SIX-YEAR EXPERIENCES IN THE ENVIRONMENTAL RADIOACTIVITY MONITORING ON TAIWAN

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An islandwide network for environmental radioactivity monitoring established in 1974 is described with reference to (1) radioactive fallout measurement from nuclear tostings, (2) environmental monitoring for nuclear power plants and radioactive waste disposal site, (3) specially designated site by the government, and (4) instalments involving radiation. Both naturally occurring and artificial radionuclides are equally emphasized. All significant results are reported and discussed.

Observation of fallout from nuclear testings mainly at Lop Nor and an islandwide network (Fig.1) for radioactivity monitoring established in the Taiwan province of the Republic of China in 1974 to provide radiation baseline data for the governmental agencies were described with reference to types of environmental samples taken and types of radioactivity monitored. The Taiwan Radiation Monitoring Stating (TRMS) of the Atomic Energy Coucnil of Executive Yuan has a primary responsibility to establish the radiation baseline data. The TRMS obtains environmental sampled from its own islandwide networks and involves the analysis for samples of air, water, soil, vegetation, food, and

direct gamma-ray using thermoluminescent dosimeters (TLD).

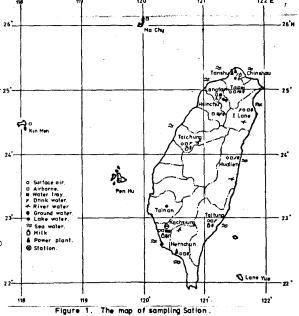
1. Direct gamma-ray
The TLD's are

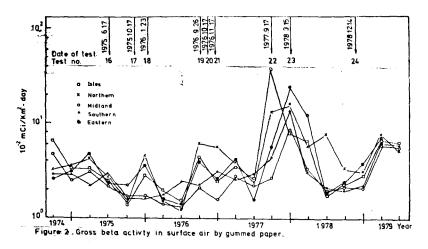
CaSO4:Dy in powder
from. They are inst-25
alled around the nuclear power plants

No. 1 and 2. The
calibration procedures
can be seen elsewhere 26
(1,2). The results
are presented in
Table 1.

2. Airborne radioactivity

The airborne radio activities are classified as gross beta activity in surface air by gummed paper (Fig. 2), for Kaohsiung City alone (Fig. 3),





and gamma-ray spectrum analysis (Fig. 4). Tritium in air is also TABLE 1. Results of background gesses sonitoring from 1977 collected by ethylene glycol with an efficiency close to 95% (3).

3. Water sample

Various kinds of water samples are generally analyzed for gross beta activity, and sometimes for $^{90}\mathrm{Sr}$ and $^{137}\mathrm{Cs}$ as shown in Table 2.

The 141/144 Ce concentration water samples after nuclear testings are shown in Table 3. activation products from nuclear power plant No. 1 such as 59_{Fe}, 57_{Co}, 60_{Co}, 64_{Cu}, 65_{Zn} have not been detected so far. Tritium in drinking water and rainwater

						uB/hr				
Exposure Period	Exposure Area									
	Towns and	Cities	Cities No.1 Power Plant No.2							
	Bange	Mean	Range	Mean	Range	Mean				
1977	4.5~10	8.2	7.3-16.5	10.8						
1978	4.6-10.4	7.5	5.8-10.2 •5.7-10.4	7.8 7.7	4.1~10.4	7.1				
1979	3.0-12.1	7-9	*6.2-10.8	8.4	3.2-10.3	6.5				

*Commercial operation in October 1, 1978

TABLE 2. Concentration of 141/144 Ce in Water Samples

			uCi/liter
Samples	Dec	1976	Mar 1977
Drink Water	96.5	54.5	52.8 50.2
Ground Water	63.8	54.8	57.5 55.4
River Water	122.8	61.8	B.K.
Lake Water	77.1	52.3	B.K.
Sea Water	112.4	44.9	B.K.

B.K.: Background

varied from 0.88 to 3.2 pCi/ml with a lower limit of detection about 300 pCi/liter(4).

4. Soil

Both surface (0.5 cm) and deep (10.25cm)soil samples are analyzed for gross beta activity (9~36 pCi/g), and for 137 Cs (1,218 pCi/kg) and ⁹⁰Sr (37.7.570.8 pCi/kg).

