NRL - F/67
ISSN 0111-6193

DEPARTMENT OF HEALTH

ENVIRONMENTAL RADIOACTIVITY ANNUAL REPORT

1987

ISSN 0110-9944

NATIONAL RADIATION LABORATORY

P.O.Box 25 099, Christchurch

New Zealand

MARCH 1988

SUMMARY

Artificial radioactivity in the environment in New Zealand and at Rarotonga during 1987 continued to be at the very low level typical of recent years.

Average levels were: total beta activity in air, 0.07 mBq m^{-3}; strontium-90 deposition, 0.4 $\pm$ 0.3 MBq km^{-2}; caesium-137 in milk, 0.19 Bq gK^{-1}; strontium-90 in milk, 0.045 Bq gCa^{-1}. No artificial radionuclides were detected on high-volume air filters.

It is concluded that there was no influx of fresh radioactive emissions into the region during 1987.

CONTENTS

INTRODUCTION

The National Radiation Laboratory has been monitoring environmental radioactivity levels in the New Zealand and South Pacific regions since 1960, as described in earlier reports in this series[1,2]. Monitoring was conducted initially for radioactive fallout from Northern Hemisphere nuclear weapon tests and then for fallout from the French testing programme in the Tuamotu Archipelago. When the French atmospheric testing programme was terminated in 1974 monitoring continued for residues from atmospheric tests and in order to detect any venting from underground tests or any influx of artificial radioactivity from other sources.

The monitoring programme was revised in 1986[3,4] after a decade showing a continuously downward trend in fallout levels,which by then had reached limits of detectability. Emphasis was shifted from monitoring actual levels, which had become insignificant, to the detection of changes in levels. The extensive atmospheric radioactivity monitoring network of low-volume air samplers was closed down in favour of a network of only three sites equipped with high-volume samplers. These new high-volume air samplers increased the sensitivity by two orders of magnitude over the low-volume samplers. Similarly the networks for rainwater and milk monitoring were reduced to two or three sites only. Considerably less data is therefore published in this report, which covers the first full year of new programme operation, than in previous reports. This should not, however, be construed as meaning less importance is now attached to environmental monitoring - it is simply that the programme, with increased sensitivity, has been redesigned in order to detect changes rather than continuing to expend considerable effort measuring and reporting levels which have become trivial in terms of health hazard. Should upward changes in environmental radioactivity levels be detected, more extensive monitoring would be activated.

The monitoring programme now comprises the following measurements: atmospheric radioactivity (with weekly sample collection) at Kaitaia, Hokitika and Rarotonga; beta activity in rainwater (weekly) at Hokitika and Rarotonga; strontium-90 in rainwater (monthly collections aggregated 6-monthly) at Kaitaia, Hokitika and Rarotonga; and strontium-90 and caesium-137 (quarterly) in milk from Auckland, Taranaki and Westland. The rationale behind the choice of these sites has been discussed earlier[4].

The high-volume air samplers which play a major role in the programme were fully described in the 1985 Annual Report[5]. Earlier reports[1] and special reports on French atmospheric tests[2] gave information on terms of reference, reference levels, potential health hazard and technical information[2,3,5].

1987 MONITORING RESULTS

Results for 1987 are summarized in Tables 1-3. The precision of measurement, when given, is based on a counting error of 2 Poisson standard deviations. (Bq = becquerel, the unit of radioactivity: 1 Bq = 1 decay event per second; mBq = millibecquerel).

1. Radioactivity in the atmosphere (Table 1)

Filters from the high-volume samplers were changed once per week, after an average of approximately 40 000 m^3 of air had been sampled, and analysed by high-resolution gamma spectroscopy[3] for any traces of artificial radionuclides, particularly fission products.

No artificial radionuclides were detected during 1987 at any site (limit of detection 10^{-6} Bq m^{-3}).

Total beta activity in air, due mainly to natural radionuclides such as lead-210, was assessed from the beta activity of the same filters (Table 1). The 1987 means for the three sites were 0.06-0.07 mBq m^{-3}, as in 1986[4].

2. Radioactivity in Rain (Table 2)

The total beta activity deposited in rain was assessed for the full year only at Hokitika. Problems were experienced with sample loss at Rarotonga and insufficient data were collected to provide an accurate deposition assessment for that site. At Hokitika (Table 2) the total deposition for the year was 238 $\pm$ 28 MBq km^{-2}, very similar to the 1986[4] level of 256 MBq km^{-2}. As mentioned in earlier reports[3,4], this beta activity is due mainly to natural lead-210 and its decay product bismuth-210, and the level is not expected to fluctuate much without a further input of artificial radionuclides.

