EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR ENERGY AND TRANSPORT

Directorate H – Nuclear Energy
Radiation protection

TECHNICAL REPORT

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35 OF THE EURATOM TREATY

IRISH NATIONAL MONITORING NETWORK FOR ENVIRONMENTAL RADIOACTIVITY; NUCLEAR MEDICAL INSTALLATIONS

REPUBLIC OF IRELAND

01 to 04 May 2007

Reference: IE-07/03

VERIFICATIONS UNDER THE TERMS OF ARTICLE 35
OF THE EURATOM TREATY

FACILITIES	Facilities for monitoring environmental radioactivity in Ireland; facilities in hospitals discharging radioactive material (Cork and Dublin)
DATE	01 to 04 May 2007
REFERENCE	IE-07/03
INSPECTORS	C. Gitzinger (leader)
	A. Godeanu-Metz
	E. Henrich
DATE OF REPORT	April 2008

SIGNATURES

C. Gitzinger

E. Henrich **A. Godeanu-Metz**

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TECHNICAL REPORT

ABBREVIATIONS

BEGe	Broad Energy Germanium (gamma radiation detector)
BSS	Basic Safety Standards
CD-ROM	Compact Disc - Read Only Memory
CEFAS	Centre for Environment, Fisheries and Aquaculture Science, UK
CT	Computed Tomography (medicine)
CUH	Cork University Hospital
DAT	Digital Audio Tape
DEC	Digital Equipment Corporation (former computer producer)
DEHLG	Department of Environment, Heritage and Local Government
DG TREN	Directorate General for Energy and Transport
EC	European Commission
EPA	Environmental Protection Agency
EURDEP	European Radiological Data Exchange Platform
FSAI	Food Safety Authority of Ireland
FTP	File Transfer Protocol
FWHM	Full Width at Half Maximum
GIS	Government Information Services
GM	Geiger-Müller (radiation detector)
HPGe	High Purity Germanium (gamma radiation detector)
IAEA	International Atomic Energy Agency
IMO	International Maritime Organization
INAB	Irish National Accreditation Board
ISO	International Standardization Organization
JRC	(European Commission) Joint Research Centres
LIMS	Laboratory Information Management System
Linac	Linear accelerator
LSC	Liquid Scintillation Counting (radiation detector)
MAFF	(former UK) Ministry of Agriculture, Fisheries and Food
MCA	Multi-Channel Analyser
MOU	Memorandum Of Understanding
NEPNA	National Emergency Plan for Nuclear Accidents
NIST	National Institute of Standards and Technology (USA)
NORM	Naturally Occurring Radioactive Material

NPL	National Physical Laboratory (UK)
OSPAR	OSlo – PARis Convention
PET	Positron Emission Tomography (medicine)
PIPS	Passivated Implanted Planar Silicon (radiation detector)
PTB	Physikalisch-Technische Bundesanstalt (Braunschweig, Germany)
QA	Quality Assurance
RPII	Radiological Protection Institute of Ireland
REM	Radioactivity Environmental Monitoring (European Commission database)
RIMNET	Radioactive Incident Monitoring NETwork (UK)
SMS	Short Message Service
Teagasc	(Irish Agriculture and Food Development Authority)
TID	Total Indicative Dose (in Drinking Water Directive)
TLD	ThermoLuminescence Dosimetry (radiation detector)
UCD	University College, Dublin
UK	United Kingdom
UPS	Uninterruptible Power Supply
VAX	Virtual Address eXtension (series of computers manufactured by DEC)
VMS	Virtual Memory System (computer server operating system developed by DEC)

1. INTRODUCTION

Article 35 of the Euratom Treaty requires that each Member State shall establish 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 (BSS)[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.

For the EC, the Directorate-General for Energy and Transport (DG TREN) and more in particular its Radiation Protection Unit (TREN H4) is responsible for undertaking these verifications.

For the purpose of such a review, a verification team from DG TREN visited sites located in Ireland, which are part of the national monitoring system for environmental radioactivity and several hospitals. The visit included meetings with representatives of the Radiological Protection Institute of Ireland (RPII), the Minister for the Environment, Heritage and Local Government, and two large hospitals.

The present report contains the results of the verification team's review of relevant aspects of the environmental radiation surveillance in Ireland and of the monitoring of radioactivity in some hospitals. The purpose of the review was to provide independent verification of the adequacy of monitoring facilities for air, soil, water and foodstuffs.

With due consideration to the scope of the verification mission and taking into account the relatively short time available for the execution of the programme, it was agreed that emphasis would be put on:

- The structure of the national environmental monitoring and sampling programme;
- The analytical laboratory of the Radiological Protection Institute of Ireland ;
- On-line automatic monitoring systems;
- Environmental monitoring programmes in south-eastern Ireland;
- Monitoring in hospitals.

The present report is also based on information collected from documents referred to in Appendix 1 and from discussions with various persons met during the visit, listed in section 2.

The verification team acknowledges the co-operation it received from all participating individuals.

[1] Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the health protection of the general public and workers against the dangers of ionizing radiation

2. PREPARATION AND CONDUCT OF THE VERIFICATION

2.1. Preamble

The Commission services decision to request the conduct of an Article 35 verification was notified to the Irish Government on 26 February 2007 (letter referenced TREN.H4/CG/bf D(2007)301198) addressed to the Permanent Representation of Ireland to the European Union). The Irish Government subsequently designated the Radiological Protection Institute of Ireland (RPII) to lead the technical preparations for the verification.

2.2. Preparatory documents

In order to facilitate the work of the verification team, information was supplied in advance by RPII in form of detailed answers to a questionnaire from the Commission services. Additional documentation was provided during and after the visit. All documentation received and other sources consulted are listed in Appendix 1. The information thus provided has been extensively used for the descriptive sections of this report.

2.3. Programme of the visit

EC and RPII discussed and agreed upon a programme of verification activities, based on a draft Communication by the EC, setting out the framework and modalities within which Article 35 verifications may be conducted.

A summary overview of the programme of verification activities is provided in Appendix 2. The verifications were carried out in accordance with the programme.

2.4. Representatives of the competent authorities and the associated laboratories

During the visit the EC verification team met the following representatives of the national authorities and other parties involved:

Representatives of the Irish Minister for the Environment, Heritage and Local Government

Renee Dempsey	Principal Officer Nuclear Safety Section, Department of Environment, Heritage and Local Government (DEHLG)

Representatives of the Radiological Protection Institute of Ireland (RPII)

Ann McGarry	Chief Executive
David Pollard	Director of Monitoring and Measurement Services
Tom Ryan	Director of Regulatory Services
Stephanie Long	Laboratory manager, specialist, environmental monitoring
Stephen Fennell	Manager, Medical, Dental and Veterinary Section, Regulatory Services Division

Ciara McMahon	Manager emergency preparedness, specialist, emergency preparedness/ early warning systems
David Fenton	Manager, Natural Radioactivity Advice Section
Mary Fegan	Scientific Officer, Environmental monitoring/ radio-chemistry section;
Catherine Organo	Scientific Officer, Advisory Services Division Natural Radioactivity Advice Section
Kevin Kelleher	Scientific Officer, Environmental monitoring/ radio-chemistry section;
Alison Dowdall	Scientific Officer, Environmental monitoring/ radio-chemistry section;

Representatives of the St. James's Hospital

Eilish Hardiman	Deputy CEO
Geraldine O Reilly	Radiation Protection Advisor
Aoife Gallagher	Senior Physicist
Aidan Cranny	Chief Medical Scientist – Endocrinology & Radiation Lab Safety Manager
Marie-Louise Healy	Consultant Endocrinologist

Representatives of Cork University Hospital

Fintan Bradley	Chief Physicist
Mike Sheehy	Acting Principal Physicist
Marie J McCarthy	Management representative
James Kelleher	SEO Services

3. BACKGROUND INFORMATION

3.1. General

Ireland does not operate nuclear reactors on its territory, neither for power production nor for research purposes. Thus, no nuclear site related monitoring is set up.

The monitoring programme of radioactivity in the environment and foodstuffs does not include natural radionuclides. Exposure to natural radiation is controlled by a separate programme (with regard to indoor radon), which was not subject to verification during this visit.

3.2. Monitoring programmes and responsible organisations

The following organisations have responsibilities in monitoring radioactivity in the environment in Ireland:

- **Radiological Protection Institute of Ireland (RPII)**
  RPII is the national organisation with regulatory, monitoring and advisory responsibilities in matters pertaining to ionising radiation. RPII is responsible to the Minister for the Environment, Heritage and Local Government. The number of staff of RPII is about 46 persons, having a sound competence in the field of RPII's activities. RPII was established in 1992 under the Radiological Protection Act, 1991. The Board of RPII consists of twelve members appointed by the Minister for the Environment, Heritage and Local Government, six of them having been nominated by organisations with interests in various aspects of RPII's work. Article 7 (1) (a) of the Radiological Protection Act assigns responsibility to RPII for monitoring levels of radioactivity in the environment.

  The key functions of RPII relevant to Article 35 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. Therefore has an active role in offering technical support to the NEPNA including PMS network.
  - To assist the food certification programme and the assessment of NORM Industries

  RPII's environmental laboratory in Clonskeagh, Dublin performs analytical measurements relevant for Art. 35.

- **Food Safety Authority of Ireland (FSAI)**
  The central competent authority with the overall responsibility for enforcement of food safety legislation. Implementation is through service agreements and MOUs with official agencies. Representatives at regional level are the County Councils, which among their responsibilities include the control and monitoring of drinking water and emergency response. FSAI is responsible to the Minister for Health and Children**.**

- **Minister for the Environment, Heritage and Local Government**
  Development of policy and legislation, implementation of the National Emergency Plan for Nuclear Accidents (NEPNA).

- **Minister for Defence, Office of Emergency Planning**
  Promotion of the coordination of emergency planning functions across all relevant public authorities.
- **Environmental Protection Agency (EPA)**
  Coordination and reporting in relation to the EC Drinking Water Directive; licensing of waste disposal. The EPA is responsible to the Minister for the Environment, Heritage and Local Government.
- **Health Service Executive**
  Responsibility to implement the medical regulations.
- **Health and Safety Authority**
  Securing health and safety at work (established under the Safety, Health and Welfare at Work Act, 2005).

