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Original Article

NECESSITY OF MANAGEMENT FOR MINOR EARTHQUAKE TO IMPROVE PUBLIC ACCEPTANCE OF NUCLEAR ENERGY IN SOUTH KOREA

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ABSTRACT

As public acceptance of nuclear energy in Korea worsens due to the Fukushima accident and the earthquakes that occurred in the Gyeongju area near the Wolsong nuclear power plant (NPP), estimating the effects of earthquakes has become more essential for the nuclear industry. Currently, most countermeasures against earthquakes are limited to large-scale disasters. Minor-scale earthquakes used to be ignored. Even though people do not feel the shaking due to minor earthquakes and minor earthquakes incur little damage to NPPs, they can change the environmental conditions, for instance, underground water level and the conductivity of the groundwater. This study conducted a questionnaire survey of residents living in the vicinity of an NPP to determine their perception and acceptance of plant safety against minor earthquakes. The results show that the residents feel earthquakes at levels that can be felt by people, but incur little damage to NPPs, as minor earthquakes (magnitude of 2.0–3.9) and set this level as a standard for countermeasures. Even if a minor earthquake has little impact on the safety of an NPP, there is still a possibility that public opinion will get worse. This study provides analysis results about problems of earthquake measures of Korean NPPs and specific things that can bring about an effect of deterioration of public acceptance. Based on these data, this article suggests that active management of minor earthquakes is necessary for the sustainability of nuclear energy.

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Q1 1. Introduction

Currently, most countermeasures against earthquakes are limited to large-scale disasters. For that reason, lots of effort has been put into mitigating the effects of earthquakes on the structural integrity of nuclear power plants (NPPs) [1]. As a result, the structural integrity has been further improved, as seen in the Fukushima accident (the structures seemed to be sound even with the strong earthquake of magnitude 9.0). However, these efforts were not likely to improve public acceptance [2].

It has been long believed that the Korean Peninsula is quite stable against earthquakes because it is not located on the boundary of tectonic plates. But the belief seems to have been broken when the Gyeongju earthquake ($M = 5.8$) and its more than 600 aftershocks occurred. The recent occurrence of earthquakes in Korea has become complicated and diversified probably due to the Great East Japan earthquake on 11 March 2011. Gyeongju earthquakes are known to occur due to the movement of the Yangsan

fault. Because the Yangsan fault is located near the Wolsong and Kori nuclear sites, public acceptance of nuclear energy in Korea has become worse due to the Fukushima accident and the Gyeongju earthquakes.

Public acceptance of NPPs can be achieved when efforts are made to not only enhance the seismic capacity of NPP buildings but also to engage in more frequent communication between the plant operators and the public, for assurance of plant safety and reliability, even when minor earthquakes occur. In this study, a minor earthquake is defined as a small earthquake of magnitude 2.0–3.9.

This study performed various analyses to emphasize the necessity of appropriate evaluation and measures for minor earthquakes based on the influence of minor earthquakes on residual public acceptance of the Korea nuclear industry. For this purpose, surveys were conducted for residents within 2 km of NPPs, and data were collected. In addition, this study investigated the problems of current earthquake response measurers of NPPs in Korea and analyzed especially if public opinion of Korea's NPPs can be exacerbated by minor earthquakes. Through these analyses, this study tried to suggest policy implications for enhancing the acceptability of NPPs and promoting nuclear energy.

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2. Current problems

When an earthquake occurs, plant operator will follow the typical actions as seen in Fig. 1 [3]. If the magnitude of the earthquake exceeds a certain level (OBE: Operating Basis Earthquake [4]), the plant will be automatically tripped. Then, operator walk-down inspection will be carried out to investigate any damage in the plant. If the plant is not automatically tripped and no damage is found, the plant can be continuously operated after immediate operator action and walkdown inspection.

However, even a minor earthquake (magnitude of 2.0–3.9), far below the OBE criteria, when perceived by people, can have an effect on public opinion about NPPs. Therefore, if the appropriate measures are not taken, it is possible to lead to uncertain problems such as changes in nuclear policy and an antinuclear movement. In addition, it is difficult to make a highly realistic and reliable evaluation of the impact of earthquakes on NPP safety only by dealing

with relatively large earthquakes that occur less frequently than OBEs.

