INTRODUCTION TO ENVIRONMENTAL RADIATION PROTECTION

Objective of this briefing note

This document aims to provide a basic, brief and introductory overview to environmental radiation protection and the roles and relevant documents of the major relevant international organisations. More information will be provided in all of the course lectures. Key references are provided for further reading and the major international documents relevant to the topic are listed for each organisation. The reference lists include earlier documents as there is often confusion about which document is most relevant and up to date.

Why do we need environmental radiation protection?

For many years, protection of the environment from radiation was based on a statement issued by the ICRP which stated that "The Commission believes that the standard of environmental control needed to protect man to the degree currently thought desirable will ensure that other species are not put at risk. Occasionally, individual members of non-human species might be harmed, but not to the extent of endangering whole species or creating imbalance between species. At the present time, the Commission concerns itself with mankind's environment only with regard to the transfer of radionuclides through the environment, since this directly affects the radiological protection of man" (ICRP, 1991, Para. 16).

The Commission's subsequent initial review of the protection of the environment as set out in Publication 91 (ICRP, 2003), concluded that there was a need for a broad international basis for evaluating and managing the actual or potential impact of radiation on the environment. It also concluded that there was a need to develop a comprehensive approach to the study of the effects on, and protection of, biota.

The need for a system capable of demonstrating that the environment is adequately protected from the effects of radioactive substances has subsequently been recognised by international organisations (e.g. IAEA) and a number of regulators. There are various reasons for this change but key among them is the need to demonstrate that the environment is protected. However, radiation protection has not always been the driver of this process, in some countries a system of protection is required to address conservation legislation.

Over the last decade systems of radiological protection for wildlife have begun to evolve with considerable international and national effort on this issue.

Some useful **references** which track the development of environmental radiation protection are a series of papers by Pentreath, the chair of the ICRP Committee 5 on Environmental Protection.

Pentreath, R.J., 1999. A system for radiological protection of the environment: some initial thoughts and ideas. J. Radiol. Prot. 19, 117–128.

Pentreath, R.J.,Woodhead, D.S., 2001. A system for protecting the environment from ionising radiation: selecting reference fauna and flora, and the possible dose models and environmental geometries that could be applied to them. Sci. Total Environ. 277, 33–43.

Pentreath, R.J., 2005. Concept and use of reference animals and plants. In: Protection of the Environment from the Effects of Ionising Radiation, IAEA-CN-109. IAEA, Vienna, pp. 411–420.

Pentreath R.J. 2009 Radioecology, radiobiology, and radiological protection: frameworks and fractures Journal of Environmental Radioactivity 100, 1019–1026

The key international organisations input into environmental radiation protection

