

## Securing the Safety of Nuclear Power Plants against Oil Spill Accidents at Sea

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### 1. Introduction

As of 2008, 20 nuclear power plants (hereinafter, 'NPPs') are under operation and six plants are under construction in Korea. NPPs account for approximately 38% of Korea's electric power production; however, it is expected that the share of power produced by NPPs will be further increased to reduce the level of CO<sub>2</sub> emissions, taking into account the concern over global warming.

All of NPPs in Korea are located on the coast to facilitate the supply of cooling water sources. Thus, tar and other floating matters from vessels following oil spill accidents at sea may affect intake systems, and consequently interrupt the supply of cooling water.

This study will review cases of response measures taken by NPPs against large-scale crude oil spill accidents that had occurred off the coast of Korea, including such accidents as the Sea Prince (July 23, 1995) and the Hebei Spirit (December 7, 2007), and relevant regulatory requirements at home and abroad.

### 2. Oil spill accident examples and relevant regulatory requirements

A. Oil spill accidents from vessels off the coast of Korea

Since the 1980s, the dramatic development of industry in Korea has led to a massive increase of the importation of crude oil, and up to 300 oil spill accidents per year took place recently. Among such accidents, 13 were of a large scale, involving the spill of more than 1,000 kL of oil and contaminants, i.e., the Hebei Spirit accident. In the period from 1997 to 2006, a total of 3,915 accidents involving oil spill from vessels occurred, with 10,234 kL of crude oil discharged into the sea.<sup>2)</sup> Jung<sup>3)</sup> quoted data from the Korea National Oil Corporation, indicating 87 types of crude oil for a total quantity of 138,796,131 kL imported from 31 countries in 2007, which means that a volume of oil equivalent to a hundred thousand times the amount of crude oil spilled from the Hebei Spirit was transported along the coast of Korea,

warning that there is always a high risk of crude oil spill at sea.

B. Cases of responses by NPPs against oil-induced contamination accidents

1) Cases in foreign countries

In the U.S., 1,003 m<sup>3</sup> of crude oil was spilled from the Athos I into the Delaware River on November 26, 2004. Two reactors of Salem NPP were shut down on December 2, 2004 supposing that the spilled crude oil would reach intake structures and that cooling water contaminated by the oil might affect cooling systems.<sup>5)</sup>  
6)

In Japan, the Nakhodka, a Russian oil tanker, sank on January 2, 1997 causing oil spill of approximately 6,200 kL. Oil first reached the coast of Mikuni within three days, with 2,228 kL of oil hitting the coast within six days of the vessel sinking. Contaminated areas stretched from Sakai toward the south to Kashiwazaki toward the north. 15 NPPs were located along the contaminated coastline. Multi-layered oil fences were installed in front of the NPPs to prevent the spilled crude oil from reaching the intake system, and vessels in the affected area were mobilized for the oil removal. These actions allowed the normal operation of all NPPs to continue without any reduction of power production.<sup>7)</sup>

2) Cases in Korea<sup>8)</sup>

Following the Hebei Spirit accident, oil fences and oil nets were installed at underwater protection networks of Younggwang NPPs on December 21, and then the activities for monitoring the tar along the intake routes were strengthened. The tar that had entered the intake route was detected at 14:00 on December 30, and additional oil nets were installed. Then, rotating oil nets at the intake inlets were operated and the tar was removed through a reverse-cleaning operation. By examining and properly responding to the various variables and power production situations concerning the intake systems, normal operation without any reduction of power production was achieved.

C. Regulatory requirements for an assessment of the effects on intake system caused by human-induced accidents

1) IAEA (International Atomic Energy Agency) Safety Standards (NS-G-3.1)<sup>9)</sup>

“External human-induced events in the site evaluation of NPPs” published by the IAEA in 2002 provides safety guidelines for the site evaluation, taking into account major human-induced events, and for the periodical assessment of the sites thereafter. These guidelines recommend the collection and survey of data relevant to the effects of materials and debris resulting from accidents involving vessels during maritime transportation as one of the major potential causes, and the description of such situations as they develop after the accidents.

2) NRC (Nuclear Regulatory Commission) Standard Review Plan (NUREG-0800)<sup>10)</sup>

Sections 2.2.1 and 2.2.2 of NUREG-0800 recommend checking potential hazards in the areas adjacent to the sites. The spill of crude oil or hazardous materials such as toxic chemicals from potential external accidents and a barge collision with intake structures during maritime transportation around the NPP sites should not affect safety functions during the expected operation of the NPPs.

3) Public notice of the MEST (Ministry of Education, Science and Technologies)<sup>11)</sup>, and guidelines on the safety inspection of light-water-reactor type NPPs (KINS/GE-001)<sup>12)</sup>

The MEST’s public notice No. 2008-7, “Technical standards for the location, structure and installation of reactor facilities”, proposes guidelines on the investigation and assessment of human-induced events when selecting sites for NPPs. The MEST’s public notice No. 2008-9, “Technical standards for investigation and evaluation of the hydrological and oceanographic conditions of reactor facility sites”, requires the assessment of whether ultimate heat sink can supply cooling water to sufficiently remove the heat generated from the plant upon normal operation and accident condition. The safety review guidelines of the light-water-reactor type NPPs published by KINS describe in-depth requirements for the evaluation of potential accidents and the function of ultimate heat sink.

D. Procedures of responses by NPPs

When considering the details stated above, it was

deemed that potential external accidents such as the crude oil spill did not give a critical threat to the safety of the NPPs. However, as in the case of removing tar from the intake screens at the Younggwang NPPs following the Hebei Spirit accident, tar- or crude oil-contaminated seawater could affect the intake systems even though the accident is occurred at a distance of more than 8 km from NPP sites. Therefore, it is essential for the NPPs to establish response procedures to cope with potential accidents such as crude oil spill.

### 3. Conclusion

The review of the cases crude oil spill accidents at sea including measures taken by the NPPs against the accidents affirms the fact that the accidents of crude oil spill are increased in proportion to the frequency of operations of oil tankers, which are, in consequence, meaningful considerations for the safe operation of NPPs.

It is, therefore, important to prepare appropriate emergency response procedures against such an accident above implemented at the NPPs.

### References

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