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Environmental Radioactivity Surveillance Programme: Results for 2013

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Environmental Radioactivity Surveillance Programme: Results for 2013

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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 2013. 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 to be 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 other 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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Contents

1 Introduction

An environmental radioactivity surveillance programme has been carried out by the Centre for Radiation, Chemical and Environmental Hazards of Public Health England (PHE CRCE), and its predecessor bodies, since the 1970s. Of necessity during that period, the programme has changed to meet 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 its remit. Concentrations of radionuclides in milk and airborne particulates are provided for locations in the UK, the Channel Islands and the Isle of Man. 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 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 on Jersey. The sampling on the Channel Islands and on the Isle of Man and at Seascale provides 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 2013/14 (Sellafield Ltd, 2014) and the Radioactivity in Food and the Environment (RIFE) report for 2013 (Environment Agency et al, 2014) for the government agencies. However, the results of the PHE surveillance programme provide independent evidence that could be used in support of responses to enquiries about the impact of Sellafield discharges to the environment. In addition, the data may find an application in the validation of predictive models of the behaviour of radionuclides in the environment.

2 Sampling and Analysis

The sampling programme that was planned for 2013 is shown in Table 1.

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 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 PHE CRCE laboratory in Glasgow, while all other filters were analysed at the Chilton laboratory 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.

Table 1: Planned sampling programme for 2013

Sample	Location	Frequency	Determinants
Airborne dust	Chilton	Fortnightly	Gamma emitters
	Glasgow	Fortnightly	Gamma emitters
	Seascale	Fortnightly, bulked monthly for actinide analysis	Gamma emitters, isotopes of Pu and Am
	Jersey	Fortnightly	Gamma emitters
Cows' milk	Leeds	5 litres each quarter	^{137}Cs, ^{90}Sr
	Glasgow	5 litres each quarter	^{137}Cs, ^{90}Sr
	Channel Islands	1.5 litre per month, bulked quarterly	^{137}Cs, ^{90}Sr
	Isle of Man	1.5 litre per month, bulked quarterly	^{137}Cs, ^{90}Sr

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 spectrometry. Strontium (^{90}Sr) is measured by extraction of its yttrium progeny (^{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 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 3-month period. Activity concentrations of ^{137}Cs were below detection limits, with 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. The results for ^{7}Be indicate the sampling equipment was operating satisfactorily at all sites. The results from Seascale for ^{7}Be, ^{137}Cs and alpha emitting radionuclides are shown in Table 5. The observed

Table 2: Activity concentrations of ^{7}Be and ^{137}Cs in airborne dust at Chilton in 2013 (µBq m^{-3})

Quarter	^{7}Be	^{137}Cs
1	1220	<1
2	736	<1
3	3196	<2
4	1824	<2

Table 3: Activity concentrations of ^{7}Be and ^{137}Cs in airborne dust at Jersey in 2013 (µBq m^{-3})

Quarter	^{7}Be	^{137}Cs
1	1155	<1
2	1304	<1
3	1367	<1
4	1100	<1

Table 4: Activity concentrations of ^{7}Be and ^{137}Cs in airborne dust at Glasgow in 2013 (µBq m^{-3})

Quarter	^{7}Be	^{137}Cs
1	2787	<1
2	2907	<1
3	3223	<1
4	2773	<1

values are consistent with the low levels reported in previous years and the values published by the site operator (Sellafield Ltd, 2014). 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 are similar to those measured previously from the same locations and are below 0.1 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 the UK, as was the case with the Fukushima Dai-ichi accident in 2011. No discernible levels of ^{131}I were measured during 2013.

3.2 Milk

The 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.

Table 5: Activity concentrations of ^{7}Be, ^{137}Cs and alpha emitting radionuclides in airborne dust at Seascale in 2013 (μBq m^{-3})

Month	^{7}Be	^{137}Cs	^{239,240}Pu	^{238}Pu	^{241}Am
January	926 ± 168	2.31 ± 0.69	0.139 ± 0.017	0.019 ± 0.004	0.201 ± 0.023
	1130 ± 203	<0.78			
February	965 ± 174	2.74 ± 0.64	0.236 ± 0.027	0.025 ± 0.005	0.271 ± 0.028
	1440 ± 259	0.90 ± 0.65			
March	1680 ± 340	<0.55	0.062 ± 0.009	0.012 ± 0.003	0.054 ± 0.007
	1810 ±366	0.71 ± 0.44			
April	1920 ± 345	0.90 ± 0.57	0.222 ± 0.028	0.023 ± 0.006	0.252 ± 0.027
	1010 ± 204	2.14 ± 0.63			
May	1180 ± 239	0.36 ± 0.29	0.171 ± 0.020	0.020 ± 0.004	0.238 ± 0.024
	1670 ± 303	3.74 ± 0.95			
June	1420 ± 256	1.24 ± 0.62	0.132 ± 0.015	0.015 ± 0.003	0.127 ± 0.014
	1520 ± 308	3.16 ± 0.74			
July	1480 ± 265	1.57 ± 0.80	0.089 ± 0.012	0.015 ± 0.004	0.140 ± 0.016
	2040 ± 413	2.31 ± 0.52			
August	1330 ± 239	<0.81	0.125 ± 0.015	0.021 ± 0.004	0.206 ± 0.022
	1210 ± 244	0.95 ± 0.47			
September	1000 ± 181	4.73 ± 1.04	0.088 ± 0.010	0.016 ± 0.003	0.150 ± 0.017
	1410 ± 255	<0.86			
October	1040 ± 187	1.17 ± 0.56	0.084 ± 0.010	0.017 ± 0.003	0.156 ± 0.017
	1310 ± 235	0.68 ± 0.40			
November	1420 ± 255	3.81 ± 0.91	0.126 ± 0.014	0.037 ± 0.006	0.231 ± 0.025
	1490 ± 270	4.30 ± 1.05			
December	1790 ± 322	1.43 ± 0.81	0.191 ± 0.026	0.028 ± 0.007	0.379 ± 0.042
	1140 ± 205	<0.63			

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 et al, 2013; Hammond and Pritchard, 2014). Activity concentrations of ^{90}Sr in milk from Guernsey and Jersey were close to detection limits as were those for 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 et al, 2013; Hammond and Pritchard, 2014).

Activity concentrations of ^{90}Sr were also close to or below detection limits (<0.1 Bq l^{-1}), consistent with the values reported in previous years (Hammond et al, 2013; Hammond and Pritchard, 2014).

Table 6: Activity concentrations of ^{137}Cs in milk for 2013 (Bq l^{-1})

Location	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Leeds	<0.036	<0.053	<0.055	<0.049
Glasgow	0.077 ± 0.034	<0.060	<0.083	<0.076
Guernsey	<0.067	<0.066	<0.071	<0.075
Jersey	<0.054	<0.096	<0.071	<0.083
Isle of Man	<0.057	<0.057	<0.054	0.082 ± 0.040

Table 7: Activity concentrations of ^{90}Sr in milk for 2013 (Bq l^{-1})

Location	Annual bulked sample
Leeds	0.072 ± 0.010
Glasgow	0.076 ± 0.010
Guernsey	0.039 ± 0.009
Jersey	0.057 ± 0.010
Isle of Man	0.085 ± 0.011

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