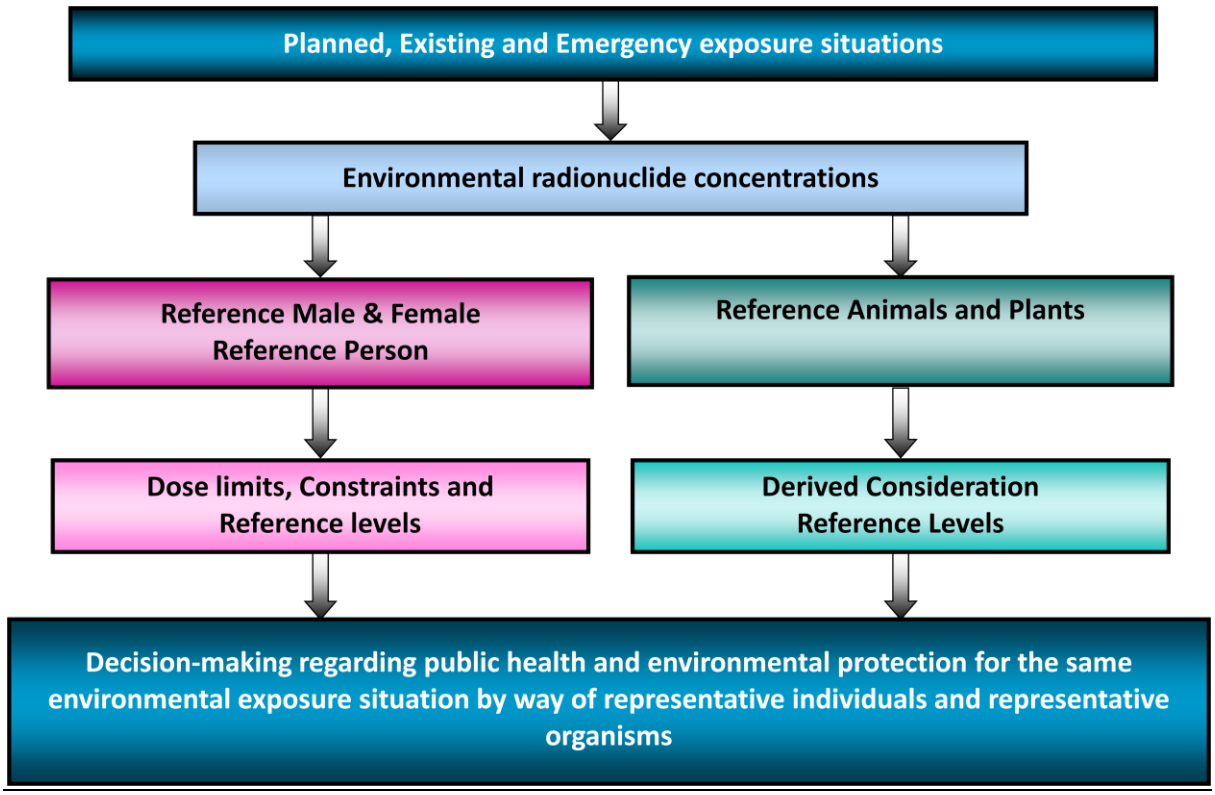
Warning: The text in the documents of the organisations considered below should be looked at very carefully. Usually, a lot of effort has gone into the exact terms used and frequently insufficient attention is paid to the exact words and meaning when quoting and comparing.

The International Commission on Radiological Protection (ICRP)

The ICRP develops, maintains, and elaborates the International System of Radiological Protection used world-wide as the common basis for radiological protection standards, legislation, guidelines, programmes, and practice. In the 2007 recommendations of the ICRP, the Committee recommended the explicit consideration of Radiological Protection of the Environment and recognised the need for advice and guidance, including a clearer framework.

Since 2005, The ICRP has had a fifth Committee, which deals specifically with the protection of the environment from ionising radiation. It aims to ensure that the development and application of approaches to environmental protection are compatible with those for radiological protection of man, and with those for protection of the environment from other potential hazards.

Committee 5 published a report in 2009 which discussed a framework for protection of the environment which uses the concept of Reference Animals and Plants (RAPs), designed to be compatible with the system of protection used for humans. The similarity of the approach is envisaged to follow the scheme given by the ICRP shown below:



Key ICRP publications

Referencing to ICRP documents is often difficult to follow as confusion arises over recommendation years, publication number and Annals number. The four most relevant documents that may be referred to for environmental protection are listed below:

ICRP 1990 Recommendations of the International Commission on Radiological Protection *ICRP Publication* 60 (*Ann. ICRP* **21 (**1–3) 1991) *Superceeded by ICRP Publication 103*

ICRP 2003. A Framework for Assessing the Impact of Ionising Radiation on Non-Human Species. *ICRP Publication* 91. (*Ann. ICRP* **33** (3) 2003).

ICRP 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. (*Ann. ICRP* **37** (2–4) 2007).

ICRP 2009 Environmental protection: the Concept and Use of Reference Animals and Plants. ICRP Publication 108. (*Ann. ICRP* **38** (4–6) 2008).

All the above can be accessed via the new ICRP web link:

http://www.icrp.org/publications.asp

United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)

UNSCEAR reports to the General Assembly of the United Nations. It assesses global levels and effects of ionizing radiation and provides the scientific basis for radiation protection. Governments and organisations rely on Committee's estimates as the scientific basis for evaluating radiation risk and establishing protective measures.

