Health & Safety Commission
Ionising Radiations Advisory Committee

INFORMATION PACK

Open Meeting

10 October 2001

Health & Safety Executive

Rose/Globe Room

Rose Court,

2 Southwark Bridge Road

London. SE1 9HS

Introduction

This information pack is designed to provide delegates to the Ionising Radiations* Advisory Committee (IRAC) Open Meeting in October with some information about the Committee and its members and other related information.

The pack includes information on relevant Government Departments and legislation and notes on current issues, also a summary of the presentations and a published paper.

Contents

*"Ionising radiations" describes the form of radiation that causes ionisation in the materials it encounters (eg alpha and beta particles, gamma rays and x-rays). It does <u>not</u> include ultraviolet (UV), light, infra-red or radiofrequency (RF) radiation.

Open Meeting, Rose/Globe Rooms, HSE, Rose Court, 10 October 2001

AGENDA

Time	Item	Presenter
10:15	Registration and coffee	
10:45 - 10:50	Welcome The role of IRAC	IRAC Chairman: Dr S A Harbison, CB
10:50 - 11:25	International influences IRAC's part in implementation: preparation of legislation and guidance	IRAC Secretary: Mrs W P Bines IRAC members: Dr R W Davies Dr P J Allisy-Roberts OBE
11:25 - 11:45	Coffee	
11:45 - 12:20	Radiological protection, now and in the future: Current position Challenges Uncertainties	IRAC members: Mr G Renn Prof R H Clarke Dr H Porter
12:20 - 1300	Open forum/ question session	
	Lunch (1300 – 1400)	

IRAC's Terms of Reference and membership

IRAC is the Health and Safety Commission (HSC)'s advisory committee on ionising radiation. IRAC was established in 1995, replacing the previous Working Group on Ionising Radiations. Its terms of reference are:

> To consider all matters concerning protection against exposure to ionising radiations that are relevant to the work of the Health and Safety Commission (the Commission) and are referred to the committee by the Commission or by the Health and Safety Executive (the Executive) and to advise the Commission and the Executive.

Members are nominated by the CBI, TUC, Professional Societies, Government Departments, Local Authority Associations, National Radiological Protection Board and the Consumer's Association.

The Chairman, Members, Assessors and Secretary are:

1. **Chairman** Dr S A Harbison CB

2. **Members**
   Dr P J Allisy-Roberts OBE
   Prof K Boddy CBE
   Prof R H Clarke
   Dr R Coates
   Dr R W Davies
   Dr D Deakin
   Mr S Ebdon-Jackson
   Dr J Godfrey
   Dr L K Harding
   Dr D S Harvey
   Mr J Kane
   Mr J Miller
   Miss M J Minski
   Mr R Moore
   Dr H Porter
   [Local Authority vacancy caused by retirement]
   Mr G Renn
   Mr D J Small

3. **Assessors**
   Ms M Cody, Department of Trade and Industry
   Dr E O Crawley, Welsh Assembly
   Mr S Conney, Food Standards Agency
   Dr J O McHugh, Environment Agency
   Dr D Snashall, Health and Safety Executive
   Mr C K Wilson, Dept for Environment, Food and Rural Affairs

4. **Secretary** Mrs W P Bines HSE

IRAC Working Groups

IRAC has two working groups. Their terms of reference and membership are given below.

Forward Look Working Group

The Ionising Radiations Advisory Committee Forward Look Working Group was established at IRAC's meeting on 28 February 2001. Its terms of reference are:

> To provide IRAC with a framework for contributing to the development of a forward look to radiation protection in the next decade and other related issues.

The membership comprises:

- Ms K Davies, Ionising Radiations Policy Unit, HSE (facilitator)
- Prof R Clarke, National Radiological Protection Board
- Dr R Coates, BNFL
- Mr S Ebdon-Jackson, Department of Health
- Dr H Porter, Western General Hospital, Edinburgh

Securing Health Together Working Group

The Ionising Radiations Advisory Committee Securing Health Together Working Group was established at IRAC's meeting on 19 October 2000. Its terms of reference are:

> To consider how the Ionising Radiations Advisory Committee (IRAC) can contribute to the Securing Health Together strategy and to take forward those contributions in consultation with IRAC.