4. LEGAL PROVISIONS FOR ENVIRONMENTAL RADIOACTIVITY MONITORING

4.1. Legally binding documents

Ireland has comprehensive legislation in the area of radiation and nuclear safety. The main legal acts are:

- Radiological Protection Act, 1991

  The Radiological Protection Act, 1991, hereafter referred to as the Act, is the main piece of primary legislation relevant to ionising radiation and nuclear safety in Ireland. The Act established the Radiological Protection Institute of Ireland and sets the framework for the control of and protection from radioactive substances in Ireland.

  Section 30 of the Act provides for the regulation by license of the custody, production, processing, handling, holding, storage, use, manufacture, importation, distribution, transportation, exportation or other disposal of such radioactive substances, nuclear devices, or irradiating apparatus.

  Section 30 (2) of the Act provides that the Minister (Environment, Heritage and Local Government) may give effect by order to existing and future acts adopted by the Institutions of the European Communities relating to the health protection of the general public and workers against the dangers of ionising radiation.

- Radiological Protection Act, 1991 (Ionising Radiation) Order, 2000

  The Basic Safety Standards are implemented in Ireland by means of the Radiological Protection Act, 1991 (Ionising Radiation) Order, 2000 (Statutory Instrument 125 of 2000) made under section 30 (2) of the Radiological Protection Act. All practices related to activities involving sources of ionising radiation may only be carried out under a licence issued by the RPII. An application for such a licence must be made to RPII and supported by a risk assessment. For new activities the undertaking must demonstrate to RPII that the facility is designed so that prospective doses to workers and members of the public do not exceed the design dose constraints set out in guidelines issued by RPII.

4.2. Legislative acts regulating environmental radioactivity monitoring

- Radiological Protection Act, 1991 (Article 7 (1) (a));

- Statutory Instrument S.I. 278 of 2007 (superseding 439 of 2000) implementing the EC Drinking Water Directive[2].

The legislative acts regulating foodstuff monitoring related to radioactivity are mostly derived from Ireland's membership to the European Union. FSAI is the single regulatory authority with responsibility for the enforcement of food safety legislation in Ireland. This responsibility for enforcement is managed through a series of service contracts and service level agreements with relevant official agencies such as the RPII.

4.3. Description of the legislative set-up with regard to NORM industries

NORM activities are covered by the Radiological Protection Act, 1991 (Ionising Radiation) Order, 2000, Part 6 (which is implementing Title VII of the European Basic Safety Standards).

This applies to exposure to natural radiation sources and work activities which

(a) take place in workplaces having radon concentrations in excess of 400 Bq m^{-3}, averaged over a minimum period of 3 months, or
(b) involve natural radiation sources, other than radon, which result in an effective dose to workers or members of the public in excess of 1 mSv in a period of 12 months.

An employer or self-employed person who is responsible for a workplace where elevated levels of naturally occurring radionuclides may be present, such as in the oil and gas industries, the metal smelting or in sectors involving the manufacture or use of thoriated products, shall investigate the extent of any exposure of workers or members of the public on being directed to do so by the RPII.

Large industries dealing with NORM (peat-fired and coal-fired power generation, natural gas extraction, bauxite processing) are usually licensed by EPA and the discharges are controlled from the – conventional – environmental point of view. The RPII has conducted investigations into specific NORM industries (coal fire power, peat fire power, bauxite, oil and gas) to determine if radiological protection issues apply. To date none have been found to fall within the scope of national radiological protection legislation.

4.4. Non-binding documents

In addition to binding legal requirements, there are important international guidance documents, which are relevant to environmental radiation monitoring. The most important ones are:

- Commission Recommendation 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, 2000/473/Euratom.

5. NATIONAL ENVIRONMENTAL RADIOACTIVITY MONITORING SYSTEM

5.1. General

The key elements of the monitoring programme implemented by RPII include:

- assessment of ambient radioactivity based on measurements of radioactivity in air and external gamma dose rate at permanent monitoring stations located throughout the country;

[2] Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption, OJ 330/32 of 5.12.1998

- assessment of levels of radioactivity in drinking water;
- assessment of levels of radioactivity in foodstuffs based on measurements of total diet, milk and miscellaneous ingredients;
- assessment of levels of radioactivity in the marine environment based on sampling and measurements of seawater, sediment, seaweed, fish and shellfish.

The locations of all permanent monitoring stations are shown in Figure 1. The sample types for each station are listed in Table 1.

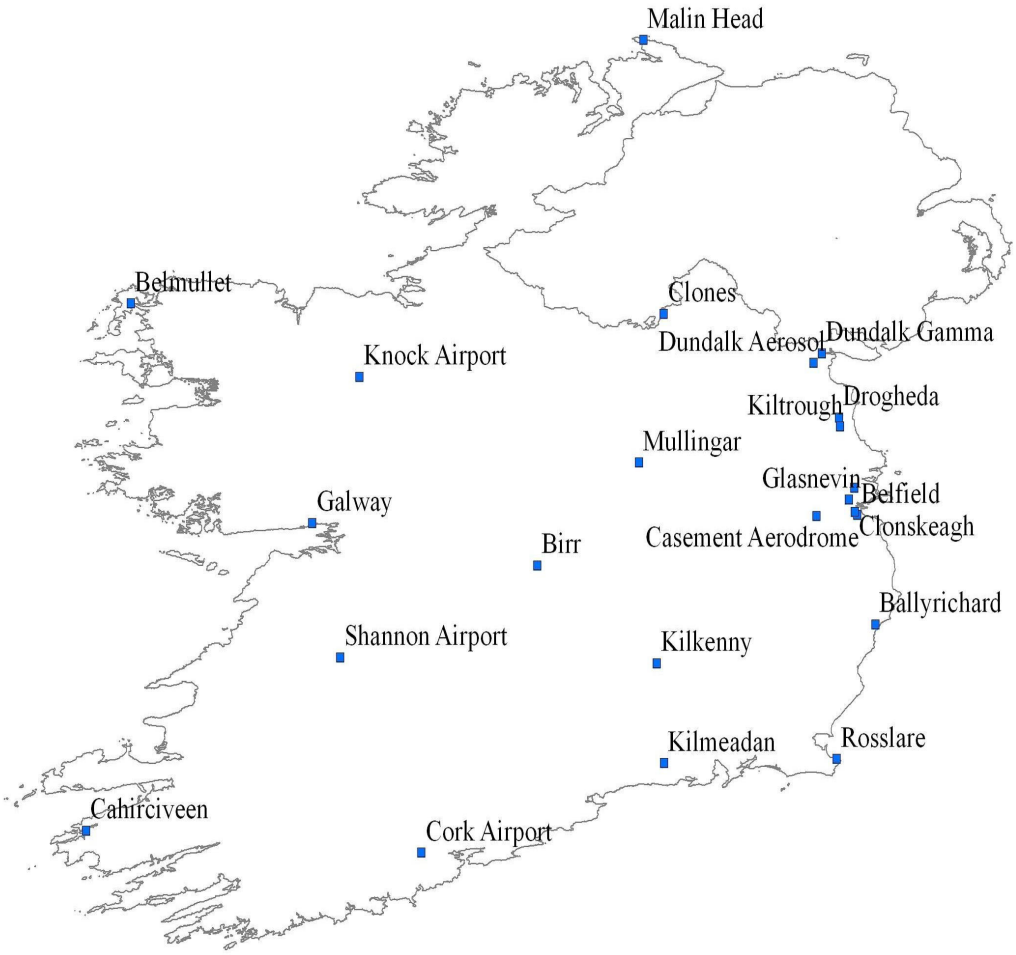


Figure 1: RPII Permanent Monitoring Stations

Table 1: RPII Permanent Monitoring Stations

County	Sampling Location	Sample Types
Clare	Shannon Airport	Rainwater, external gamma dose rate
Cork	Cork Airport	Rainwater, external gamma dose rate, airborne particulates
Donegal	Malin Head	Rainwater, external gamma dose rate
Dublin	Dublin Airport	Rainwater
Dublin	Glasnevin	Airborne particulates
Dublin	Casement	Rainwater, external gamma dose rate

Table 1: RPII Permanent Monitoring Stations (continued)

Dublin	Belfield	High Volume Airborne particulates (Sparse network)
Dublin	Clonskeagh	Rainwater, external gamma dose rate, airborne particulates, krypton-85
Galway	Galway	Airborne particulates
Kerry	Cahirciveen	Rainwater, external gamma dose rate, airborne particulates
Kilkenny	Kilkenny City	Rainwater, external gamma dose rate
Monaghan	Clones	Rainwater, external gamma dose rate, airborne particulates
Louth	Dundalk	External gamma dose rate, airborne particulates
Louth	Kiltrough	External gamma dose rate
Mayo	Belmullet	Rainwater
Mayo	Knock Airport	External gamma dose rate
Offaly	Birr	Rainwater, external gamma dose rate
Waterford	Kilmeadan	external gamma dose rate
Westmeath	Mullingar	Rainwater, airborne particulates
Wexford	Rosslare	Rainwater, external gamma dose rate, airborne particulates

5.2. Ambient gamma dose rate monitoring locations

Ireland has an automatic nation-wide monitoring network for external dose rate. This system has two main functions: to provide continuous monitoring of radiation levels and to alarm in the event of an emergency. The network has 15 stations equipped with GM-tubes and is shown in Figure 2. Maintenance and development of the network is carried out by RPII in close co-operation with MET Éireann, the Irish National Meteorological Service.

Ambient gamma dose rate (H*10) is automatically monitored (measuring 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 dose and high dose detectors. Measurement is continuous with integration intervals of 1 minute, 10 minutes and two hours. Values are polled by the RPII server every hour. Each location has an associated long-term background value. Email/SMS alarms can be programmed into the software, triggered by defined gamma dose rate levels or by equipment malfunction. Currently, the Duty Officer alarm is set at 1.8 times the mean station background. Station gamma dose rate data are published on the RPII web site hourly where they can be viewed graphically.

The network includes two models of devices:

- TechniData AGS – Solar Powered with 48-hour minimum battery backup. Transmits data using the GSM Network. Built in rain sensor (yes/no decision).
- TechniData DLM – Mains Powered with 48-hour minimum battery backup. Transmits data using the analogue landline network. External rain sensor (yes/no decision).

