

# **Peer Review of the RPII's Environmental Monitoring Programme 2009**

## **Foundation Document**

### **C. Overview of Monitoring Projects**

#### **1. Introduction**

In general artificial exposure pathways are addressed through continuous monitoring, while natural exposure pathways are more often addressed through project based elements of the monitoring programme. This distinction reflects differences in the expected temporal variations for individual natural and artificial pathways.

Project-based monitoring is undertaken by the RPII for a number of reasons:

- to investigate in greater detail and/ or to complement continuous monitoring for specific aspects of terrestrial and marine environmental radioactivity
- to investigate the level of monitoring required to assure validity of results or to decide if continuous monitoring is justified in a specific context

This document describes recent RPII projects undertaken as part of the Environmental Monitoring Programme. A full list of relevant RPII reports, journal articles, conference papers and general articles produced by staff of the RPII which provide an overview of historical research and project work is provided in Supplementary Document B.

#### **2. Legislation**

National and European legislation relevant to the RPII Environmental Monitoring Programme is outlined in Supplementary Document A.

Of particular relevance to monitoring conducted on a project-basis are the general requirements defined in Section 7 of the Radiological Protection Act, 1991 for monitoring to underpin advice and information to Government and the public regarding particular aspects of terrestrial and marine radioactivity (7.—(1) (c)).

Section 7 also defines a general requirement to carry out or to coordinate research into any matter relating to the functions or activities of the Institute (7.—(1) (j)).

#### **3. Aims and Objectives**

The aims and objectives of the RPII Monitoring Programme are laid out in the Overview of the Peer Review.

Of particular relevance to monitoring conducted on a project-basis are the aims to assess doses and the temporal and geographical distributions of concentrations of artificial and natural radionuclides in the environment as accurately and

effectively as possible. This is related to the aim to support the RPII's role to provide high quality scientifically-based advice as an input to Government policy.

#### **4. Summary of Key Projects Undertaken**

##### **4.1 Terrestrial Radioactivity**

While the continuous monitoring programme has concentrated on drinking water supplied from either surface waters or large aquifers, two projects have investigated radioactivity in that sourced from ground water:

###### *A study of radon in drinking water in Co Wicklow – a pilot study (2003)*

Commission Recommendation 2001/928/Euratom (European Commission, 2001) recommends that member states undertake studies to determine the scale and nature of exposures caused by radon activity concentrations in private drinking water supplies.

In 2003 a pilot study to assess the distribution and concentrations of radon in private ground water supplies was completed in Co. Wicklow (Ryan et al, 2003). Wicklow was chosen for this study because high indoor radon levels in homes had been identified throughout the county; the underlying geology is predominantly granite (with elevated uranium content); and there are an estimated 1200 to 5000 private ground water supplies in use in the county.

Radon activity concentrations were measured in the private ground water supplies of 166 houses in Co. Wicklow. Four supplies had activity concentrations in excess of the Recommended EC action level of 1000 Bq/l and 15 had activity concentrations between 500 and 1000 Bq/l.

Dose estimates based on measurements made in this study demonstrate that radon in drinking water may pose a significant additional health risk, in the longer term, to some consumers who depend on private ground water supplies as their primary source of drinking water.

A number of scientific issues were also addressed in order to underpin the results. These included determination of an appropriate sampling and analysis methodology for radon in drinking water (Sequeria et al, 2003) and analysis of a subset of samples for radon decay products (Po-210) and elemental uranium.

###### *A national survey of radioactivity in ground water drinking water supplies (in collaboration with the Environmental Protection Agency) (2008 – 2010)*

The groundwater project addresses the issue that historically the focus of the RPII drinking water monitoring programme has been concentrated on supplies derived from either surface waters or large aquifers.

See Foundation Document H for more details.

*A Total Diet Study to investigate of levels of radioactivity in a range of food ingredients (in collaboration with the Food Safety Authority of Ireland) (2003 – 2004)*

This project was set up in order to reassure the public and confirm RPII advice that consumption of food produced in Ireland is of no radiological impact on health. This project complemented the routine mixed-diet and milk monitoring performed as part of the continuous monitoring programme and the certification programme which addresses food destined for exports. It also investigated the requirement under Articles 35 and 36 of the Euratom treaty for monitoring of individual food ingredients where appropriate.

The RPII analysed for Cs-137 in a range of individual ingredients. Most samples were below the limit of detection and consequentially no dose was calculated.