2.1. Limitations of measures for earthquakes

The earthquake scale normally used in the NPP design is in the range of peak ground acceleration (PGA) of 0.15–0.3 g [5]. PGA design values for Korean NPPs are 0.2 g or 0.3 g; 0.2 g corresponds to an earthquake of magnitude of approximately 6.5, and 0.3 g corresponds to an earthquake of magnitude of approximately 7.0. On the other hand, the MMI scale is more related to how people feel earthquakes and how much buildings and structures are damaged. Even with small earthquakes, the MMI scale may be high according to the degree of damage. Therefore, people become more sensitive to the MMI scale. Table 1 shows the relationship between earthquake scales, MMI, PGA, and magnitude. It can be seen in Table 1 that minor earthquakes (magnitude of 2.0–3.9) do not

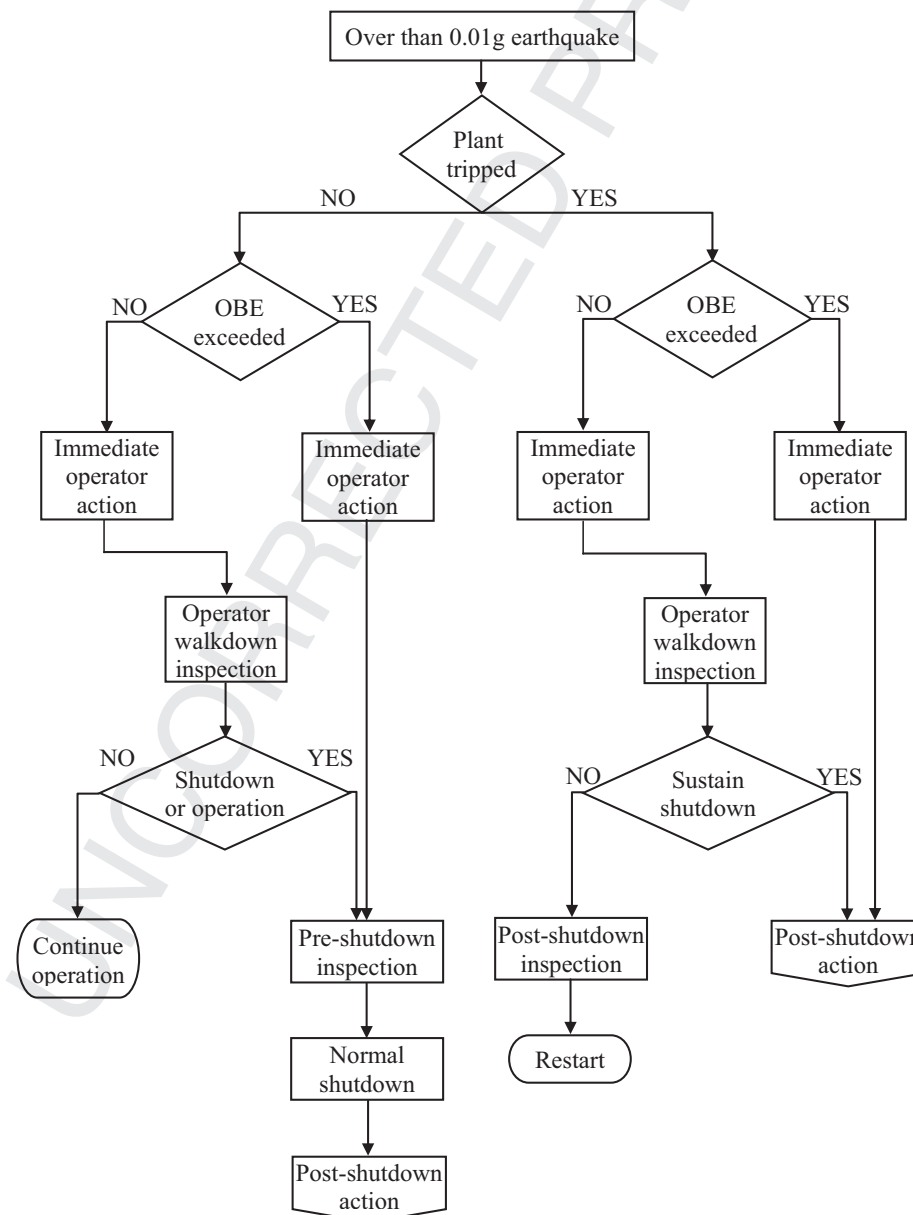


Fig. 1. Flow diagram of actions for more than 0.01 g earthquake (Korea Hydro & Nuclear Power standard procedure).

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