

The NRPB environmental radioactivity surveillance programme

Norman Green

Abstract The National Radiological Protection Board (NRPB) has operated an environmental radioactivity surveillance programme for some years. Originally, samples of airborne dust, rainwater and milk were collected from the constituent countries of the UK. However, due mainly to the decreasing activity concentrations of radionuclides in these materials, this programme has been reduced and now forms part of contingency planning in the event of an accident. The programme can be expanded to fill the need for rapid results and answer public concerns. Other programmes within the UK complement the Board's programme.

Key words airborne dust • environment • milk • radioactivity • surveillance • UK

Introduction

The National Radiological Protection Board (NRPB) keeps under review the radiation exposure of the UK population from all sources, one of which is fallout from both nuclear weapons testing and nuclear accidents. The Board began a routine radioactivity surveillance programme in 1975, and in 1979 took over the responsibility for a nationwide milk monitoring programme. During recent years, however, the activity concentrations of radionuclides in airborne dust, rainwater and milk have fallen to very low levels, sometimes even below the limits of detection of the methods employed. For this reason, the sampling of rainwater ceased in 1995. The nation-wide programme of milk monitoring was discontinued in 1996 because many of the original contributing creameries had closed. In addition, by this time the Ministry of Agriculture, Fisheries and Food (MAFF) monitored milk on a county basis. From the beginning of 1997, the NRPB programme focused on single farms close to each of the Board's centres at Chilton, Leeds and Glasgow. Samples were collected in March, June, September and December. The programme for the Channel Islands and the Isle of Man remained unchanged, with monthly samples bulked quarterly for analysis.

The objective of the main part of the environmental radioactivity surveillance programme is to provide data typical of the UK against which site specific monitoring data can be compared. The change in arrangements for the sampling of milk in 1997 reflects an extension of interest towards contingency planning; in the event of a nuclear accident the frequency of sampling can be escalated rapidly. Measurements in milk from the Channel Islands and the Isle of Man provide a convenient means of assessing the effects of authorised discharges from the nearby nuclear fuel reprocessing plants at Cap de la Hague and

N. Green
National Radiological Protection Board,
Chilton, Didcot, Oxfordshire OX11 0RQ, United Kingdom,
Tel.: 44-1235/ 822 662, Fax: 44-1235/ 833 891,
e-mail: norman.green@nrpb.org.uk

Received: 4 June 2001

Sellafield, respectively. Results were published approximately annually up to those for 1994 [7].

In addition to the main programme, NRPB has made use of the area around the Sellafield nuclear reprocessing plant for various research projects for more than twenty years. The results of measurements of activity concentrations in environmental media from that area from 1980–1990 were published in 1992 [4]. Since that time, sampling of airborne dust has continued at a farm on the northern edge of Seascale, a large village close to Sellafield, and milk has been collected on a monthly basis at a farm about 3 km to the north of the site.

The measurements made in the vicinity of the Sellafield reprocessing plant enable trends resulting from authorised discharges to the environment to be evaluated and the effects of any episodic discharges to be discerned. The environment around Sellafield is already monitored extensively by the site operator [1] and by Government Agencies [2, 5]. The results of the NRPB programme provide independent evidence that could be used to support responses to queries about the impact of Sellafield discharges to the environment. In addition, the data may find an application in the validation of predictive models.

Sampling and analysis

The sampling and measurement regime for the entire programme for 1998 is summarised in Table 1. The methods of measurement and analysis employed are in regular operational use at the Board's laboratories at Chilton and Glasgow, and since 1995 have been carried out within a formal agreement with the United Kingdom Accreditation Service.

Airborne dust

Airborne dust is sampled continuously by drawing air through a polycarbonate filter at a flow rate of about $1 \text{ m}^3 \text{ min}^{-1}$ using a centrifugal fan assembly; the flow rate is measured by an axial flowmeter. Samples of airborne dust are normally collected over a period of two weeks, although the sampling frequency can be easily increased in case of an accidental release of radionuclides. In addition, at the Board's Chilton site, the volume sampled can be increased by about an order of magnitude using a larger assembly which is not operated routinely. The filters are compressed into a known geometry and the activity concentrations of

gamma-ray emitting radionuclides are determined directly using hyper-pure germanium detectors housed in a purpose-built low background facility and appropriately calibrated. Measurements of actinides are carried out by α -spectrometry following radiochemical separation.

Milk

Milk is sampled from the bulk tank of farms or creameries. Caesium-137 is measured either directly using freeze-dried milk or by extraction using ammonium molybdophosphate; in both cases the gamma-ray spectrometry facility described earlier is used. Strontium-90 is measured by extraction of its ^{90}Y daughter followed by beta counting several times over a period of a few days using a low-background, gas-flow proportional counter.

Results and discussion

The most recent report in the NRPB environmental surveillance series draws together previously unpublished data for the nation-wide programme and from around Sellafield for the first time [3]. That report presents data for the nation-wide programme for 1995 to 1998, and for the Sellafield programme for 1991 to 1998.

Airborne dust

No ^{137}Cs was detected at either Glasgow or Guernsey from 1995 to 1998. Activity concentrations of the cosmogenic radionuclide ^7Be showed the normal seasonal variation. The activity concentrations of gamma-ray emitting radionuclides, ^{241}Am and alpha-emitting isotopes of plutonium at Seascale for the years 1991 to 1998 showed a similar pattern to previous years. Activity concentrations of ^{106}Ru are normally below the limit of detection (typically about $10 \mu\text{Bq m}^{-3}$), although, occasionally, small amounts are just detectable. In November 1997, an accidental release from the Sellafield plant led to a higher than normal activity concentration for a short time. Using a time integrated activity concentration, the dose to a member of the public in Seascale was estimated to be about $0.2 \mu\text{Sv}$.