The beta activity concentration in rainwater averaged 0.08 Bq l^{-1} at Hokitika.

Strontium-90 deposition (Table 2) was measured at Kaitaia, Hokitika and Rarotonga where totals for the year were 0.5 $\pm$ 0.2, 0.3 $\pm$ 0.1, and 0.5 $\pm$ 0.2 MBq km^{-2} respectively. The 3-site mean was 0.4 $\pm$ 0.3 MBq km^{-2}.

Six-monthly aggregates of monthly collections were used in these determinations in order to improve sensitivity. This procedure was first introduced in July 1986[4] and the results for each half year (Table 2) are similar to those reported for the second half year 1986[4], which are also shown in Table 2 for comparison. The Rarotongan level for the first half-year, 0.4 $\pm$ 0.2 MBq km^{-2}, seems slightly higher than usual, though the second half-year level, 0.1 $\pm$ 0.1 MBq km^{-2}, was normal. No explanation is apparent for the difference between periods - it was not repeated at the other sites.

The strontium-90 concentration in rainwater was less than 0.001 Bq l^{-1} at all sites.

3. Radioactivity in milk (Table 3)

Caesium-137 levels in cows' milk, assessed by analysis of 3-monthly aggregates of monthly samples, averaged 0.09, 0.36 and 0.12 Bq per gram potassium in Auckland, Taranaki and Westland respectively, with a three region mean of 0.19 Bq gK^{-1} (2.6 Bq kg^{-1}), similar to the 1986 mean[4] of 0.33 Bq gK^{-1}.

Strontium-90 levels in milk, also measured in quarterly aggregates, averaged 0.031, 0.056 and 0.049 Bq per gram calcium in Auckland, Taranaki and Westland respectively, with a three region mean of 0.045 Bq gCa^{-1} (0.5 Bq kg^{-1}), similar to the 1986 mean[4] of 0.048 Bq gCa^{-1}.

The strontium-90 level in Taranaki during the third quarter (0.121 Bq gCa^{-1}) was significantly higher than the annual mean level. The reason for this is not known, but it is probably due to a seasonal variation in pasture or other foodstuff or in the milk treatment process. The effect was not reflected in measurements in the other regions, in rainwater or air filter measurements, and so is clearly not due to a fresh influx of strontium-90 into the environment. The annual mean for the region, 0.067 Bq gCa^{-1}, was similar to that of 1986[4], 0.045 Bq gCa^{-1}.

CONCLUSION

Environmental radioactivity levels in the New Zealand and South Pacific regions, as indicated by measurements of air, rain and milk radioactivities in New Zealand and Rarotonga, did not change significantly during 1987 and continued to be at very low levels consistent with an environment containing only traces of residual global weapons test fallout. There has been no detectable influx of emissions from any other source including the Chernobyl nuclear reactor accident.

EXPORT CERTIFICATION

As a legacy of the Chernobyl accident the National Radiation Laboratory now has a significant role to play in certifying exported foodstuffs for compliance with importing countries' requirements, and in advising exporters on matters involving radioactivity levels. Most countries have now introduced legislation controlling the radioactivity levels in imported foodstuffs and although New Zealand received no fallout from Chernobyl, it is not exempted from the certification requirements. Fortunately, the requirements of most countries are such that certificates can be issued on the basis of the environmental monitoring programme described in this report - with such low environmental levels of radioactivity, foodstuffs produced here could never be contaminated sufficiently to be subject to import restrictions. Some countries, however, have introduced extraordinarily stringent requirements such that even the trace levels of global fallout present in New Zealand are sufficient to make periodic testing of foodstuffs advisable.

During 1987 210 export certificates were issued covering a wide range of foodstuffs to many countries. In addition a significant number were issued by the Ministry of Agriculture and Fisheries (under authority) for dairy product exports. National Radiation Laboratory Environmental Radioactivity reports are now referred to by some countries in assessing the need for New Zealand exports to be tested or certified.

OTHER WORK

(a) Beryllium-7, a natural radionuclide present in the atmosphere, was monitored as an extension to the atmospheric and rainwater radioactivity monitoring programme. A paper on its deposition characteristics has been prepared in co-operation with the New Zealand Meteorological Service and submitted for publication.

