Environmental Radioactivity Surveillance Programme: Results for 2006

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ABSTRACT

This report is the latest of a series in which the results of the Health Protection Agency (formerly NRPB) environmental radioactivity surveillance programme are presented. It contains the measurement data for the year 2006. Within the main programme, samples of airborne dust and milk are collected routinely from selected locations within the UK, the Channel Islands and the Isle of Man. The activity concentrations of various radionuclides are measured. In general, the radionuclides detected result from nuclear weapons tested in the atmosphere in earlier years and from the nuclear reactor accident at Chernobyl in the Ukraine in 1986, although the programme is able to detect any other sources of significant contamination. The results indicate that concentrations of artificial radionuclides in the general environment remain at the low levels observed in recent years. In addition to the main programme, samples of airborne dust have been collected in the vicinity of the Sellafield nuclear fuel reprocessing plant in west Cumbria. The results are consistent with those published by the site operator and government agencies.

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The measurements included in this report were performed at laboratories at HPA-RPD (UKAS accredited testing laboratories No 1269 and 1502). All the analyses and measurements are included within the relevant UKAS accreditation schedules.

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1 INTRODUCTION

The Health Protection Agency, Radiation Protection Division (HPA-RPD), formerly the National Radiological Protection Board (NRPB), has carried out an environmental radioactivity surveillance programme since the 1970s. Of necessity during that period, the programme has changed due to differing circumstances. A more complete history of the programme prior to 1998 is given in a previous report in this series [Hammond et al, 2000]. In 1999, the overall responsibility for the programme was moved from NRPB Scotland to the Environmental Investigations Group in NRPB headquarters at Chilton. In 2005 the NRPB became part of the HPA as part of a government initiative to consolidate agencies dealing with public health protection issues.

The primary intention of this series of reports is to provide a compendium of surveillance data, detailed radiological or radio-ecological assessments using these data being outside the remit. A principal objective of the main part of the programme is to provide data typical of the UK against which site specific monitoring data can be compared. The main part of the programme of milk sampling on the UK mainland makes use of dairy farms close to the HPA-RPD laboratories in Chilton, Leeds and Glasgow. Milk is also collected from the Channel Islands and the Isle of Man, and the data provide a convenient means of monitoring the effects of authorised discharges from the nearby nuclear fuel reprocessing plants at Cap de la Hague and Sellafield respectively.

The measurements made at Seascale, which is in the vicinity of the Sellafield reprocessing plant, enable trends resulting from authorised discharges to the environment to be determined and the effects of any episodic discharges to be discerned. The local environment around Sellafield is already monitored extensively by the site operator, the British Nuclear Group Sellafield Limited (BNGSL), formerly British Nuclear Fuels plc, the Environment Agency (EA) and the Food Standards Agency (FSA). The results of both of these sets of programmes are published annually, the latest reports being for 2006 for BNGSL and government agencies, respectively [BNGSL, 2007, EA et al, 2007]. However, the results of the HPA surveillance programme provide independent evidence that could be used in support of 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 of behaviour of radionuclides in the environment.

2 SAMPLING AND ANALYSIS

The sampling programme originally planned for 2006 is shown in Table 1.

TABLE 1 The planned sampling programme for 2006

Sample	Location	Frequency	Determinants
Airborne dust	Glasgow	Fortnightly	Gamma-ray emitters
	Seascale	Fortnightly, bulked monthly for actinide analysis	Gamma-ray emitters, Pu and Am
Cows 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
	Channel Islands	1.5 litres per month, bulked quarterly	^{137}Cs, ^{90}Sr

Airborne dust is sampled continuously by drawing air through a polycarbonate filter at a flow rate of about 1 m^3 min^{-1} using a centrifugal fan assembly; the flow rate is measured by an axial flowmeter. The filters are changed twice per month. Each filter is compressed into a defined 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 filters from Glasgow were carried out at HPA-RPD's laboratory in Glasgow whilst Seascale filters were analysed at Chilton as in previous years. Measurements of plutonium and americium are carried out on monthly bulk samples from Seascale using α-spectrometry following radiochemical separation.

Discussions with the Guernsey and Jersey authorities are in progress to determine whether it is feasible for an air sampling programme to be established.

Milk is sampled from the bulk tank at farms or creameries. In this way, the milk is representative of either the whole herd of cows or a number of herds. Samples are despatched to the Chilton laboratory soon after collection. On receipt at Chilton, milk is freeze-dried, after which ^{137}Cs is determined directly using gamma-ray spectrometry. ^{90}Sr 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. The decision was taken during 2006 not to pursue milk sampling from the Seascale area. This is because it has become increasingly impractical to obtain samples consistently over the last few years, and the value of any data that could be supplied via the HPA-RPD programme is therefore very limited. Substantial programmes of milk sampling are in any case already carried out in the area around Sellafield by both the site operator and FSA.

Measurements and analyses at Chilton are carried out under a quality system accredited to ISO 17025 by the United Kingdom Accreditation Service (accreditation number 1269). Measurements at Glasgow are carried out under a similar system also accredited to ISO 17025 (accreditation number 1502).

3 RESULTS AND DISCUSSION

The uncertainties quoted are based on standard uncertainties multiplied by a coverage factor of k=2 which provides a level of confidence of approximately 95%. The Minimum Detectable Activity quoted is the value for which there is a 5% probability of not detecting that activity if it is present in a sample, and a 5% probability of erroneously detecting activity where none was present.