The membership comprises:

- Mrs L West, IRAC Secretariat (facilitator)
- Mr R Anderson, BNFL
- Mr J Croft, National Radiological Protection Board
- Ms K Davies, Ionising Radiations Policy Unit, HSE
- Dr J Horrocks, Barts and the London NHS Trust
- Mr T Moseley, Sheffield University
- Mr G Renn, British Energy
- Mr G Royal, IRAC Secretariat (minutes secretary)

Information about IRAC members

Dr S A Harbison CB (Chairman)

Dr Harbison had early experience as research scientist, then research physicist, before joining the Royal Naval College, Greenwich as Senior Lecturer in the Dept of Nuclear Science for 5 years. Joined the Nuclear Installations Inspectorate in 1974, rising from Site Inspector to Head of Branch (including 3 years in another part of HSE as Head of Hazardous Substances Branch) before becoming Director of Nuclear Safety, Head of Radiation Protection Policy and HM Chief Inspector of Nuclear Installations from 1991 until retirement from HSE in 1998. Fellow of the Institution of Nuclear Engineers and Member of the Society for Radiological Protection.

Chairman of IRAC since it was established in 1995. Other appointments include:
- member of the Euratom Scientific and Technical Committee;
- member of the Group of Experts set up under Article 31 of the Euratom Treaty to advise the European Commission on radiation protection matters;
- consultant to British National Space Centre on Nuclear Power Sources in Space;
- consultant to HSE in its Review of Arrangements for Controlling the Risks from GMOs and Harmful Biological Agents;
- consultant to OECD Nuclear Energy Agency on regulatory effectiveness;
- Expert Lecturer at IAEA Workshops on Nuclear Power Plant Safety;
- member of Expert Evaluators Panel for Radiation Protection proposals within the EC's Fifth Framework Research Programme.

Publications include more than 30 scientific and policy papers on a wide range of topics, from fundamental nuclear physics to risk assessment and nuclear regulation. Co-author of a book on radiation protection which was first published in 1972 and is now in its fourth edition.

Dr P J Allisy-Roberts OBE (Nomination: Professional Societies)

Dr Allisy-Roberts is Head of the Ionising Radiations Section of the Bureau International des Poids et Mesures, responsible for the international standards in radiation metrology, both for dosimetry and radioactivity measurements. Director of Medical Physics and Medical Engineering, Southampton University Hospitals (1991-1994). Consultant Physicist, Head of Regional Radiation Physics and Protection Service in the Department of Medical Physics at the Queen Elizabeth Medical Centre, Birmingham (1988-1990).

Dr Allisy-Roberts has been involved in a number of committees - member of the Council of the Society for Radiological Protection (1994-1997); member of the British Committee on Radiological Units since 1994; member of the International Commission on Radiological Protection Committee 3 on Medical Radiations (1993-1997); UK member of the Group of Experts set up under Article 31 of the Euratom Treaty to advise the European Commission (1993-1996); member of the National Measurement System Policy Unit Working Group of the Department of Trade and Industry (DTI) reviewing the National Physical Laboratory's ionising radiation programme since 1991 (Chairman since 1998) and member of the DTI Measurement Advisory Committee (1998-); member of the Department of Health Radiological Advisory Committee (1990-1994); President of the Institute of Physical Sciences in Medicine (1990-1992); Chairman of the British Radiation Protection Association (1989-1990); member of the Editorial Board of the Journal of Radiological Protection (1988-1993 and 1999-); and member of the National Accreditation of Measurement and Sampling Working Group on radiation measurements (1986-1992). Member of the IRAC guidance preparation working group on pregnant women. Member of IRAC since 1995.

Prof K Boddy CBE (Nomination: Professional Societies)

From 1978 until retirement in November 1997, Prof. Boddy was the Head of the Regional Medical Physics Department, Newcastle General Hospital and concurrently Professor and Head of Newcastle University Department of Medical Physics. Regional Radiation Protection Advisor. Representative of West Cumbria Health Authority on Sellafield Local Liaison Committee (SLLC) and elected Chairman of the Environmental Health Sub-Committee of the SLLC. Independent Advisor on Sellafield with special reference to whole-body counting. Chairman of Hospital Medical Committee of Newcastle Health Authority (1985-90). Consultants' elected representative on Newcastle District Management Board and District Health Authority (1985-90).

President of Hospital Physicists' Association and Institute of Physical Sciences in Medicine (1986-88); Honorary Fellow of the British Nuclear Medicine Society and Honorary member of the Royal College of Radiologists. Calderwood Award presented by Postgraduate Medical Institute of Isle of Man; Glazebrook Medal and Prize of the Institute of Physics for contributions to the organisation of science (1991); President of the International Organisation for Medical Physics (1994-97). Awarded D. Sc. (Honoris Causa) De Montfort University (1997), Honorary Fellowship of the Society for Radiological Protection (1999) and Skinner Medal of the Royal College of Radiologists (1999). President of the International Organisation for Medical Physics (1994 - 1997). President of the International Union for Physical and Engineering Sciences in Medicine (IUPESM)(1997 - 2000) having led IUPESM to Full Membership of the International Council for Science. Recipient of IUPESM Award of Merit.

