# Development of environmental radiation monitoring system with multi channel analyzer

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## 1. Introduction

In the situation that the monitoring of disaster and terror is more necessary, the role and importance of environmental monitoring system around nuclear power plant are reviewed actively. Because of that environmental radiation is affected by the rain and weather, it is difficult to detect early the absence of artificial radiation release, from nuclear power plant and nuclear experiment form neighbor country. To detect radiation more precisely, it is necessary that development of environmental radiation monitoring system with radiation spectrum analysis which use MCA(Multi Channel Analyzer)..

## 2. System configuration.

Ionization chamber and NaI(Tl) scintillator is widely used to monitor environmental radiation monitoring system(ERMS). But until now, NaI(Tl) detector is used to detect 2 or 3 single windows. 32k channel MCA is developed and applied to this detector and environmental radiation spectrum can be measured. In other hand metrological information also need at environmental radiation monitoring, rain sensor wind direction and speed sensor also applied. Figure 1 shows system configuration.

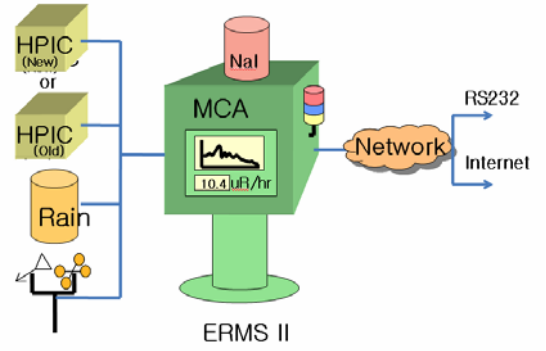


Figure 1. System configuration.

## 3. Spectrum to dose conversion function.

To calculate G(E) function (dose conversion function), MCNP simulation is performed in the condition of real ERMS monitor, and calculated G(E) function is shown in Figure 2. With is function we can calculate dose rate from NaI(Tl) radiation spectrum.

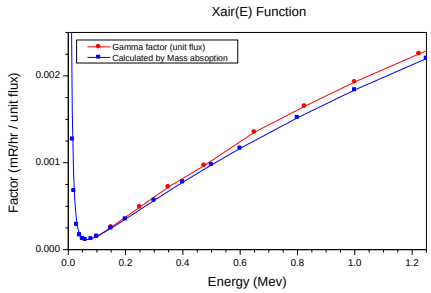


Figure 2. Spectrum to dose conversion function.

## 4. Artificial radiation distinguish.

Because of that environmental radiation varies widely according to weather it is difficult to distinguish artificial radiation release. But the ratio between artificial radiation and natural radiation changes when there is artificial radiation release, Zero by Zero method[1] is one of the method and when the Zero by Zero values go certain level, there is artificial radiation. Figure 3 shows the result.

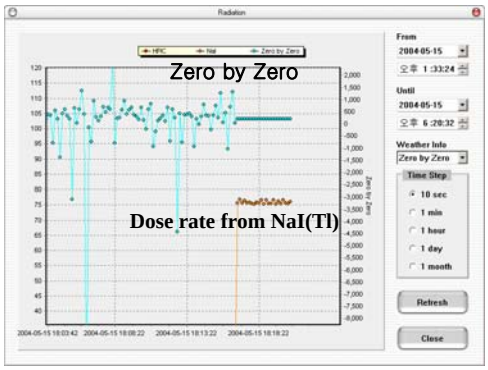


Figure 3. Zero by Zero monitoring.

Developed ERMS can monitor not only the existence of artificial radiation but also which nuclide exist. ERMS monitor radiation spectrum and it can detect peaks of major nuclide, for example, in natural radiation spectrum, K-40, Bi-214, Pd-214, Ac-228 and so on, can be detected. When there is a peak from artificial nuclide, such as Cs-137, C0-60, Ba-133 ERMS can detect tease peak and distinguish what it is. Of course there is a limit of this function because that NaI(Tl) has a limited resolution.

## 5. Automatic temperature compensation.

Because of the temperature dependence of the light yield from NaI(Tl), measured spectrum shift according to temperature. It cause lower or higher measured radiation dose. Until now, To compensate this effect, ERMS operated in fixed temperature and for example, small room with heater and cooler. Developed ERM system can measure radiation spectrum so, it monitors K-40 and Bi-214 peak every 5 minute and automatically change the linear constant for channel to energy calculation. So, with this function even though ERMS operate at outside environment, the error from temperature is minimized and the cost for heater and cooler will be saved.

### 6. Environmental Test and Calibration Test.

Environmental Test performed at KTL for Industrial environment EMS (IEC 61000-6-2) and Electrical Fast Transient / Burst test (IEC 61000-4-4), Surge Immunity test (IEC 61000-4-5), and temperature test and so on. All the test result is suitable for environmental radiation monitoring.

Calibration test also performed at KAERI, for the Ion chamber and NaI(Tl). Table 1 shows the result of the test and at low range each detector shows less then 5% errors and at high range Ion chamber shows less then 10% error.

| Irradiated dose (uR/hr) | Ion chamber | | NaI | |
|---|---|---|---|---|
| | Measure (uR/hr) | Error(%) | Measure (uR/hr) | Error(%) |
| 200 | 190.18 | 4.91 | 203.96 | 1.98 |
| 400 | 380.22 | 4.94 | 413.60 | 3.40 |
| 800 | 865.08 | 8.13 | 800.20 | 0.02 |
| 1000 | 1085.21 | 8.52 | 966.19 | 3.38 |

Table 1. Test result for calibration

### 6. Conclusion

Environmental Radiation Monitoring System with Multi channel analyzer is developed and it can monitor radiation spectrum with 32K channel MCA. It also store radiation spectrum at every 1 hour so, if there is an accident, stored spectrum can be use to determine what is the reason of that accident. ERMS also has the function which can distinguish artificial radiation with Zero by Zero method and it can find out which artificial radio isotope is in air. Temperature compensation algorithm is also developed and it is very important function to ERMS because it should be operated at outside. In Korea, there is an Environmental radiation monitoring system by NPP and KINS, and if developed ERMS will be used in there, more accurate and detail radiation monitoring can be possible.

Figure4. Developed Environmental Radiation Monitoring System

### REFERENCES


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