

Peer Review of the RPII's Environmental Monitoring Programme 2009

Foundation Document

F. Exposure from Natural Sources in Ireland

1. Introduction

The European Commission is currently in the process of recasting five Council Directives including the BSS Directive 96/29/Euratom (European Commission, 1996). It is expected that the revised Directive will clarify and strengthen legal requirements concerning natural sources, based on the revised ICRP Recommendations published in 2007 (ICRP, 2007), the revised IAEA BSS (IAEA, 2009) and on experience gained by Member States and the Commission since the present Basic Safety Standards Directive was adopted in 1996.

The European Commission envisages a more comprehensive approach to exposure to natural radiation sources and has published a consultation document on this topic, based on the work of the Working Party Natural Sources of the Article 31 Group of Experts (European Commission, 2009). This document covers NORM industries, radon exposure and building materials containing natural radiation sources.

2. RPII Programme for Natural Sources

In general RPII has assessed exposure to the population due to natural sources through a number of discrete projects addressing specific sources or pathways rather than through its continuous monitoring programme.

The RPII has recently completed a review of four large industries operating in Ireland dealing with NORM (natural gas extraction, coal-fired power generation, peat-fired power generation and bauxite processing) to determine the level of radiation to which workers and members of the public are potentially exposed as a result of their work activities (Organo and Fenton, 2008). Of these industries none was found liable to give rise to a total effective dose (excluding radon) in excess of 1 mSv above background in any 12-month period. In accordance with S.I. 125 of 2000 NORM industries, which give rise to effective doses to workers or the public in excess of 1 mSv/ year (from natural radiation sources other than radon), fall within Regulatory Control. A summary of the review is provided in Annex 1.

A PhD thesis which was completed in 2006 investigated the radioactivity and potential doses from building materials in use in Ireland (Doorly, 2006). This study concluded that there were no building material currently being used or manufactured in Ireland liable to give rise to an effective dose to workers or members of the public in excess of 1 mSv above background in any 12-month period.

The RPII has undertaken a range other projects looking at specific natural radiation sources or pathways. These are described in more detail in Foundation Document C. These projects include:

- The National Radon Survey (1992 – 1999)
- An assessment of the doses to the Irish public from the consumption of Po-210 in seafood (1998)
- Radon in drinking water in Co Wicklow – a pilot study (2003)
- A national survey of radioactivity in ground water drinking water supplies (2008- 2010)
- The National Thoron Survey (2007 – present)

The only natural radiation pathway monitored on a continuous basis is drinking water. Water samples are assessed against a parametric value for total indicative dose (TID). The TID is based on an assessment of total radioactivity including both naturally and artificially occurring radionuclides. See Foundation Document H for more details.

3. Issues for Consideration by the Peer Review Group

The terms of reference are laid out in the Overview of the Peer Review.

Exposure from natural sources has been identified as an area of emerging interest and importance where it may be appropriate to direct resources in the future. Comment is sought from the group in relation to possible approaches by the RPII regarding monitoring of natural radionuclides in the future (either on a continuous basis or project-based) having regard to:

- the accuracy of public dose assessment;
- demonstration of compliance with relevant standards;
- the need to provide accurate, up to date and scientifically based advice to Government;
- identified information gaps or research.

References

European Commission, 1996. Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation. Official Journal of the European Communities, L159, 29.6.1996, p 1-114.

IAEA, 2009. International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources. Draft Safety Requirements DS379. Available: <http://www-ns.iaea.org/committees/comments/default.asp?fd=804>.

ICRP, 2007. Recommendations of the ICRP. International Commission on Radiological Protection. Publication 103. Oxford: Pergamon Press.

Organo, C. and David Fenton, D., 2008. Radiological assessment of NORM Industries in Ireland – Radiation doses to workers and members of the public. Dublin: Radiological Protection Institute of Ireland.

Organo, C., Lee, E.M., Menezes, G., Finch, E.C., 2005. Investigation of occupational radiation exposures to NORM at an Irish peat-fired power station and potential use of peat fly ash by the construction industry. *Journal of Radiological Protection*, 25, 461-474.

Doorly, E. M. (2006) PhD Thesis 'Radioactivity from Buildings Materials in the Republic of Ireland', University of Dublin, 231 pages.

Annex 1: RPII Review of NORM Industries

Natural gas extracting industry

The radiological assessment of the routine and maintenance activities of the gas extracting industry was undertaken in collaboration with the main natural gas producer currently operating in Ireland. Exposure to radon and NORM residues for workers and also members of the public were investigated during a project which lasted over three years. Radon gas concentrations in the gas stream brought ashore were monitored continuously during a two-year period and the annual radiation dose to the domestic gas end users (workers are never in direct contact with the gas as it is always contained inside the production equipment) resulting from an exposure at the measured average radon concentrations was calculated to be about 8 μSv .