Radiation protection of the environment: providing knowledge and skills to the user community

UNSCEAR produced a report of the effects of Radiation on the Environment in 1990 based on limited data. It has now finalised a new report on the subject which should be published shortly. The conclusions of the new report are thought to be consistent with those produced in 1996.

Key UNSCEAR publication

UNSCEAR 1996 Effects of radiation on the environment *United Nations Scientific Committee on the Effects of Atomic Radiation, Report to the General Assembly. Annex 1* (New York: United Nations).

http://www.unscear.org/unscear/en/publications/1996.html

The International Atomic Energy Agency (IAEA)

The IAEA has unique statutory responsibilities within UN for:

- Establishing standards of radiation safety (and by implication also for environmental protection)
- Providing for the application of the standards at the request of any state

One of the tasks of the International Atomic Energy Agency (IAEA) in developing safety standards is to transform ICRP Recommendations into practical guidance. In doing so, the standards should contribute to the safety objectives as well as the fundamental safety principles of the IAEA. The IAEA is currently in the final stages of revising one of its central Safety Requirements, the International Basic Safety Standards (BSS) (IAEA 2006) which itself refers to environmental protection. The Revision of the International Basic Safety Standards explicitly considers protection of People and the environment with respect to registration and licensing and setting discharge limits. Protection of the environment is identified as an issue to consider during optimization in existing and emergency exposure situations. Three Safety Guides and a Safety report are under development to assist member states with respect to the new BSS.

Key relevant IAEA publications

IAEA 1995 The principle of radioactive waste management. Waste Safety Fundamentals Safety Series No. 111-F. IAEA, Vienna.

http://www-pub.iaea.org/MTCD/publications/PDF/Pub989e_scr.pdf

IAEA 1996 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115. IAEA, Vienna.

http://www-pub.iaea.org/MTCD/publications/PDF/SS-115-Web/Start.pdf

IAEA 2000 Regulatory control of radioactive discharges to the environment. Safety Standards Series No. WS-G-2.3. IAEA, Vienna.

http://www-pub.iaea.org/MTCD/publications/PDF/P088_scr.pdf

IAEA 2001.Generic models for use in assessing the impact of discharges if radioactive substances in to the environment. Safety Series reports No. 19. IAEA: Vienna

http://www-pub.iaea.org/MTCD/publications/PDF/Pub1103_scr.pdf

IAEA 2002. Ethical Considerations in Protecting the Environment from the Effects of Ionizing Radiation: A report for discussion. IAEA-TECDOC-1270, IAEA, Vienna.

Radiation protection of the environment: providing knowledge and skills to the user community

http://www-pub.iaea.org/MTCD/publications/PDF/te_1270_prn.pdf

IAEA 2006 Fundamental Safety principles. IAEA Safety Standards Series No SF-1. IAEA: Vienna.

http://www-pub.iaea.org/mtcd/publications/PubDetails.asp?pubId=7592

European Commission (EC)

The legal basis on which the EC provides for radiation protection under the Euratom Treaty of 1957 are:

Article 2: … the Community shall … establish uniform standards to protect the health of workers and of the general public and ensure that they are applied;

Article 30: Basic safety standards (BSS) shall be laid down within the Community for the protection of the health of workers and the general public against dangers arising from ionising radiations:

» maximum permissible doses compatible with adequate safety
» maximum permissible levels of exposure and contamination
» fundamental principles governing the health surveillance of workers

