Trend of Gross Beta Radioactivity in Air Particles and Rainwater of around the Domestic Nuclear Power Plants

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1. Introduction

To check whether radiation from running a nuclear power plant is under the dose limit, our country is investigating/assessing the effect it is causing surrounding areas according to the notification of Nuclear Safety and Security Commission.[1]

Investigating items can be distinguished into two parts, regional radiation and concentrations of environmental radioactivity, and in environmental radioactivity, to access the internal exposure dose, gross beta-radioactivity of particles in air and rainwater specimen are being tested.

Gross beta-radioactivity quickly shows whether radiation is unusual or no since most of nuclide released in radioactive emergency while operating an atomic energy facility emits beta rays, and the method used to test it is simple.

Looking at the years of analyzed results of particles in air and rainwater around the facility for gross beta-radioactivity, they have a constant trend.

The cause of the trend was investigated with a doubt that something else rather than operation of a nuclear power plant might have caused this trend.

2. Materials and Method

2.1. Gross beta-radioactivity analysis outline

The method of investigating gross beta-radioactivity is, in the case of particles in air, collect filter beds weekly and in the case of rainwater specimen, take 500ml of it to evaporate and concentrate then put it into measuring specimen to be dried by an infrared dryer. After that, take a sample to naturally decrease radon-related, and 72hours later, take a measurement with a low level alpha-beta counting system. [1]

2.2. Gross beta-radioactivity trend analysis point

Particles in air and rainwater specimen for this gross beta-radioactivity concentration test are taken in accordance with Environmental Radioactivity Investigation Plan (2014.1, Korea Hydro & Nuclear Power co.). Near main office for Hanbit Nuclear Power Plants, inside Nuclear Unit 1 for Kori Nuclear Power Plants, radwaste storage space and Nuclear Unit 1 for Wolsung Nuclear Power Plants and for Hanul Nuclear Power Plants, the meteorological station was chosen which is located closest to the nuclear unit.[1]

2.3. Tendency of Gross beta radioactivity in each site

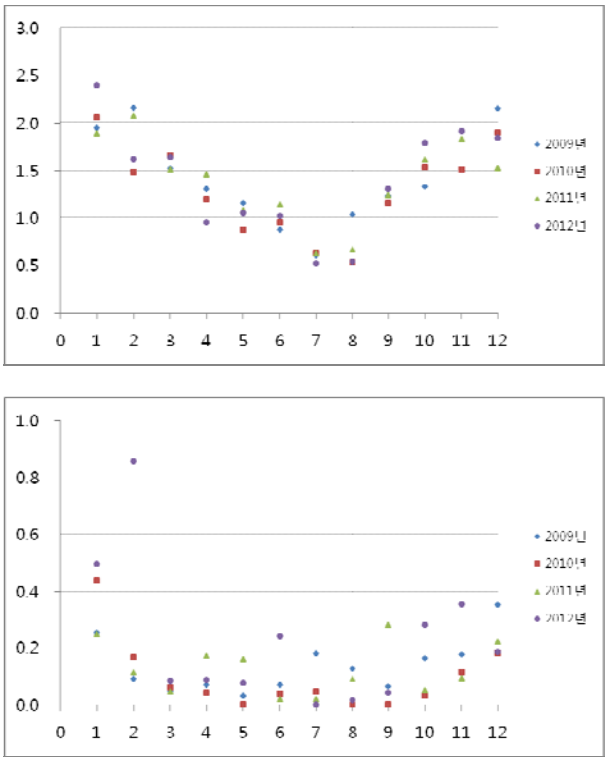
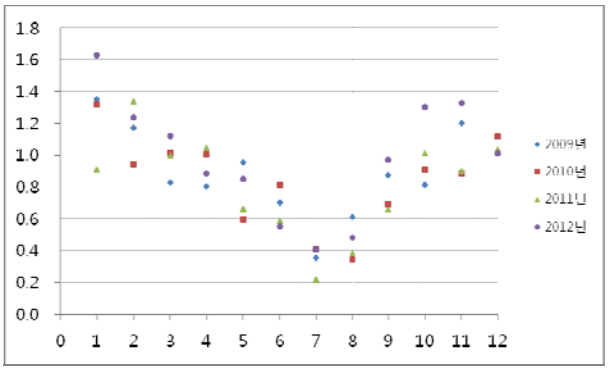


