EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY
DIRECTORATE D - Nuclear Safety and Fuel Cycle

Radiation protection

TECHNICAL REPORT

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

Environmental radioactivity monitoring in Ireland

23-26 September 2014

Reference: IE 14-02

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35

OF THE EURATOM TREATY

FACILITIES:	National monitoring network for environmental radioactivity
LOCATIONS:	Dublin (Clonskeagh, Belfield, Baldonnel), Mullingar, Drogheda, Dundalk, Clones, Knock
DATES:	23-26 September 2014
REFERENCE:	IE 14-02
TEAM MEMBERS:	Mr S. Mundigl (team leader) Mr A. Ryan Mrs M. Marin Ferrer
REPORT DATE:	31 March 2015

SIGNATURES:

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TABLE OF CONTENTS

1 INTRODUCTION

Article 35 of the Euratom Treaty requires that each Member State shall establish the facilities necessary to carry out continuous monitoring of the levels of radioactivity in air, water and soil and to ensure compliance with the Basic Safety Standards[1]. Article 35 also gives the European Commission (EC) the right of access to such facilities in order that it may verify their operation and efficiency. The Radiation Protection Unit (ENER D.3) of the EC's Directorate-General for Energy (DG ENER) is responsible for undertaking these verifications.

The main purpose of verifications performed under Article 35 of the Euratom Treaty is to provide an independent assessment of the adequacy of monitoring facilities for:

- Liquid and airborne discharges of radioactivity into the environment by a site (and control thereof).
- Levels of environmental radioactivity at the site perimeter and in the marine, terrestrial and aquatic environment around the site, for all relevant pathways.
- Levels of environmental radioactivity on the territory of the Member State.

Taking into account previous bilateral protocols, a Commission Communication[2] was published in the EU Official Journal on 4 July 2006 describing practical arrangements for the conduct of Article 35 verification visits in Member States.

[1] Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation (OJ L-159 of 29/06/1996) which will be superseded by Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom (OJ L 13 of 17.1.2014, p. 1)

[2] Commission Communication Verification of environmental radioactivity monitoring facilities under the terms of Article 35 of the Euratom Treaty. Practical arrangements for the conduct of verification visits in Member States. (OJ C 155, 4.7.2006, p. 2–5)

2 PREPARATION AND CONDUCT OF THE VERIFICATION

2.1 PREAMBLE

The EC's decision to conduct an Article 35 verification was notified to the Irish Government by a letter addressed to the Irish Permanent Representation to the European Union. The Irish Government subsequently designated the Environmental Protection Agency's (EPA) Office of Radiological Protection (ORP) to lead the preparations for this visit.

2.2 DOCUMENTS

In order to facilitate the work of the verification team, a package of information was supplied in advance by the national authorities. Additional documentation was provided during and after the visit. All documentation received is listed in Appendix 1 to this report. The information thus provided has been extensively used for drawing up the descriptive sections of the report.

2.3 PROGRAMME OF THE VISIT

The EC and the EPA-ORP discussed and agreed upon a programme of verification activities which is given in Appendix 2, with due respect to the Commission Communication of 4 July 2006 setting out practical arrangements for the conduct of Article 35 verification visits.

During the opening meeting two presentations were given by the EPA-ORP, firstly on the structure of the EPA and secondly on radiation monitoring in Ireland. The EC team also presented Article 35 in general and particularly the proposed programme for Ireland.

The verification team notes the quality and comprehensiveness of all presentations made and documentation provided.

The following representatives of the national authorities and other parties involved were met:

Environmental Protection Agency (EPA)

Ann McGarry	Director, Office of Radiological Protection
Ciara McMahon	Programme Manager, Radiation Monitoring and Emergency Preparedness
Micheal Lehane	Programme Manager, Office of Environmental Assessment
Lorraine Currivan	Laboratory Manager, Radiation Monitoring
Kevin Kelleher	Scientific Officer, Radiation Monitoring
Stephen Somerville	Scientific Officer, Radiation Monitoring
Olwyn Hanley	Technician, Radiation Monitoring
Jennie Wong	Technician, Radiation Monitoring
Paul McGinnity	Scientific Officer, Radiation Monitoring
Ciara Maguire	Administration, Measurement Services
Vicki McGowan	Administration, Radiation Monitoring

Food Safety Authority of Ireland (FSAI)

Anna Picazo	Service Contracts Executive

Defence Forces Ireland

Comdt. George O'Connell	Defence Forces Radiological Protection Officer
Lt. Patrick Ryan	EPA-ORP Liaison Officer for Dundalk Visit

3 MONITORING PROGRAMMES AND RESPONSIBLE ORGANISATIONS

The Environmental Protection Agency (EPA), is the national organisation with regulatory, monitoring and advisory responsibilities in matters pertaining to ionising radiation. This is managed through the EPA's Office of Radiological Protection (EPA-ORP) that was established on the 1st August 2014 following the merger of the EPA and the Radiological Protection Institute of Ireland (RPII). The Radiological Protection (Miscellaneous Provisions) Act 2014 dissolved the RPII, the body previously responsible for these matters and transferred all of RPII's functions, assets, liabilities and staff to the EPA. The EPA is an independent public body established in July 1993 under the Environmental Protection Agency Act, 1992, its sponsor in Government is the Department of Environment, Community and Local Government (DECLG).

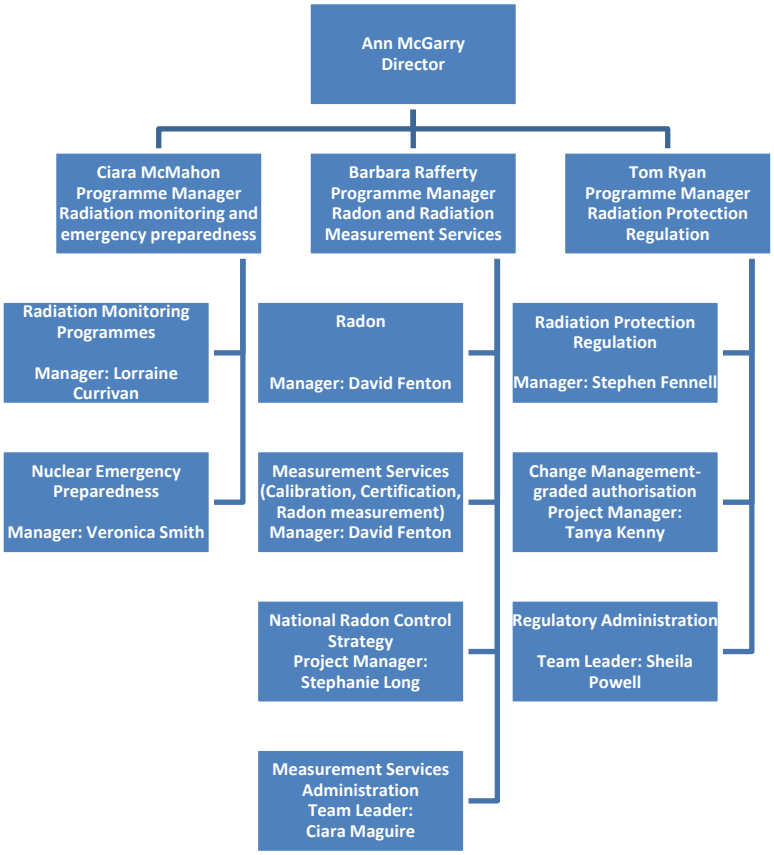
The EPA is managed by a full-time Executive Board consisting of a Director General and five Directors:

- Laura Burke - Director General
- Dara Lynott - Deputy Director General & Director, Office of Climate, Licensing, Resources and Research (OCLRR)
- Ann McGarry – Director, Office of Radiological Protection (ORP)
- Micheál Ó Cinnéide - Director, Office of Communications and Corporate Services (OCCS)
- Gerard O'Leary - Director, Office of Environmental Enforcement (OEE)
- Matthew Crowe - Director, Office of Environmental Assessment (OEA)

The key functions of the EPA relevant to Article 35 Euratom are:

- To maintain and develop a national laboratory for the measurement of levels of radioactivity in the environment, and to assess the significance of these levels for the Irish population.
- To regulate by licence the custody, use, manufacture, importation, transportation, distribution, exportation and disposal of radioactive substances, irradiating apparatus and other sources of ionising radiation.
- To assist in the development of national plans for emergencies arising from nuclear accidents and to act in support of such plans.

The EPA-ORP structure is summarised in the diagram below:



Other organisations involved in the environmental radioactivity monitoring programme are the Food Safety Authority of Ireland (FSAI), which operates under the aegis of the Department of Health, Met Éireann (Irish meteorological service), local authorities, the Department of Agriculture, Food and the Marine and the Defence Forces under the aegis of the Department of Defence.

All analytical measurements relevant for radioactivity monitoring are performed at the EPA-ORP's radiation monitoring laboratory in Clonskeagh, Dublin.

