CLASSIFICATION OF MONITORING SITES AROUND TSURUGA NUCLEAR POWER STATION BASED ON VARIOUS VARIATIONAL PATTERNS OF AVERAGE MONTHLY EXPOSURE RATES

Y. Ogawa[*], Y. Kimura[*], Y. Honda[*],
I. Urabe[**] and T. Tsujimoto[***]

[*]   Department of Nuclear Engineering, Kinki University,
Osaka, Japan
[**] Fukuyama University, Hiroshima, Japan
[***] Research Reactor Institute, Kyoto University, Osaka,
Japan

ABSTRACT

     In order to elucidate the fluctuations of the exposure
rate, claasification of monitoring sites based on various
variational patterns of monthly exposure rate was attempted.
To obtain various variational patterns, seasonal adjustment
method and period analysis method were used. By comparing
various variational patterns and correlation coefficients,
classification of monitoring sites could be carried out.
The classification of monitoring sites is an usuful tool to
get some information for estimating the reasons and the
intensity of variation on exposure rates.

INTRODUCTION

     The exposure rates due to environmental gamma-rays show
roughly constant levels at respective monitoring sites.
However, if examined in detail, the exposure rate varies
periodically or occasionally from several to ten-several
percent. It is important to make clear the reasons of the
variation from the view points of monitoring of nuclear
facilities and research of environmental radiation and
radioactivity. In order to elucidate the fluctuations of
the exposure rate due to environmental gamma-rays near
nuclear power station, classification of monitoring sites
was attempted. This paper briefly describes monitoring site
classification method based on various variational patterns
of monthly exposure rate. As an application of this method,
classification of monitoring sites around TSURUGA Nuclear
Power Station is also described.

MONITORING SITE CLASSIFICATION METHOD

     To obtain various variational patterns of monthly
exposure rate, time series analysis methods, that is, sea-
sonal adjustment method and period analysis method, were
used. Seasonal adjustment method calculates trend-cicular
exposure rate, seasonal factor and irregular factor by the
moving average method. Trend-circular exposure rate repre-
sents the moving average of original data and the deviation
of original data from trend-cicular exposure rate represents

seasonal and irregular factors. The periodic component of
this deviation is seasonal factor and the rest is irregular
factor. Period analysis method, on the other hand, calcu-
lates periodgram by the finite fourier transformation.
Periodgram represents the order of periods involved in
original data. From the calculational results obtained, the
interpretation of variational patterns is discussed.

Using time series analysis methods mentioned above,
monitoring site classification based on various variational
paterns of monthly exposure rate could be carried out as
follows.
    Step 1. Calculate correlation coefficients among month-
ly exposure rates at monitoring site,
    Step 2. Calculate monthly trend-cicular exposure rate,
seasonal factor and irregular factor of monthly exposure
rate at each monitoring site by seasonal adjustment method,
    Step 3. Calculate correlation coefficients among month-
ly trend-circular exposure rates at monitoring site,
    Step 4. Calculate periodgram of monthly exposure rates
at each monitoring site by period analysis method,
    Step 5. Calculate periodgram of trend-circular exposure
rate at each monitoring site,
    Step 6. Compare the various variational patterns and
the correlation coefficients,
    Step 7. Classify monitoring sites.
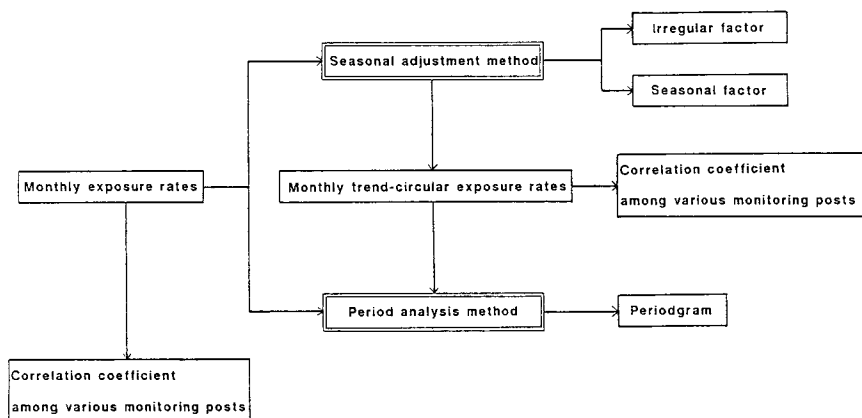Flow chart of monitoring site classification method is shown
in Fig.1.