3.1 Airborne dust

The results from gamma-ray spectrometric measurements on samples of airborne dust at Glasgow are listed in Table 2. These results derived from the data from the fortnightly samples, averaged over a three monthly period. Activity concentrations of ^{137}Cs were below detection limits whilst activity concentrations of cosmogenic ^{7}Be were typical of those observed in previous years. Results from Seascale for ^{7}Be and ^{137}Cs and alpha emitting radionuclides are shown in Table 3. The observed values were consistent with the low levels reported in previous years, the results for actinides being lower than those published by the site operator. With the occasional exception of ^{125}Sb at low levels no other gamma-ray emitting radionuclides of artificial origin were detected.

TABLE 2

Activity concentrations of ^{7}Be and ^{137}Cs in airborne dust at Glasgow in 2006 (μBq m^{-3})

Quarter	^{7}Be	^{137}Cs
1	2820 ± 300	<1.2
2	3630 ± 480	< 1.0
3	2350 ± 210	< 1.0
4	2350 ± 250	< 1.2

TABLE 3

Activity concentrations of ^{7}Be and ^{137}Cs and alpha emitting radionuclides in airborne dust at Seascale in 2006 (μBq m^{-3})

Month	^{7}Be	^{137}Cs	^{239,240}Pu	^{238}Pu	^{241}Am
January	1390 ± 240	3.14 ± 1.57	0.059 ± 0.009	0.010 ± 0.003	0.016 ± 0.004
	2540 ± 420	1.28 ± 0.72			
February	2520 ± 420	3.71 ± 1.20	0.35 ± 0.038	0.015 ± 0.004	0.087 ± 0.011
	2190 ± 360	10.6 ± 2.27			
March	1680 ± 280	9.26 ± 1.94	0.15 ± 0.016	0.016 ± 0.003	0.114 ± 0.013
	2350 ± 390	1.03 ± 0.06			
April	2180 ± 360	3.3 ± 1.25	0.154 ± 0.019	0.012 ± 0.004	0.034 ± 0.006
	3720 ± 610	5.09 ±1.45			
May	2750 ± 510	< 5.17	0.12 ± 0.016	0.016 ± 0.004	0.030 ± 0.005
	1730 ± 290	4.55 ± 1.11			
June	3490 ± 570	2.3 ± 0.98	0.096 ± 0.011	0.016 ± 0.003	0.044 ± 0.007
	2090 ± 340	2.33 ± 0.92			
July	2310 ± 390	4.06 ± 1.84	0.105 ± 0.013	0.018 ± 0.004	0.130 ± 0.014
	2570 ± 430	1.7 ± 0.70			
August	1260 ±230	11.5 ± 2.34	0.144 ± 0.017	0.021 ± 0.004	0.117 ± 0.014
	1580 ± 270	7.8 ± 1.46			
September	1760 ± 290	8.56 ±1.70	0.223 ± 0.033	0.097 ± 0.018	N/A
	2250 ± 490	1.18 ± 0.92			
October	2410 ± 440	6.96 ± 1.45	0.223 ± 0.03	0.091 ± 0.016	0.269 ± 0.027
	1950 ± 350	2.26 ± 0.81			
November	2350 ± 440	2.47 ± 1.26	0.212 ± 0.023	0.049 ± 0.007	0.304 ± 0.031
	2190 ± 370	< 1.07			
December	1550 ± 270	0.70 ± 0.64	0.165 ± 0.022	0.049 ± 0.01	0.487 ± 0.048
	2080 ± 370	< 1.74			

N/A- no result available due to a problem with the analysis.

3.2 Milk

Activity concentrations of ^{137}Cs in milk from Chilton, Leeds and Glasgow and the offshore islands (Isle of Man, Guernsey and Jersey) are given in Table 4. The corresponding data for ^{90}Sr are given in Table 5. The data from the off shore islands relate to samples that have been bulked on a quarterly basis. Activity concentrations of ^{137}Cs in all milk samples were mostly close to or below detection limits, consistent with the trend observed in previous years. [Hammond and Wilding, 2006]

The activity concentrations of ^{90}Sr in milk from Guernsey were close to or below detection limits. The measured values were very similar to those observed at locations that are more remote from nuclear licensed sites. A similar situation was observed for samples from the Isle of Man. However, the results for ^{90}Sr in milk from Jersey were very slightly elevated compared with the previous year but still within the expected range of values.

TABLE 4

Activity concentrations of ^{137}Cs in milk for 2006 (Bq l^{-1})

Location	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Chilton	< 0.05	< 0.04	< 0.05	< 0.05
Leeds	0.03 ± 0.03	< 0.04	0.03 ± 0.03	0.04 ± 0.02
Glasgow	0.03 ± 0.03	0.05 ± 0.03	0.04 ± 0.03	0.02 ± 0.02
Guernsey	< 0.06	< 0.04	< 0.06	<0.05
Jersey	< 0.06	< 0.06	< 0.05	<0.07
Isle of Man	0.05 ± 0.03	0.06 ± 0.03	0.09 ± 0.03	0.04 ± 0.03

TABLE 5

Activity concentrations of ^{90}Sr in milk for 2006 (Bq l^{-1})

Location	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
Chilton	0.023 ± 0.004	0.026 ± 0.004	0.011 ± 0.003	0.012 ± 0.004
Leeds	0.019 ± 0.005	0.015 ± 0.003	0.014 ± 0.004	0.014 ± 0.004
Glasgow	0.035 ± 0.005	0.028 ± 0.004	0.031 ± 0.005	0.027 ± 0.006
Guernsey	0.017 ± 0.007	< 0.007	< 0.011	0.011 ± 0.009
Jersey	0.069 ± 0.022	0.038 ± 0.01	0.028 ± 0.013	0.027 ± 0.02
Isle of Man	0.035 ± 0.092	0.039 ± 0.009	0.049 ± 0.019	0.016 ± 0.01

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