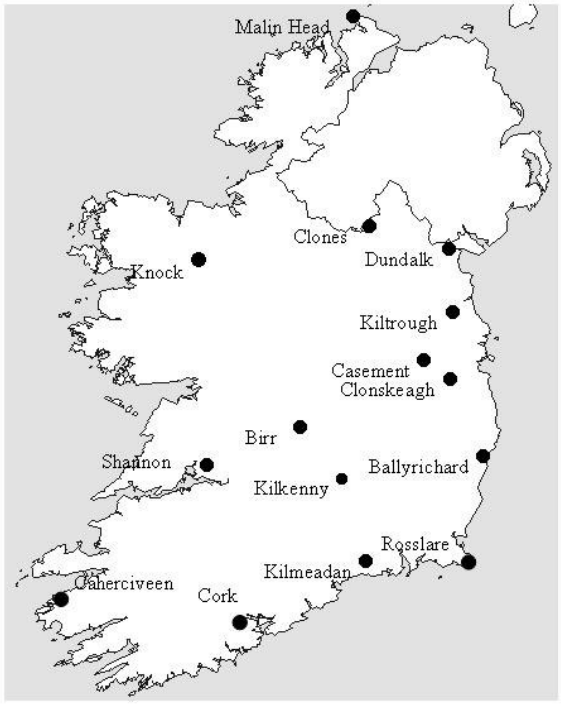


Figure 2: Gamma dose measuring locations

5.3. Airborne radioactivity; gases and particulates

The nationwide monitoring of airborne radioactive substances is as follows:

Off-line aerosol sampling

Currently nine low volume (10 m^3/h) aerosol sampling stations (dense network) and one high volume (ca. 2,000 m^3/h) station (sparse network) are operated continuously.

Six of these stations are operated by the Irish Meteorological Service, one by University College Galway, one by Dundalk Urban District Council, and one by RPII in Clonskeagh, Dublin.

Routine operation involves particulate sampling using glass fibre filter paper. In addition, a supply of charcoal filters is available at each monitoring site of the dense network for sampling gaseous iodine if deemed necessary.

Each complete off-line sampler is mounted inside a standard wooden meteorological Stephenson Housing. The sampling head consists of a metal holder with a 47 mm circular diameter GFA filter paper and a TEDA impregnated charcoal cartridge (only fitted during emergencies or tests). A ¾ hp oil-less vacuum pump (carbon vane) pulls air through the system at a variable flow rate of between 50 LPM (3 m^3/h) and 200 LPM (12 m^3/h), depending on filter loading. The airflow through the filter is measured using a venturi airflow calibrator/totaliser with electronic differential pressure sensor/transmitter. Instantaneous, minimum, maximum flow rates in LPM and the total air volume are registered.

The sampling interval is usually seven days and approximately 1,500 m^3 of air are sampled in that period. Filters are collected by hand and sent by mail to RPII for total beta analysis using a gas flow proportional counter. The minimum detectable activity for this method is typically 0.05 mBq/m^3 gross beta (based on a 2-hour count and after a minimum of five days' delay to allow radioactive decay of short-lived natural radionuclides).

A high volume air sampling system is installed at Dublin-Belfield. Monthly filter samples are analysed for gamma-emitting radionuclides. Technical details are presented in Appendix 5. The device is situated on the roof of the School of Physics of University College Dublin.

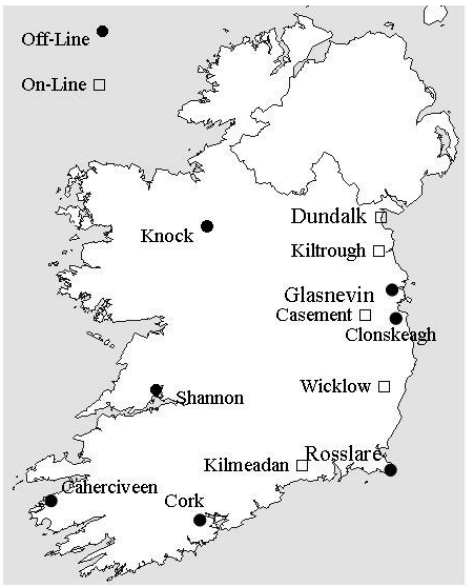


Figure 3. Upgraded Aerosol Monitoring Network (Dense Network).

On-line aerosol sampling

During the second half of 2007 the aerosol sampling network will be further amended to include five on-line aerosol monitoring stations that will be located along the east and southeast coasts. They will be based on a Berthold Technologies BAI 9128-ENV Moving Filter instrument (moving filter monitor with pumping unit and silicon semi-conductor detector for the detection of alpha/beta emitting particulates). The monitor will report radioactivity in Bq/m^3 to RPII using the landline telephone.

The planned dense air monitoring network (including the new on-line stations) will then include 7 off-line and 5 on-line aerosol sampling stations as shown in Figure 3.

Krypton-85 monitoring

Measurements of krypton-85 in air are made for the RPII site at Clonskeagh / Dublin once per month on the basis of two hour grab samples. The sampling system used at RPII was designed and built by the Subatomic and Radiation Physics Group at the University of Gent in Belgium. Krypton is sampled using a pump to draw air over an activated charcoal trap maintained at the temperature of liquid nitrogen for approximately two hours. The krypton sample is then transferred by distillation from the charcoal trap to a copper coil containing a molecular sieve. The copper coil is then sent to Belgium (University of Gent) for analysis, which involves gas chromatographic separation followed by liquid scintillation counting to determine the Kr-85 concentration.

5.4. Precipitation

Dry deposition sampling is not routinely undertaken.

Rainwater is collected continuously at 13 stations 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. The location of rainwater sampling stations is shown in Figure 1.

5.5. Iodine measurements

All air samplers are equipped to use activated charcoal cartridges for determination of gaseous iodine. Each station is equipped with a supply of cartridges, which can be switched in on request.

The on-line aerosol monitors of the upgraded network will feature automatic switching of the airflow through a charcoal cartridge if an alarm level is exceeded.

5.6. Water monitoring (inland and seawater; drinking water; ground water)

Until 2004 RPII's drinking water monitoring protocol required all drinking water supply zones serving populations in excess of 10,000 to be sampled at least once every four years and analysed for tritium, gross alpha and gross beta activities. In addition, those supplies serving the major population centres were sampled annually. This protocol is currently under review so as to avoid duplication with monitoring carried out by local authorities in accordance with the Drinking Water Directive. The Drinking Water Directive is implemented by means of Statutory Instrument 439 of 2000. Local authorities are responsible for collection and analysis of samples, while the Environmental Protection Agency (EPA) is responsible for reporting data nationally and to the EU.

Where possible, drinking water is sampled at the point at which the treated water is released into the distribution network. Sampling is normally carried out following instructions by RPII by the relevant local authority. Drinking water samples are acidified with nitric acid as soon as practicable after sampling to minimise the adsorption of radioactivity on the walls of the sample container. An aliquot of between 100 and 500 ml (depending on the concentration of dissolved solids) from each sample is evaporated to dryness and analysed for both naturally and artificially occurring radionuclides by measuring the gross alpha and gross beta activities. Where the gross alpha or gross beta activities exceed the screening levels of 0.1 Bq/l and 1.0 Bq/l respectively, nuclide specific analysis is undertaken so as to determine compliance with the total indicative dose (TID) as defined in the Drinking Water Directive.

Since Ireland has no nuclear industry, the requirement to measure tritium routinely is not applicable. However, since 2001 all drinking water samples have been measured for this radionuclide by liquid scintillation counting.

Coastal samples of seawater are taken at the locations indicated in Figure 4 with the exception of Howth, Carlingford and Clogherhead.

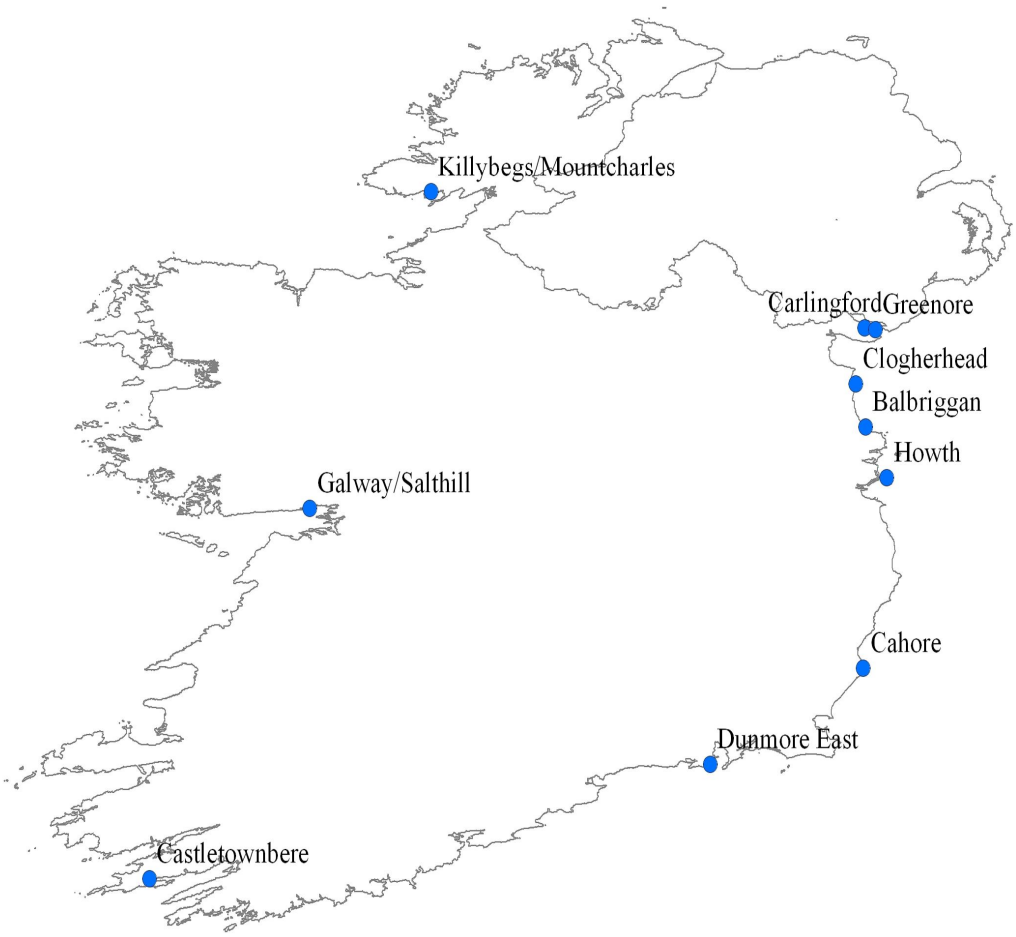


Figure 4. Coastal sampling locations

5.7. Milk monitoring

Cow's milk is sampled at four commercial dairies by Department of Agriculture and Food Diary inspectors on a monthly basis (Figure 5). These dairies have been chosen with a view to have a good geographical coverage of the country and also to ensure that the dairy producing for the main population centre (Dublin) is sampled. On receipt at the laboratory, samples are bulked and analysed quarterly for Sr-90 and gamma-emitting radionuclides.

