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Environmental Radiation monitoring system with GPS(Global positioning system)

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1. Foreword

Shimane Nuclear Power Station Chugoku Electric Power Co., Inc. adopted a monitoring car equipped with a new monitoring system resorting to a global positioning system (hereinafter referred to as GPS) for monitoring of the surrounding area.

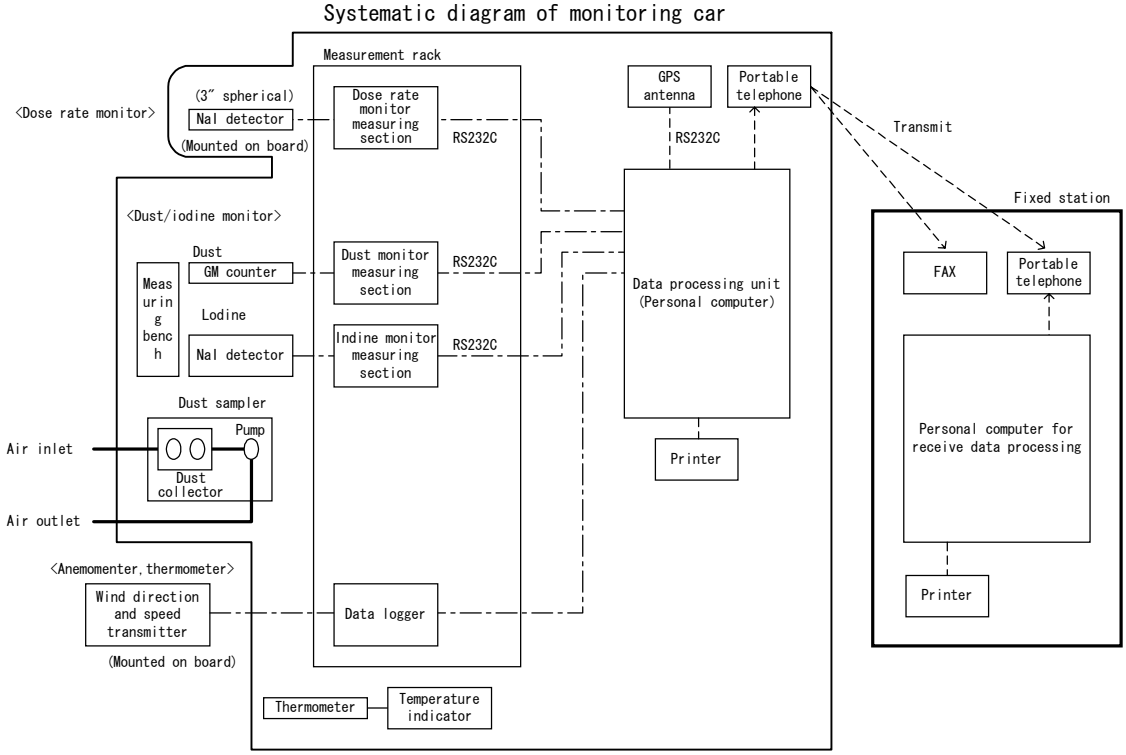
The monitoring car has functions of adding positional information to measurement results such as γ ray dose rate in the nuclear power station area, displaying immediately on a map and transferring the data to such disaster prevention headquarters as fixed stations via a mobile phone.

We think that they allow disaster prevention staff to grasp accurate information in routine patrol as well as in nuclear calamities, etc.

External view of monitoring car

2. Outline of mounted devices

The mobile monitoring system installed on a box type vehicle contains the radiation measuring instruments of γ ray dose rate monitor, radioactive iodine monitor, radioactive dust monitor, sampling equipment together with wind speed, temperature and humidity measuring instruments, data processing unit (personal computer), GPS, etc. Outline of the systematic diagram of the monitoring car is shown as follows.



The following shows features of each mounted device.

The γ dose rate monitor adopts 3" ∅ spherical NaI (TI) scintillation detector which has excellent directive characteristics. The detector is mounted outside the vehicle roof.

The measuring range is 10 to 10^5 nGy/h so that any magnitude level of accidents can be measured with sufficient margin. The measurement is available in real time while driving.

The measuring section has multi-channel analyzer functions. The dust monitor is intended for measuring the radioactive dust in air of β ray nuclide. GM counter examines the filter paper on which dust has been collected by sampler of 70L/min.

The iodine monitor is intended for measuring the radioactive iodine concentration in air. Sharing the sampler with the dust monitor, it is so designed as to collect dust via a charcoal cartridge having 99% of collecting efficiency.

The detector is 2" ∅ × 2" NaI (TI) scintillation detector, and the measuring section has a multi-channel analyzer function the same as the dose rate monitor.

The anemometer is a propeller type which can easily be checked for soundness and is installed on the folding pole on the top.

The temperature and humidity gauges resort to semiconductor sensors for their simple structure and easy handling and maintenance.

The retained GPS is so accurate that at least 5 artificial satellites can be kept captured and that, during a movement, the current position can be located within an error of several ten meters.

Further, a data communication facility via a mobile phone is provided for quickly conveying the acquired information.