Fig. 1. Concentrations of gross beta radioactivity in air particle and rainwater by Hanbit site (unit; mBq/m^3, Bq/L)



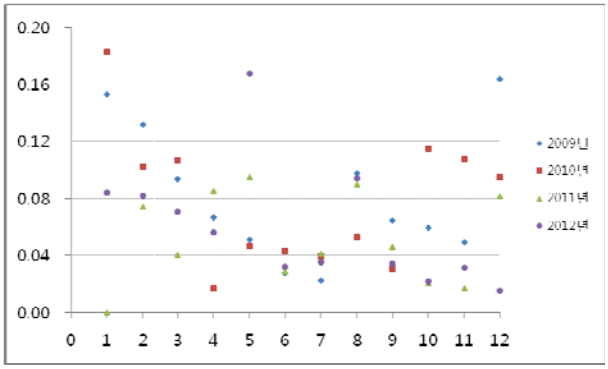
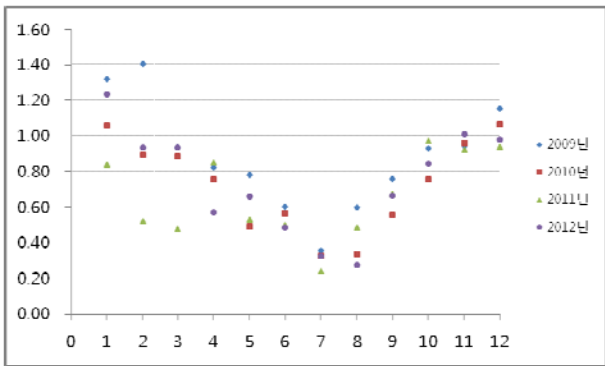


Fig. 2. Concentrations of gross beta radioactivity in air particle and rainwater by Kori site (unit; mBq/m^3, Bq/L)



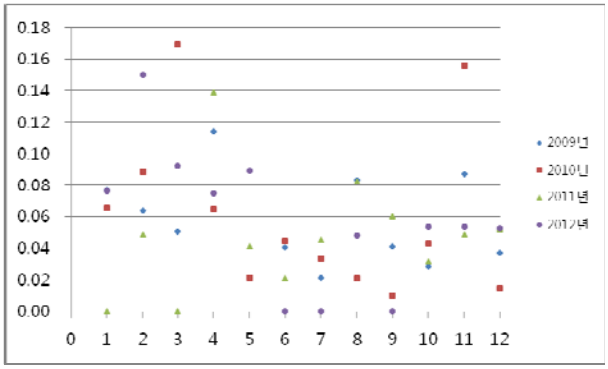
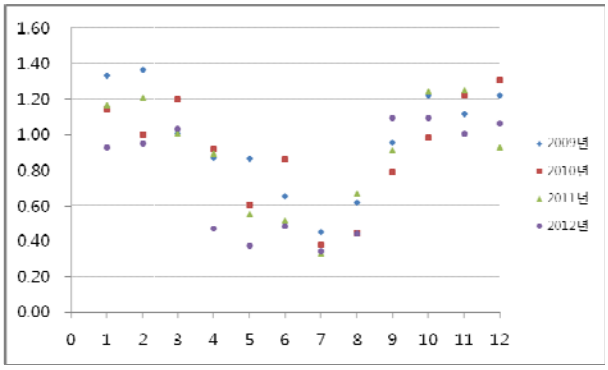