Member of Department of Environment Food and Rural Affairs (DEFRA) Radioactive Waste Management Advisory Committee (RWMAC) and until recently member (and cross-representative) of the Department of Health's Committee on Medical Aspects of Radiation in the Environment (COMARE). He is a member of the IRAC Radiation Emergencies Working Group and a member of the Scottish Environment Protection Agency's Dounreay Particles Advisory Group. Member of IRAC since 1995.

Prof R H Clarke (Nomination: NRPB)

Prof. Clarke has been Director of the National Radiological Protection Board since 1987. Chairman of the International Commission on Radiological Protection 1993 - to date; UK Representative to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 1992 to date; Chairman of the Organisation for Economic Co-operation and Development (OECD) Nuclear Energy Agency Committee on Radiological Protection and Public Health (CRPPH) 1987-1992; Member of the Group of Experts under Article 31 Euratom Treaty 1988-to date; Visiting Professor Imperial College of Science, Technology and Medicine, University of London since 1993; and University of Surrey since 1994; Member of the Radioactive Waste Management Advisory Committee (RWMAC) 1991-1999; Honorary Fellow and Former President of the Society for Radiological Protection 1995; Honorary Fellow of the Royal College of Radiologists 1994; Member of Forward Look Working Group of IRAC; Member of IRAC since 1995.

Dr R Coates (Nomination: CBI)

Dr Coates graduated from Cambridge University in 1968 with a degree in Natural Sciences. This was followed by seven years in physics research, initially at Reading University (PhD awarded 1972) and then at the University College of Swansea. He joined the Health and Safety Department at British Nuclear Fuels (BNFL), Sellafield in 1975, acting as secretary of the Sellafield Local Liaison Committee for two of the next 15 years.

In 1990 he transferred to BNFL's Corporate Headquarters at Risley, initially to support the legal defence to allegations of causation of childhood leukaemia, later transferring to the Corporate Health and Safety Directorate to take responsibility for corporate policy and external liaison on occupational safety and environmental protection. He returned to Sellafield in mid-1996 to take up the post of Head of Safety, Health and Environment, Thorp Group, becoming Site Head of Safety for BNFL Sellafield in mid-1997. In 1999 he took up the new position within the Company of Head of UK Environment, Health and Safety with responsibility for policy, strategy and direction for the BNFL operations in the UK, including the former Magnox Electric plants. He has recently also taken the role of Acting Director, Environment, Health and Safety for BNFL.

He has particular interests in the application of the 'as low as reasonably practicable' (ALARP) principle and has been an invited lecturer on Commission of the European Communities (CEC) courses and the National Radiological Protection Board (NRPB) Radiological Protection courses. He has also, recently, taken a close interest in issues relating to clearance and exemption. In 1995/96 he was the President of the Society for Radiological Protection (SRP) and is currently a member of the SRP International Committee. He was a member of an International Commission on Radiological Protection (ICRP) Task Force on Occupational Exposure which drafted the recently issued ICRP 75. Member of the Forward Look Working Group of IRAC. Member of IRAC since 1997.

Dr R W Davies (Nomination: CBI)

Dr Davies studied Physics for his first degree and completed a Masters degree before joining the Medical College of St Bartholomew's Hospital in 1968, first as a research scientist then later lecturing in Radiation Biology. During this time he obtained his Doctorate in Radiation Biology (1973). From 1975 to 1982 he was Lecturer in Physics in the Department of Physics at the Medical College, as well as being the Radiation Protection Officer. While lecturing, Dr Davies' main research interests covered radiation dosimetry, oxygen concentration measurements related to cancer therapy and studies of drosophila longevity. He was appointed Co-Chairman of the Dosimetry Committee of the European Late Effects Project during this period and continued to serve in this role until 1999.

In 1982 Dr Davies moved to Amersham International plc as Assistant Manager in their Physics Department. In his 18 years at Amersham he has been Manager of Environmental Safety (1985-89), Hazardous Wastes Manager (1989-90), Director of Safety and Environmental Protection (1990-94) and Director of Group Safety, Quality Assurance and Environmental Affairs (1994-97). He has been Radiation Protection Adviser for all the company sites in the UK since 1985. Following the mergers of Amersham with Pharmacia Biotech and Nycomed AS in 1997 to form Nycomed Amersham plc[1], he was appointed the Vice President, Group Health, Safety and Environment for the enlarged company. In this role he is responsible for developing policy and monitoring performance in health, safety and environmental matters. The role also represents the principal appointment in radiation protection in the company worldwide.