(b) Natural radioactivity levels in New Zealand coals, surveyed during 1986 and 1987, are the subject of a report presently being compiled.

(c) Polonium-210, a natural radionuclide which tends to accumulate in the organs of some shellfish, is the subject of a small study of New Zealand shellfish presently being conducted.

ACKNOWLEDGEMENT

The assistance given by the staff of this and other Government Departments, especially the New Zealand Meteorological Service, and managers of milk processing plants, is gratefully acknowledged. The Laboratory's Environmental Radioactivity and Chemistry Section organized the monitoring and analysed the samples. This report was written by the Section Head, Dr K M Matthews. He was assisted technically by Miss M-J Okey.

A C McEwan
Director

REFERENCES

1. "Environmental Radioactivity Annual Reports" Nos: NRL-F/48 (1972) - NRL-F/52 (1974) summarizing previous results, NRL-F/54 (1975) - NRL-F/66 (1987). National Radiation Laboratory, Christchurch.

2. "Environmental Radioactivity: Fallout from nuclear weapons tests conducted by France in the South Pacific ... and comparisons with previous test series." Reports NRL-F/47 (1972) summarizing all monitoring since 1966, NRL-F/49 (1972), NRL-F/51 (1973), NRL-F/53 (1974). National Radiation Laboratory, Christchurch.

3. "Environmental Radioactivity Annual Report", NRL-F/65 (1986). National Radiation Laboratory, Christchurch.

4. "Environmental Radioactivity Annual Report", NRL-F/66 (1987). National Radiation Laboratory, Christchurch.

5. "Environmental Radioactivity Annual Report", NRL-F/64 (1985). National Radiation Laboratory, Christchurch.

TABLE 1

Radioactivity in the atmosphere, 1987

	Total beta activity ($mBq\ m^{-3}$)		
	Range	Mean	S.D.
Kaitaia	<0.04 - 0.22	0.07	0.04
Hokitika	<0.04 - 0.16	0.06	0.03
Rarotonga	<0.04 - 0.15	0.07	0.03

TABLE 2

Radioactivity in rain, 1987

	Total beta activity deposition at Hokitika ($MBq\ km^{-2}$)	Rainfall (mm)
1st quarter	58 ± 13	764
2nd quarter	50 ± 14	835
3rd quarter	59 ± 14	656
4th quarter	71 ± 14	780
1987 Total	238 ± 28	3035

	Strontium-90 deposition ($MBq\ km^{-2}$)		
	Kaitaia	Hokitika	Rarotonga
Jan-Jun	0.3 ± 0.2	0.2 ± 0.1	0.4 ± 0.2
Jul-Dec	0.2 ± 0.1	0.1 ± 0.1	0.1 ± 0.1*
1987 Total	0.5 ± 0.2	0.3 ± 0.1	0.5 ± 0.2
Jul-Dec 1986[4]	0.2	0.3	0.1
Rainfall (mm)	1183	2997	1125*
Concentration ($Bq\ l^{-1}$)	<0.001	<0.001	<0.001

* 4 months only

TABLE 3

Radioactivity in milk, 1987

	Auckland		Taranaki		Westland	
Caesium-137 content, Bq gK^{-1} (Bq kg^{-1})						
1st quarter	0.14	(2.1)	0.40	(5.7)	0.14	(2.4)
2nd quarter	0.12	(1.6)	0.42	(5.6)	0.12	(1.5)
3rd quarter	0.04	(0.6)	0.27	(3.4)	0.10	(1.2)
4th quarter	0.04	(0.6)	0.33	(4.9)	0.12	(1.9)
1987 average	0.09	(1.2)	0.36	(4.9)	0.12	(1.8)
The counting error was approximately ± 0.03 Bq gK^{-1}.						
Strontium-90 content, Bq gCa^{-1} (Bq kg^{-1})						
1st quarter	0.026	(0.31)	0.036	(0.43)	0.047	(0.56)
2nd quarter	0.031	(0.37)	0.035	(0.42)	0.048	(0.58)
3rd quarter	0.044	(0.53)	0.121	(1.45)	0.050	(0.60)
4th quarter	0.022	(0.26)	0.031	(0.37)	0.050	(0.60)
1987 average	0.031	(0.37)	0.056	(0.67)	0.049	(0.59)
The counting error was approximately ± 0.002 Bq gCa^{-1}.						