5.8. Soil, sediments, grass, marine biota

Seaweed samples are collected by RPII staff from the same locations as those indicated above for seawater. Sampling frequencies range from monthly to biennially. On return to the laboratory, samples are washed to remove all sediment and other extraneous material. They are then dried to constant weight, pulverised and thoroughly mixed. Samples are analysed individually for Cs-137 and other gamma-emitting radionuclides. Selected individual and bulked samples are analysed for C-14 and Tc-99.

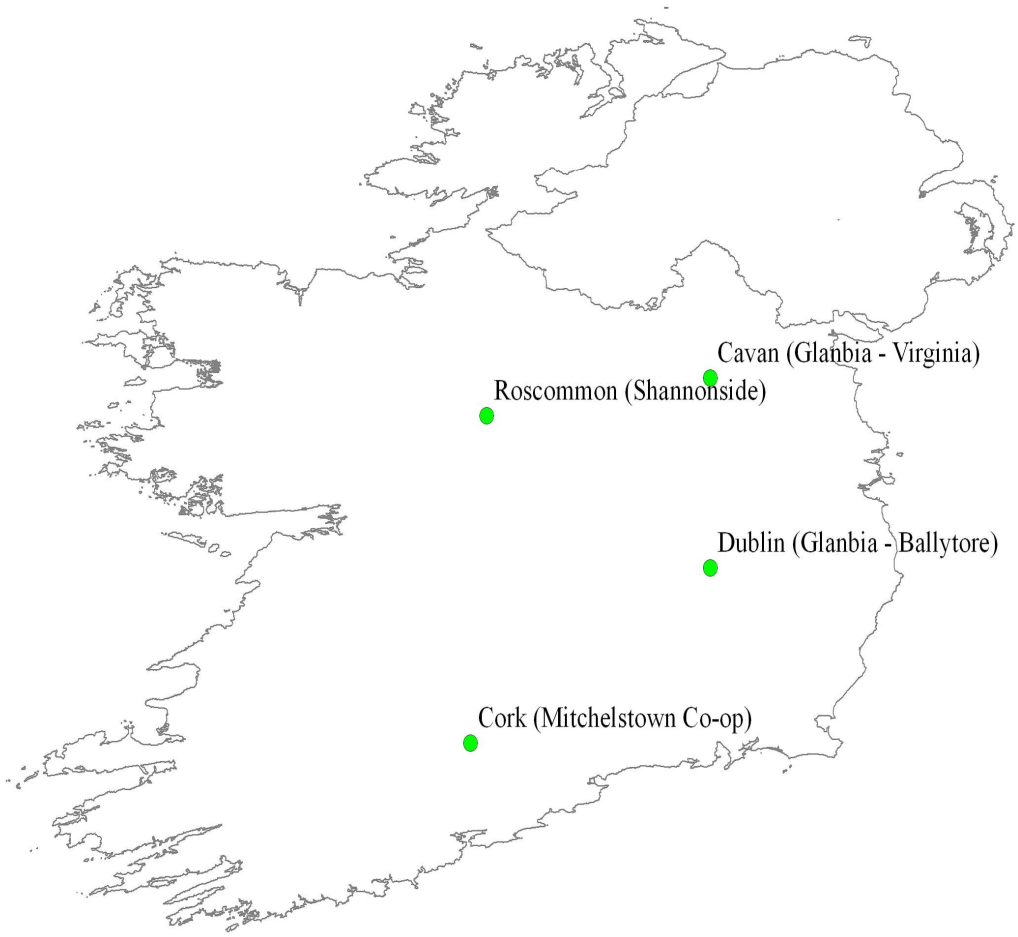


Figure 5. Sampling locations for milk

5.9. Foodstuffs and mixed diet

Approximately 1000 individual foodstuffs are analysed annually by RPII; during 2003 and 2004 in a joint study with the Food Safety Authority (FSA) of Ireland additional 105 samples were analysed. Samples are homogenised and tested by gamma spectroscopy. Approximately 50 samples of barley, wheat, oats and animal feed are sampled by the Department of Agriculture annually; the rest of 20 samples is sheep meat from upland areas affected by Chernobyl fallout also annually.

Samples of complete meals (mixed diet) are collected annually from 3-4 university restaurants located around the country. During 2006, a once-off study of concentrations of C-14, Sr-90, Pb-210, Pu-238 and Pu-239,240 in mixed diet was carried out.

5.10. Wild berries, game, mushrooms, freshwater fish

Wild food-stuffs are not commonly consumed in Ireland. In 2004 samples of wild blackberries and locally produced honey were collected. In 2005 a fresh-water fish sample was collected. These samples were analysed for Cs-137 and other gamma emitting radionuclides. Wild mussels were collected quarterly between 2002 and 2005 and analysed for Cs-137, Tc-99 and plutonium isotopes.

5.11. Marine food

Marine food samples are collected by RPII staff at the same locations as those indicated on Figure 4 (with the exception of Cahore, Balbriggan and Greenore). Sampling frequencies range from monthly to annually reflecting the resolution judged to be necessary to assess the population dose. Initial preparation of fish and shellfish samples includes cleaning and separation of the edible portion for analysis. Samples are then dried to constant weight, pulverised and thoroughly mixed. Samples are analysed individually for Cs-137 and other gamma-emitting radionuclides. Selected individual and bulked samples are analysed for Tc-99, Pu-238 and Pu-239,240.

5.12. Feeding stuff

Approximately 50 samples of grain (barley, wheat and oats) are measured annually for Cs-137 and other gamma emitting radionuclides. These samples are collected by the Department of Agriculture and Food and are representative of the main grain types produced in Ireland.

5.13. Mobile measurements

No mobile vehicle or other mobile measuring systems are currently available in Ireland.

6. HOSPITALS WITH NUCLEAR MEDICAL FACILITIES

6.1. Cork University Hospital (CUH), Cork

This public medical institution, is a major teaching hospital attached to University College Cork. It operates the state's Marine Medical Consultancy service and contains one of two undergraduate schools for dentists in the Republic of Ireland. The hospital was designated by the Health Research Board as Clinical Trials Centre.

The radiological services comprise:

Radiation Oncology:

The radiation oncology department operates several Siemens linear accelerators (linacs), Siemens CT-Simulator, a Varian Acuity simulator, a Therapax superficial treatment unit, an integrated brachytherapy unit, and does Zevalin®Yttrium-90 targeted radiotherapy. Old bunkers were modified to accommodate the equipment.

Diagnostic Radiology:

The originally built (1979) diagnostic x-ray facilities have been replaced almost completely. The department is also responsible for regional replacement and expansion.

Nuclear Medicine:

Two twin head rectangular full body gamma cameras, technetium and blood labelling isolators, white cell labelling, a wide range of diagnostic isotopes, e.g. Tc-99m, I-123, In-111, are at disposition.

The centre is specialized in thyroid ablation, radiotherapy, brachytherapy. By 2013 it will operate 7 linear accelerators. It will be responsible for a satellite centre of 2 linacs in Waterford. Still for 2007

the installation of a PET/CT is foreseen. Table 3 gives some data on the administration of I-131 in the hospital.

Table 3: I-131 treatment at CUH (the number in brackets is the activity applied per patient)

	Patient Numbers			
Year	**Thyrotoxicosis (370 MBq)**	**Cancer (3.7 GBq)**	**Uptake studies (0.37 MBq)**	**Thyroid scans (185 MBq)**
2004	89	6	25	22
2005	97	10	32	31
2006	168	24	59	55

The hospital increased recently the number of personnel involved in nuclear diagnostics and therapy. The radiological services actively contribute in the development of the written procedures such as: new radiation safety procedures introduced for radiation therapy, protocols implemented for work related to the iodine suite. They also carried out formal risk assessments for working with iodine-131. The hospital returns used radioactive sources to the manufacturers. It also has a documented management of unsealed sources (and aspires to monitor source use through spreadsheet development or ISOCHECK software).

6.2. St. James's Hospital, Dublin

St. James's is a major teaching hospital, performing diagnostic imaging (x-rays), diagnostic nuclear medicine and radionuclide therapy. All its practices, operating policies and procedures as well as the local arrangements for the radiation safety are under the regulatory control of the RPII.

Diagnostic Nuclear Medicine Department

Every year approximately 2500 scans are performed in this separate self contained department. More than 70% of the patients are treated as out-patients. All radioactive waste is segregated and stored until decayed to background levels. The nuclear medicine department has dedicated toilets for its patients.

The isotopes currently used for diagnostics are:

Isotope	**Activity Administered (total, annual)**
Tc-99m	1438 GBq
Xe-133	47 GBq
I-123	8.03 GBq
In-111	1.9 GBq
Ga-67	0.2 GBq
I-131	0.346 GBq

Radionuclide Therapy Department

Saint James's has a licence of 132GBq for the purposes of ablation therapy and a further 9.5GBq for other uses in Nuclear Medicine. These would include the use of I-131 in the treatment of thyrotoxicosis and its use in diagnostic imaging. Saint James's is licensed to hold and use 14.1GBq Y-90 for the purposes of Zevalin therapy for NHL. An individual administration would be less than 1480 MBq.

