Isle of Man Government
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RADIOACTIVITY MONITORING ON THE ISLE OF MAN 2021-22

Isle of Man Government Laboratory Report

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1. INTRODUCTION

The Isle of Man Government carries out its own independent monitoring of environmental radioactivity on the Island [(1)]. The main objective of the monitoring is to provide public reassurance that levels of environmental radioactivity are below internationally accepted limits for public safety. This report details the results of the monitoring of radioactivity levels in foodstuffs and the general environment, for both 2021 and 2022.

The Isle of Man is only some 32 miles from the centre of Britain's nuclear industry, located at Sellafield on the Cumbrian coast. Sellafield is the source of different forms of gaseous and liquid radioactive waste. Although most of these radioactive wastes are stored on site, some gaseous wastes are vented to the atmosphere and some low-level radioactive effluent is discharged into the Irish Sea. Authorised radioactive discharges from Sellafield make a very small addition to the public radiation exposure from the natural background radioactivity level on the Island. The proximity of Sellafield to the Isle of Man does mean that there is public concern about both the authorised waste discharges and operational safety at the nuclear site [(2)].

Sellafield's nuclear fuel reprocessing work ended in July 2022. Unavoidably, Sellafield will continue to store spent nuclear fuel from the UK's Advanced Gas-Cooled Reactor (AGR) power stations. Sellafield will also store most of the UK's higher-level nuclear waste, until such time as it can be removed for permanent underground geological disposal.

Over many decades, work will continue on the decommissioning of Sellafield's redundant nuclear facilities, with resulting discharges of low levels of radioactivity to air and sea. Consequently, Sellafield will remain a licensed nuclear site for the foreseeable future and subject to statutory radiological monitoring by the UK Environment Agency. Nuclear safety and security at Sellafield is regulated by the Office for Nuclear Regulation (ONR).

Background Radiation Measurement

2. MONITORING OF FOODSTUFFS: 2021-22

Most foods contain trace amounts of naturally occurring radioisotopes. Some foods also contain traces of artificial radioisotopes. The presence of artificial radioisotopes in foods may be as a result of the waste discharges of the nuclear industry, or from fallout from nuclear accidents, or from past atmospheric testing of atomic weapons.

2.1 MILK

Manx milk was monitored on a monthly basis during the years 2021 and 2022. Samples of whole milk were obtained from the Central Creamery. Table 1 shows the results of gamma spectrometric analysis of whole milk.
In the distant past, the only artificial gamma-emitter detected was Caesium-137. During 2021 and 2022, there was no detectable Cs-137 at the detection limit of 0.11 $Bq.L^{-1.}$

The trace of radiocaesium found in milk in earlier years was due to residual Chernobyl fallout [(1)]. The Caesium-137 concentrations were extremely small in comparison with the European Community (E.C.) recommended maximum permitted level for Cs-137 in milk for consumption by infants, which is 400 $Bq.L^{-1}$. The artificial beta-emitter Strontium-90 has also been present at low concentration in milk since the 1950's atmospheric testing of atomic weapons [(3)]. Analysis of Manx milk in previous years has found a uniform concentration of less than 0.1 $Bq.L^{-1}$[(1)]. The EC maximum permitted level for Sr-90 in milk for consumption by infants is 75 $Bq.L^{-1}$.

TABLE 1: RADIOACTIVITY IN MILK (2022 and 2021 + 2020)

Whole Milk from the Central Creamery	2022	2021	2020
	Caesium-137 Becquerels per litre		
January	< 0.10	< 0.10	< 0.10
February	< 0.11	< 0.10	< 0.10
March	< 0.10	< 0.10	< 0.10
April	< 0.10	< 0.10	< 0.10
May	< 0.10	< 0.10	< 0.10
June	< 0.10	< 0.10	< 0.10
July	< 0.10	< 0.10	< 0.10
August	< 0.10	< 0.10	< 0.10
September	< 0.11	< 0.10	< 0.10
October	< 0.10	< 0.10	< 0.10
November	< 0.10	< 0.10	< 0.10
December	< 0.10	< 0.10	< 0.10

2.2 MEAT PRODUCTS

Samples of Manx lamb were collected from suppliers over the summer months of 2021 and 2022 (Table 2). A trace amount of radiocaesium detected in some samples of lamb can be attributed to residual Chernobyl fallout. The maximum legally permitted radiocaesium concentration in sheep meat is 1000 $Bq.kg^{-1}$. All samples of Manx lamb therefore contained less than 1% of the legally permitted maximum. The EC recommended maximum permitted level for radiocaesium in major foodstuffs (including lamb, beef and pork) is 1250 $Bq.kg^{-1}$.