Member of the Advisory Committee on Safety of Nuclear Installations (ACSNI) since 1996 and its successor the Nuclear Safety Advisory Committee (NuSAC). Member of the Radioactive Waste Management Advisory Committee since 1998. He is a member of the IRAC/NuSAC Radiation Emergencies Working Group. Member of IRAC since 1995.

[1] renamed Amersham plc in July 2001

Mr S Ebdon-Jackson (Nomination: Department of Health)

Steve Ebdon-Jackson joined the Department of Health in 1990 after serving 11 years in the NHS as a medical physicist at the Royal Berkshire Hospital, where his responsibilities included radiotherapy and radiation protection.

Currently working in the Policy Directorate of the Department of Health, providing the lead on diagnostic imaging and radiation protection policy (ionising and non-ionising) for the National Health Service. This involves membership of a number of working parties and committees of other government departments, agencies and professional bodies and IRAC's Forward Look Working Group. Member of IRAC since 1995.

Dr J Godfrey (Nomination: National Consumer Council)
Dr Godfrey's wide experience includes early involvement, with the Medical Research Council, Radiobiological Research Laboratory, Harwell, in work on the genetic effects of ionising radiation on mammalian populations. In the 1960s he was a member of an EEC working group on research priorities for radiation and chemical hazards to human populations.

As a lecturer and then Fellow of Edinburgh University, Dr Godfrey worked on the evolution of behaviour in mammalian populations and then turned to better management of populations of sea fishes; at the same time he was widely involved in University administration, beyond his Department.

Dr Godfrey is Director, European Research in Consumer Affairs (ERICA), working on the impact of Biotechnology on the public. Vice Chairman, Consumers in Europe (CEG). Other experience includes being consultant to the Glynn Laboratory, which is an independent biochemical research institute in Cornwall. He was also a member of a Ministry of Agriculture Fisheries and Food (MAFF) Consumer Panel until the Food Standards Agency was set up, Member of the European Commission's Advisory Committee on Fisheries and Agricultural Product Health and Safety. "Public interest" member of IRAC since 1996.

Dr L K Harding (Nomination: Professional Societies)
Dr Harding has over 25 years experience in Nuclear Medicine at City Hospital, Birmingham, and is also a Reader in Medicine at the University of Birmingham.

He is a member of the European Commission's Article 31 Group of Experts, as well as an adviser to the UK Medicines Control Agency and the European Committee on Proprietary Medicinal Products. He is secretary of Committee 3 of the International Commission on Radiological Protection. Committee 3 is concerned with protection of persons and unborn children when ionising radiation is used for medical diagnosis, therapy, or for biomedical research. Dr Harding is also chairman of the Royal College of Physicians Nuclear Medicine Committee.

He is the referee for 10 specific journals and was Editor of Nuclear Medicine Communications for 13 years; currently he is on the editorial board of this journal and that of the European Journal of Nuclear Medicine. He has given many lectures on radiation safety throughout Europe and has written/co-written over 60 radiation protection publications. Member of the IRAC Working Group on Pregnant Women. Member of IRAC since 1997.

Dr D S Harvey (Nomination CBI)
Dr Harvey got his degree in Chemistry and Ph.D in Organic Chemistry at Leeds University before joining British Steel (now CORUS). After working as a researcher on the chemistry of steelmaking, he became involved with ionising radiation and radiation safety in 1987. He has been involved with the safety of sealed sources for gauging and radiography on production sites and is currently the Radiation Protection Adviser for six steelworks sites. He leads the Radiation Safety Group within the company and reports to and advises the Head Office,

Health and Safety function on the implications of legislation for the Company. The Group also disseminates information and produces written guidance for the company. In addition, he advises on environmental issues connected to radioactivity.

Dr Harvey has undertaken research on a range of topics related to radioactivity in steel and iron and particularly in scrap including the recycling of slightly radioactive scrap via the steelmaking process; the problems of detection of radioactivity in steel scrap; and the occurrence of enhanced levels of natural radioactivity in the production of iron and steel. Ongoing research has European funding and is being undertaken with Spanish and German steelmakers and the results of some studies have been presented at various conferences.

He is a member of the Society for Radiological Protection, sits on an Environment Agency committee dealing with the illicit movements of radioactive materials, and is a member of the United Nations Economic Commission for Europe group on radioactivity in scrap. He is also a member of the CBI's Ionising Radiations Working Party. Member of IRAC since 2000.

Mr J Kane (Nomination: TUC)
Mr Kane is a shift process worker at British Nuclear Fuels plc, (BNFL) Sellafield, where he has worked since 1974. He has successfully represented the interests of 125 shop stewards and 2,600 members for the past 10 years, and represented the General and Municipal Boilermakers Union (GMB) at International Nuclear Conferences in America and Japan.