Fig. 3. Concentrations of gross beta radioactivity in air particle and rainwater by Wolsung site (unit; mBq/m^3, Bq/L)



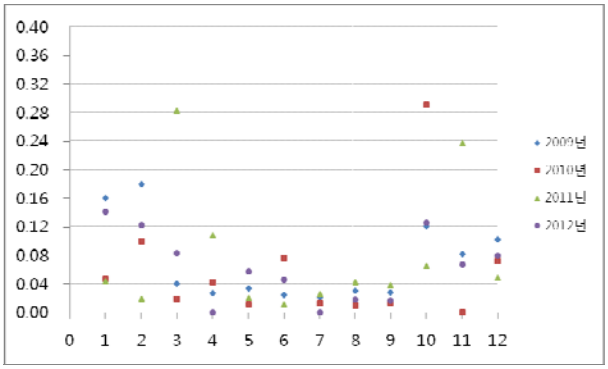


Fig. 4. Concentrations of gross beta radioactivity in air particle and rainwater by Hanul site (unit; mBq/m^3, Bq/L)

Examining the trend of air particle and rainwater gross beta radioactivity from 2009 to 2012, the concentrations of gross beta radioactivity has higher tendency in winter from November to February.

3. Results and Discussion

3.1. Concentrations of gross beta radioactivity influence factors

The gross beta radioactivity has higher tendency in winter and the influence factors were investigated. Management of power plant was excluded since there was no radioactive accident during the period.

The influence factors of gross beta radioactivity concentration chosen in this report were precipitation, the weight of sampled air particles and elemental distribution of air particles, were investigated.

3.2. Precipitation

Our country has four distinctive seasons with temperate climate, most of precipitation is focused in summer. This is a precipitation recorded in Investigation of Environmental Radioactivity around Nuclear Power Plants and Valuation Report, Hanbit Nuclear Power Plants site for the last four years.[1]

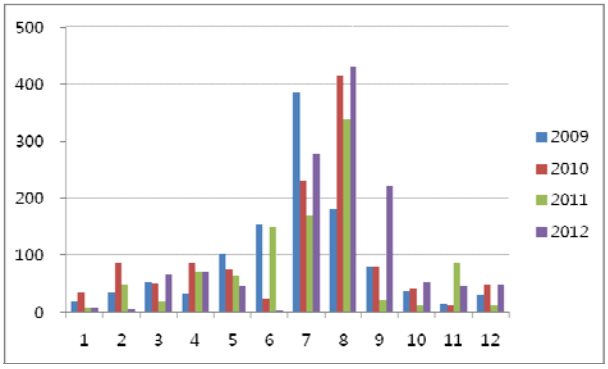


Fig. 5. Precipitation of Hanbit nuclear power plants site in recent 4 years (unit; mm)

Precipitation of Hanbit Nuclear Power Plants site shows similar tendency to national precipitation.

3.3. Weight of air particles

For a low level alpha beta detector used to measure gross beta radioactivity is calibrated every six month for its accurate measurement. As one way of calibration, an efficiency curve is drawn using gross beta concentration change with increased weight by potassium chloride.
Accordingly, influence on gross beta radioactivity concentration depending on the weight of air particles was examined.