TABLE 2 : RADIOACTIVITY IN MEAT PRODUCTS (2021-22)

Sample	Sampling Date	Origin	Cs-137	Cs-134
			$Bq.kg^{-1}$(fresh weight)	
Lamb (chopped)	June 2021	Manx	< 0.7	< 0.6
Lamb (chopped)	June 2021	Manx	< 1.0	< 0.4
Lamb (chopped)	June 2021	Manx	< 0.7	< 0.6
Lamb (chopped)	July 2022	Manx	1.6	< 0.5
Lamb (chopped)	July 2022	Manx	1.0	< 0.7

2.3 LOCAL FOODS

A wide range of locally produced foods have been analysed in previous years [(1)]. During 2022, a sample of Manx grown cabbage, was analysed by gamma spectrometry and no artificial radioactivity was detected (Cs-137 less than 0.2 $Bq.kg^{-1}$ fresh wt.).

Two samples of Manx honey were also analysed in 2022 for traces of artificial radioactivity and the Caesium-137 content was determined as 2.4 $Bq.kg^{-1}$ and < 0.4 $Bq.kg^{-1}$ (fresh wt.). These trace amounts of radiocaesium in locally produced honey present no radiological hazard to consumers of the product.
Wild foods such as heather honey and hedgerow berries collected from hill land can sometimes contain a trace of radiocaesium attributable to Chernobyl fallout [(4)]. A sample of Blackberries was also analysed in 2022 for the presence of artificial radioactivity and no Caesium-137 was detected < 1.0 $Bq.kg^{-1}$ (fresh wt.).

2.4 FISH AND SHELLFISH

Caesium-137 was detected at very low concentration in one of the seafood samples tested during the years 2021 and 2022 (Table 3). The EC recommended maximum permitted level for Caesium-137 in fish and shellfish is 1250 $Bq.kg^{-1}$.Analysis for total beta activity also indicated a low level of artificial radioactivity in local seafood.

Although discharges of radioactive effluent from Sellafield into the Irish Sea are well below the peak levels of the mid-1970, from 1994 onwards there have been increased discharges of the radioisotope, Technetium-99. Since the mid-1990's Technetium-99 has been the principal contaminant in lobsters caught in Manx coastal waters, although present day concentrations are very low.

The low concentrations of Tc-99 found in recent years are because in 2003, the site operating company BNFL began to reroute certain liquid wastes streams for storage on land and imposed a moratorium on Tc-99 discharges into the Irish Sea. In April 2004, BNFL announced that it had received approval, from the nuclear regulatory authorities, [5] to use a new technology at Sellafield's waste treatment plants to cut 90 % of the existing discharges of Tc-99 into the Irish Sea. The new treatment process was developed to remove Tc-99 from a substantial volume of historic waste stored in tanks, and thereby allow for disposal of a solidified waste product on land.

Our monitoring results in earlier years show that Tc-99 concentrations, in locally caught lobsters, have been on a downward trend over the period from 1998. Concentrations of Tc-99, in lobsters caught off the Isle of Man in 2020, averaged 13 $Bq.kg^{-1}$ and were lower than the levels found in lobsters caught off the Cumbrian coast.[6]. Technetium-99 concentrations in lobsters are now much reduced from the peak level of 418 $Bq.kg^{-1}$ found in February 1998.The presence of these low levels of Technetium-99 will result in only a very small radiation exposure to people who eat lobster on a regular basis.

TABLE 3: ARTIFICIAL BETA/GAMMA RADIOACTIVITY IN SEAFOOD LANDED ON THE ISLE OF MAN (2021 and 2022)

Sample	Sampling	Location	Total Beta *	Cs-137	Cs-134	Co-60
	Date		Concentration $Bq.kg^{-1}$(wet)			
Scallops	June 2022	A	-	< 0.6	< 0.6	< 0.6
	June 2022	A	-	< 0.4	< 0.5	< 0.6
	Sept. 2022	A	-	< 0.5	< 0.6	< 0.6
Lobster	June 2021	A	14	0.2	< 0.2	< 0.3
Location	A: IOM coastal waters					

* Total Beta values include naturally occurring radioactivity: $Bq.kg^{-1}$(wet) equiv. Potassium-40

3. ENVIRONMENTAL MONITORING: 2021-22

Under normal circumstances, natural background radiation is the major contributor to public radiation exposure. In comparison, any environmental contamination by artificial radioisotopes should be of little significance.

3.1 BACKGROUND RADIATION MEASUREMENTS

The Department of Environment, Food and Agriculture (DEFA) operates a three station Radioactivity Monitoring Network on the Isle of Man. The automatic radiation detectors continuously monitor background radioactivity levels on the Island.
The detectors are housed in remote monitoring cabinets located at Douglas, Ramsey and Snaefell Mountain. The background gamma dose rate is measured at each location and additionally, the Ramsey station contains detectors to monitor alpha and beta particulate in air, and radioiodine. Monitoring can also be extended by collection of rainwater using Deposit Gauges (BS 1747:1969). Background radiation levels were normal at all three locations throughout the years 2021 and 2022.