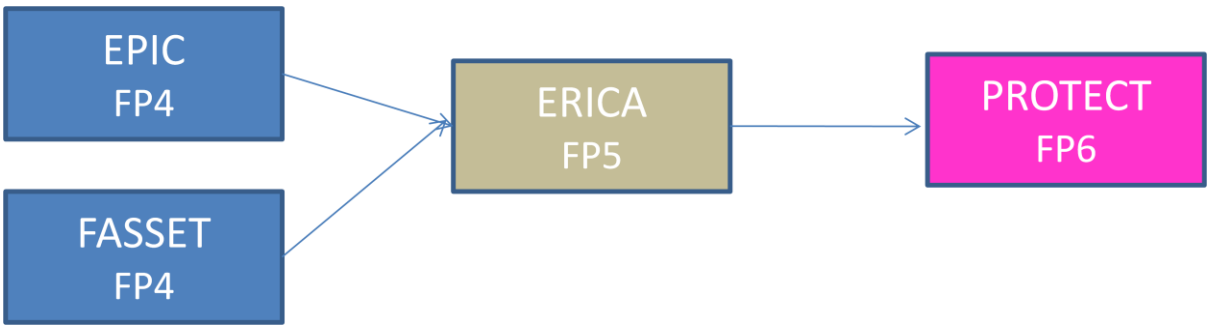
Article 31: The basic standards shall be worked out by the Commission after it has obtained the opinion of a group of persons appointed by the Scientific and Technical Committee from among scientific experts, and in particular public health experts, in the Member States. The Commission shall obtain the opinion of the Economic and Social Committee on these basic standards.

The BSS was published in 1996 and is currently being revised (96/29/Euratom: http://ec.europa.eu/energy/nuclear/radioprotection/doc/legislation/9629_en.pdf). The revision takes account of the new ICRP recommendations 2007 and is intended to harmonise with the Revision of the IAEA BSS. The Article 31 Group of Experts oversees the process of revision and published its opinion on the revised Basic Safety Standards in February 2010 and the EC is currently finalising the draft.

Other EC drivers are relevant to current legislation in the UK on this issue (*sorry non UK people but this is a UK funded course!).* Firstly, the European Habitats and Birds Directives on the conservation of natural habitats and of wild flora and fauna. The UK Conservation (Natural Habitats) regulations of 1994 implements the Habitats Directive in the UK. It requires steps to maintain and restore to favourable conservation status habitats and species of Community level interest.

European Assessment approaches

The EC has funded a series of projects to develop an approach to assessment of the effect of radiation exposure on the environment; the relationship between the different projects is shown in the diagram.



The ERICA Integrated Approach uses Reference Organisms in a way which is complementary to that of the Reference Animals and Plants outlined by ICRP. The ERICA project developed the ERICA Tool which is freely available and is the focus of the courses given under this NERC programme. Other tools are also available, notably the freely available RESRAD Biota developed in the USA, there are links to information about the tools on the wiki. www.ceh.ac.uk/PROTECT

Key European publications and information on projects

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. EC: Luxembourg.

