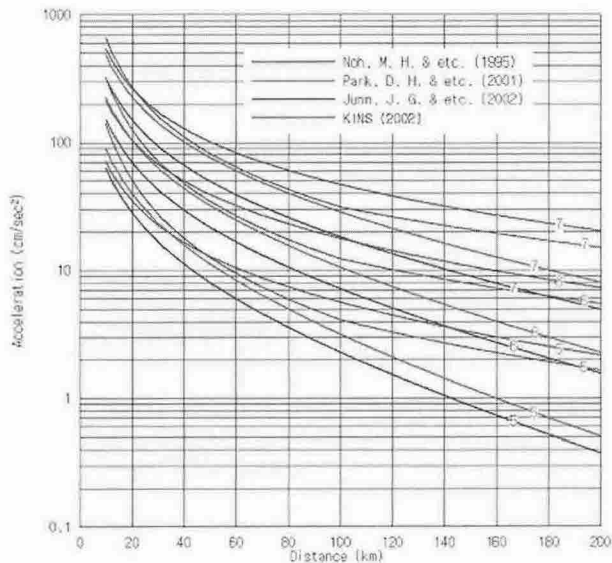


Figure 1. Acceleration curves calculated with representative attenuation equations according to their distances and magnitudes in Korea

4. Concluding remarks

The notification 2000-8 of Ministry Of Science and Technology applies the Appendix A "Seismic and Geologic Siting Criteria for Nuclear Power Plants" to 10 CFR Part 100 "Reactor Site Criteria" of the United States correspondingly to the evaluation of geological and seismological aspects of proposed NPP sites in Korea.

Korean government has currently been developing site-specific regulatory standards for future NPP sites in Korea through a multidisciplinary research project since year 2000. The research project, being led by Korea Institute of Nuclear Safety, has involved 17 research teams, so far, from universities and research institutes in Korea.

Final framework for the ranges and depths of geological and seismological investigations for NPP siting will be available only through continuous review of further results from current research activities and feedback from the experts, relevant to this field.

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