He was involved in the establishment of several committees set up to reduce worker exposure to ionising radiation following the 'Gardner' Report (which suggested a possible link between the incidence of childhood leukaemia and paternal exposure to ionising radiation) in 1989. He also led on one of the most successful trade union campaigns of this era 'The THORP - Trust Us' tour, resulting in the opening of the THORP plant.

Mr Kane is also involved in BNFL's design and responses to the Nuclear Installations Inspectorate reports that were issued in March 2000. Working closely with regulators, he has helped restructure the relationships between safety representatives, BNFL management and the regulatory authorities. Member of IRAC since 1996.

Mr J Miller (Nomination: TUC)
Mr Miller is a technical craftsman in the Estates Department of Swansea NHS Trust at Singleton Hospital, Swansea. He has been a safety representative since 1974 (initially at Borg Warner Ltd and since 1985 in the NHS). He is a member of the Amalgamated Engineering and Electrical Union's NHS National Industrial Committee. He holds a National Examination Board for Occupational Safety and Health (NEBOSH) certificate (1993) and is an Associate Member of the Institute of Occupational Safety and Health, as well as a member of Swansea Safety Group. Member of IRAC since 2000.

Miss M J Minski (Nomination: Association of University Radiation Protection Officers)
Miss Minski's career began in 1959 as a scientist with the Laboratory of the Government Chemist, London, where she was involved in the development of methods of analysis for elements in British Standards. She then became a scientist with the Medical Research Council at the National Radiological Protection Board, where her research included theoretical dose calculations to humans from ingestion and injection of radionuclides. For a brief time, she was a lecturer in the Department of Physics Applied to Medicine, at the Middlesex Hospital Medical School, before becoming a scientist with the British Industrial Biological Research Association. In 1975, she became a lecturer at the Reactor Centre of

the Imperial College, and since 1986 has been the Senior Lecturer there. Though now semi-retired, Miss Minski has been the College's Radiation Protection Adviser since 1983 and is now responsible for a larger site including various Medical Schools. Member of IRAC since 1995.

Mr R Moore (Nomination: Ministry of Defence)

Mr Moore is a Chartered Engineer with long experience in the Ministry of Defence (MoD). He has worked in a variety of engineering research, development and project management appointments across a spectrum of disciplines ranging from aero engine testing, through explosives engineering and avionics to the construction of a major office complex.

As Deputy Chief Environment Safety Officer (MOD) he is responsible for policy development and audit in the areas of explosives storage and transport, environment, occupational hygiene, safety and radiological protection. MOD assessor on Committee on Medical Aspects of Radiation in the Environment (COMARE). Member of IRAC since 1998.

Dr H Porter (Nomination: TUC)

Dr Porter is a Consultant Radiation Physicist in the Edinburgh Cancer Centre at the Western General Hospital in Edinburgh and the Department of Radiation Oncology at the University of Edinburgh. He is qualified as both a Chartered Physicist and a Chartered Chemist. He spent fifteen years as a university lecturer and Fellow at the Universities of Edinburgh, Stirling, Manchester, London and Oxford and two years at the Carnegie-Mellon Institute in Pittsburgh, United States.

Dr Porter has chaired the Radiotherapy Committee of the Institute of Physics and Engineering in Medicine and served on both the Scientific Committee and the Cancer Action Group of the Institute. He edited the radiotherapy chapters of the Medical and Dental Guidance Notes and has a continuing interest in both the operational and technical aspects of medical radiation safety. He is a member of the TUC Nuclear Safety Forum. He is a member of both the Forward Look Working Group of IRAC and the Radiation Emergencies Working Group of IRAC/NuSAC. Member of IRAC since 1995.

Mr G Renn (Nomination: TUC)

Mr Renn is a radiation protection adviser at the Sizewell B power station, operated by British Energy. He represents the Engineers and Managers Association. He has previously held operational health physics posts at Heysham 1 power station and in the UK Atomic Energy Authority at Winfrith. He holds a Masters degree in Radiation and Environmental Protection. He is a member of the UK Society for Radiological Protection (SRP) and has held their Certificate of Competence in Applied Health Physics since 1990. He is the secretary of SRP's topic group on Practical Health Physics. Member of the IRAC Securing Health Together Working Group. Member of IRAC since 2000.

Mr D J Small (Nomination: Small Firms Organisations)

Mr Small is a Director of CET Medway Ltd, Non-Destructive Testing Engineers, and has 19 years of practical and management experience in the field of industrial radiography.

He began his career as a pipe work engineer, working in the UK and abroad; later training as a non-destructive testing inspector. Mr Small has since worked on a number of important projects, including Dungeness A Power Station, the Shell Expro St Fergus Terminal and on various civil engineering contracts for companies such as Gleesons, Laings and Tarmac.