I-131 Ablation Therapy

Radio-iodine containing capsules containing 5.5 GBq I-131 are received and assessed in the radio pharmacy 'unit'. They are transported to the radio-iodine suite (the 'Victor Synge Ward'; details see Appendix 6) immediately before administration to the patient, which is performed by a consultant endocrinologist (two physicists are present).

The radio-iodine suite is located in the top floor of the building and is a controlled area with restricted access. Only authorised staff (badge-access), equipped with gloves, aprons and overshoes is allowed to enter the suite. Strict procedures apply for any work in this room.

The room is sparsely furnished and the bed is placed at a maximal distance from the internal walls. The walls and the floor are shielded with 4 mm lead and all surfaces are made of non-porous materials. A gamma dose rate monitor (Thermo ESM FHT 6020) is connected to the lobby for measurement of external gamma dose rate.

The patient bathroom contains a WC ('patient only'), a shower, a hand wash basin and a washing/drying machine (all connected directly to an external drain). A shielded bin is installed which is foreseen to take all solid radioactive waste (e.g. protective paper and plastic, the patient's private clothes); it is emptied when the patient has left; the contents go into the solid radioactive waste scheme.

The isotope is taken up by the thyroid respectively the thyroid remnant and excreted over the following few days via urine, sweat and saliva in the following percentages: day 1 – 60%, day 2 – 20%, day 3 – 5%. The dose rate is daily monitored by the medical personnel. The patient remains in the room until the amount of radioactivity that remains is comparable to that of an out-patient administration. The typical release activity is 100 – 200 MBq. The patient is released with instructions that insure that the exposure of others is kept minimal.

I-131 mIBG Therapy (iodine-131-meta-iodobenzylguanidine therapy)

This therapy is used in the treatment of malignant neuro-ectodermal or neuro-endocrine tumours. The typical administrated activity is 3.7 GBq – 15 GBq, depending of the tumour burden. The isotope is administrated by slow intravenous infusion, in a dedicated shielded isolation therapy suite. The primary route of excretion is via urine, in the first five days post-therapy. It is also eliminated via sweat and saliva. The patient remains in isolation for 7-10 days in a shielded convalescence suite (the 'Victor Synge Ward'; details see Appendix 6). During this period the patient stays confined in his room having minimal contact with the staff and very restricted visits. The dose rate is measured daily. For an administration of 5.5 GBq the dose rate from the patient ranges from some 333 μSv/h at one meter on the first day of treatment to 39 μSv/h on the fourth day.

Y-90 Zevalin Therapy

This is a new radio-immunotherapy to treat Non-Hodgkin's lymphoma. An activity of up to 1.48 GBq Y-90 is administrated to the patient. All patients are treated as out patients.. Residual, unused Y-90 is stored until decayed to background levels. The isotope has a slow primary route of urinary excretion: 2% in the first 24h, some 7% over 7 days.

Y-90 Citrate Radiosynovectomy

Typically 185 MBq of Y-90 in citrate form are injected intra-articularly under fluoroscopic guidance in the treatment of synovitis. Post treatment the knee stays immobilised for 48 hours.

7. RPII'S ANALYTICAL LABORATORY

7.1. General

RPII is an Agency of the Department of the Environment, Heritage and Local Government. The RPII's funding comes mainly from grant in aid from central Government, charges for services (radon measurements, calibrations, product certification, etc), license fees and from participation in funded research projects. RPII's organisational chart is shown in Figure 6.

All routine laboratory measurements made for Article 35/36 purposes are undertaken by the radiochemical laboratory of RPII, which is part of the Institute's Monitoring and Measurement Division. The Division is subdivided into a monitoring section and a measurement services section.

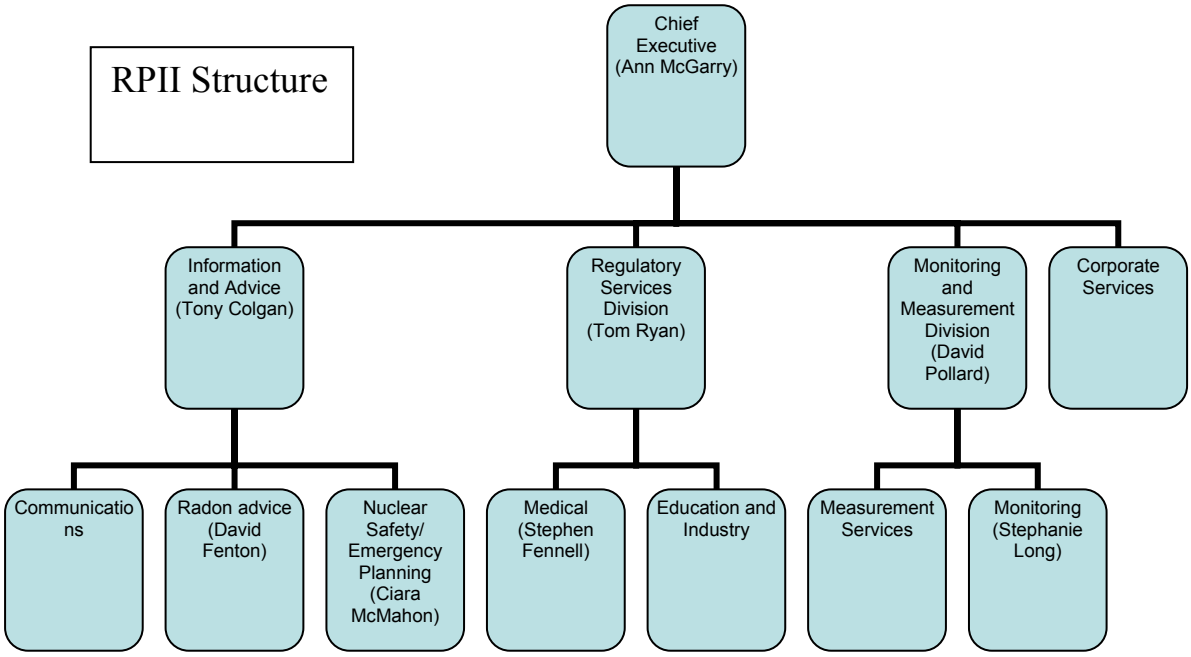


Figure 6: RPII's organigramme

The monitoring section implements RPII's environmental programme and is responsible for the radiochemical laboratory, while the measurement services section provides dosimetry, radon measurement and instrument calibration services.

RPII monitors the marine and terrestrial environment; it analyses approximately 2500 samples per year. The majority of test methods employed are accredited by the Irish National Accreditation Board according to ISO 17025. In the RPII laboratory work nine persons.

7.2. Sample registration and storage

On arrival at the laboratory all samples are logged into laboratory information system (LIMS) and bar-coded. The data recorded for each sample includes: sampling location, type, date analysis type etc.

All sampling procedures are available on paper and electronically. The laboratory's bespoke LIMS is currently being replaced by an off the shelf LIMS system from LabwareLIMS.

Marine samples are stored for indefinitely, filters from the high volume air sampler indefinitely, other samples for three months after measurements

7.3. Sample measurement

The RPII laboratory's capability in terms of measuring equipment is illustrated in Appendix 4.

Gamma spectrometry laboratory

All gamma spectrometers will be accessible within the RPII network. Relative detector sizes range from 35 to 70%). The detectors are n- and p-type; NIM devices are from Canberra and Ortec; Canberra acquisition interface modules serve two detectors each. Canberra X: Genie (VMS version of Canberra's Genie gamma spectrometry suite) is used as data acquisition and analysis system.

The shields are made from up to 10 cm Pb and have Cu lining; no Cd liners are used.

Calibration has been performed for seven geometries (plus a well geometry) in the range of 1 to 3000 ml. Standard sources used are no older than 3 years. Re-calibrations are performed after detector change or when a detector is moved.

Weekly QA checks (with regard to efficiency, energy and FWHM) are performed. Background measurements are done at Christmas (12 days); these are quarterly checked (24 hr measurements).

LN_2 for detector cooling is refilled regularly every week.

A UPS is available covering power failures lasting up to 20 minutes.

Alpha and beta measurement

The laboratory performs measurements of Rn, Pu, Tc, Pb-210 (as necessary, but not routinely), H-3 and C-14 (in seaweed). Also total alpha, beta and tritium (in water), Krypton-85 (in air). Pu and Tc measurements in fish and shellfish at made at the beginning of the year on composite sample of the year before.

It has available: two Perkin Elmer TriCarb (3170TR/SL and 2770TR/SL) LSC systems with QuantaSmart software; an alpha spectrometry system with 5 Canberra Quad chambers (housing 4 PIPS detectors each); a Tennelec alpha/beta counting system LB5100-2080 with sample changer; and a Berthold LB770 10 channel measurement device with LB530PC low radioactivity data system.

7.4. Quality assurance

The Division is accredited to ISO 17025 by the Irish National Accreditation Board (INAB). A single quality management system is in place across the division covering all four service areas (radiochemistry, dosimetry, radon measurement and instrument calibration). All measurements are carried out in accordance with RPII's documented procedures.

Procedures for receipt of test items (basically: samples) are set out in the Quality Manual and in the administrative procedures for the radiochemical laboratory. These procedures cover:

- receipt and identification of test items;
- storage of test items;
- test item identification codes.

All calibrations are carried out using certified radionuclide solutions traceable to international standards. Certificates are available for all standard solutions. For each test method calibration procedures are set out in the relevant test procedure. Certified radionuclide solutions are purchased from a number of suppliers including: PTB, NPL and NIST.

All data calculations, report generations, etc are carried out in accordance with the relevant test procedure. The laboratory currently uses a proprietary Laboratory Information Management System (LIMS) to monitor sample throughput, manage sample information and report results. The laboratory is in the process of replacing this system with an industry standard LIMS product (Labware LIMS).

7.5. Intercomparison exercises

According to INAB, the Division is required to participate regularly in inter-laboratory comparison programmes relevant to each of its four service areas. A brief summary of inter-comparisons the monitoring laboratory participated in during 2006 and 2007 is given in Table 2.