The purpose of the monitoring stations is to provide immediate information on radiation levels on the Island, in the event of an accident at Sellafield or any other nuclear site, which could result in widespread radioactive contamination, such as what occurred following the Chernobyl accident. All operational nuclear power stations are potential sources of accidental emissions. Heysham in Lancashire is the sole operational nuclear power generation site on the Irish Sea coastline.
Two separate projects for new nuclear power stations on the Irish Sea coastline have been terminated, due to insurmountable financial risks. Horizon Nuclear Power, a Hitachi-owned subsidiary, has halted construction at Wylfa (Anglesey) and likewise the NuGen project at Moorside (Cumbria) was cancelled in late 2018, by their parent company Toshiba.

Background monitoring Glen Wyllin Beach

3.2 SEAWEED AND HARBOUR SEDIMENTS

Seaweed was collected from the shore at Port Lewaigue. Analysis for artificial gamma emitting nuclides found very low concentrations of Caesium-137 (Table 5).
Certain species of seaweed are known to bioaccumulate Technetium-99 to a significant extent. The uptake of Tc-99 from seawater by the brown wracks, which are common to the Isle of Man coast and particularly the species known as **Fucus vesiculosus** has been widely reported [7]. Analysis of this species of seaweed, collected from Port Lewaigue in 2020, found 80 $Bq.kg^{-1}$ Tc-99 which is well below the peak concentration of 3769 $Bq.kg^{-1}$ Tc-99 found in June 1997. The current levels of Tc-99 in seaweed are similar to those found in the early 1980's [8] before increased inputs of Tc-99 due to commissioning of Sellafield's EARP waste cleanup facility. Present day concentrations of Tc-99 in seaweed do not present any radiological hazard to the general public, as the Tc-99 content of seaweed is far too low to give any measurable skin contact exposure, from handling seaweed.

Harbour sediment collected at low tide from one harbour area contained very low levels of radiocaesium (Table 6). The concentration detected is certainly too low to constitute any hazard to people using these areas for recreation.

TABLE 5 : RADIOACTIVITY IN SEAWEED (2021 and 2022)

Sample	Sampling		Total	Cs-137	Cs-134	Co-60
	Date	Location	Beta*	$Bq.kg^{-1}$ (wet weight)		
Fucus vesiculosus[1]	19 Feb. 2021	Port Lewaigue	389	0.3	< 0.2	<0.3
Fucus vesiculosus	22 April 2021	Port Lewaigue	177	0.4	< 0.2	<0.3
Fucus vesiculosus	1 March 2022	Port Lewaigue	-	0.3	< 0.2	<0.3

Note: (1) Bladder wrack (a brown seaweed)
* Total beta values include naturally occurring radioactivity.

TABLE 6: RADIOACTIVITY CONCENTRATIONS IN HARBOUR SEDIMENT (2021)

Sampling Location	Type	Date	Cs-137	Cs-134	Am-241	Eu-155
			$Bq.kg^{-1}$ (dry weight)			
Ramsey Harbour	muddy sand	22 April 2021	3.8	< 1	< 3	< 2
Douglas Harbour	not accessible #	----	n.a.	n.a.	n.a.	n.a.

Note: # sediments not exposed since construction of marina in 2001

4. ESTIMATES OF PUBLIC RADIATION EXPOSURE

The appropriate standard against which to judge the significance of inadvertent radiation exposure has been set by the International Commission on Radiological Protection (ICRP).
The I.C.R.P. recommends a principal dose limit for members of the public of one millisievert per year (1 mSv) from artificial sources, excluding medical procedures. The results of monitoring Manx foodstuffs during the years 2021 and 2022, are consistent with the recent years [1] [6] calculation of the annual dose received by adults from artificial radioactivity in local food estimated to total less than 0.005 mSv. The average dose to an adult from artificial radioactivity in food would therefore be less than 0.5% of the I.C.R.P. annual limit of 1 mSv.

Inside Ramsey Monitoring Station

5. CONCLUSIONS

1. Routine monitoring of Manx foodstuffs, including milk, lamb and vegetables found no significant level of radioactivity in any of the foods tested. Manx lamb sampled from local suppliers during 2021 and 2022 contained less than 1% of the legally permitted residual concentration of radiocaesium. No hazardous level of radioactivity was found in any of the foods.

2. Seafood landed on the Island during 2021 and 2022 contained low levels of radioactivity associated with discharges from Sellafield. Technetium-99 is detectable in lobsters caught off the Manx coast; however, the Tc-99 concentrations have declined from a peak of around 400 $Bq.kg^{-1}$ in February 1998 to average 13 $Bq.kg^{-1}$ during 2020. These Tc-99 concentrations are lower than the levels found in lobsters caught off the Cumbrian coast. People who eat lobster on a regular basis will receive only a trivial radiation exposure, which can have no measurable effect on health.

3. Background radiation levels on the Island were normal throughout the years 2021 and 2022. Radiation levels measured in harbour basins and on beaches were consistently low.

Appendix 1: References

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