In 1991 he formed CET Medway Ltd where, as one of its two company directors, he is responsible for sales, operations and development. Member of IRAC since 1995.

Where to find IRAC Agendas on the INTERNET

1. Type in the address of HSE's web home page address (http://www.hse.gov.uk) in the address bar of your web browser or search for 'HSE' using a search engine such as MSN.

2. Once you are on the HSE website there are several different routes to navigate to the web page with IRAC Agendas. One way would be to use the search button at the bottom of the home page and type in 'IRAC' or alternatively click on the subject index button at the bottom of the page and then click on ‘R’ for Radiation.

The following information is displayed:

“Information about HSC's Ionising Radiation Advisory Committee and the agendas of its meetings
HSE's leaflets and information sheets relating to Radiation
Information about Ionising Radiation and Non-ionising Radiation has been provided by HSE's Health Directorate”

Clicking on these links will take you to the information described. HSC/E plans to add minutes and papers from committees in the near future.

The Health Directorate pages on Ionising Radiation contain information about the Ionising Radiations Regulations 1999, Information Sheets, information of interest to radiation protection advisers (RPAs) and employers, and useful links to other sites dealing with ionising radiation.

Principal Government Departments and Agencies involved in regulating exposure to ionising radiation

(showing website addresses for further information)

The Department for Environment, Food and Rural Affairs (DEFRA)

www.defra.gov.uk

The Department for Transport, Local Government and the Regions (DTLR)

www.dtlr.gov.uk

The Department of Trade and Industry (DTI)

www.dti.gov.uk

The Department of Health (DoH)

www.doh.gov.uk

The Ministry of Defence (MOD)

www.mod.uk

The Health and Safety Commission and Executive (HSC/E)

www.hse.gov.uk

The Environment Agency (EA)

www.environment-agency.gov.uk

The Scottish Environment Protection Agency (SEPA)

www.sepa.org.uk

The Food Safety Agency (FSA)

www.foodstandards.gov.uk

The Welsh Assembly

www.wales.gov.uk

The Scottish Executive

www.scotland.gov.uk

The Department for Economic Development, Northern Ireland

www.nics.gov.uk/ni-direct/ded

The Health and Safety Executive for Northern Ireland www.hseni.gov.uk

The Environmental Heritage Service, Northern Ireland

www.ehsni.gov.uk

The National Radiological Protection Board

The National Radiological Protection Board ('NRPB') was set up under the Radiological Protection Act 1970 with functions which include the gathering of knowledge and the provision of information and advice to persons including government departments.

Website address: www.nrpb.org.uk

Legislation implementing the Euratom Basic Safety Standards Directive (96/29/Euratom)

The Health and Safety at Work etc. Act 1974 ('HSWA') set up the Health and Safety Commission ('the Commission') and its executive arm the Health and Safety Executive ('the Executive'), and placed a duty on the Commission to submit and secure the implementation of proposals for Regulations on health and safety topics. The Act gives power to the Secretary of State (subject to Parliamentary scrutiny) to make regulations and to the Commission to approve, with the consent of the Secretary of State, codes of practice which give practical guidance on the Regulations and which have legal effect by virtue of section 16 of HSWA.

The Ionising Radiations Regulations 1999 ('IRR99') regulate the exposure of workers and the public, and are supported by standards or procedures described in the Approved Code of Practice and by non-statutory guidance.

The Radiation (Emergency Preparedness and Public Information) Regulations 2001 ('REPPIR'), which came into force on 20 September 2001, cover preparedness for radiation emergencies in respect of sites which have sufficiently large inventories of radionuclides that could cause such emergencies, also some transport situations (mainly transport by rail). REPPIR also largely subsume the Public Information for Radiation Emergencies Regulations 1992.

The Nuclear Installations Act 1965 (as amended) ('NIA') has three purposes. It provides for the licensing and inspection of sites which are to be used for the operation of nuclear reactors and certain other nuclear installations, except for reactors which form part of a means of transport. It also provides for the control of the processes and the application of security measures associated with the enrichment of uranium and the extraction of plutonium or uranium from irradiated matter. It further sets up a special legal regime to govern the liability of the licensees towards third parties for certain kinds of damage (primarily nuclear damage) caused by nuclear matter on, or coming from, their sites.

The Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 are also relevant.