A number of related but unreported studies have also been conducted:

- An analysis of local produce from the Dundalk area and its hinterland for Cs-137 was undertaken in 2002. There was concern that sea to land to crop transfer could be taking place. Most samples were below the limit of detection and consequentially no dose was calculated.
- Also in 2002 produce from the Dublin Fruit & Vegetable market was analysed for Cs-137 but once again most samples were below the limit of detection and consequentially no dose was calculated.
- A number of samples of food products from ethnic shops were analysed for Cs-137 to ensure safe levels. There is a possibility that the products could originate from countries badly contaminated by the Chernobyl accident. Most samples were below the limit of detection and consequentially no dose was calculated. It was noted that many products were of German origin.

*A radiological impact assessment of discharges of therapeutic iodine-131 from hospitals into Dublin Bay (2003 – 2004)*

The only radionuclide that is present in measurable quantities as a result of discharges from Irish hospitals is I-131. A study to assess the environmental impact of these discharges and doses to workers potentially exposed to them was carried out between 2003 and 2004 (Akinmboni et al, 2005) in order to fulfil the RPII's responsibilities under S.I. 125 of 2002 to assess radiation doses from practices.

The study concluded that, since this radionuclide is short-lived and the amounts discharged relatively small, their impact on the environment was negligible and doses to potentially exposed workers significantly less than the annual dose limit to members of the public from exposure to all controlled sources of ionising radiation of 1 mSv/y.

### *National Radon Survey (1992 to 1999)*

The RPII carried out a National Radon Survey between 1992 and 1999 to assess the level of radon gas in Irish homes (Fennell et al, 2002). The survey identified those parts of the country most at risk from high indoor radon. The survey was geographically based using the 10 km grid square of the Irish National Grid as the unit area. Radon measurements were carried out in 11,319 houses throughout the country. Radon levels varied from 10 to 1,914 Bq/m<sup>3</sup> with an average indoor radon concentration of 89 Bq/m<sup>3</sup>. Based on this survey it has been estimated that 91,000 houses throughout the country, or 7% of the total, have indoor levels in excess of 200 Bq/m<sup>3</sup>.

### *The National Thoron Survey (in collaboration with University College Dublin (UCD) and the National Institute of Radiation Science in Japan) (2007 – 2009)*

Thoron is a naturally occurring radioactive gas produced by the decay of radium-224 which is present in the earth's crust. Thoron like radon can be found in higher concentrations in homes and workplaces than outdoor air. The RPII's national dose assessment report published in 2008 estimated that exposure to indoor thoron gas accounted for approximately 7% of the average per caput radiation dose in Ireland. This estimate, however, was based on very limited study and so a national survey of indoor thoron levels in Irish homes was commenced by the RPII. This is a collaborative project between the RPII, UCD and the National Institute of Radiation Science (NIRS) in Japan. The principal source of thoron in homes is thorium in building materials. Unlike radon, the local geology has little influence on the levels of thoron in homes because the short half-life of thoron (55.6 seconds) means that most of it has decayed by the time it migrates from the underlying soil into the home. The short half-life of thoron also means that it is the decay products and not thoron itself that contribute to radiation dose.

As part of the survey, thoron gas, thoron decay products and radon gas were measured in 253 homes in Cork, Dublin, Galway and Limerick. Homes were selected to be representative of major population centres and major housing types (houses, apartments, etc). In each home measurements were made in the main living room and the main bedroom. Approximately 180 of the houses measured had previously been measured as part of the National Radon Survey and so this study also provides the opportunity to investigate long term variability in indoor radon levels. The survey was divided into two phases and measurements for phase one were completed in 2008. Based on the phase one results, the mean and highest annual dose received from thoron decay products were 0.3 and 2.6 mSv/year, respectively. These may be compared to a dose of 5 mSv/year from indoor radon concentrations at the national Reference Level of 200 Bq/m<sup>3</sup>.

### *Kr-85 and other airborne radioactivity measurements throughout Ireland (2004)*

RPII operated a Kr-85 monitoring programme between 1993 and 2007 to establish a baseline concentration before start up of THORP operations at

Sellafield and to measure the effect of its operation on the Kr-85 concentration. All sampling was performed at Clonskeagh, Dublin.

This longitudinal study correlated measured activities with discharges from Cap La Hague (Smith et al, 2005). The pattern observed in the measured activities was of a slowly increasing baseline with occasional spikes in concentration. The study found that the spikes correspond to situations where the air mass over Dublin had in the previous few days passed over either La Hague or Sellafield. It concluded, therefore, that the spikes resulted from a Kr-85 plume from the reprocessing plant and are not representative of the equilibrium situation over Dublin.