4 LEGAL FRAMEWORK FOR RADIOACTIVITY MONITORING

4.1 ENVIRONMENTAL RADIOACTIVITY MONITORING

The legislative acts regulating environmental radioactivity monitoring and establishing responsibilities are:

- The Radiological Protection Act 1991, http://www.irishstatutebook.ie/1991/en/act/pub/0009/print.html
- Environmental Protection Agency Act, 1992 http://www.irishstatutebook.ie/1992/en/act/pub/0007/print.html
- The Radiological Protection Act, 1991 (Ionising Radiation) Order, S.I. No. 125 of 2000 http://www.irishstatutebook.ie/2000/en/si/0125.html
- European Communities (Marine Strategy Framework) Regulations 2011, S.I. No. 249/2011 http://www.irishstatutebook.ie/pdf/2011/en.si.2011.0249.pdf
- Radiological Protection (Miscellaneous Provisions) Act 2014 http://www.irishstatutebook.ie/pdf/2014/en.act.2014.0020.pdf

4.2 RADIOLOGICAL SURVEILLANCE OF FOODSTUFFS

The following legislative acts cover the radiological surveillance of foodstuffs and drinking water:

- The Radiological Protection Act, 1991 http://www.irishstatutebook.ie/1991/en/act/pub/0009/print.html
- The Radiological Protection Act, 1991 (Ionising Radiation) Order, S.I. No. 125 of 2000 http://www.irishstatutebook.ie/2000/en/si/0125.html
- European Communities (Natural Mineral Waters, Spring Waters and other water in bottles or containers) Regulations 2007, S.I. No. 225 of 2007 http://www.irishstatutebook.ie/pdf/2007/en.si.2007.0225.pdf
- European Union (Drinking Water) Regulations 2014, S.I. No. 122 of 2014 http://www.irishstatutebook.ie/pdf/2014/en.si.2014.0122.pdf
- European Communities (General Food Law) Regulations 2007, S.I. No. 747 of 2007. http://www.irishstatutebook.ie/2007/en/si/0747.html

4.3 INTERNATIONAL LEGISLATION AND GUIDANCE DOCUMENTS

The following Acts and guidance documents are followed:

General

- 87/600/Euratom: Council Decision of 14 December 1987 on Community arrangements for the early exchange of information in the event of a radiological emergency
- Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation
- Commission Recommendation 2000/473/Euratom of 8 June 2000 on the application of Article 36 of the Euratom Treaty concerning the monitoring of the levels of radioactivity in the environment for the purpose of assessing the exposure of the population as a whole
- Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation

Drinking Water

- Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption
- Commission Recommendation of 20 December 2001 on the protection of the public against exposure to radon in drinking water supplies
- Council Directive 2013/51/Euratom of 22 October 2013 laying down requirements for the protection of human health of the general public with regards to radioactive substances in water intended for human consumption

Marine Environment

- 1998 Convention for the Protection of the Marine Environment of the North-East Atlantic (The OSPAR Convention)
- Directive 2008/56/EC of 17 June 2008 establishing a framework for community action in the field of marine policy (Marine Strategy Framework Directive)

5 NATIONAL ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMME

5.1 INTRODUCTION

The key elements of the monitoring programme implemented by the EPA-ORP include the assessment of:

- Levels of ambient radioactivity based on measurements of radioactivity in air, rainwater and external gamma dose rate at permanent monitoring stations located throughout the country;
- Levels of radioactivity in drinking water;
- Levels of radioactivity in foodstuffs based on measurements of total diet, milk and miscellaneous ingredients;
- Levels of radioactivity in the marine environment based on sampling and measurements of seawater, sediment, seaweed, fish and shellfish.

There are currently no plans to further develop the EPA-ORP's monitoring network. However, the EPA-ORP is currently developing a data warehouse with a geodatabase and simple Web GIS that will handle all of EPA-ORP's archiving and reporting of environmental monitoring data. This database has been configured taking into consideration the JRC's REM database structure.

In 2009 there was an extensive peer review of the environmental monitoring programme carried out by an international peer group to investigate the scope and effectiveness of the programme. The outcome of the review was a set of recommendations that were implemented to ensure EPA-ORP's monitoring programme continues to meet Irish and EU requirements. Further information on this can be found at **http://www.epa.ie/pubs/reports/radiation/peerreview/**

5.2 EXTERNAL GAMMA DOSE RATE MONITORING

The network operated by the EPA-ORP includes two models of sensor:

- Technidata (Envinet) AGS-421S – solar powered with 48-hour minimum battery backup. Transmits data using the GSM network. Built in Y/N rain sensor.

- Technidata (Envinet) DLM-1450 with IGS421-H probe – mains powered with 48-hour minimum battery backup. Transmits data using the analog landline network. External Y/N rain sensor.

Ambient gamma dose rate is automatically monitored within the range 10 nSv/h - 10 Sv/h. Each monitoring station consists of three GM detectors mounted in a single housing. Two duplicated detectors cover the low dose range and one is used for the high dose range. The energy range is 38 keV- 1.3 MeV and 70 keV – 1.3 MeV respectively for the low and high dose rate detectors. Sampling is continuous with a base interval of 1 minute; 10 minutes and two hour averages are calculated. Values are polled by the EPA server every hour. Each station location has an associated long-term background value. Email/SMS alarms can be programmed into the software that triggers on defined elevated gamma dose rates or equipment malfunction. The Duty Officer alarm is set at 1.8 times the mean station background (The EPA-ORP operates an on-call Duty Officer system whereby a senior staff member is contactable 24 hours a day, 7 days a week). Station gamma dose rate data is published to the EPA web site hourly. It can be viewed graphically at http://www.epa.ie/radiation/monassess/mapmon/.

The 15 stations comprising the network are shown on the map below:

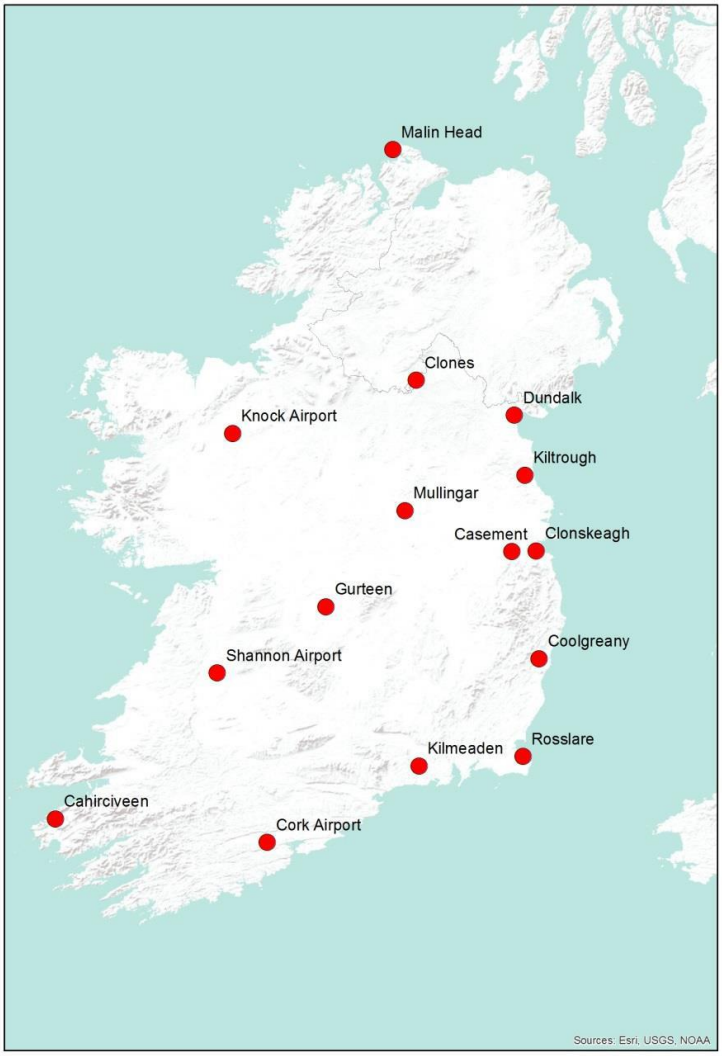


Figure 1 On-line radiation dose rate monitoring network

The control centre uses proprietary software (NMC-RAD version 2.5.0) supplied by the manufacturer Envinet. NMC-RAD (Network Monitoring Centre – Radioactivity) is a specialised software product developed for data acquisition, processing, evaluation and presentation purposes. The product itself consists of three major components: Client, Server and Database.

The Client presents a user interface for configuring, data evaluation and presentation of data. Server components function in the system background and perform hidden tasks like data communication to stations, cyclic job execution, etc. The database is responsible for long-term measurement and configuration of data storage.

NMC includes the following set of basic functions:

- Management of users and user rights;
- Management of measuring stations and measuring networks;
- Automatic and manual data calls;
- Data presentation in graphic and table based forms with data export possibilities;
- Manual data correction for available measurement results;
- Monitoring and protocolling of the system operational processes.

5.3 AIR MONITORING

There are three components to the air sampling programme: high volume sampling, off-line and on-line sampling at a total of 10 locations nationwide, shown on the map below:

Figure 2 Air monitoring stations

5.3.1 Off-line high volume air sampling

One high volume sampler (900 m^3/h) operates continuously at University College Dublin (UCD), Belfield. The equipment is manufactured by Senya, Finland and is the JL-900 model (Snow White). Filter changes are usually performed weekly and the weekly filters composited into a monthly sample for analysis by high resolution gamma spectrometry in a 1000 ml Marinelli with a counting time of seven days.