The Health Departments advise on the general control of clinical procedures and medicinal products. The Medicines (Administration of Radioactive Substances) Regulations 1978 (the MARS Regulations 1978) prohibit the administration to human beings of radioactive medicinal products for the purpose of diagnosis, treatment or research except by a doctor or dentist holding a certificate issued by Health Ministers or by a person acting under the directions of such a doctor or dentist. The Medicines (Radioactive Substances) Order 1978 extends the scope of the primary legislation (The Medicines Act 1968) so that the MARS Regulations also apply to brachytherapy and in-vivo neutron activation analysis. The Medicines (Administration of Radioactive Substances) Amendment Regulations 1995 address procedural aspects of the MARS Regulations 1978.

The Radioactive Substances Act 1993 ensures control over radioactive waste. The detailed arrangements for control of radioactive materials and radioactive waste are contained in certificates of registration or authorisation issued in respect of particular premises, or in Exemption Orders made under the Act. By means of these Orders, exemption may be given from particular provisions where the nature of the material or the conditions of use are such that the protection of the public can be assured without the need for registration or authorisation in individual cases.

The Food Safety Act 1990 includes a prohibition on the addition of substances to food which are injurious to health, which might include radioactive substances. Section 13 of the Act allows for emergency orders to be made to prohibit the carrying out of commercial operations with respect to food, food sources or contact materials and could be used to control the import or export and distribution of contaminated foods.

The Food and Environmental Protection Act 1985 provides for emergency orders where Ministers consider that circumstances exist, or may exist, which are likely to create a hazard to human health through human consumption of contaminated food. Such orders may prohibit, amongst other things, the movement and sale of affected produce from a designated area where foodstuffs have, or may have, been contaminated.

Other Advisory Committees with related interests

The Administration of Radioactive Substances Advisory Committee (ARSAC)

ARSAC's terms of reference are: 'to advise Health Ministers with respect to the grant, renewal, suspension, revocation and variation of certificates and generally in connection with the system of prior authorisation required by Article 5(a) of Council Directive 76/579/Euratom.'

Contact: ARSAC Secretariat, Department of Health, Room 323, Wellington House, 133-155 Waterloo Road, London SE1 8UG
Tel : 020 7972 4802; Fax: 020 7972 4800

The Committee on Medical Aspects of Radiation in the Environment (COMARE)

COMARE's terms of reference are 'to assess and advise Government and the devolved authorities on the health effects of natural and man-made radiation in the environment and to assess the adequacy of the available data and the need for further research.'

Contact: Julie Kedward, COMARE, National Radiological Protection Board, Chilton, Didcot, Oxon OX11 0RQ
Tel: 01235-822629; Fax: 01235-822630; Email: julie.kedward@nrpb.org.uk

www.doh.gov.uk/comare.htm

The Nuclear Safety Advisory Committee (NuSAC)

NuSAC's terms of reference are: 'To advise the Health and Safety Commission and, when appropriate, Secretaries of State, on major issues affecting the safety of nuclear installations including design, siting, operation, maintenance and decommissioning which are referred to it or which it considers require attention. To advise the Health and Safety Commission on the adequacy and balance of its nuclear safety research programme.'

Contact: The Secretary (NuSAC), Health and Safety Executive, Head of NHIPD, Room 216, Magdalen House, Stanley Precinct, Bootle, Merseyside, L20 3QZ

~~http://www.hse.gov.uk/foi/release~~s/0502nusac/index.htm

The Radioactive Waste Management Advisory Committee (RWMAC)

RWMAC's terms of reference are: 'To advise the Secretary of State for Environment, Food and Rural Affairs, and, in relation to devolved matters, to advise the Minister for Environment and Rural Affairs in Scotland and the Minister for the Environment in the Welsh Assembly, on the technical and environmental implications of major issues concerning the development and implementation of an overall policy for all aspects of the management of civil radioactive waste, including research and development: and on any such matterrs referred to it by these persons.'

Contact for general RWMAC enquiries: Zone 4/F4, Ashdown House, 123 Victoria Street, London SWE1 6DE
Tel: 020 7944 6267

www.defra.gov.uk

Current issues

Radon

Radon is a natural radioactive gas which decays into other radioactive species, all of which cause human exposure to radiation. It comes from the minute amounts of uranium present in all earth materials such as rocks, soils, brick and concrete. It is present in caves, mines and above ground buildings. Exposure to high levels of radon for long periods can result in an increased risk of developing lung cancer.

Radon levels in buildings (homes and workplaces) vary:

- during the day
- from one day to the next, and
- from winter to summer,

mainly because of temperature differences between indoors and outdoors but also because of occupancy factors. They are generally higher at night and during the winter, when doors and windows are more likely to be kept closed. Although radon enters buildings all the time, some is carried away by the natural ventilation. Even in a home with good draught proofing and double glazing, the air changes several times a day. The highest levels have been found in some homes on or near granite in Southwest England, but not all granites give high levels. Some other rocks, but not clays, also cause high radon levels. Radon from rocks and soil in the open disperses rapidly in the air.