Table 2. Summary of radiochemistry inter-comparisons 2006 and 2007

Organised by	Radionculide(s)	Matrix	Status
JRC	Cs-134/Cs-137 ratio Pu-238/Pu-239,240 ratio	Liquid	Complete
Risø, DK	Tc-99	Seaweed	Complete
IAEA	A range of gamma emitters	Water, grass, soil	Complete
IAEA	Po-210	Liquid	Results submitted
NPL	Low-level gamma emitters Low-level beta emitters	Liquid	In progress
RPII/CEFAS/IMO	Cs-137 and Tc-99	Sea-water	In progress

7.6. Data centres. Reporting

All data from the national permanent monitoring stations is collected on a central computer at the RPII. All RPII monitoring data are reported in a series of environmental monitoring reports. Monitoring data are uploaded to the National Food Residue Database, maintained by Teagasc (the national body providing research, training and advice for the agri-food industry in Ireland). This information is available on web as well.

Data are reported annually to FSAI in relation to radioactivity in foodstuffs.

Data on environmental and food/feed samples are routinely transferred to the European Commission (JRC Ispra, REM system) in accordance with the Commissions requirements (Art. 36).

Gamma dose monitoring data are exchanged continuously with the UK. This exchange is automated in both directions. These data are also transmitted automatically to JRC Ispra as part of the EURDEP system.

Marine monitoring data are reported to OSPAR.

8. VERIFICATION ACTIVITIES

8.1. Introduction

In accordance with the agreed verification programme, the verification team visited the following locations:

Sampling sites and measuring stations

(The visited stations are situated in the south-eastern part of Ireland, some along the coast of the Irish Sea.)

- Cahore
- Rosslare
- Kilmeaden
- Kilkenny

Cork University Hospital

- Nuclear medicine department
- Radio-pharmacy laboratory
- Discharge tank

St James's Hospital, Dublin

- Radioiodine suite - Victor Synge Ward
- Radio-Pharmacy laboratory
- RadionuclideTherapy Department
- Liquid Discharge system

RPII headquarters and analytical laboratory, Dublin

- Air monitoring/sampling systems
- Filter sample archive
- Results database
- Radioactivity laboratory
- Chemistry laboratory
- Archiving facilities
- Dose rate monitor, precipitation sampler

8.2. Sampling sites and measuring stations

8.2.1. Cahore

Within the frame of verification of the arrangements for carrying out marine sampling and analysis the verification team visited the sampling point on the Irish Sea shore at Cahore. Sampling of sea water is

done two times a year using four plastic containers of 25 litres each. The containers have no labels with respect to the collection data. The verification team was informed that this was the routine if only one location was visited. In case several sites would have to be visited for sampling the containers would be labelled beforehand in the laboratory. The water is transported immediately to RPII's laboratory for analysis, where 50 l are used for Cs-137 measurements and 50 l for Tc-99 measurements.

Due to the possibility of changes in wind direction and force the exact sampling point can be chosen ad hoc along a coastal line of some 30 m. The weather in this area is usually windy with generally Westerly winds (leading to rather calm sea). At the time of the verification however, relatively strong Easterly wind predominated leading to rough sea.

The team could not acknowledge the seaweed sampling (*fucus vesiculosus*) because of the high tide which covered the access to the usual sampling site. The rough sea conditions had led to a delay in sea water sampling and thus the 'normal' sampling time at low tide had passed. One employee from RPII stayed at the site and waited approximately one hour until low tide. The verification team was later informed that however, due to the rough sea the algae sampling had to be cancelled altogether. The amount of algae usually sampled is about 2-3 kg; sampling is done twice per year.

Verification does not give rise to recommendations.

8.2.2. Rosslare

The verification team visited the location Rosslare station, situated in the premises of the Irish National Meteorological Service (MET Éireann) at Rosslare. The location is situated on a large flat field, fenced in, showing no trees and large distances to buildings. Thus the choice of this location is excellent.

The team verified the presence of the following devices:

- TechniData dose rate monitor (IGS421B-H, Serial Number 0457) mounted with effective sensor point 1 meter above ground and powered by connection to the electric grid. The device is equipped with an external (heated) rain sensor (TechniData RD203, Serial Number 0041).

- Aerosol sampler manufactured by Hi-Q Environmental Products Co., San Diego, USA. The last quality control inspection dates June 2006 (signed off by controlling officer). The filters are changed weekly. The team noted that one device, the 'pressure filter' indicator, was broken; however this does not affect the measurement since this device forms part of the old system readings. The new electronic readings are in a good state and function properly (air flow rate, elapsed time). Service and routine checks (such as flow rate) of the systems are performed, typically every 18 months. The verification team was informed that a new type of glass fibre filter with improved strength characteristics will be used from the end of 2007.

- Rain samplers: there are three devices on the site, only one belonging to RPII (the others being part of the meteorological system). The rain collector is made of plastic, round, and has approximately 20 cm diameter. The rain water collection schedule can be found in a log book in the meteorological office nearby. No heating device is needed for melting any snow, since due to the proximity of the sea even during the cold season no critical situations that could lead to snow covers or equipment freezing arise. Corrosion problems led to abandon one 1 m^2 sampler, which could still be seen stowed away in the yard.

The verification team visited the office situated inside the meteorological station building, where the TechniData data logger DLM1450 is located. The equipment sheets are on site; the status display shows the current dose value. The device is locked with a key which is available on site. Written procedures from TechniData were available at the work place.

The verification team was informed that the meteorological station may move; thus the RPII equipment will move too. The new location will be New Johnstown Castle, at some 10 km away, more inland.

Verification does not give rise to recommendations.

8.2.3. Kilmeaden

The verification team visited the Kilmeaden station situated on the premises of the local water distribution company. The location is well chosen (several km outside the town) and the siting is very good, with no buildings or trees in the close neighbourhood.

The team acknowledged the solar powered gamma dose rate system TechniData (type AGS421S, Serial Number 0113) with built-in rain sensor (which – for lower power consumption) is not heated. The system is equipped with GSM data transmission.

The verification team was informed that the installation of a new air monitor is planned at the same location some 100 m near the dose rate monitor site. This device will have electric power connection.

Verification does not give rise to recommendations.

8.2.4. Kilkenny

The station is located within the premises of the local meteorological station (belonging to the Irish Meteorological Institute) in the outskirts of Kilkenny town, not easy to find.

The location is well chosen and the siting is good, with no high buildings or trees in the neighbourhood. The station is not accessible outside working hours being situated within a fenced-in area.

The team noted the presence of the following devices:

- TechniData dose rate monitor (IGS421B-H) connected to the electric power grid. The device is equipped with an external, heated rain sensor.

- one rain sampler identical with the one described under 8.2.2..

No air monitor is foreseen for this place.

For purposes of a better identification of the stations' location and easier orientation in changing local environments, the verification team suggests RPII to supply the staff with a portable navigation system.

8.3. Cork University Hospital

The verification team visited some areas where nuclear medicine work is carried out at Cork University Hospital.

The team acknowledged that approximately 24 thyroid cancer patients per year undergo a thyroid ablation treatment. The patients are kept for 6 days in the radio-iodine suite although according to general guidance 3 nights should normally be sufficient (as evidenced in ICRP Publication 94 'Release of Patients after Therapy with Unsealed Radionuclides').

8.3.1. Discharges

Liquid radiobiological wastes from the radio-iodine suite are piped into a holding/delay tank with a capacity of 1000 litres. The verification team was informed that the fluids are stored as long as possible for decay. The activity discharged is calculated based on the full administered amounts of radioactivity (i.e. worst case scenario). After the decay period (calculated) the tank content is discharged into the sewage system without measurement.

The team was told that some patients, despite the information and warnings received from the hospital personnel flushed a wide variety of detritus into the toilet. On one occasion in 2005 blocked sewage pipes led to the radio-iodine suite being removed from service because of a leak from the sewage system which contaminated an area of ground outside the suite. This leak required a major modification to the liquid waste system to reduce significantly the risk of a recurrence. In case of a blockage in the sewage pipe leading to the holding tank, there is now a separate direct overflow into the general sewage system. A revised risk assessment was carried out and new quality control measures and procedures were implemented which have prevented further contamination incidents. Installing a second tank and switching from one to the other (one allowing decay while the other one is being filled) has not been deemed necessary by hospital staff.

The Irish regulator informed the team that, currently there is no legal requirement for storage tanks; however, Ireland committed itself to follow OSPAR requirements and thus may change the regulations accordingly if necessary.

Reporting and quality assurance

The discharge report of Cork Hospital, which is sent on an annual basis to RPII, is based on the OSPAR reporting mechanism. The department intends to review the process and the reporting procedures by the end of 2007. The verification team was informed that a process of increased and continuous training of the personnel is ongoing. At present one senior physicist and three basic grade physicists are working in the nuclear medicine department.

In Ireland the storage system of old sealed radioactive sources is not clearly defined. In 2006, the hospital started to return about 33 old sources to their origin, thus significantly reducing the risk profile for the hospital. The process will continue in 2007.

In order to validate the models used and to cross check the initial activity calculations and dose estimations, the verification team recommends periodically taking and analysing appropriate discharge samples. In addition, if a further reduction of the activity discharged is envisaged the installation of a decay system with separate tanks that can be used in alternation should be considered.

8.3.2. Radio-pharmacy laboratory

The verification team visited the radio-pharmacy laboratory, where diagnosis and treatments of patients are prepared. The team acknowledged ten technetium generators which are used in a turnaround mode (eight being intermediately stored in a shielded place). The generators are produced by Amersham.

The verification ream noticed the availability of a Berthold LB3210 B and an FHT 111M contamination monitor that are used for performing regular checks.

Syringes, gloves and other used materials are kept in shielded containers situated in a continuously monitored room. Other waste is stored in dedicated plastic bags. Staff change these bags on a monthly basis.

The team acknowledged the presence of two toilets dedicated to patients treated at the nuclear medical department. The WCs are monitored twice a day with portable gamma monitors. The same checking procedure applies for all the rooms of the radiopharmacy laboratory. Spreadsheets containing information on contamination measurements of the rooms, and on activities distributed to the patients are available in the laboratory.

Quality assurance

The authorisation and the annual calibration of the devices used for diagnostics and treatments are done by RPII. The necessary equipment is checked according to quality assurance manuals before treatment.

Written procedures were available at the work places. Since 2005 procedures are being reviewed. Recently the discharge procedure was updated.

Verification does not give rise to recommendations.