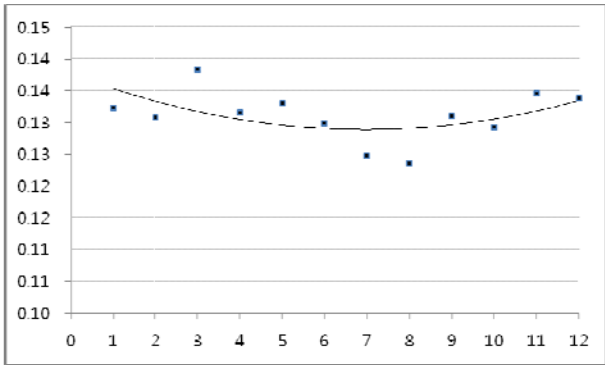
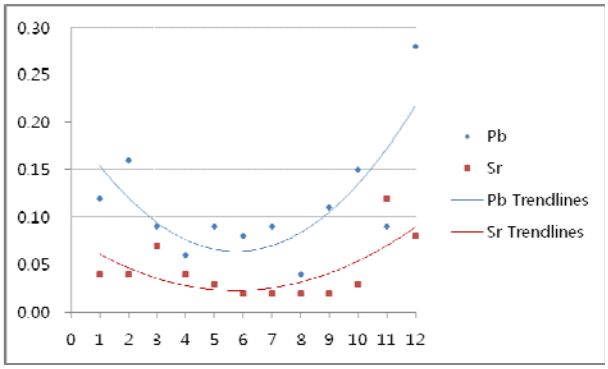


Fig. 5. Weight of air particles of Hanbit nuclear power plants site in 2010 (unit; g)

3.4. Analysis result of ICP-Atomic Emission Spectrometer of air particles

To check the existence of beta ray emission nuclide which influences the gross beta radioactivity concentration ICP-Atomic Emission Spectrometer analysis was performed. Six nuclides, Pb, Sr, K, S, U and P, were chosen as analyzed beta ray emission nuclides. In the case of S, it is assumed that exhaust gas for heating the area has influenced.



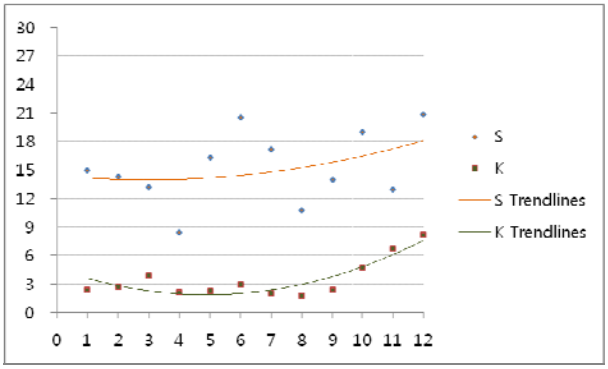


Fig. 6. Concentrations of elements in air particles of Hanbit nuclear power plants site in 2010 (unit; ppm, parts per million)

As a result of component element concentration analysis of air particles, U and P were not found but Pb, Sr, S and K showed similar trend as gross beta radioactivity concentration.

4. Conclusions

The gross beta radioactivity concentration shows that Hanbit Nuclear Power Plants located in west coast has twice the concentration than the others located in east coast. It is assumed the distance from China can be one factor.

Due to high gross beta radioactivity concentration in winter, sometimes, radioactivity concentration five times higher than reported last five years average gross beta radioactivity concentration is detected.

Looking at the contents investigated above, we can see nuclear power plants have correlation with surrounding gross beta radioactivity concentration. Precipitation has negative correlation, and the weight of air particles and concentration of component element have positive correlation. [3]

Our country is influenced by northwest wind in winter. China which is located northwest, has heavy air pollution and smog due to industrialization and there was a report saying it is affecting Korea.

Therefore, not because of management of power plants but because of change in season, it can be misunderstood that operating power plants is causing the increased gross beta radioactivity concentration.

Based on this investigation, more research to find various causes of gross beta radioactivity concentration in winter is necessary.

REFERENCES

[1] Korea Hydro & Nuclear Power co., Investigation of Environmental Radioactivity around Nuclear Power Plants and Valuation Report, 2009-2012

[2] Korea Hydro & Nuclear Power co., Investigation of Environmental Radioactivity around Nuclear Power Plants Plan

[3] W.K.Lee, S.M.Woo, The measurement of gross beta-ray radioactivity concentration of precipitation and fallout with low background alpha/beta counter according to change of th e season, The Journal Industrial Liaison Research Institute Vol.13, 2007