

Preliminary Assessment for the Effects of the External Hazard Factors on the Safety of NPPs

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1. Introduction

The Chūetsu Offshore Earthquake(2007.7.16) in Japan caused damage to the Kashiwazaki-Kariwa(K-K) Nuclear Power Plants (NPPs) with seismic ground motion that exceeded the design level. This incident drew the interest of the safety evaluation studies for NPPs subjected to earthquakes exceeding the design basis around the world. Also, the Indian Ocean Tsunami(2004.12.26) tripped the Madras NPP by reason of flooding of the intake pump house and inundated the construction site of a fast breeder reactor site in India. In addition, from the various man-made and natural hazards such as the oil spill accident near Mallipo, Taean, Chungnam (2007.12), the forest fire near the Ulchin NPP site, the several inflows of marine organism into the intake of the Ulchin NPP, it was confirmed that the safety of NPPs may be affected by natural and human induced disasters.

Intergovernmental Panel on Climate Change (IPCC) has been warned about global warming; the average temperature rose about 1.5 °C during the 20th century and the damages caused by typhoons and heavy rains have also increased in Korea.

Accordingly, a natural disaster prevention research team(hereafter team) ,which have been organized and operated since 2009, has assessed the impact of various hazards such as earthquakes and environmental changes due to global warming on the safety of NPP and has discussed to establish countermeasures.

This paper introduces that the preliminary assessment for the effects of the external hazard factors on the safety of NPPs was conducted by the team.

2. Assessment Results

The team has investigated the environmental changes, earthquake and other site characteristics in domestic and foreign countries and carried out the preliminary assessment of the effects of external hazard factors and countermeasures on the safety of NPPs. In the case of earthquakes, the implementation of seismic performance improvement of NPPs established in 2008 has been also reviewed. Table 1 shows detailed threatening factors for each disaster.

As a result of preliminary assessment considering the current natural environment near the NPP and preparation for hazard, it was confirmed that there was no threatening factor which could greatly affect the safety of NPPs. However, associated with climate change, the follow-up detailed assessment and long-term study were found to be necessary for some of the factors which varied depending on the long-term observations and research.

In addition, it has been also verified that seven items of the seismic performance improvement of NPPs derived from a previous study have been properly implemented.

Table 2 shows the subsequent detailed assessment and necessary tasks for long-term research derived from the preliminary assessment by each hazard type.

3. Summary

The team had carried out the preliminary assessment of the safety of NPPs for the external disasters in 2009. Through this study, nine long-term research topics and one follow-up detailed assessment in three areas had

Table 1 Detailed Threatening Factors for each hazard type

Hazard type	Detailed threatening factors
Earthquake	Earthquake
Climate changes due to global warming	Super typhoon, rise of seawater temperatures and level, storm surge, local heavy rain, tsunami, etc
Site specific safety related events	Forest fire, marine oil spill, inflow of marine organics into the intake system, lightning strike, etc.

been derived. The implementation status of seven seismic performance improvement plans of NPPs had been identified as well.

Acknowledgement

This study was conducted by the natural disaster prevention research team. The team consisted of the professionals from Korea Institute of Nuclear Safety(KINS), Korea Hydro & Nuclear Power Co. Ltd.(KHNP), KEPCO Engineering & Construction(KEPCO ENC), Korea Electric Power Research Institute(KEPRI) and KHNP Nuclear Engineering & Technology Institute.

References

[1] Korea Institute of Nuclear Safety(KINS), 2010, Preliminary Assessment for the Effects of Hazard Factors Caused by Global Warming and Other Events on the Safety of NPPs, KINS/RR-752

Table 2 The results of preliminary assessment

Field of countermeasure	Tasks to be performed
Earthquake safety	<ul style="list-style-type: none"> o Improvement of seismic performance of NPP - Selection and enhancement of equipments needed for the seismic performance improvement -Improvement of seismic performance of the transformer foundation - Improvement of seismic performance of the temporary radioactive waste storage facilities - Establishment of an optimal operating system for earthquake monitoring equipment - Establishment of an auto shutdown system for safe shutdown earthquake and improvement of a countermeasure for fire due to earthquake - Establishment of a countermeasure system for earthquake and tsunami - Improvement of a countermeasure for fire due to earthquake
Climate changes	<ul style="list-style-type: none"> o A necessary topic for the follow-up detailed assessment - Storm surge effect assessment considering the site specific conditions (Younggwang Site) o Necessary topics for the long-term research - Evaluation of missile characteristics due to typhoon - Literature survey for the evaluation of probable maximum precipitation and flood impact assessment based on the research result. - Periodic evaluation of ultimate heat sink in operating NPPs - Periodic seawater inundation assessment considering tidal observations and coastal changes - Establishment of a tsunami probabilistic safety assessment method - Evaluation of debris and sand movement effects on the cooling water intake structures due to tsunamis - Assessment of tsunami impacts around NPP site regarding evacuation of residents in the case of nuclear emergency
Safety related events	<ul style="list-style-type: none"> o Necessary topics for the long-term research - Research about establishing a disaster prevention system for minimizing the impact of NPP by the oil spill accident - Research about establishing a disaster prevention system for inflow of marine organics into the cooling water intake system