8.4. St James's Hospital

8.4.1. Radioiodine suite (Radionuclide Therapy Department)

At the time of the verification the radioiodine suite was not occupied by a patient thus access was possible.

The verification team saw that the suite is quite comfortable and equipped up to current standards; it noted that the room looks into the green with a large window is letting in light.

Dose rate records are written daily into a logbook. Radiation safety procedures for staff are available at all workplaces around the suite. A wash–hand basin is also situated in the entrance lobby. Food and drinks enter and leave the suite via a shielded access hatch, the patient being previously announced by phone. Food wastes are disposed in a waste disposal.

Before hospitalisation, the patient is required to bring old clothes which must be abandoned as waste at the end of the period of staying in the suite. Private visits are restricted: no visitors for the first 24 hours. Visits should not be longer than 30 minutes and the visitor should stay at a minimum of 3 m distance from the patient. No children or pregnant women are allowed to enter the suite. The contact with nursing or clinical staff is limited to the necessary.

Verification does not give rise to recommendations.

8.4.2. Radio-pharmacy laboratory (Radionuclide Therapy Department)

The main activity of the laboratory is to receive the radio-nuclides (all arrivals are recorded in a log-book), to assess them, eventually store them in a safe and prepare the administration to the patients. Five scientists and three technicians presently work here. For open sources the hospital has a frame authorisation. For closed sources individual authorisations are needed.

The laboratory is divided in a 'clean' and an 'active' side.

The laboratory continually disposes of two technetium generators ('milking' Tc-99m from a Mo-99 solution); it uses them in alternation. A technetium generator arrives every Monday via a licensed Irish company. Generators that are no more usable go back to the Irish distributor (transports twice a year) who returns them in bulks to the original supplier (in Belgium, France).

Intermediate storage of radioactive material

The verification team visited the room dedicated for storage of radioactive material. In this room, old generators which are marked with the date are stored intermediately. Small sources are kept in a cupboard. A list with the provenience of the sources and source parameters was available at the visit. In accordance with RPII requirements wipe tests are made every 2 years. The verification team noted a shielded safe containing old unsealed sources (e.g. Xe-133); the contents are checked routinely; measurements are performed; a logbook with the according information is available at place. If possible the items are disposed of (by sending e.g. to the Netherlands). If necessary wastes are transferred to the outer storage room (see below).

Quality assurance

The verification team acknowledged the presence of the notebooks in which all details of radioactive stocks and of radio-nuclide arrivals are recorded. Special logs for the usage of the radioactive materials are also available. Transfer of material to a secure waste store in the hospital is documented.

Checklists with procedures as well as the procedures themselves are available in the laboratory. RPII monitors the calibration.

Verification does not give rise to recommendations.

8.4.3. Radioactive waste storage room situated outside main building

Ireland does not operate a radioactive waste repository. Thus, e.g. a legacy of very old technetium generator cores (the lead having been stripped) with residual Tc-99 activity exists. Storage of such wastes currently is somehow unclear. In some cases wastes can be sent to other countries for disposal. St. James's hospital stores such wastes in a dedicated room outside of the laboratory. It is accessible via a backyard on the Campus.

The verification team visited this storage room. Radioactive wastes are segregated according to their half-life. They are stored in plastic bags, 'sharpak' containers and other special recipients, until the radiation level decays 'to background'. These recipients are labelled with the radioisotope name, the date they were brought in and the foreseen end of storage. Results of radiation monitoring are noted at regular intervals on a list available in the storage room. Outside, the room is not marked with a radiation warning sign (to avoid problems with trespassers) but inside, the recipients are. After decay to 'normal' values, the labels are removed and the material is transferred as non-radioactive waste to the normal hospital waste as required by the hospital policy. Incineration or disposal of such waste underlies special regulation in Ireland.

Verification does not give rise to particular remarks concerning radioactive waste handling. However, it would endorse Ireland finding a country-wide solution for the radioactive waste storage issue.

8.4.4. Liquid Discharge System

The verification team was informed that St. James's does not operate a discharge tank; liquid radioactive discharges go directly to the main sewage pipe. The sewage purification plant taking up the discharges is operating automatically. Model calculations performed have shown that the dose to workers in the sewage purification plant due to discharges is acceptable.

In order to validate the models used and to cross check the initial activity calculations and dose estimations, the verification team recommends periodically taking and analysing appropriate discharge samples. In particular, with regard to potential doses to workers in the sewage purification plant, the use of a highly conservative approach for modelling such exposures is recommended. In addition, if a further reduction of the activity discharged is envisaged the

installation of a decay system with separate tanks that can be used in alternation should be considered.

8.4.5. Diagnostic Nuclear Medicine Department

The verification team paid a short visit to this unit. It was informed that patients generally stay several hours in the unit after having received a radioisotope injection. Most patients are scanned on the day of injection. Exceptions arise for scanning for infection or metastases of thyroid origin but the vast majority of procedures are based on a scan on the day of injection. Since patients were waiting for treatment the team could not make an in-depth survey.

Verification does not give rise to remarks.

8.5. RPII - Analytical Laboratory

8.5.1. Sample registration and preparation

The verification team verified the laboratory where the samples are registered and chemically prepared for the measurements.

The team was informed that the connection to the new laboratory information system was successfully tested for gamma spectroscopy; no obstacles are foreseen for connecting the Berthold counter and the LSC devices.

The samples are all bar-coded (on the side and on the top of the sample containers) according to the laboratory procedures. If the sampling takes place at more than one location, the sampling containers are pre-marked. The stickers do not contain the sampling date, which can be found however in the laboratory database and on the barcode. The procedures and the sample database could be equally found in paper format and electronically (are shared and updated on the institution's intranet system).

The laboratory has two furnaces and three dryers; it operates a ventilation and extraction system.

Verification does not give rise to recommendations. The team strongly supports the full implementation of the new laboratory information management system.

8.5.2. Sample measurement

Gamma spectrometry laboratory

The verification team visited the gamma spectrometer laboratory and noted that one of the 8 detectors (belonging to an automatic sample changer) was under repair. Currently four staff members are involved in gamma spectrometry tasks.

The team was informed that the currently used VMS version of the gamma spectrometry system is in the process of replacement by a PC version. The laboratory applies summing corrections and – for soil and sediment samples – density corrections.

Each sample measurement: is noted on a work sheet (one for each detector) by sticking an according label and checked off with the signature of the technician.

The verification team noted that the detectors have sample centering devices and are contamination protected by cling film.

During demonstration of one of the systems with a sample changer the changing mechanism got somehow stuck. As this was the system with the detector under repair the failure will be fixed when the device is brought back to operation.

Alpha and beta measurement

The verification team saw the LSC and alpha spectrometry devices as well as the Tennelec and Berthold alpha/beta counters used for air, drinking water and Tc-99 measurements.

It was informed that calibrations with Am-241 and Sr-90 sources are performed monthly i.e. at every change of counting gas; QA plots are done to check the performance of the devices. Background is measured once per year respectively for every batch. Currently the transfer of data to spreadsheet is manual; however trials to connect the Berthold device to the LIMS are ongoing.

Verification does not give rise to recommendations. The verification team encourages connecting all measurement systems to the laboratory information management system to avoid as far as possible manual input errors.

8.5.3. Devices outside the main RPII building

Dose rate monitor; precipitation sampler

The verification team saw the gamma dose rate monitor installed at RPII (TechniData version with external rain sensor). The device is mounted relatively close to the fence and building.

It also noted a stainless steel precipitation sampler (diameter ca. 40 cm). It was informed that, sample change takes place 1/2 weeks; the samples are kept but normally not measured; measurement is only performed when a contamination event is suspected.

High volume air sampler

The verification team acknowledged the 'Risø' high volume air sampler (ca. 2000 m^3/h) which ensures continuous monitoring of the air in Dublin. The device was originally installed at the Risø research centre in Denmark and bought by RPII

The filters are changed bi-weekly. They are analysed in monthly batches in the RPII analytical laboratory for gamma emitting radionuclides.

The team was informed about the indirect method of air flow determination. Since the flow rate for such high values (at the time of construction) could not be measured directly, a special by-pass type system was installed inside the air sampler leading the air stream to six small filters. For details of this method, see Appendix 5.

Verification does not give rise to recommendations However, the verification team suggests investigating if the assumption underlying the check of the used air flow 'calibration' method – i.e. that the Be-7 relevant particle size distribution is the same for the main air stream and the bypass – is correct.

Krypton sampling

The verification team saw the device used for sampling krypton in air. Kr-85, is released into the environment primarily as a result of the reprocessing of nuclear fuel at installations such as Sellafield in the UK and Cogema La Hague in France. The samples are collected once a month. Final sample preparation and measurement is done in Belgium.

Verification does not give rise to recommendations.

8.5.4. Quality assurance issues

The handling procedures and the training of the personnel are according to RPII's Quality Manual (last updated in September '06).

The team noted that all the procedures for sample preparation are available at the working place, they exist in duplicate or triplicate and there are very detailed. They can also be consulted by everybody on the internal network (intranet).

At the time of the visit no preparation of marine samples took place in the laboratory (such preparations are done in specific campaigns).

Verification does not give rise to recommendations.

8.5.5. Archiving and sources storage

After the measurement the samples are kept for 3 months. Marine samples are kept indefinitely. The archive for air filters dates since 2003. The spectra of all the measurements are also kept.

The team performed the tracing of a historical sample and its archiving. For this a filter taken from the high volume air sampler from Belfield from 27 May 2004 was chosen. The measurement data could be traced by the team and the archiving of the sample itself could be verified as well. The gamma spectrum was archived on CD-ROM (PC based system) and was transferred for the gamma spectrometric analysis to the VAX based system via FTP. Generally there the laboratory prefers to archive on DAT tape. RPII has an agreement with Canberra to transfer the results to DAT tape.

The analytical balances and other measuring devices are calibrated by an officially certified company, Mason Technology. Every individual calibration is noted in a book which can be consulted in the laboratory.

The majority of liquid and solid calibration sources are from Amersham. The sources are kept in the laboratory in a secured and isolated cupboard. The access to them is limited only to a small number of people. They are recorded in a specific book in the laboratory and accounted. This book contains all data related to source history, technical description, manufacturer, corrections, and controls effected. The calibration certificates are archived also.

Verification activities with respect to archiving lead to no remarks.

