Public Health England

Environmental Radioactivity Surveillance Programme: Results for 2012

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ABSTRACT

This report is the latest of a series in which the results of Public Health England's Environmental Radioactivity Surveillance Programme are presented. It contains the measurement data for the year 2012. 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 the 1950s and 1960s 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. There is no evidence of any very low levels remaining in the environment from the Fukushima Dai-ichi accident in 2011, as is expected due to the very low levels measured in the environment at the time. 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 PHE CRCE, which is a UKAS accredited testing laboratory (No 1269 (Chilton) and No 1502 (Glasgow)). All the analyses and measurements are included in the schedule of the laboratories' UKAS accreditation.

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1 INTRODUCTION

The Centre for Radiation, Chemical and Environmental Hazards of Public Health England (PHE CRCE)* has carried out an environmental radioactivity surveillance programme since the 1970s. Of necessity during that period, the programme has changed due to differing circumstances.

The primary intention of this series of reports is to provide a compendium of surveillance data, detailed radiological or radio-ecological assessments using this data being outside the remit. Concentrations of radionuclides in milk and airborne particulates are provided for locations in the UK, Isle of Man and the Channel Islands. 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 PHE-CRCE laboratories in Chilton, Leeds and Glasgow. Milk is also collected from the Channel Islands and the Isle of Man. Air monitoring stations are located at Chilton, Glasgow, Seascale and Jersey. The sampling on the Channel Islands and the Isle of Man and at Seascale 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 air filter 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 monitored extensively by the site operator, Sellafield Ltd, the Environment Agency (EA) and the Food Standards Agency (FSA). The results of these programmes are published annually, the latest reports being the Sellafield Ltd annual report for 2011 (Sellafield Ltd, 2012) and Radioactivity in Food and the Environment (RIFE) report for 2012 (Environment Agency et al, 2013) for the government agencies. However, the results of the PHE 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.

* On 1 April 2013 the Health Protection Agency was abolished and its functions and staff transferred to Public Health England.

2 SAMPLING AND ANALYSIS

The sampling programme originally planned for 2012 is shown in Table 1.

TABLE 1 Planned sampling programme for 2012

Sample	Location	Frequency	Determinants
Airborne dust	Chilton	Fortnightly	Gamma-ray emitters
	Glasgow	Fortnightly	Gamma-ray emitters
	Seascale	Fortnightly, bulked monthly for actinide analysis	Gamma-ray emitters, isotopes of Pu and Am
	Jersey	Fortnightly	Gamma-ray emitters
Cows' milk	Leeds	5 litres each quarter	^{137}Cs, ^{90}Sr
	Glasgow	5 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 a 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 the CRCE laboratory in Glasgow, while all other filters were analysed at Chilton as in previous years. Measurements of plutonium (Pu) and americium (Am) were carried out on monthly bulk samples from Seascale using alpha-spectrometry following radiochemical separation.

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 caesium-137 (^{137}Cs) is determined directly using gamma-ray spectrometry. Strontium (^{90}Sr) is measured by extraction of its yttrium daughter (^{90}Y) followed by beta counting several times over a period of a few days using a low-background gas-flow proportional counter.

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.

3.1 Airborne dust

The results from gamma-ray spectrometric measurements on samples of airborne dust at Chilton, Jersey and Glasgow are listed in Tables 2, 3 and 4, respectively. These results are derived from the data from the fortnightly samples, averaged over a three-month period. Activity concentrations of ^{137}Cs were below detection limits with the naturally occurring beryllium-7 (^{7}Be) at levels similar to those measured in previous years. Beryllium-7 results are used to show that the efficiency of the air sampling equipment is being maintained. Results for ^{7}Be indicate the sampling equipment is operating satisfactorily at all sites. Results from Seascale for ^{7}Be, ^{137}Cs and alpha-emitting radionuclides are shown in Table 5. The observed values are consistent with the low levels reported in previous years and those values published by the site operator (Sellafield Ltd, 2011). Measurements of alpha-emitting radionuclides (plutonium and americium) were also made on the January and July filters from Chilton and Glasgow to check the background levels in airborne dusts. The values were similar to those measured previously from the same locations and were all below 0.01 µBq m^{-3}.

Measurements of iodine-131 (^{131}I) were also made on the fortnightly samples from Chilton, as ^{131}I can be an early indicator of a release outside of the UK, as was the case with the Fukushima Dai-ichi accident in 2011. No discernible levels of ^{131}I were measured during 2012.