http://ec.europa.eu/energy/nuclear/radioprotection/doc/legislation/9629_en.pdf

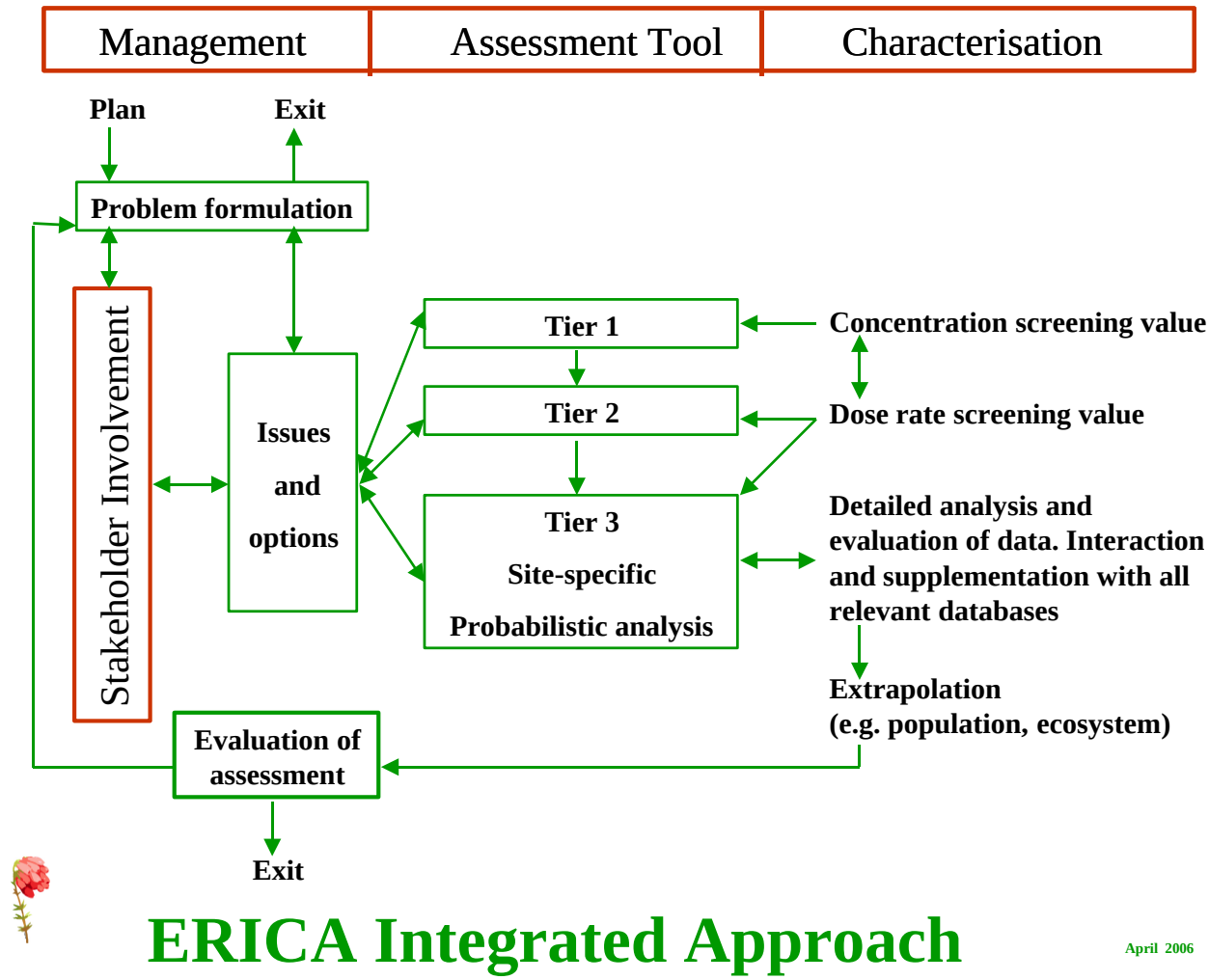
Link to European project outputs:

https://wiki.ceh.ac.uk/display/rpemain/EC+EURATOM+projects

Tiered assessments

Many approaches use a tiered assessment structure (in common with other areas of risk assessments). The approach starts with a simple initial screening through to more refined assessments where needed. It is sometimes referred to as a staged or graded approach. The aim is to ensure that the level of detail in a risk assessment is proportionate with the nature and complexity of the risk being addressed and consistent with decision-making needs.

In the first screening tier the approach is highly conservative (with maximum values used for contamination and transfer rates) and is intended to ensure that if an assessed site passes the first tier there is a very high likelihood that no effect of the radiation present will occur on the ecosystems wildlife populations. As an assessor goes up the tiers the degree of conservatism goes down and the data requirements and resources needed to complete the assessment increase. An example of a tiered approach for ERICA is given below which shows how the tiered approach interacts with other elements of an assessment.



Approach for other chemicals

Both the ICRP Committee 5 and the approach used in ERICA and PROTECT emphasise the importance of being consistent with the approach used for other chemicals such as pesticides and heavy metals. There are similarities and differences between chemical and radiological risk assessment approaches. Assessment of chemicals only considers internal exposure whereas that for radiation also considers external exposure, also, the dose from many radionuclides can be combined whereas chemical assessment considers each chemical separately. Currently, chemical assessment often takes account of environmental bioavailability whereas currently many radiological assessments do not.