Fig.1 Monitoring site classification method based on various
variational patterns of monthly exposure rates

Using this monitoring site classification method, the
classification of monitoring sites around TSURUGA Nuclear
Power Station was carried out. The area around TURUGA
Nuclear Power Station is the area of higher exposure rates
due to the terrestrial natural gamma-rays than the other

area in FUKUI Prefecture. Monthly exposure rates measured and evaluated at nine monitoring sites from April 1984 to March 1990 were used.

CLASSIFICATION RESULTS AND DISCUSSION

Several typical characteristics obtained from the calculational results and the classification of monitoring sites are listed below.

Considering seasonal factor obtained from seasonal adjustment method, there are three types of monitoring sites.
Type 1 : Monitoring site where low monthly exposure rate in winter has been measured because of shielding terrestrial gamma-rays by the snow.
Type 2 : Monitoring site where low monthly exposure rate in winter and rainy season has been measured because of shielding terrestrial gamma-rays by the snow and by the increase of water content in soil.
Type 3 : Monitoring site where no significant seasonal variation in monthly exposure rate has been measured.

Considering periodgram obtained from period analysis method, there are three types of monitoring sites.
Type 4 : Monitoring site where seasonal variation in monthly exposure rate has been measured because of the influence of the four seasons.
Type 5 : Monitoring site where trend variation in monthly exposure rate has been measured because of the gradual change of the topography.
Type 6 : Monitoring site where zigzag variation in monthly exposure rate has been measured.

Considering correlation coefficients, there are two types of monitoring sites.
Type 7 : Monitoring site where similar variation in monthly exposure rate to that at the other monitoring site has been measured because of the similar influence of environmental conditions.
Type 8 : Monitoring site where similar variation in trend-cicular exposure rate to that at the other monitoring site has been measured because of the similar influence of environmental conditions without the effect of the four seasons.

From the classification results obtained, the reason of spatial and time dependent variation on exposure rate could be estimated by investigating in detail at the other monitoring site which has the similar classified characteristics, if low or high exposure rate were temporarily measured at some monitoring sites. Accordingly, the classification of monitoring sites is an usuful tool to get some information for estimating the reasons and the intensity of varia-

tion on exposure rate.

CONCLUSION

In order to elucidate the fluctuations of the exposure rate due to environmental gamma-rays near nuclear power stations, claasification of monitoring sites based on various variational patterns of monthly exposure rate was attempted. To obtain various variational patterns, time series analysis methods, that is, seasonal adjustment method and period analysis method, were used. By comparing various variational patterns and correlation coefficients among monthly exposure rates at monitoring site, classification of monitoring sites could be carried out.

Using this monitoring site classification method, the classification of monitoring sites around TSURUGA Nuclear Power Station, where is the area of higher exposure rate due to the terrestrial natural gamma-rays than the other are in FUKUI Prefecture, was carried out. As a results, it is found that there are eight types of monitoring sites which have typical similar characteristics around TSURUGA Nuclear Power Station.

From the classification of monitoring sites, the reason of spatial and time dependent variation on exposure rates could be estimated by investigating in detail at the other monitoring site which has the classified similar characteristics. Accordingly, the classification of monitoring sites is an usuful tool to get some information for estimating the reasons and the intensity of variation on exposure rates.

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