8.5.6. Inter-comparison exercises

The verification team was informed that RPII participates regularly in different inter-comparisons.

Verification does not give rise to recommendations.

8.5.7. Data Centre

The verification team was shown the central data system for gamma dose rate values on RPII's internal network. The system is based on the Danish Argos software. In addition to the management of Irish data it allows a geographical presentation of the UK's RIMNET data. Data from the new air monitors will be integrated in the system.

Verification does not give rise to recommendations.

8.5.8. Mobile measurement systems

RPII does not have mobile monitoring equipment.

The verification encourages the acquisition of a mobile monitoring station by RPII, taking into account that this may be useful for emergency monitoring purposes as well as for other environmental measurements and radiological surveillance.

9. 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 led to the following observations:

(1) 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 with regard to the surveillance of the Irish territory are adequate. The Commission could verify the operation and efficiency of these facilities.

(2) However, a few recommendations and suggestions are formulated, mainly in relation to general quality assurance and control. These aim at improving some aspects of the environmental surveillance. They do not detract from the general conclusion that the Irish national monitoring system is in conformity with the provisions laid down under Article 35 of the Euratom Treaty.

(3) With regard to hospital discharges, in order to validate the models used and to cross check the initial activity calculations and dose estimations, the verification team recommends periodically taking and analysing appropriate discharge samples. The verification team endorses and encourages the ongoing review process regarding reduction of discharged activity by e.g. using decay tank systems and expresses interest in its outcome. For such reduction purposes the installation of separate decay tanks for liquid radioactive discharges that can be used in alternation, should be considered.

(4) With regard to radioactive waste in general, the verification team endorses Ireland finding a country-wide solution.

(5) The recommendations presented in this report are summarised in the ‘Main Findings’ document that is addressed to the Irish competent authority through the Permanent Representative of Ireland to the European Union.

(6) The present Technical Report is to be enclosed with the Main Findings.

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

APPENDIX 1

REFERENCES AND DOCUMENTATION

Main related websites

Radiological Protection Institute of Ireland	www.rpii.ie
Teagasc:	www.teagasc.ie
St James's Hospital	www.stjames.ie

Legal framework

Radiological Protection Act, 1991 (Article 7 (1) (a)) [http://www.irishstatutebook.ie/ZZA9Y1991.html].

Radiological Protection Act, 1991 (Ionising Radiation) Order, 2000. [http://www.irishstatutebook.ie/front.html]

Radiological Protection Act, 1991 (Article 7 (1) (a)) [http://www.irishstatutebook.ie/ZZA9Y1991.html].

European Communities (Drinking Water) Regulations, 2000. (Statutory Instrument 439 of 2000). [http://www.fsai.ie/legislation/food/eu_docs/Water/SI439_2000.pdf]

Other documents:

Questionnaire on the implementation of Art. 35 of the EURATOM Treaty in the Republic of Ireland, 2005.

Verification activities under the terms of Art. 35 of the Euratom Treaty, preliminary information questionnaire addressed to the national competent authority in view of preparing the Art. 35 verification in Ireland 19-23 March 2007.

RPII powerpoint presentation: "Overview of the regulatory framework including the licensing and inspection programme and conditions for discharge /disposal", presented by Stephen Fennel

RPII powerpoint presentation: "Overview of the radiation protection infrastructure in Ireland, the role of the RPII and relevant foodstuffs/environmental legislation"

RPII powerpoint presentation: "Automated national monitoring systems"

RPII powerpoint presentation:"Radiological Assessement of Irish NORM Industries (2001- 2006)", presented by Catherine Organo

RPII powerpoint presentation:"An Overview of the RPII's Monitoring Programme", presented by Stephanie Long

RPII- radioactivity Monitoring of the Irish Environment 2003-2005

Tables containing the radioactivity levels for 2006 year for: airborne particulates (low and high volume), mixed diet, milk, seawater, marine sediments, seaweed (*Fucus vesiculosus*), gross alpha and beta activities in drinking water, Cs-137 activity concentrations in fish and shellfish

St. James's Hospital – Annual report 2005.

APPENDIX 2

VERIFICATION PROGRAMME

Tuesday 01 May

1. **09:00** **Opening meeting** : introduction + presentations at RPII's premises in Dublin

2. **13:00** **Verifications activities:**
   - environmental monitoring facilities and sampling (Cahore and Rosslare);
   - EC team travels to Cork

Wednesday 02 May

3. **09:00** **Verifications activities:**
   - Monitoring of the discharge facilities at the licensed site: Cork University Hospital (CUH)

4. **13:00** **Verification activities:**
   - Environmental monitoring and sampling facilities at Kilkenny and Dublin-Belfield

Thursday 03/May

5. **09:00** **Verification activities:**
   - Monitoring of the discharge facilities at the licensed site: St. James's Hospital, Dublin

6. **13:00** **Verification activities:**
   - Environmental laboratory of RPII, Dublin

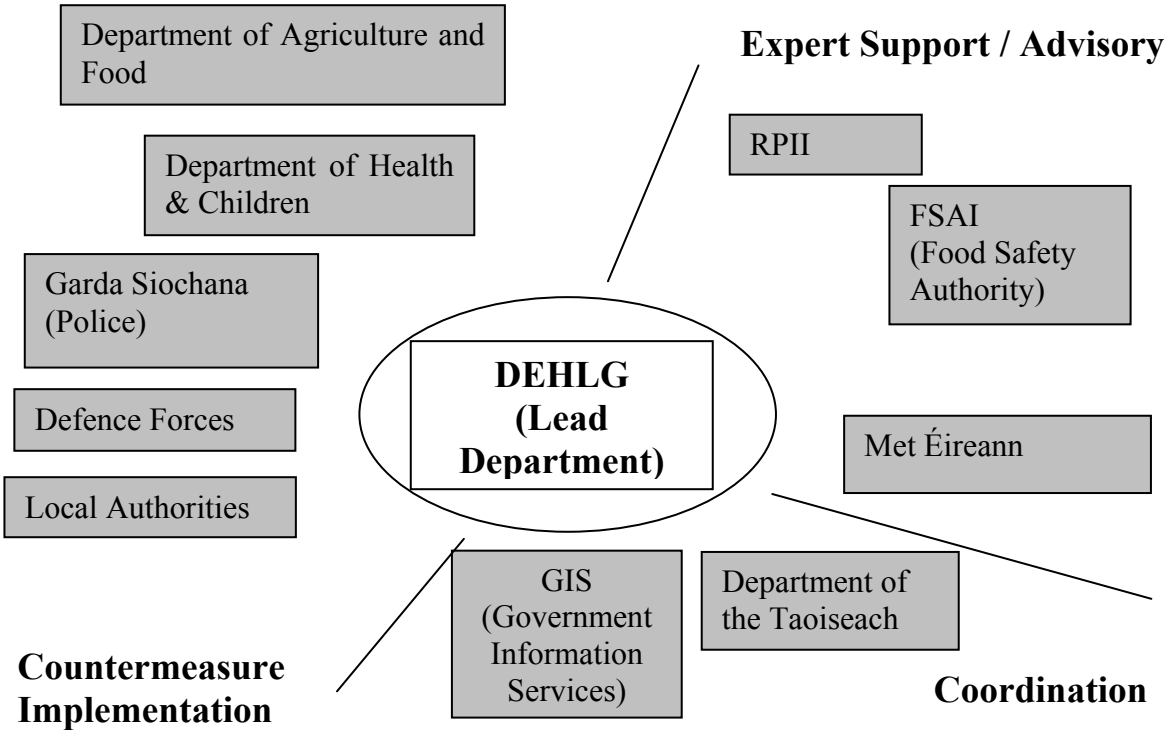
Friday 04/May

7. **09:00** **Closing meeting: presentation of preliminary verification findings (RPII headquarters)**

8. **13:00** **EC verification team returns to Luxembourg**

APPENDIX 3

ORGANISATION OF NEPNA



APPENDIX 4

RPII: SUMMARY OF RADIO-ANALYTICAL EQUIPMENT

Measuring Equipment	**No. of Units**	**Technical Details**
Gamma spectrometer	8	Detectors: EG&G Ortec and Canberra high resolution germanium photon detectors. Spectroscopy system: Canberra X:Genie system; Sample changer: 3 units are equipped with Canberra / Nuclear Data sample changers
Low level liquid Scintillation counter	1	Canberra Packard Tri-Carb 2770 TR/SL
Ultra-Low Level Liquid Scintillation Analyser	1	Perkin Elmer Tri-Carb 3170 TR/SL
Alpha Spectrometer	20	Detectors: Canberra Spectroscopy system: Canberra
Gas flow proportional counter	1	Tennelec LB 5100-2080 with automatic sample changer
Gas flow proportional counter	1	Berthold LB 770 10 Channel Low level Counter

APPENDIX 5

HIGH VOLUME AIR SAMPLER AT UCD

Specifications/details

- The system was purchased from Risø, Denmark
- The system requires six polypropylene G-3 filters, each 0.56 x 0.48 metres. These are mounted on a hexagonal structure below which the air blower is located. This hexagonal filter holder can be rotated to facilitate the filter change.
- The power rating of the electrical blower is 4.0 kW
- A gas meter or totaliser connected to a shunt, drawing air through a small filter, records the airflow. This reading is scaled by the ratio of the areas of the small and large filters to give the flow rate through the high volume system. This was calculated to be 650. The airflow rate is typically between 2000 and 2500 m^3 hr^{-1}.
- This scaling factor of 650 was checked by comparing the Be-7 concentrations measured on the small filter with those measured on the large high volume filter. These agreed within uncertainties.
- The sample (6 filters) is collected on a monthly basis by RPII staff and after logging to the database is counted in a Marinelli beaker for approximately 3.5 days on a high resolution gamma spectrometer. All results are decay corrected to the sampling date and corrected for decay during the collection period.
- Two filters measured by Risø (ashing followed by gamma spectrometry) were in excellent agreement with RPII results (filters placed in Marinelli beakers for gamma spectrometry).
- UCD staff are to undertake some maintenance to allow the housing be opened to examine the air handling unit and allow a calibration check measurement be made on the flow rate. This is considered important.

APPENDIX 6

ST. JAMES'S HOSPITAL – RADIO-IODINE SUITE