Specifications of main devices

Device	Description	
γ ray dose rate monitor	object to measure	:Space γ ray
	Detctor	:NaI(Tl)scintillation 3" φ spherrical
	measuring range	:10 to 105 nGy/h
	Energy	:50 kev to 3 Mev
	Dirction	:Within +20° from 0 (axial to detector) to ± 90° (perpendicular)
	others	:Multi-channel analyzer function provided
Dust monitor	object to measure	:Atomospheric radioactive dust (β ray)
	Detctor	:GM counter
	measuring range	:0 to 999999 count
	collecting material	:cellulose filter paper (collecting efficiency 99%)
Iodine moitor	object to measure	:Atomospheric radioactive Iodine (γ ray)
	Detctor	:NaI(Tl)scintillation 2" φ ×2" cylindrical
	measuring range	:0 to 999999 count
	collecting material	:Activated carbon filter (collecting efficiency 99%)
	others	:Multi-channel analyzer function provided
Anemometer	Detctor	:Propeller type anemometer transmitter
	measuring range	:wind speed 0.3 to 60 m/s ,wind direction 0 to 360°
	portable telephone	:date rate 9.6 kbps
GPS	positional	:100m max
	receiving ensitivity	: -130 dB
	Date update time	:1 sec max

3. Features of monitoring car

(1) Link function for position data and measurement data by GPS

Fetching the latitude, longitude and time data from the GPS to the data processing unit allows to display the measurement data for γ ray dose rate, atmospheric radioactive dust concentration and wind direction and speed on a topographic map.

The display range covers our periodic observation points and calamity refuges as well as major town roads. This arrangement provides a visual recognition of changes of numeric values from normal ones, location of most appropriate refuges, etc. and, we think, can make the data observation better and human errors less, for example, than by numerical display only.

The following shows an example of display on a map.

Dose map

(2) Real time data processing by data processing unit

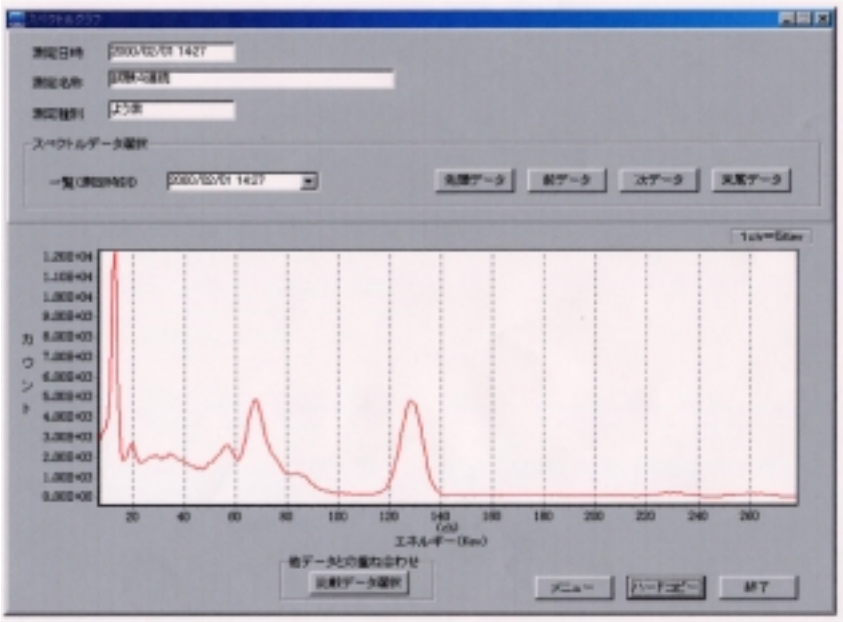
Acquired data including the above-mentioned positional information can be processed and analyzed in real time. Particularly, the γ ray dose rate and atmospheric radioactive iodine concentration are measured by NaI (TI) scintillation detector and measurement data energy spectral graph can be displayed.

Therefore, the measured nuclide can be estimated and determination of increase or decrease of each nuclide by spectral graphs put on one another are available, for example. As for γ dose rate, further, analyzing the transmittance data acquired from the energy characteristics compensation circuit can evaluate an average energy of the γ ray.

The following shown main functions of data processing unit.

a. Spectral graph (γ ray dose rate, atmospheric radioactive iodine concentration)
b. Time series graph (γ ray dose rate)
c. Dose map (γ ray dose rate, atmospheric radioactive iodine concentration)
d. Distance and bearing from power station to current position

Spectral graph (γ ray dose rate)



(3) Data transfer function via a mobile phone

Measurement data and GPS information can be transferred from the monitoring car to a fixed station.

Data communication resorts to a mobile phone. Latest data can always be transmitted from the site of measurement.

Data are received by personal computer installed in a fixed station and, based on received data, processing and analyses are available the same as on the monitoring car.

The facsimile function provided can transmit results of analyses by the monitoring car, etc. to any facsimile receivers.

(4) Others

a. Effective use of interior space with use of compact devices

Use of midget unit type measuring section and data processing unit, and small generator mountable in the engine room and devised layout leave a room for 3 operators. The layout is such that they need not move from their seat for service.

b. Unmanned measurement function with external power supply

The electric power is self-procured in principle. An external power supply is also usable upon changeover so that the devices can operate even if the engine does not run. Thus, by installing the monitoring car at a stationary point, a measurement is available at all times. And it can act as a simplified wireless telemetric station, transmitting the data in real time via data communication.

5. Epilogue

The new monitoring car has been working since bigining of march.

In Japan, the concern about the nuclear power disaster prevention is increasing on account of accident at JCO last year.

The new monitoring car featuring the above points would have to effectively be utilized as a means of ensuring the safety control of the area of nuclear power station.