5.3.2 Off-line air sampling

Six low volume (approx. 6 m^3/h) air sampling stations are operated continuously. Five of these stations are operated by the Irish Meteorological Service and one by the EPA-ORP in Clonskeagh. Routine operation involves particulate sampling using glass fibre filter paper. A supply of charcoal

filters is available at each monitoring site for sampling gaseous iodine, in the event of a nuclear emergency.

The complete off-line system is a bespoke unit designed by Berthold Technologies. The pump with electronics is mounted inside a standard aluminium meteorological Stephenson housing from Hi-Q products (USA). The sampling head consists of a metal holder with a 47mm circular diameter GFA filter paper and TEDA impregnated charcoal cartridge (only fitted during emergencies or tests). A carbon vane pump pulls air through the system at a variable flow rate of approx. 5 - 6 m^3/h, depending on filter loading. No radioactivity detectors are fitted to the low volume off-line air samplers. The airflow through the filter is measured using an ultrasonic (Vortex) airflow meter, calibrated by the manufacturer. The sampling interval is usually seven days and approximately 900 m^3 of air is sampled in that period. Filters are collected by hand and posted to the EPA-ORP for gamma spectroscopy using a high purity germanium detector and total beta analysis using a gas flow proportional counter. The minimum detectable activity for this method is typically 15 mBq gross Beta (based on a 2-hour count after a minimum of five days' delay to allow radioactive decay of short-lived natural radionuclides). Typical service interval of the system is every 18 months with flow meter cleaning part of service.

5.3.3 On-line air sampling

The on-line air sampling units are based on a Berthold Technologies BAI 9128-ENV Moving Filter instrument. A 600mm^2 PIPS Silicon semiconductor detector is used for the detection of artificial alpha and beta particulates. The monitor reports radioactivity in Bq/m^3 to the EPA using a landline telephone. A single 35 m filter belt will last typically 18 months of continuous operation. The base measurement interval is 10 minutes and a typical MDA 0.2 – 0.3 Bq/m^3.

All on-line air samplers are fitted with TEDA Carbon Cartridges. An electromechanical air flow valve can be activated by the central server to allow a sub-stream air flow to pass through the carbon cartridge. The cartridges are replaced at each filter belt replacement interval, typically every 18 months.

5.3.4 Precipitation sampling

Total fallout sampling is not routinely undertaken. Rainwater is collected continuously at six stations shown on the map below so that in the event of an accidental release of radioactivity into the atmosphere, concentrations in rainwater could quickly be assessed. It is not considered necessary to analyse these samples routinely.

There is monthly sampling of rainwater at Clonskeagh for gamma emitters. Each station consists of a NILU Products AS, high density polyethylene precipitation collector with 2.5 litre collection bottle. The funnel is mounted approx. 1.75m off the ground. The sample is collected for two weeks at all stations (except Clonskeagh, where monthly) and kept for two weeks, then disposed of unless requested by EPA-ORP. Rainwater samples, if measured, are assessed for ^{137}Cs and, in the event of an emergency, other gamma emitting radionuclides.

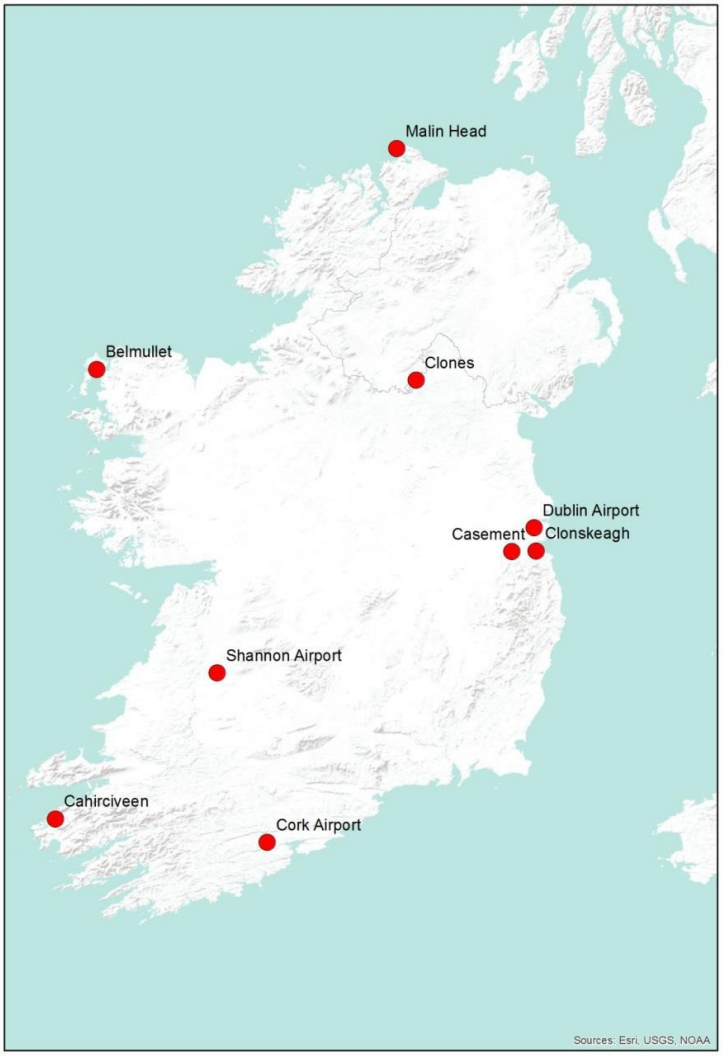


Figure 3 Precipitation sampling locations

5.4 WATER MONITORING

5.4.1 Surface waters

Surface water is monitored only at a single location, the Leixlip reservoir in Co. Kildare that supplies drinking water to the Dublin region. A 5 litre water sample is collected on an annual basis. Up until 2013, Dublin City council collected the samples. Since 2013, Irish Water is responsible for the collection of these samples. Irish Water is Ireland's national water utility that is responsible for providing water services throughout Ireland (www.water.ie).

The sample is analysed for ^{137}Cs and screened for gross alpha and gross beta activity. If the levels of gross alpha activity are below 100 mBq/l and the levels of gross beta activity are below 1000 mBq/l then the water sample is deemed to be in compliance with the Euratom Drinking Water Directive 2013/91/Euratom (transposed into Irish Law under S.I. 278 of 2007) and no further analyses are carried out. This has always been the case for this monitoring location. However, if the screening limits were exceeded, then subsequent analyses would be carried out to determine the activity concentrations of the individual radionuclides ^{40}K, uranium, ^{226}Ra, ^{222}Rn, ^{210}Po and ^{210}Pb.

5.4.2 Ground water and drinking water

The EPA-ORP monitors all drinking water supplies serving populations in excess of 10000 in rotation for radioactivity, so that supplies from every county in Ireland are measured approximately every four years. A list of the water supplies sampled, along with its county in Ireland is given below:

County	Scheme Name	Population Served	Volume Supplied m^3/day
Dublin	F_ZONE1	245372	81000
Dublin	SD_ZONE2	227000	61309
Dublin	DCC_ZONE1	170000	72899
Dublin	DCC_ZONE6	130000	71606
Cork	Cork City Water Supply	125230	62700
Dublin	DCC_ZONE3	106000	42853
Cork	Cork Harbour & City	88020	66000
Dublin	DCC_ZONE2	85000	13192
Galway	Galway City Council Public Water S.S.	75415	42525
Kildare	Poulaphouca Regional	59000	31000
Kildare	Barrow/Poulaphouca Blend	55000	20000
Limerick	Limerick City Water Supply	55000	60000
Dublin	DLR_ZONE8	54745	17200
Meath	East Meath	53282	13604
Dublin	DLR_ZONE1	48996	14750
Waterford	Waterford City Water Supply	46747	21000
Kildare	Leixlip Regional	45000	26000
Dublin	DLR_ZONE7	40908	11700
Dublin	DLR_ZONE2	38020	9500
Louth	Cavanhill	35000	17366
Meath	Staleen	35000	24000
Meath	Navan-Mid Meath	34933	11694
Galway	Tuam RWSS	32763	13374
Mayo	Lough Mask RWSS	30698	34000
Clare	Ennis PWS	30000	15880
Dublin	F_ZONE3	26627	8800
Wicklow	Bray Reservoir Public Supply	26500	6250
Carlow	Carlow Town	24702	8262
Cork	Glashaboy	23663	16500
Laois	Portlaoise PWS	22544	8100
Dublin	DLR_ZONE6	21626	6150
Cork	Innishannon	21522	7250
Wexford	Wexford Town	21000	7200
Limerick	Limerick City Environs Public DWS	20573	10000
Westmeath	Athlone WSS	19900	3998
Kerry	Central Regional : Sheheree 408F*	19640	9728
Dublin	SD_ZONE4	18000	4605

