

A preliminary study on the effect of fine dust on the air in the nuclear reactor

SungTaek Hong^{a*}, MinSu Kim^a, SungHwan Oh^a

^aKorea Atomic Energy Research Institute, 111, Deadeok-daero 989beon-gil, Yuseong-gu, Daejeon 34057, Korea

*Corresponding author: hong79@kaeri.re.kr

1. Introduction

The ventilation system of a nuclear facility provides workers with a suitable environment in which to work, and prevents the accumulation of radioactive particles or gases in the radiation management zone. It, however, does not circulate air to prevent radioactive contamination. Therefore, the outside air closely affects the air quality of the air inside a nuclear facility.

The air quality of the outside air is greatly affected by the weather, seasons, and industrial activities. In the past, seasonal factors such as yellow sand or pollen had a significant impact on the air quality of the outside air. Recently, fine dust generated by an increase in the use of fossil fuels has affected the air quality of the outside air.

This report addresses the impact of such fine dust on the quality of the air in a reactor chamber.

2. Methods and Results

2.1 Facility Status

All substances entering or leaving the radiation management zone of a nuclear facility are monitored and controlled. This helps to prevent the spread of pollutants into the environment and to reduce the amount of radioactive waste.

The ventilation system of a nuclear facility is designed to release air that is found to be below a regulatory limit. Such air is released through various filters installed in the exhausting equipment of the ventilation system, and all particles in the air are controlled by the ventilation system. The typical filter types of such a system and their corresponding filtration efficiencies are shown in Table I.

Table I: Efficiency of filters [1]

Filters	Efficiency	Installed in
Pre-filter	N/A	supply
Mod-filter	85%, < 10 μm particles	exhaust
HEPA filter ¹	99.97% < 0.3 μm particles	exhaust

¹ High-Efficiency Particulate Air filter

In the air supply equipment of the ventilation system, only pre-filters are installed. Therefore, the HEPA filter of the exhausting equipment not only collects fine dust generated from the radiation management zone, but also fine dust collected from outside the facility.

2.2 Measures

In this study, we compared the air conditions outside a reactor building with the air conditions inside the reactor hall. Measurement of the external air quality of the facility was performed near the air intake equipment, which is located on the roof of the facility. Measurement of the internal air quality of the facility was performed at the upper side of the reactor tank. Measurements were performed over a period of 3 h, in which time the air in the reactor hall was replaced three times over.

2.3 Measured Data

Figures 1 and 2 show the results of measurements of fine dust levels regarding the external air quality and the internal air quality of the reactor building, over the 3 h measurement period. Figure 1 shows the data for a clear day, whereas Figure 2 shows that for a day where the fine dust level was high.

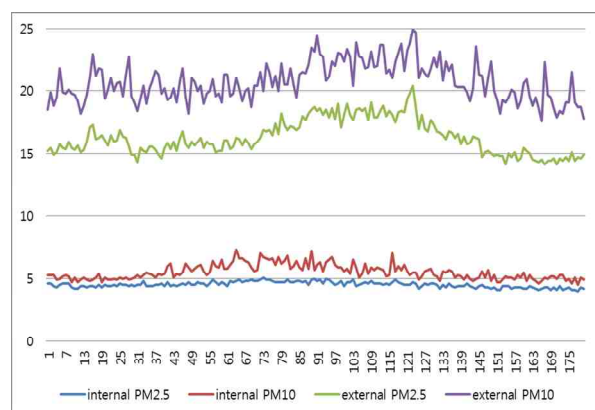


Fig. 1. Fine dust is good.

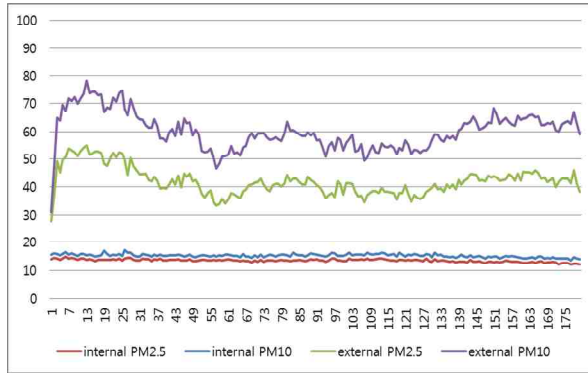


Fig. 2. Fine dust is bad.

2.4 Result

As shown in Figures 1 and 2, when dust levels are high in the outside a reactor building, the levels in the inside reactor building are also high. The reason is that the supply of the ventilation system is not effectively filters.

As shown in Figures 1, the internal and external ratio of PM10 is about 25%, and the internal and external ratio of PM2.5 is about 32%. As shown in Figures 2, the internal and external ratio of PM10 is about 27%, and the internal and external ratio of PM2.5 is about 28%.

3. Conclusions

Through actual measurements, it has been confirmed that ultra-fine dust in the external air of a nuclear facility affects the internal air quality of the reactor hall.

It was deemed that if pre-purified air were to enter the radiation management zone, the following benefits could be achieved. First, the clean air would be good for the respiratory organs of the workers. Ultra-fine dust with a diameter of less than 2.5 μm is more likely to stay calm in the lungs. Second, the lifetime of the filters installed in the exhausting equipment of the ventilation system would increase, and the amount of radioactive waste would decrease. The HEPA filters installed in the exhausting equipment collect fine dust not only generated from the radiation management zone, but also from outside the facility. If purified air were to be supplied to the facility, the lifetimes of the installed HEPA filters could be extended, which would result in a reduction in the amount of radioactive waste.

REFERENCES

- [1] KAERI, HANARO SAR, Chapter 10.4, p26~28, KAERI/TR-710/1996.