5. Vegetation

The gross beta activity of vegetation mainly comes from $^{40}\mathrm{K}.$ fission products such as $^{95}\text{Nb}-^{95}\text{Zr},^{144}\text{Ce},^{103}\text{Ru},\text{etc.}$ were also detected after nuclear testings at Lop Nor.

6. Food

Ten kinds of major food such as rice, pork, fish, egg, powdered milk, potatoes, chicken, duck, flour, and vegetables in Taiwan were analyzed for 90 Sr and 137 Cs(5,6). The results are listed in Table 4. The tea leaves from nuclear power plant No. 1 were also analyzed for 90 Sr and 137 Cs.

All data reported in this paper are in good agreement with previous investigations. The estimation of the population dose based on present data is insignificant.

Several new experimental techniques have been developed. For example, the TLD's for environmental monitoring which have been proved to be quite efficient after participating the international intercomparison program, the ion-exchange method for water sample treatment. the chemical analysis of soil samples, wet-ashing method for food samples, and the chemical procedures for activation product analysis in the effluents from the nuclear power plant. Relatively high activity from nuclear testing at Lop Nor during 1974-1979 is indicated with corresponding dates and sequence number of tests in the figures concerned.

TABLE 3. Radioactivity of Various Water Samples during 1974-1979

	Gross beta			90 _{Sr}			¹³⁷ Cs		
Sample	Min	Max	Mean	Min	Max	Mean	Min	Нах	Неап
Drink Water	0.9	2.4	1.7	0.08	0.95	0.4	0.14	0.34	0.3
Ground Water	0.8	3.6	1.6	0.13	1.27	0.6	0.13	0.38	0.3
River Water	1.1	1.8	1.6	0.08	0.48	0.3	0.12	0.44	0.3
Lake Water	1.0	2.3	1.7	0.13	1.88	0.6	0.14	0.6	0.4
Sea Water	1.0	3.9	2.0	0.18	0.51	0.3	0.53	0.6	0.6

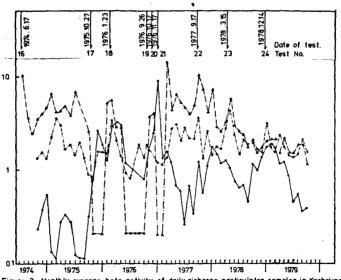
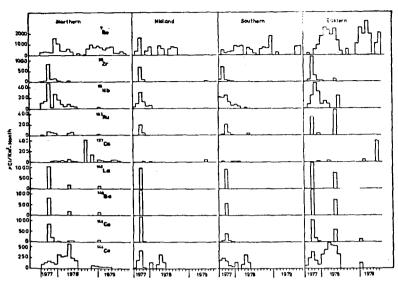


Figure 3. Monthly average beta activity of daily airborne particulates samples in Kaohsiung.



TABLEA 4. Concentration of Strontium 90 and Cesium 137 in ten important foodstuffs, and estimated total daily intake in the average diet.

Food	Personal	أغا		90 _{Sr}		137 _{Cs}	
	communition kg/year	Ca	k	pCi/kg	yearly intake	pCi/kg	yearl; intak
tice	132.7	0.04	0.3	3.9	43.4	29.1	44.5
Vegetable	98.0	0.01	0.34	3.6	15.6	3.3	3.7
Pork	2.2	0.11	0.18	6.6	3.7	16.3	4.2
Fish	21.9	0.59	0.36	6.5	12.0	6.6	1.7
Eggs	9.5	0.05	0.30	2.7	2.1	2,1	0.2
Milk	9.4	1.29	0.90	19.5	15.4	65.1	42.1
Potato	8.9	0.09	0.15	2.6	1.9	11,8	1,2
Chicken	7.7	0.18	0.16	2.4	1.5	4.3	0.4
Wheat	5.1	0.02	0.26	5.1	2.2	22.4	1.3
Duck	3.6	0.15	0.15	6.9	2.1	15.8	0.6
yearly intake 320 kg 374 g 6		653 g	1191.7 pCi 3.18 pCi/g.Ca		8672.3 pCi 23.8 pCi/d		

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