Milk

Activity concentrations for ^{137}Cs in milk from the main surveillance programme were mostly close to or below the detection limit, typically 0.03 Bq l^{-1} . The highest values of about 0.2 Bq l^{-1} were obtained for areas of relatively high

Table 1. Sampling programme in 1998.

Sample	Location	Frequency	Determination
Airborne dust	Glasgow	Fortnightly	Gamma-ray emitters
	Guernsey	Fortnightly	Gamma-ray emitters
	Seascale	Fortnightly, bulked monthly for actinide analysis	Gamma-ray emitters, Pu and Am
Milk	Chilton	10 litres each quarter	^{137}Cs , ^{90}Sr
	Leeds	10 litres each quarter	^{137}Cs , ^{90}Sr
	Glasgow	10 litres each quarter	^{137}Cs , ^{90}Sr
	Isle of Man	1.5 litres per month, bulked quarterly	^{137}Cs , ^{90}Sr
	Guernsey, Jersey and Alderney	1.5 litres per month, bulked quarterly	^{137}Cs , ^{90}Sr
	Seascale	5 litres each month	^{137}Cs

annual rainfall, where deposition from weapons testing is also high compared with other parts of the UK. Activity concentrations of ^{90}Sr were all at or close to detection limits. Interpretation of the results is limited due to the changes made in the sampling regime. In particular, results obtained for 1997 onwards relate to single farms in one month each quarter, and so cannot be compared with those from previous years.

Activity concentrations in milk from the Isle of Man were comparable with those from near Glasgow and values in milk from the Channel Islands were comparable with the corresponding ones in central southern England. This suggests that discharges from Sellafield and Cap de la Hague have little influence on activity concentrations in milk from these islands. Activity concentrations of ^{137}Cs in monthly samples of milk from near Sellafield were higher than those observed in the main part of the surveillance programme, although consistent with the values published by MAFF, which represent the average of samples from 12 farms close to the Sellafield site. Strontium-90 was not determined in these samples.

Following an enhanced release of ^{35}S from the Calder Hall reactors in the week of 3rd to 10th January 1998, measurements of this radionuclide were undertaken in samples of milk and grass collected on 13th January. At that time, dairy cattle were indoors and feeding on silage that had been prepared during the previous year. Intakes from releases to atmosphere would therefore be via inhalation rather than via deposition on to pasture. As might be expected, activity in the milk was below the detection limit of 0.5 Bq l^{-1} . The activity concentration of the fresh grass indicated a deposition of $1.5 \pm 0.1 \text{ Bq m}^{-2}$.

Other relevant programmes

In addition to the Board's programme of environmental surveillance, other programmes are also in operation in the UK. The main national programmes are listed here.

RIMNET

The Radioactive Incident Monitoring Network (RIMNET) consists of a fully automated network of 92 gamma-radiation dose rate monitors spread throughout the UK. Readings are automatically downloaded every hour to a central database, although additional readings may be taken at any time. Alarms are triggered if abnormal increases are noted. The system is intended primarily for use for accidents happening overseas, and the information will be used to establish whether the National Response Plan needs to be activated. The system also allows for other relevant measurements to be collected and collated; these include measurements of airborne radionuclides, food,

water supplies, animals and crops within the UK, and also imports from affected areas.

RIFE

The Ministry of Agriculture, Fisheries and Food (MAFF), in conjunction with the Scottish Environment Protection Agency (SEPA), publish a joint report on Radioactivity in Food and the Environment (RIFE), the latest being for 1998 [5]¹. The results include data from monitoring milk and other foodstuffs collected near nuclear sites, independently of the monitoring carried out by the individual site operators. Samples are also collected from around some industrial and landfill sites in the UK to monitor exposure resulting from operations from industries other than nuclear sites. In addition, the report also contains the results of a county-by-county programme of milk monitoring, supplied to the European Commission as part of the requirements under the EURATOM Treaty.

AEA Technology

AEA Technology (AEAT) operated the UK Radioactivity in Air and Rainwater Monitoring Programme, established in 1950, on behalf of the Environment Agency until 1998. Since 1983, the results from the Board's programme and that of AEAT have been complementary. Samples of airborne dust and rainwater collected from seven locations within the UK were bulked into quarterly samples for measurement. In general, measurements for 1997–1998 were close to or below the limits of detection for ^{137}Cs . Beryllium-7 was readily detectable in all air and most rainwater samples at expected concentrations [6].

¹ The responsibility for the programme in England and Wales passed to the Food Standards Agency in April 2000.

References

1. BNFL (1999) Annual report on discharges and monitoring of the environment, 1998. Risley, Warrington
2. Environment Agency (1998) Radioactivity in the environment. Report for 1997. HMSO, London
3. Hammond DJ, Green N, Welham D, Gow C, Bulloch KA, Mitchell L (2000) Environmental radioactivity surveillance programme: Results to 1998. NRPB-M1169. NRPB, Chilton
4. Johnson D (1992) Measurements of activity concentrations in environmental media in the vicinity of the Sellafield reprocessing plant, 1980–1990. NRPB-M387. NRPB, Chilton
5. Ministry of Agriculture, Fisheries and Food/Scottish Environment Protection Agency (1999) Radioactivity in food and the environment. RIFE-4. MAFF, London
6. Playford K, Baker SJ (2000) Radioactivity in air and rainwater: UK results to the end of 1998. DETR/RAS/00.002 HMSO, London
7. Welham D, Bulloch KA, Gow C, Ross K (1996) Environmental radioactivity surveillance programme: Results for 1993 and 1994. NRPB-M699. NRPB, Chilton