#### 4.2 Marine Radioactivity

*A marine habits survey along the north east coast of Ireland (conducted by CEFAS) (2008)*

The aim of this survey was to identify the critical pathways by which people living in Ireland are exposed to ionising radiation as a result of radioactive discharges into the Irish Sea (Clyne et al, 2009). The survey concentrated on the coastline from Clogherhead to Omeath, Co. Louth, the area in which the highest levels of radioactivity attributable to Sellafield are observed. This was carried out by collecting comprehensive information on the habits of the public to enable realistic dose assessments to be made. Specifically, investigations were conducted into the consumption of aquatic foods, the occupancy of intertidal areas, the handling of fishing gear and catch, the handling of sediment, the occupancy in and on water, and any unusual exposure pathways.

*Development of a model to simulate the transport and distribution of Tc-99 along the east coast of Ireland (jointly undertaken with the National University of Ireland, Galway) (2007 – 2008)*

Through modelling spatial and temporal variability of Tc-99 along the eastern Irish Sea, the project aims to establish an objective basis for the choice of monitoring densities and frequencies (Olbert and Hartnett., 2009). The use of models allows us to take into account known sources of variability. It should also provide a framework for interpretation of monitoring data. Environmental monitoring involves sampling particular environmental compartments at fixed geographic locations at discrete points in time. In order to make general conclusions from monitoring data, it is necessary to assume that the samples taken are representative of the environment more generally. The project aims through the use of models to provide a framework for the interpretation of monitoring data.

*An assessment of the doses to Irish seafood consumers from Tc-99 over the period 1991 – 2006 (2007)*

In this study, the effects of the Sellafield discharges on the <sup>99</sup>Tc activity concentrations in fish and shellfish and the committed effective doses to

consumers of seafood landed at ports on the north-east coast of Ireland since 1990 were presented (Smith et al, 2009).

Samples of whiting, prawns and mussels in pre EARP samples and 2006 samples were compared. The <sup>99</sup>Tc activity concentrations in whiting in August 2007 were approximately three times higher than the pre-EARP baseline. The <sup>99</sup>Tc activity concentration in prawns in 2006 was still approximately six times higher than the pre-EARP baseline while the <sup>99</sup>Tc activity concentration in wild mussels in January 2008 was three times higher than the pre-EARP value. Consequently the doses to both typical and heavy seafood consumers in 2006 were greater than the baseline levels of the early 1990s by a factor of two.

*A detailed assessment of the doses to the Irish public from the consumption of Po-210 in seafood (1998)*

The concentrations of polonium-210 were measured in a range of fish and shellfish species that are part of the Irish seafood diet. The dose to a typical and heavy consumer was estimated to be 32 µSv and 148 µSv respectively (Pollard et al, 1998).

*Measurement of Tc-99 and Cs-137 from sediment cores taken from the Irish Sea (in progress) (2009)*

Although discharges of <sup>99</sup>Tc from Sellafield have returned to pre-EARP levels, contaminated sediments may become an important secondary source of <sup>99</sup>Tc in seafood in the future. RPII can measure Tc-99 in water biota and seafood. This study highlighted the need to investigate the introduction of a sediment core sampling technique.

#### *Collaborative Monitoring Projects*

A number of collaborative projects with UCD and the Environment and Heritage Service (EHS) of the Department of the Environment for Northern Ireland (now the Northern Ireland Environment Agency (NIEA)) have been conducted in the past twenty years. These included joint sampling of seawater around the Island of Ireland in recent years and assessments of artificial radioactivity levels in Lough Foyle in 1996 (Cunningham et al, 1996) and Carlingford Lough in 1992 and 1997 (Mitchell et al, 1992; Long et al, 1997). A follow up study of Carlingford Lough to assess levels twenty years on is planned. These projects have been useful in maintaining links between RPII and NIEA and work as part of all island study.

#### *Other Projects*

Previously RPII staff participated in a number of international projects, many funded by the European Union. These included terrestrial and marine radioecology projects following Chernobyl and REMOTRANS which studied the

remobilization of radionuclides from contaminated marine sediments. Related publications are included in Supplementary Document B.

## **5. Issues for Consideration by the Peer Review Group**

The terms of reference are laid out in the Overview of the Peer Review. In particular the group is asked to comment on information gaps or research needs going forward which should be addressed through targeted research over the next 3 to 5 years.

In considering the need for project based monitoring/ research the group should take into account of emerging issues including greater emphasis on exposure from natural sources and protection of non-human species.

The group should identify specific issue to be addressed through targeted research which would:

- Support the RPII in better addressing legal requirements, international obligations and international best practice?
- Improve the accuracy of public dose assessment and demonstration of compliance with the basic standards?
- Support the RPII with respect to the need to provide accurate, up to date and scientifically based advice to Government?

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