County	Scheme Name	Population Served	Volume Supplied m^3/day
Donegal	Lough Mourne	17000	7973
Dublin	DCC_ZONE4	17000	3744
Cork	Clonakility	16708	7364
Clare	Shannon/ Sixmilebridge RWSS	16000	13500
Dublin	DCC_ZONE5	16000	6580
Wexford	Gorey Region	16000	9500
Wicklow	GREYSTONES PUBLIC SUPPLY	16000	4200
Mayo	Ballina RWSS	15000	9000
Wicklow	Arklow Public Supply	15000	3000
Kerry	Central Regional : Lissardboola 404F*	14920	12731
Wexford	Fardystown	14100	8670
Donegal	Letterkenny	14075	6826
Kilkenny	Kilkenny City (Radestown) WS 1010	13298	8000
Kilkenny	Kilkenny City (Troyswood) WS 1011	13298	7200
Sligo	Lough Talt Regional Water Supply	13198	8039
Offaly	Tullamore P.W.S.	13080	7156
Westmeath	Ardonagh Reservoir	12940	2588
Dublin	SD_ZONE1	12400	3208
Cork	Mallow	12020	5288
Tipperary	Glenary	12000	10000
Wicklow	Wicklow Regional Supply	11988	2397
Leitrim	South Leitrim Regional	11870	6850
Wexford	Sow Regional	11800	3030
Tipperary	Galtee Regional	11600	8574
Donegal	Pollan Dam Public	11450	8076
Cork	Youghal Regional	11286	2000
Cork	Skibbereen Ballyhilty	11197	3308
Monaghan	LERWSS	11150	2230
Meath	Kells-Oldcastle	11133	4006
Sligo	Foxes Den Public Water Supply	10830	4640
Tipperary	Nenagh RWSS	10824	4300
Roscommon	SRRWSS - Killeglan	10500	5138
Meath	Trim	10467	2944
Cork	Whitegate Regional	10392	4000
Cork	Newmarket	10338	3900
Donegal	Rosses Regional Public	10000	4180
Cork	Charleville	9979	7180

A 5 litre water sample is collected from each supply on a 4 yearly rotation. Up until 2013, local authorities collected the samples. Since 2013, Irish Water is responsible for the collection of these samples.

Each sample is analysed for gross alpha and gross beta activity. If the levels of gross alpha activity are below 100 mBq/l and the levels of gross beta activity are below 1000 mBq/l then the water sample is deemed to be in compliance with the Euratom Drinking Water Directive and no further analyses are carried out. This has always been the case for these monitoring locations. However, if the screening limits were exceeded then subsequent analyses would be carried out to determine the activity concentrations of the individual radionuclides ^{40}K, uranium, ^{226}Ra, ^{222}Rn, ^{210}Po and ^{210}Pb.

Ground water sources supplying populations of less than 10000 are not routinely measured. However, between 2007 and 2011 the RPII in conjunction with the EPA undertook a comprehensive national survey of radioactivity in groundwater sources in Ireland. Gross alpha and beta screening was carried out for 203 sources from the EPA's groundwater monitoring network. For 175 of the 203 sources the screening levels for gross alpha activity and gross beta activity were below 100 mBq/l and 1000 mBq/l respectively. The remaining 28 sources have gross alpha activity concentrations in excess of 100 mBq/l and these sources were further analysed for the naturally occurring radionuclides uranium, ^{226}Ra and ^{210}Po. No source was found to have activity concentrations of naturally occurring radionuclides that would lead to radiation doses in excess of 0.1 mSv/y as specified in S.I. 278 of 2007. Therefore all sources analysed were deemed fit for human consumption. Further information on this can be found at
http://www.epa.ie/pubs/reports/radiation/groundwaterreport2013.html.

Concerning bottled drinking water the EPA-ORP completed a survey in 2013 of the levels of natural radioactivity in 21 samples of bottled water produced in Ireland. All of the 21 bottled water samples complied with the radiological quality requirements of Statutory Instrument (S.I) 225 of 2007, the World Health Organisation (WHO) recommendations and the Euratom Drinking Water Directive. The samples which give rise to the highest doses of radioactivity would not add significantly to the average annual dose received by people living in Ireland. The full report can be found at
http://www.epa.ie/pubs/reports/radiation/RPII_Rad_Bottled_Water_13.pdf.

5.4.3 Sea water

Seawater samples are taken at the following locations:

Sampling Location	Sampling Frequency
Ballagan	Quarterly
N1 – N6	Annually
Salthill (Galway)	Biennially
Woodstown	Biennially

The concentration of monitoring points along the northeast coast is related to the proximity of the Sellafield nuclear reprocessing facility, situated approximately 180km to the east.

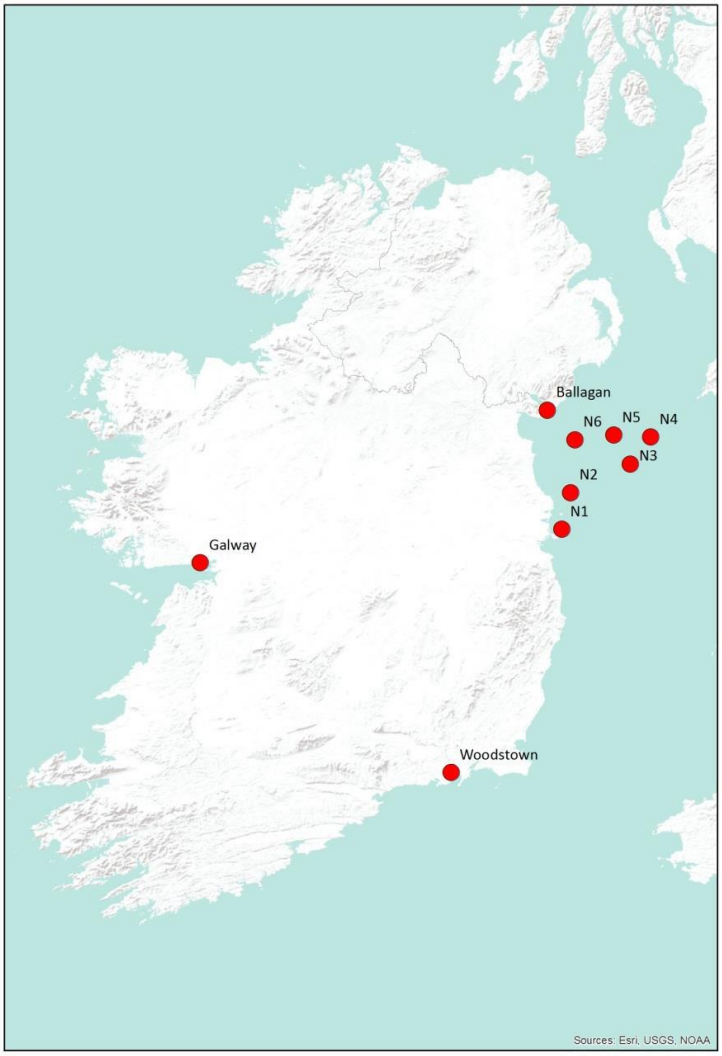


Figure 4 Sea water sampling locations

For samples collected on the east and south coasts of Ireland approximately 50 litres are taken for analysis. For samples on the west coast, approximately 100 litres are taken. Seawater sampling is organised by EPA-ORP staff and the subsequent analysis is carried out in their laboratory. The radionuclides measured in seawater are ^{137}Cs and ^{3}H.

5.5 OTHER ELEMENTS OF THE PROGRAMME

5.5.1 Soil and sediments

The EPA-ORP does not routinely measure terrestrial soil samples. Marine sediment samples are taken on a bimonthly basis from Ballagan and on an annual basis from the Irish Sea at locations N4, N5 and N6 (Fig. 4 above).

Marine sediment samples are taken using a grab sampler, the minimum sample size is approximately 1 kg (wet). Approximately 250 g of each sample is analysed via gamma spectrometry for ^{137}Cs and other gamma emitting radionuclides.

5.5.2 Terrestrial and aquatic biota and flora

The EPA-ORP does not routinely measure terrestrial biota and flora, with the exception of cereals included in the food monitoring programme.

The EPA-ORP has a comprehensive marine monitoring programme that routinely measures radioactivity in aquatic biota and flora at the sampling locations below:

Figure 5 Terrestrial and aquatic biota and flora sampling locations

The sampling locations, type of flora and biota and radionuclides measured are summarised in the table below.

Sampling Location	Sampling Frequency	Sample Type	Radionuclides
Carlingford	Quarterly Annually	Mussels Oysters Winkles	^{137}Cs, other gamma emitters. $^{238/239}$Pu, ^{240}Pu, ^{241}Am and ^{99}Tc (as annual composite)
Ballagan	Bimonthly	Fucus Vesiculosis	^{137}Cs, other gamma emitters, ^{99}Tc
Clogherhead	Quarterly Annually	Fish Prawns	^{137}Cs, other gamma emitters $^{238/239}$Pu, ^{240}Pu, ^{241}Am and ^{99}Tc (as annual composite)
Kilmore Quay	Annually	Fish	^{137}Cs, other gamma emitters
Galway	Annually Biennially	Fish Fucus Vesiculosis	^{137}Cs, other gamma emitters ^{137}Cs, other gamma emitters
Killybegs	Annually	Fish	^{137}Cs, other gamma emitters
Woodstown	Biennially	Fucus Vesiculosis	^{137}Cs, other gamma emitters

Approximate sample sizes for seafood are as follows:

- Cod (Flesh) 3 kg
- Plaice (Flesh) 3 kg
- Whiting (Flesh) 3 kg
- Herring (Flesh) 2.5 kg
- Mackerel (Flesh) 2.5 kg
- Ray (Flesh) 3 kg
- Prawn tails (Flesh) 4 kg
- Mussels 12 kg
- Oysters 120 shells minimum

Fish may include cod, plaice, haddock, mackerel and ray. Plant material is taken from a single plant at a time by tracing back to the root of the plant before removing grab - each grab should contain material from a single plant so as to avoid mixing in different plant species in a sample. All of the above samples are dried and homogenised before subsequent analyses.