NORM residues, in the form of sludge, resulting from the processing of natural gas were collected offshore and analysed for radioactivity. Activity concentrations for various natural radionuclides were all found to be well below the indicative recommended exclusion/exemption values for NORM materials published separately by the EU and the IAEA. The dose received by workers removing the sludge from the vessels offshore was calculated to be at most of the order of 100 μSv per year. Various radiation surveys were also undertaken both offshore and onshore at a disused production equipment disposal site. Both external gamma radiation fields and contamination levels were indistinguishable from the natural background.

Coal-fired power generation

Activity concentrations measured in coal fly ash produced by the only Irish coal-fired power plant were found not to be significantly enhanced when compared with results from other similar studies carried out elsewhere. The incorporation of fly ash into Irish cement and/or concrete was found to have no radiological health significance.

The radiological impact of atmospheric releases through the stack indicated that the additional doses resulting from exposure to radon emitted through the stack were 0.05 and 0.04 nSv per year for workers and members of the public respectively, while the estimated dose through inhalation of other radionuclides released in the plume at floor level was calculated for members of the public at 0.02 μSv per year. Assuming that the plume inhalation pathway represents approximately 70% of the total dose received by a typical individual, it was concluded that the radiological impact of such atmospheric emissions was negligible.

Liquid effluents discharged into the Shannon estuary from the ash disposal area were analysed and, apart from potassium-40 which was present in negligible concentrations, no other radionuclides could be detected. Lead-210 activity concentrations were measured in the residues collected inside the boilers and a maximum value of 400 Bq/kg was found. This is well below both EU and IAEA recommended exclusion/exemption values for lead-210 in NORM material (5000

and 1000 Bq/kg respectively). Therefore, workers dealing with residues of this type will not receive a radiation dose in excess of 0.3 mSv per year. The upgrading of the plant to meet new environmental standards will require the installation of a new type of boiler which could be more prone to the production of residues enriched in lead-210 and a new assessment may be necessary in future years.

Activity concentrations in coal fly ash can vary considerably depending on the origin of the coal. The doses reported here are specific to the coal presently being burnt in Ireland. If in the future coal is sourced from other international markets then its radioactive content may differ and the estimated doses to workers and the public will need to be revised.

Peat-fired power generation

Occupational radiation exposures at the largest peat-fired power plant in Ireland were assessed during a research project led in collaboration with Trinity College (Organo et al, 2005). Ambient gamma dose rate measurements, radon measurements, quantification of the occupational exposure from inhalation of airborne peat particles and gamma spectrometry analysis of peat, peat ash and effluent samples from the ash ponds were undertaken.

The results indicated that the radiation dose received by any worker involved in the processing of the peat and the handling of the ash resulting from peat combustion did not exceed 50 μ Sv per year. The potential use of peat fly ash as a by-product for incorporation into cement and/or concrete by the building industry was also found to have a negligible radiological impact for both construction workers and members of the public. Radiation doses associated with maintenance duties (cleaning of hoppers and freeing of blockages in the filters controlling the emissions) were not assessed but they were not expected to be significant as they are always carried out with respiratory protective equipment in a wet environment to minimise resuspension of the ash and only occur two to three times every year. Similarly, the inhalation of peat ash dust on the landfill sites arising from the generation of windborne ash on the ash pond was ruled out as a significant pathway because when it dries out, the top layer of the pond usually forms a crust underneath which the ash is trapped, making it very unlikely to be wind blown.

Bauxite processing – alumina production

The following three scenarios were investigated:

1. Exposure of workers involved in the running of the red mud (main waste produced by the industrial process) disposal area
2. Exposure of workers involved in the maintenance and cleaning of process equipment (digesters and flash tanks) where waste such as scales can form and accumulate as a result of the chemical treatment to which the bauxite is subjected
3. Exposure of members of the public in a post-closure scenario of the red mud disposal area

For the first scenario, analysis of red mud samples and direct measurements of the external gamma dose rate to which workers were exposed on the landfill site led to the conclusion that in the worst case, a worker would receive a maximum radiation dose of 405 μSv per year. The exposure of a member of the public would be expected to be many times lower. The analysis of waste samples collected inside the processing equipment showed activity concentrations for all the radionuclides well below both EU and IAEA recommended exclusion/exemption values.

Gamma dose rate measurements conducted inside a flash tank indicated values which were similar to those characteristic of the ambient natural background.