TABLE 2 Activity concentrations of ^{7}Be and ^{137}Cs in airborne dust at Chilton in 2012 (µBq m^{-3})

Quarter	^{7}Be	^{137}Cs
1	1350	<1
2	1220	<1
3	990	<1
4	860	<1

TABLE 3 Activity concentrations of ^{7}Be and ^{137}Cs in airborne dust at Jersey in 2012 (µBq m^{-3})

Quarter	^{7}Be	^{137}Cs
1	1620	<1
2	1700	<2
3	1120	<1
4	970	<1

TABLE 4 Activity concentrations of ^{7}Be and ^{137}Cs in airborne dust at Glasgow in 2012 (μBq m^{-3})

Quarter	^{7}Be	^{137}Cs
1	2140	<1
2	1680	<1
3	2840	<1
4	1960	<1

TABLE 5 Activity concentrations of ^{7}Be, ^{137}Cs and alpha-emitting radionuclides in airborne dust at Seascale in 2012 (μBq m^{-3})

Month	^{7}Be	^{137}Cs	^{239,240}Pu	^{238}Pu	^{241}Am
January	1680 ± 260 2200 ± 340	<1.15 <1.16	0.10 ± 0.01	0.03 ±0.01	0.20 ±0.02
February	3120 ± 520 2120 ± 360	<1.24 <1.14	0.07 ± 0.01	0.02 ± 0.01	0.10 ± 0.01
March	2430 ± 410 3070 ±480	1.89 ±1.05 2.47 ±0.84	0.07 ± 0.01	0.02 ± 0.01	0.10 ± 0.01
April	1850 ± 310 1520 ± 260	1.08 ±0.68 <1.51	0.07 ± 0.01	0.03 ± 0.01	0.12 ± 0.02
May	2160 ± 340 2690 ± 50	2.92 ± 0.86 1.17 ± 0.50	0.07 ± 0.01	0.02 ± 0.01	0.11 ± 0.01
June	1190 ± 200 1740 ± 270	1.07 ± 0.69 <1.08	0.14 ± 0.02	0.03 ± 0.01	0.27 ± 0.03
July	1080 ± 70 890 ± 140	3.95 ± 0.73 <0.97	0.14 ± 0.02	0.03 ± 0.01	0.26 ± 0.03
August	1040 ± 170 1120 ± 190	1.37 ± 0.6 8.71 ± 1.83	0.07 ± 0.01	0.02 ± 0.01	0.16 ± 0.02
September	1130 ± 180 740 ± 120	<1.14 1.09 ± 0.61	0.19 ± 0.02	0.03 ± 0.01	0.33 ± 0.04
October	960 ± 150 910 ± 140	3.09 ± 0.93 0.81 ± 0.49	0.12 ± 0.01	0.03 ± 0.01	0.24 ± 0.02
November	980 ± 150 450 ± 70	1.13 ± 0.53 1.52 ± 0.62	0.12 ± 0.01	0.02 ± 0.01	0.45 ± 0.05
December	930 ± 140 880 ± 160	1.38 ± 0.54 <0.75	0.11 ± 0.01	0.02 ± 0.01	0.26 ± 0.03

3.2 Milk

Activity concentrations of ^{137}Cs in milk from Leeds, Glasgow and the offshore islands (Isle of Man, Guernsey and Jersey) are given in Table 6 and the corresponding data for ^{90}Sr in Table 7. The ^{137}Cs data relates to samples that have been bulked on a quarterly basis. For

^{90}Sr, the milk samples are bulked into annual samples. The individual samples are retained so that if the activity concentrations on the annual samples are unusual, the monthly samples can be analysed separately.

Activity concentrations of ^{137}Cs in all milk samples were close to or below detection limits, consistent with the trend observed in previous years (Hammond and Wilding, 2012; Hammond et al, 2013). The activity concentrations of ^{90}Sr in milk from Guernsey and Jersey were close to detection limits as were those of the samples from the Isle of Man. The measured values were very similar to those observed at locations that are more remote from nuclear licensed sites and consistent with the results from previous years (Hammond and Wilding, 2012; Hammond et al, 2013).

The activity concentrations of ^{90}Sr were also close to or below detection limits, consistent with the values reported in previous years (Hammond and Wilding, 2012; Hammond et al, 2013).

TABLE 6 Activity concentrations of ^{137}Cs in milk for 2012 (Bq l^{-1})

Location	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Leeds	<0.06	<0.08	<0.05	N/S
Glasgow	<0.09	<0.05	<0.05	<0.08
Guernsey	<0.1	<0.1	<0.07	<0.08
Jersey	<0.1	<0.09	<0.1	<0.09
Isle of Man	<0.09	<0.05	<0.05	0.07 ± 0.05

N/S No Sample

TABLE 7 Activity concentrations of ^{90}Sr in milk for 2012 (Bq l^{-1})

Location	Annual bulked sample
Leeds	0.011 ± 0.004
Glasgow	0.020 ± 0.005
Guernsey	0.020 ± 0.005
Jersey	0.017 ± 0.005
Isle of Man	0.018 ± 0.008

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