5.6 FOODSTUFFS AND FEEDING STUFFS MONITORING

5.6.1 Milk

The milk samples analysed by the EPA-ORP are taken from four of the largest dairy processing facilities in Ireland, taking into consideration geographical location (Fig. 6). These facilities were chosen in consultation with the Irish Department of Agriculture, Food and the Marine (DAFM).

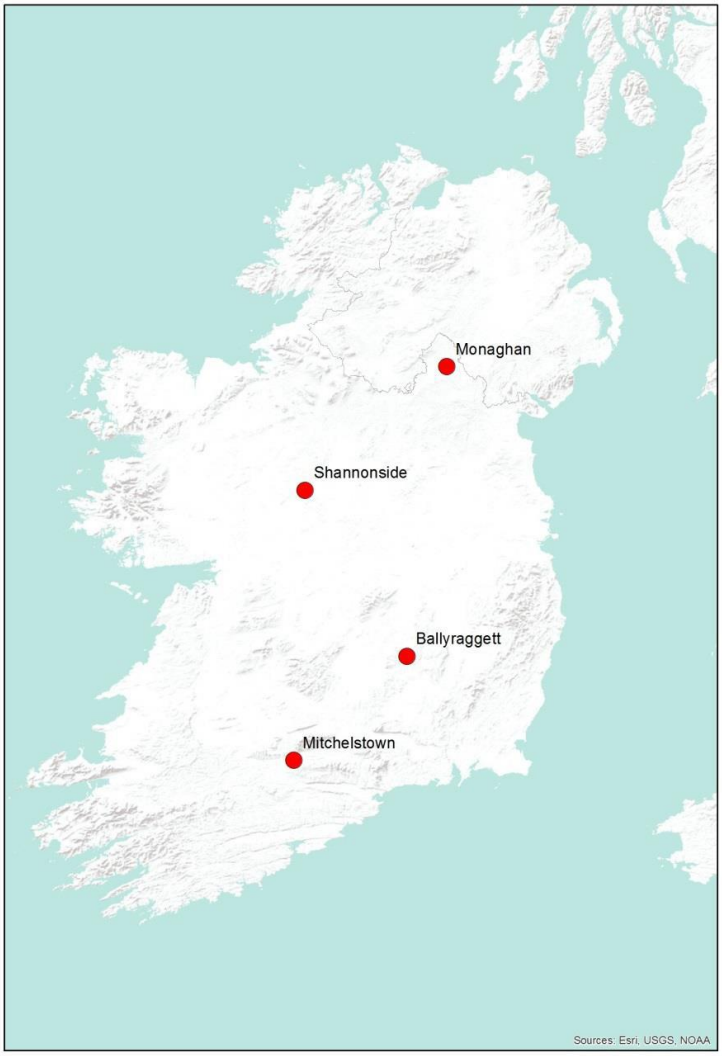


Figure 6 Milk sampling locations

Raw milk samples (untreated and unpasteurised) are collected on a monthly basis by dairy inspectors from the DAFM and delivered to the EPA-ORP for analysis. Milk samples from Ballyragget are analysed on a monthly basis for ^{137}Cs, ^{131}I and other gamma emitters. Milk samples from all locations are bulked and homogenised on a quarterly basis and analysed for ^{137}Cs, other gamma emitters and ^{90}Sr.

5.6.2 Mixed diet

Mixed diet samples are collected as per Commission Recommendation 2000/473/Euratom, i.e. sampling complete meals from large consumption centres such as canteens or restaurants to give a representative figure for the average level of radioactivity in mixed diet. Sampling is carried out by EPA-ORP staff on a monthly basis from the main restaurant in University College Dublin, Belfield.

After drying and homogenisation the samples are analysed for ^{137}Cs and other gamma emitters. Samples are bulked and homogenised on a quarterly basis and analysed for ^{90}Sr, ^{14}C and ^{3}H.

5.6.3 Foodstuffs

The foodstuffs collected on an annual basis and analysed for ^{137}Cs and other gamma emitting radionuclides are malting barley, milling oats and milling wheat.

From 2014 onwards EPA-ORP analyses 10 meat samples on an annual basis from meat processing facilities throughout Ireland. These include beef, pork, lamb, and poultry (chicken) flesh. Samples are taken by officials from the DAFM and analysed for ^{137}Cs and other gamma emitting radionuclides.

It is also worth noting that on request, the EPA-ORP provides a service to test and certify the radioactivity of Irish produce which may be required by producers exporting to certain markets outside of the EU. Certificates of Radioactivity Measurement are issued on the basis of both individual sample results for the product concerned and the national monitoring programme. So a range of meat, dairy and processed food products are routinely screened for gamma-emitting radionuclides as part of the product certification programme**.**

5.6.4 Feeding stuffs

The EPA-ORP does not routinely measure feeding stuffs produced in Ireland for radioactivity. However, feeding stuffs imported from third countries are sampled by DAFM staff and sent to the EPA-ORP's radiation monitoring laboratory for analysis for ^{137}Cs and other gamma emitting radionuclides. Animal feedstuffs and supplements analysed for ^{137}Cs between 2012 and 2014 are outlined in the table below:

Country	Sample Type	Country	Sample Type
Belarus	Sugar beet	Russia	Copper Sulphate
Egypt	Soya Fat	Russia	Maize
Iceland	Maerl	Russia	Rapeseed
Iceland	Seaweed	Russia	Soya Hulls
India	Molasses	Russia	Sugar beet
India	Niger Seed	Russia	Sunflower Seed
India	Sunflower Seed	Switzerland	Horse Feed
Indonesia	Palm Kernels	Taiwan	Molasses
Malaysia	Palm Kernels	Taiwan	Vinasses
Mauritius	Molasses	Turkey	Magnesium Oxide
Morocco	Palm Fatty Acid	Turkey	Zinc Oxide
Morocco	Soya Fat	Ukraine	Maize
Pakistan	Molasses	Vietnam	Vinasses

5.7 NATURALLY OCCURRING RADIOACTIVE MATERIALS

The EPA-ORP has assessed exposure to the population due to natural sources through a number of discrete projects addressing specific sources or pathways rather than through its continuous monitoring programme.

A review was completed in 2008 of four large industries operating in Ireland dealing with naturally occurring radioactive materials (NORM) (natural gas extraction, coal-fired power generation, peat-fired power generation and bauxite processing) to determine the level of radiation to which workers and members of the public are potentially exposed as a result of their work activities (Organo and Fenton, 2008). Of these industries none was found liable to give rise to a total effective dose (excluding radon) in excess of 1 mSv above background in any 12-month period. In accordance with S.I. 125 of 2000, only NORM industries which give rise to effectives doses to workers or the public in excess of 1 mSv/year (from natural radiation sources other than radon) fall within regulatory control. Full details can be found at https://www.epa.ie/pubs/reports/radiation/RPII_NORM_Report_08.pdf.

5.8 LABORATORIES PARTICIPATING IN THE NATIONAL ENVIRONMENTAL RADIOACTIVITY MONITORING PROGRAMME

5.8.1 Introduction

The only laboratory participating in the national environmental radioactivity monitoring programme is the EPA-ORP's radiation monitoring laboratory, and the descriptions contained in sections 5.8.2 to 5.8.10 refer exclusively to that laboratory.

Tc-99 measurements in seaweed and biota are outsourced to a third party. The contract for analysis and QA of the samples is awarded on an annual basis through the issuing of an invitation to tender to interested laboratories. The contract is awarded to the most economically advantageous response.

In addition, the EPA-ORP has an informal arrangement with the Radiation Physics Laboratory, School of Physics, University College Dublin to ensure their analytical equipment remains available for use by the EPA-ORP in the event of failure of EPA-ORP's analytical equipment, power failure in Clonskeagh or for additional analysis capacity (e.g. in the event of a nuclear emergency). The EPA-ORP intends to formalise this arrangement in the near future.

5.8.2 Sample registration and preparation

Sample registration and identification is handled by the EPA-ORP's Laboratory Information Management System (LIMS). This is a commercially available LIMS, (Labware LIMS), configured for use in the EPA-ORP. Each sample is logged in the laboratory's sample preparation area with a unique identifier for tracking in the laboratory and for reporting purposes.

The table below summarises the matrices analysed, the nuclides measured, together with the analytical methods and equipment used.

Sample Type	Measurement	Sample Preparation	Counting Technique
High volume air filter	Gamma emitters	None	HPGe
Low volume air filter	Gross beta	Wait 5 days for decay of short-lived radon decay products	Gas flow proportional counter
	Gamma emitters	None	HPGe
Drinking water	Gross alpha and beta	Evaporation onto planchette	Gas flow proportional counting
	Gamma emitters	None	HPGe
Mixed diet	Gamma emitters	Drying and homogenisation	HPGe
	^{90}Sr	Ashing and liquid-liquid extraction	LSC Cerenkov counting
	$^{14}C/^{3}H$	Combustion furnace	LSC Counting
Milk	Gamma emitters	None	HPGe
	^{90}Sr	Ashing and liquid-liquid extraction	LSC Cerenkov counting
Fish, shellfish and seaweed	Gamma emitters	Drying and homogenisation	HPGe
	$^{238/239}Pu$, ^{240}Pu, and ^{241}Am	Acid digestion and radiochemical separation using extraction chromatography	Alpha spectrometry
	^{99}Tc	Radiochemical separation (carried out by third party)	Gas flow proportional counting
Seawater	^{137}Cs	Radiochemical separation using ASG resin	HPGe
	^{3}H	Distillation	LSC

5.8.3 Measurement methods

The table below summarises the sample types, radionuclides assessed, measurement device used and the counting times.

