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A Study on the Wind Direction and Wind Speed Distribution around Hanbit Nuclear Power Plant in the Last 3 Years through Wind Roses

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Introduction

The direction and speed of the wind have the greatest influence when radioactivity (radioactive material) leaks from a nuclear facility to the outside. In case of a radiation emergency, there is a radiation emergency planning area set up to prepare in advance measures to protect residents, such as evacuation or evacuation of residents.[1] The radiation emergency planning zone is divided into an Urgent Protective Action Planning zone and a Precautionary Action Zone. The emergency protection action planning zone averages 3 to 5 km, and the Urgent Protective Action Planning zone averages 20 to 30 km. This is the distance centered on the nuclear power plant. In this study, we analyze the wind direction and wind speed based on the synoptic records of meteorological stations around the Hanbit nuclear power plant for the past 3 years, and compare it with the facility location of the radio accident emergency response observation equipment to examine the suitability of installation.

Materials and methods

2.1 Wind direction and speed

Korea is affected by the westerlies caused by the Earth's rotation. Also, dep ending on the season, it is also affected by the monsoon. In summer, the south east monsoon is developed by the high pressure of the North Pacific Ocean, w hich is hot and humid. In winter, the northwest monsoon wind develops as col d and dry high pressure develops in the air mass of Siberia. In addition, typho ons cause wind and flood damage by eastern storms with a maximum wind sp eed of 17 m/s or more. Wind direction and speed according to these regional a nd seasonal factors affect the diffusion of radioactive materials.

Atmospheric circulation ranges from small scale circulations such as turbulence and tornadoes to circulations such as typhoons, high pressures, lo w pressures, and large atmospheric circulations.

It is usually classified into microscale, intermediate scale, synoptic scale, an d global scale, and the Korea Meteorological Administration provides synopti c observation data for 103 regions nationwide.[3]

Synoptic meteorological observation refers to ground observation performed at the same time at all observatories at a fixed time in order to understand the weather on a synoptic scale. The data measured at the Hanbit nuclear power plant and the meteorological stations around the power plant were analyzed using data from 5 (Yeonggwang 252, Gochang 172, Gochang 251, Jeongeup 245, Buan 243) data.

The wind rose shows the frequency of appearance of the wind direction in each direction for a certain period of the observation point on a radial graph. T he percentage (%) of the frequency is expressed as the length of the bearing li ne on the bearing plate corresponding to each wind direction. However, the fre quency of appearance of calm (calm, wind speed less than 0.4 m/s) is indicate d in the center of the graph. The bar indicates the direction in which the wind i s blowing, along with the frequency for each wind speed class in each wind di rection.

2.2 Emergency Planning Zone

A radiation emergency planning zone(EPZ) is an area set up to intensively prepare resident protection measures such as evacuation and evacuation in adv ance in case a radiation leakage accident occurs at a nuclear facility. It is divid ed into a Precautionary Action Zone and an Urgent Protective Action Planning zone[1] .The Precautionary Action Zone is a zone designated to take precauti onary measures such as introducing residents in advance in case of a radiation emergency, and the average range is 3 to 5 km. The Urgent Protective Action Planning zone is an area designated for emergency protection measures for res idents based on the results of radiation impact assessment or environmental m onitoring in the event of a radiation emergency, and the average length is 20 to 30 km [2].

The scope of the radiation emergency planning zone is based on the basic area for each type of nuclear facility announced by the Nuclear Safety and Securit y Commission (in the case of a nuclear power plant, the basic scope is stipulat ed by law), and the nuclear power operator consults with the local government to determine regional characteristics such as road network, population distrib ution, topography, etc. It is established in consideration of the effectiveness of the countermeasures. After that, it is confirmed with the approval of the Nucle ar Safety and Security Commission.

Fig. 1 Korea Meteorological Administration Meteorological Observatory near Hanbit Nuclear Power Plant

Fig. 2 Hanbit Nuclear Power Plant Radiation Emergency Planning Area

Table 1 Area of the Hanbit Nuclear Power Plant Radiation Emergency Planning Area

Classification	Corresponding Area		
Precautionary Action Zone (NPP radius 3 – 5km)	Jeonnam	Yeonggwang	Hongnong-eup(some areas)
Urgent Protective Action Planning Zone (NPP radius 21 – 30km)	Jeonbuk	Gochang	SangHa-myeon(some areas)
	Jeonnam	Yeonggwang	Hongnong(some areas), Yeonggwang-eup, Baeksu-eup, Daema-myeon, Myoryang-myeon, Bulgap-myeon, Gunnam-myeon, Gunseo-myeon, Yeomsan-myeon, Beopseong-myeon,Nakwol-myeon
		Muan	Hapeu-myeon
		Jangseong	Sanseo-myeon,Hwangryong-myeon, Sangdong-myeon
		Hampyeong	Sobuk-myeon,Shingwang-myeon,Haeje-myeon,Wolya-myeon
	Jeonbuk	Gochang	Gochang-eup, Gosu-myeon, Asan-myeon, Mujang-myeon, Seongsong-myeon, Daesan-myeon, Simwon-myeon, Sangha-myeon (part), Heungdeok-myeon, Gongeum-myeon, Haeri-myeon, Sillim-myeon, Buan-myeon
		Buan	Jinseo-myeon, Boan-myeon, Byeonsan-myeon, Wido-myeon, Julpo-myeon

Results

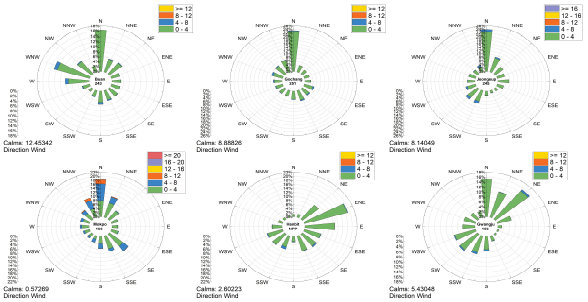

Fig. 3 Wind roses obtained from the Meteorological Observatory at Hanbit Nuclear Power Plant for the past 3 years from 2012 to 2022 - a) Buan 243, b) Gochang 251, c) Jeongeup245 d) Mokpo 165, e) Hanbit NPP, f) Gwangju 156 [4]

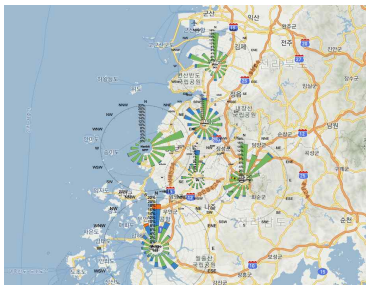

Fig. 4 Wind direction distribution map for 3 years around Hanbit nuclear power plant

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Conclusion

The distribution of wind direction around a power plant is important as it determines the direction of diffusion of radioactive material in the event of an accident. The wind direction measured within the power plant was dominated by the northeast wind. It is more likely to spread toward Sinan-gun and the west sea.

Long-term data on wind direction is useful when planning an evacuation in case of an emergency.