Sample Type	Sample Measurement	Radionuclides Assessed	Measurement Device Used	Counting Time
High volume air filter	Bulked sample (4 filters per month)	^{137}Cs, ^{7}Be	HPGe	7 days
Low volume air filter	Individual filter (1 filter per month for each location) Individual filter (1 filter per month for each location)	Gross beta ^{137}Cs	Gas flow proportional counter HPGe	2 hours 24 hours
Drinking water	Individual sample Individual sample	Gross alpha and beta ^{137}Cs	Gas flow proportional counting HPGe	24 hours 24 hours
Mixed diet	Individual sample Bulked sample (quarterly for each location) Bulked sample (quarterly for each location)	^{137}Cs ^{90}Sr ^{14}C/^{3}H	HPGe LSC Cerenkov counting LSC Counting	24 hours 100 minutes 24 hours
Milk	Bulked sample (quarterly for each location). Individual sample for Ballyraggett Bulked sample (quarterly for each location)	^{137}Cs ^{131}I ^{90}Sr	HPGe LSC Cerenkov counting	24 hours 100 minutes
Fish, shellfish and seaweed	Individual sample Annual composite for each location Annual composite for each location	^{137}Cs, ^{40}K $^{238/239}$Pu, ^{240}Pu, and ^{241}Am ^{99}Tc	HPGe Alpha spectrometry Gas flow proportional counting	3.5 days 6 days Unknown
Seawater	Individual sample Individual sample	^{137}Cs ^{3}H	HPGe LSC	3.5 days 24 hours

5.8.4 Measurement devices

The laboratory is equipped with the following devices:

Measurement Device	Detector #	Technical Details	Status
HPGe [3]	1	Ortec GMX/Fixed	In use
	3	Ortec GEM/PopTop	In use
	4	Ortec GMX/Fixed	In use
	6	Canberra GCW2023 (well detector)	In use
	7	Ortec GMX/Fixed	In use
	9	Ortec GMX/PopTop	In use
	10	Canberra GC7520/S	In use
	13	Canberra Broad Energy	In use
LSC		Perkin Elmer Tri-Carb 3170 TR/SL	In use
		Hidex 300 SL	Under commissioning
Alpha spectrometry	1-16	4 x Canberra 7404 alpha spectrometers with 16 PIPS detectors	In use
Gas flow proportional counting		Berthold LB 770 10 channel low level counter	In use
		Protean MPC 9604	In use

5.8.5 Gamma spectrometry

The gamma spectrometry system in the EPA-ORP comprises 8 HPGe detectors and 3 sample changers controlled by the Canberra Apex Gamma spectrometry software. Detectors are calibrated at least once every 3 years or when necessary, using certified multigamma standard solutions. Calibration is carried out using the ApexGamma software in conjunction with GESPECOR software in order to take into consideration coincidence summing corrections. Annual background counts are carried out by EPA-ORP staff using the ApexGamma software.

The gamma spectrometry system is maintained in-house using weekly QA checks with control charts investigating background, channel energy and Full Width Half Maximum (FWHM) criteria for specific gamma energies, namely, ^{241}Am (59 keV), ^{137}Cs (661 keV) and ^{60}Co (1332 keV). Maintenance is carried out on the gamma spectrometry system every six months by EPA-ORP staff as part of the laboratory's ISO 17025 QA and maintenance procedures. In addition, the EPA-ORP has a support

[3] EPA-ORP have three additional HPGe detectors as spares in the event of these detectors failing.

contract with Canberra UK to resolve any major issues that arise with the system, this contract also includes two preventative maintenance visits from Canberra UK per annum.

All gamma spectrometry results are calculated by the ApexGamma software using Canberra's Genie2000 software. These results are then imported into the EPA-ORP LIMS and any subsequent calculations to take into consideration dry to wet activity concentrations etc. are performed there.

5.8.6 Liquid scintillation counting

The EPA-ORP has two liquid scintillation counters, a Perkin Elmer TriCarb 3170 TR/SL and a Hidex 300SL super low level TDCR counter. The Hidex 300 SL is currently being commissioned so it will not be dealt with in detail. It is worth noting, however, that there is an annual preventative maintenance contract with LabLogic (UK), the supplier of the Hidex LSC.

The Tri-Carb 3170 TR/SL is maintained in house using Self Normalisation and Calibration (SNC) and Instrument Performance Analysis (IPA) checks on a weekly basis. These checks look at the instrument background and $^{3}H/^{14}C$ efficiency through the use of control charts. Maintenance is carried out on the LSC every 6 months by EPA-ORP staff as part of the laboratory's ISO 17025 QA and maintenance procedures; this includes a review of control chart data and quench checks. In addition, the EPA-ORP has a preventative maintenance visit from Perkin Elmer Ireland every year.

The counting efficiencies for ^{3}H analyses in seawater are calculated using the internal standards method on the LSC for each sample analysed.^{14}C and ^{90}Sr counting efficiencies are determined on an annual basis. All activity calculations for these analyses are performed in the EPA-ORP LIMS after the automatic input of the counting results from the LSC.

5.8.7 Gas flow proportional counters

The EPA-ORP has two gas flow proportional counters, a Berthold LB 770 and a Protean MPC 9604.

The Berthold LB 770 is used to determine raw counts for gross alpha and beta water analyses. Maintenance is carried out on the Berthold LB 770 every six months by EPA-ORP staff as part of the laboratory's ISO 17025 QA and maintenance procedures; this includes a background check on the detector's chambers. All activity calculations for the gross alpha and beta water analyses are performed in the EPA-ORP LIMS after the manual input of count rate results from the device.

The Protean MPC 9604 is used to determine the gross beta activity in air filters. Maintenance on the Protean is carried out every six months by EPA-ORP staff as part of the laboratory's ISO 17025 QA and maintenance procedures; this includes a background and counting efficiency checks on the detector's chambers. The Protean is calibrated for air filters every 12 months and QA is maintained through weekly checks and the use of control charts on the Protean system.

An arrangement is in place for a preventative maintenance visit for the Protean every 2-3 years with ORTEC-AMETEK (UK). The EPA-ORP intends extending this arrangement to the Berthold in the near future.

5.8.8 Alpha spectrometry

The alpha spectrometry system comprises 16 PIPS detectors contained in 4 Canberra Quad Alpha high vacuum chambers and Canberra's ApexAlpha software. The PIPS detectors are calibrated on an annual basis using a certified Plutonium and Americium source and annual background counts are

acquired through the ApexAlpha software. Maintenance on the alpha system is carried out every 6 months by EPA-ORP staff as part of the laboratory's ISO 17025 QA and maintenance procedures.

All activity calculations for plutonium and americium analyses are performed in the EPA-ORP LIMS after the manual input of raw counts from the alpha spectrometry system. The determination of whether an analytical result is above or below detection limits is done using the Currie Minimum Detectable Activity (MDA) method for a confidence interval of 95%.

Records of original observations, derived data, calibration records, staff records, test results and any other information necessary to establish an audit trail are retained for at least 5 years as per EPA-ORP's requirements under ISO 17025 and the EPA-ORP's records management system.

For paper records, all data is retained on the EPA-ORP filing system for a minimum of 1 year but thereafter may be transferred to an external archive company. For computer records, the data is retained on the database for a minimum of 5 years.

5.8.9 Data handling and reporting

All data in the EPA-ORP laboratory is handled through the use of databases, principally the EPA-ORP LIMS. All sample tracking, from sample registration, test assignment, result entry (including automatic result import from other systems), sample authorisation and reporting is handled in the EPA-ORP LIMS, a SQL server database. It also handles some QA/QC control charts.

Other databases in use are ApexGamma, ApexAlpha, Vista and Oracle. ApexGamma stores all data related to gamma spectrometry. This is a SQL server database containing all calibration, background, QA/QC and gamma result data. ApexAlpha stores all data related to alpha spectrometry. This is an MS Access server database containing all calibration, background and alpha result data.

The Vista database stores all data related to the Protean gas flow proportional counter. This database stores information such as calibration, background, QA/QC and gross beta activity in air results. The Oracle database is responsible for storage of gamma dose rate measurements and the configuration of station parameters.

The EPA reports gamma dose rate monitoring data to the JRC/ISPRA on an hourly basis as part of the implementation of EURDEP. Results from the food, water and marine monitoring programmes are reported to JRC/ISPRA on an annual basis using the JRC data submission tool. The EPA has an obligation to report environmental monitoring data to the Irish public via the EPA website and through regular Environmental Monitoring Reports.

Results from the marine monitoring programme are also submitted to the European Commission as part of the obligations under the Marine Strategy Framework Directive. EPA-ORP also submits specific marine monitoring data to the OSPAR Radioactive Substances Committee on an annual basis.

There are no requirements laid out by EPA-ORP for the storage or archiving of samples. This is left at the discretion of the monitoring programme manager. Typically, environmental monitoring samples are kept for a minimum period of 1 year or until the sample has been authorised.

The EPA-ORP has an extensive QA and control system as outlined in the laboratory's QA and maintenance procedures that have been set up under our Irish National Accreditation Board (INAB) ISO 17025 accreditation. This includes routine maintenance and calibration of laboratory equipment, QA and QC control charts for detectors and analyses, participation in international Inter-Laboratory

Comparisons and Proficiency tests and maintaining and controlling all laboratory records and data appropriately. The scope of the accreditation can be found at http://www.inab.ie/directoryofaccreditedbodies/laboratoryaccreditationtesting/086T.pdf.

5.8.10 Inter-Laboratory Comparisons and Proficiency Tests

Since 2008 the ORP laboratory has participated in the following inter-laboratory comparisons (ILCs) and proficiency tests (PTs):

Year	Organiser	Type
2008	JRC	Mineral water ILC
	NKS	REMSPEC gamma spectrometry ILC
2009	NPL	Environmental Radioactivity PT
	Aquacheck	Gross alpha and beta activity in water PT
	IAEA	Radioactivity in moss soil samples ILC
2010	JRC	^{137}Cs and ^{90}Sr in soil ILC
	NPL	Environmental Radioactivity PT
	IAEA-ALMERA	Natural radioactivity in water and ^{226}Ra in soil ILC
2011	IAEA	Baltic Sea fucus ILC
	JRC	^{90}Sr, ^{137}Cs and ^{40}K in wild bilberry ILC
	NPL	Environmental radioactivity PT
2012	IAEA	^{137}Cs in seawater PT
	MRI	Cs and ^{90}Sr in spinach powder ILC
	JRC	Gross alpha and beta in drinking water ILC
	NPL	Environmental radioactivity PT
2013	IAEA	Radionuclides in water, hay and soil PT
	IAEA	Actinides in sediment and coral ILC
	IAEA	Cs in seawater PT
	NPL	Environmental radioactivity PT
	IAEA	Radioactivity in water and flour PT
2014	IAEA	Gamma spectrometry ILC
	MRI	^{134}Cs, ^{137}Cs, ^{131}I and ^{90}Sr in raw milk ILC
	IAEA	Radioactivity in water, seaweed and sediment ILC

5.9 MOBILE MEASUREMENT SYSTEMS

The EPA-ORP has no mobile laboratory. It maintains a stock of radiation monitoring instruments which may be brought offsite to measure ambient background radiation, to detect radioactive contamination and to identify contaminating radionuclides. In addition, under emergency preparedness arrangements, the Defence Forces' mobile radiological monitoring capability is available to supplement the ORP's fixed stations.

Furthermore the EPA could call on the assistance of the volunteer-based Civil Defence to assist in the collection and transport to the EPA-ORP laboratories of the additional samples which would be required in an emergency situation. Training in general nuclear radiation topics and in the use of radiation detection instruments is provided for Scientific Officer members of the organisation's Warden Service. These individuals will generally have engineering, scientific or other technical background. In addition to the above tasks, they may assist, where required, in the implementation of control measures.

6 REPORTING OF ENVIRONMENTAL RADIOACTIVITY MONITORING RESULTS TO THE EUROPEAN COMMISSION

6.1 INTRODUCTION

Member States should forward to the Commission their results of monitoring of the levels of radioactivity in the environment, in accordance with Commission Recommendation 2000/473/Euratom of 8 June 2000 on the application of Article 36 of the Euratom Treaty concerning the monitoring of the levels of radioactivity in the environment for the purposes of assessing the exposure of the population as a whole, as listed in Annex 1 therein [4].

6.2 DENSE NETWORK

The table below summarises the sampling media, nuclide categories and sampling locations for which data are provided.

Sampling media	Nuclide categories	Sampling locations
Airborne particulates	^{137}Cs, gross beta	Clonskeagh Glasnevin Cork Shannon Knock Cahirciveen
Air	Ambient gamma dose rate	All data is available on-line
Surface water	^{137}Cs, gross beta residual beta	Leixlip, Co. Kildare
Drinking water	^{3}H, ^{90}Sr, ^{137}Cs	See table under section 5.4.2 above
Milk	^{137}Cs, ^{90}Sr	Ballyragget, Co. Kilkenny Mitchelstown, Co. Cork Town of Monaghan, Co. Monaghan Shannonside, Co. Roscommon
Mixed diet	^{137}Cs, ^{90}Sr	University College Dublin, Belfield, Dublin 4

[4] Source: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:191:0037:0046:EN:PDF

6.3 SPARSE NETWORK

The table below summarises the sampling media, nuclide categories and sampling locations for which data are provided.

Sampling media	Nuclide categories	Sampling locations
Airborne particulates	^{137}Cs, ^{7}Be	University College Dublin, Belfield, Dublin 4
Surface water	^{137}Cs	Leixlip, Co. Kildare
Drinking water	^{3}H, ^{90}Sr, ^{137}Cs	Leixlip, Co. Kildare. ^{90}Sr is not routinely measured in drinking water
Milk	^{137}Cs, ^{90}Sr, ^{40}K	Ballyragget, Co. Kilkenny
Mixed diet	^{137}Cs, ^{90}Sr, ^{14}C	University College Dublin, Belfield, Dublin 4

7 VERIFICATIONS

7.1 INTRODUCTION

The principal focus of the verification activities was the EPA-ORP laboratories, which are the only laboratories carrying out analysis of environmental samples, with the exception of ^{99}Tc analyses, which are subcontracted out to a third party. In addition, a number of stations belonging to the external gamma dose rate monitoring and the air sampling networks were visited, in the north and east, broadly above a line running from Dublin to Galway.

The EPA-ORP currently disposes of an adequate level of staff to routinely perform the national environmental monitoring programme. However, in crisis situations further trained staff would be needed.

The verification team particularly appreciated the extensive peer review carried out in 2009 of the environmental monitoring programme (see Section 5.1) which it considers as a valuable example of best practice in this area.

7.2 NATIONAL ENVIRONMENTAL MONITORING PROGRAMME

Chapter 5 gives full details of the programme implemented, which is considered to be comprehensive, with the exception of terrestrial biota and flora which are not routinely monitored (section 5.5.2). No sampling sites were visited in the course of the verification.

The verification team suggests including monitoring of soil or leafy vegetables/grass in the routine monitoring programme in order to allow determination of the surface contamination in case of radioactive fall-out.

7.3 ORP ANALYTICAL LABORATORIES

For a detailed technical description of the EPA-ORP laboratories, the installed equipment and the matrices analysed, please, refer to chapter 5.8.

A very comprehensive visit was undertaken where additional information on the equipment installed and the analyses performed was given. In addition to the laboratory manager and one person dealing with administrative matters, seven scientific staffs work in the laboratory. Annually around 2000 samples are analysed, of which approximately 50% are for external clients. The laboratory holds ISO 17025 accreditation with the current certificate being valid until 6 February 2018. All sample preparation and analytical procedures were readily available.

The sample receipt area, whilst essentially destined to receive low activity level samples, can be divided by means of a sliding door to handle potentially higher activity samples, which may be expected in the event of an emergency. On arrival at the laboratory all samples are logged into the laboratory information system (LIMS) and bar-coded. The data recorded for each sample includes sampling location, type, date, analysis type, operator name, etc. Under normal operation, all sample analysis data is automatically transferred to the LIMS.

In 2011/12 the laboratories were completely modernised and now separate areas are available for the treatment of different sample types (water, foodstuffs, etc.). This ensures that there is no risk of any cross contamination between sample types.

A high volume air filter sample (reference ES1400393) was selected for tracing and staff were quickly able to show all the stages that the sample had passed from initial registration through to the final analysis protocol. It demonstrates that their tracking system is reliable and efficient.

Gamma spectrometry

A total of 8 HPGe gamma detectors are currently available, with a further 3 currently not used. Background measurements are carried out annually (12 days, normally over the Christmas period), background checks are carried out quarterly (24h counting time). Calibration is performed for seven geometries, using standard sources, as a minimum every 5 years, but typically every 2-3 years.

Alpha and beta measurement

A Canberra 7404 alpha spectrometer with 16 PIPS detectors is routinely used.

Liquid scintillation counting

The recently purchased Hidex system is expected to be commissioned by the end of 2014 and will complement the Perkin Elmer TriCarb 3170 TR/SL currently in use. The ^{90}Sr analysis is being added to the scope of accreditation in the near future once additional validation requirements identified during an assessment visit are addressed.

It is recommended to maintain an adequate level of staff for the routine programme and to foresee training of other EPA staff to be able to assist in emergency situations.

7.4 ON-LINE AND OFF-LINE PERMANENT MEASUREMENT STATIONS

A complete technical description of the gamma monitoring and air sampling equipment in place and the locations thereof can be found in chapters 5.2 and 5.3. All data from the national permanent monitoring stations is collected on a central computer at the EPA.

On the lawn outside the EPA-ORP's offices in **Clonskeagh,** four devices have been installed: a gamma dose rate monitor, an on-line air sampler, an off-line air sampler and a precipitation collector. Whilst the siting may not be ideal, as there is a high hedge at less than 5m from the equipment, these devices are useful for demonstration purposes. Data from the gamma dose rate monitor are fed directly by cable to the central computer located in the EPA-ORP's offices, which are situated less than 10m away.

It was pointed out that the weak point of the air sampler is the pump, which due to the level of humidity in the air is prone to corrosion, leading eventually to failure of the unit. Unfortunately this problem will always persist as it would be unreasonable to de-humidify the air, which could lead to extracting activity, thus falsifying the result from the analysis of the filter.

A plastic sieve was placed in the funnel of the precipitation collector to avoid any particles or other bodies entering the sample bottle, particularly important in this case due to the proximity of the hedge.

In common with other on-line air sampler stations, active charcoal cartridges are available for the capture of ^{131}I. These cartridges are not deployed on a routine basis.

The verification team suggests monitoring ^{131}I regularly at this location to ensure that staff is adequately trained in this method.

The sole high volume air sampler (Snow White) is ideally located on the flat roof of the Physics Department of UCD in **Belfield**. Though there are a number of other items installed on the roof, these do not interfere with the air flow to the sampler. Filter changes are facilitated by the proximity of the EPA-ORP's offices, which are about 10 minutes' walk away, a fact that would be particularly important in an emergency situation. Given that the city of Dublin, representing a population of over 1 million (from a total of approximately 4.6 million in Ireland) is built on a large plain and that there are no high buildings in the vicinity the representativeness of this sampling location is outstanding.

At **Casement** aerodrome, which is the property of the Irish Department of Defence, situated approximately 16km south of Dublin city, the Irish Meteorological Service (Met Éireann) maintains a weather station within the secure perimeter. The EPA-ORP has installed a gamma dose rate monitor and a precipitation collector, both of which were correctly installed in an area free of any obstructions.

The gamma dose rate monitor in **Mullingar** is the sole Technidata (Envinet) AGS-4215 device seen during the verification. Sited in a meteorological garden which was securely fenced and with a locked gate, there were no obstructions which could impact on the measurements. Mounted on a base weighing approximately 25kg and fixed in the ground using 2 metal stakes this compact equipment can quickly and easily be moved if required. A further 5 stations of this type are stored in the EPA-ORP's offices and could be rapidly deployed should the need arise.

On the outskirts of **Drogheda** town an on-line airborne particulate monitoring unit is sited within a fenced maintenance depot attached to a cemetery. It was obvious that the nearby hedge had recently been cut. Nevertheless the air flow is somewhat distorted by the hedge being so close to the sampling unit.

Dundalk has 2 separate fixed monitoring stations. Firstly a gamma dose rate station situated within the Defence Forces Aiken Barracks. The chosen site, on a lawn is not 100% ideal due to the presence of a tree nearby, which though young does not yet adversely affect the measurement but this could be an issue in the future. Secondly an on-line airborne particulates station is sited at the Cavan Hill water treatment plant. As the place name suggests this is a flat hilltop with no obstructions to the free flow of air to the sampler.

Clones has a gamma dose rate monitor sited in a fenced and locked meteorological garden belonging to Met Éireann close to a housing estate on the outskirts of the town. A device for collecting rainwater, identical to that seen in Clonskeagh was also present. Both the gamma dose rate monitor and rainwater sampler were free of any interfering obstructions in the vicinity.

The final off-line air monitor seen by the verification team was situated airside at Ireland West Airport **Knock**. It enjoyed a good airflow, unobstructed by any buildings or other interferences.

Currently the siting of both gamma dose rate and air sampling equipment is generally as close to ideal as possible. However this should be kept under regular review, particularly in the case of automation of Met Éireann sites which currently offer good and secure siting. In view of the merger between the EPA and RPII it is suggested to examine opportunities for siting instruments at EPA premises. Notwithstanding, siting of the on-line air sampler in Drogheda and the gamma station in Dundalk should be reviewed.

7.5 DEFENCE FORCES EMERGENCY MONITORING EQUIPMENT

The EPA-ORP maintains a stock of radiation monitoring instruments which may be brought offsite to measure ambient background radiation, to detect radioactive contamination and to identify contaminating radionuclides. The EPA-ORP also relies on co-operation with the Defence Forces for additional monitoring capacity, particularly in the event of a radiological emergency.

By way of a service level agreement with the EPA-ORP, the Defence Forces can deploy hand held Rados RDS200 radiation survey meters to 19 designated nationwide locations as necessary. This equipment was briefly presented to the verification team. Unfortunately time did not allow a visit to the Curragh camp, some 50km south west of Dublin, for a more detailed presentation.

During the course of the visit to Aiken barracks in Dundalk a further model of a portable gamma detector designed to be mounted on a tripod for in-situ measurements was presented. It is an Environmental meter, type 6-80 manufactured by Mini Instruments in the UK. In the context of reviewing emergency monitoring capabilities and their effectiveness this instrument will be withdrawn from the Defence Forces service in Q1 2015, to be replaced by the Rados RDS200.

The verification team supports the review of emergency monitoring capabilities and their effectiveness

8 CONCLUSIONS

All verification activities that had been planned were completed successfully. In this regard, the information supplied in advance of the visit, as well as the additional documentation received during and after the verification activities, was useful.

The information provided and the verification findings lead to the following observations:

(1) In general, the national environmental radioactivity monitoring programme in the Republic of Ireland is in compliance with the requirements of Article 35 of the Euratom Treaty.

(2) The verification activities that were performed demonstrated that the facilities necessary to carry out continuous monitoring of levels of radioactivity in the air, water and soil are adequate. The Commission could verify the operation and efficacy of these facilities.

(3) A few topical recommendations are formulated, in particular as regards maintenance of staffing levels at the EPA-ORP laboratories, the routine monitoring programme, ^{131}I measurements, siting of on-line and off-line measurement stations and emergency monitoring equipment. The recommendations do not discredit the fact that environmental monitoring is in conformity with the provisions laid down in Article 35 of the Euratom Treaty.

(4) The Commission Services ask the Irish competent authority to inform them of any achievements with regard to the situation at the time of the verification.

(5) The verification team acknowledges the excellent co-operation it received from all persons involved in the activities it performed.

APPENDIX 1

REFERENCES & DOCUMENTATION

1. Preliminary information questionnaire addressed to the EPA-ORP in advance of the verification.

2. Radiation Doses Received By the Irish Population (2014)
http://www.epa.ie/pubs/reports/radiation/radiationdosebyirishpopulation.html 37

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http://www.epa.ie/pubs/reports/radiation/tritiuminseawaterreport.html

4. Radioactivity Levels in Groundwater Sources in Ireland (2013)
http://www.epa.ie/pubs/reports/radiation/groundwaterreport2013.html

5. Radioactivity in Bottled Water Produced in Ireland (2013)
http://www.epa.ie/pubs/reports/radiation/naturalradioactivtybottledwater.html

6. Proposed Nuclear Power Plants in the UK – potential radiological implications for Ireland (2013)
http://www.epa.ie/pubs/reports/radiation/proposednuclearpowerplantinuk.html

7. Assessment of the Impact on Ireland of the 2011 Fukushima Accident (2012)
http://www.epa.ie/pubs/reports/radiation/fukushimareportfinal.html

8. Radioactivity Monitoring of the Irish Environment 2010-2011 (2012)
http://www.epa.ie/pubs/reports/radiation/envmonrep2010to2011.html

9. Radioactivity Monitoring of the Irish Environment 2009 (2010)
http://www.epa.ie/pubs/reports/radiation/envmonrep09.html

10. Radioactivity Monitoring of the Irish Environment 2008 (2010)
http://www.epa.ie/pubs/reports/radiation/envmonrep08.html

11. A Peer Review of the RPII Environmental Monitoring Programme (2009)
http://www.epa.ie/pubs/reports/radiation/peerreview/

12. Radioactivity of Monitoring of the Irish Environment 2007 (2008)
http://www.epa.ie/pubs/reports/radiation/envmonrep07.html

13. Radiation Doses Received by the Irish Population (2008)
http://www.epa.ie/pubs/reports/radiation/radiationdosesreceived.html

14. Radiological assessment of NORM Industries in Ireland – Radiation doses to workers and members of the public
https://www.epa.ie/pubs/reports/radiation/RPII_NORM_Report_08.pdf

APPENDIX 2

THE VERIFICATION PROGRAMME

ARTICLE 35 VERIFICATION

IRELAND

Day / date	Time	Activities
Monday 22/9		EC team travel to Dublin
Tuesday 23/9	9.00 – 17.30	- opening meeting at EPA - visit to ORP analytical laboratories - Clonskeagh monitoring station - Belfield high volume air sampler - Casement gamma dose rate station
Wednesday 24/9	8.30 – 17.30	- Mullingar gamma dose rate station - Drogheda airborne particulates station - Dundalk gamma dose rate station (Aiken Barracks) - Dundalk airborne particulates station (Cavan Hill Water Treatment Plant)
Thursday 25/9	8.30 – 17.30	- Clones gamma dose rate, airborne particulates station - Knock airport gamma dose rate and airborne particulates station
Friday 26/9	8.30 – 10.30 10.30 – 12.30	Return travel Athlone to Dublin Closing meeting at EPA

EC team:
Mr Stefan MUNDIGL (DG ENER) – team leader
Mr Alan RYAN (DG ENER)
Mrs Montserrat MARIN FERRER (JRC-ISPRA)