IRR99 covers radon exposure in the workplace. If exposure to radon in a workplace might be significant (for example, based on the geographical location), employers should determine whether the action level of 400 Bq/m3 in air is exceeded. If the action level is exceeded, employers are encouraged to introduce remediation measures (generally increased ventilation) so that the levels are reduced below this value. No further action is then required by employers, other than ensuring that remediation measures remain effective and radon levels remain below the reference value. If remediation below the reference criteria is not practicable, then IRR99 apply in full and the employer must implement appropriate measures to restrict exposures to a level which is as low as reasonably practicable (ALARP). HSE is currently updating guidance on radon for employers, which will explain the legal requirements and give advice on measures which restrict exposures.

Radon in homes is the responsibility of DEFRA. More information is available on the DEFRA and NRPB websites (see pages 13 and 14).

Naturally occurring radioactive material (known as NORM)

There are several industries where the storage and use of materials, not generally regarded as radioactive, can give rise to significant radiation doses - sometimes directly from the raw materials, but more commonly as a result of processing. IRR99 will apply where the process is likely to lead to employees or other persons receiving an annual dose in excess of 1 mSv. Employers who work with such material will need to establish through an initial survey whether the doses are likely to be of radiological significance. If they are, employers will need to introduce adequate measures to ensure exposure is kept as low as is reasonably practicable. The provisions of the Radioactive Substances Act 1993 (RSA 93) may also apply if the concentrations of naturally occurring radioactive elements exceed those specified in Schedule 1 of that Act. Normally a registration or authorisation from the Environment Agency or by SEPA is required. In some cases the levels of radioactivity may fall within the scope of Exemption Orders under RSA 93, eg the Radioactive Substances (Phosphatic Substances, Rare Earths etc) Exemption Order. If the provisions of the exemption order are complied with, no registration or authorisation would be necessary.

Some processes with a recognised potential to cause significant exposure occur in the oil and gas industries; here scale in pipes and vessels, enriched in naturally occurring radium and its daughters, may build up over time. Some metal smelting applications may also cause exposure to NORM; here naturally occurring radionuclides may concentrate in foundry slag or may be present in significant concentrations in special sands containing low concentrations of natural uranium and thorium, used as refractory materials in metal casting.

HSE is commissioning research which aims to obtain realistic data to enable employers to carry out practical assessments of radiation doses to employees from work with NORM. The research aims are to:

- undertake a critical review of the current data available on the exposure to enhanced levels of NORM;
- conduct visits to a sample of workplaces from the affected industries and assess from air sampling in typical working atmospheres the radioactive content, the particle size and the solubility of the dust/ aerosol particles; and
- incorporate the data collected into dosimetry models to set criteria/guidance to enable employers to assess radiation doses arising from work in the affected industries.

The research is expected to be completed in 2003.

Depleted uranium

Uranium is a silver-coloured heavy metal, similar to lead, cadmium and tungsten. Like tungsten it is very dense, nearly twice as dense as lead. Thus a 10 cm cube would weigh 20 kilograms (kg). Uranium occurs naturally, and is found in all rocks and soil, and in water and air. It occurs in soils at an average concentration of about

2 parts per million, equivalent to 2 g per tonne. Put another way, the top metre (m) of soil in a garden (one-tenth of an acre, or 10 m by 20 m) contains about 1 kg of uranium.

In its natural state, uranium consists of three isotopes (uranium-234, uranium-235 and uranium-238). In any quantity of natural uranium, these are found, by weight, as follows

uranium-234	0.0057%	(half life = 247,000 years)
uranium-235	0.72%	(half life = 710,000,000 years)
uranium-238	99.28%	(half life = 4,510,000,000 years)

The half life of a radioactive isotope is the time taken for it to decay to half of its original amount.

An 'enriched' form of uranium, in which the uranium-235 concentration is enhanced, is required to produce energy both in nuclear reactors and nuclear weapons. The remaining uranium mixture (after the enriched uranium is removed) has reduced concentrations of the uranium-235 and uranium-234 isotopes; this is known as depleted uranium (DU).

DU is less radioactive than natural uranium because it has less of the more radioactive isotopes, uranium-234, and uranium-235, per unit weight than does natural uranium. The International Atomic Energy Agency (IAEA) defines DU as a low specific activity material. Specific activity (the activity in becquerels per unit mass) is used as a measure of how radioactive something is.

DU has both civil and military applications:

- as a counter-balance in some aircraft
- to shield radiation in hospital radiotherapy units
- for containers for radioactive sources, and
- in heavy industrial drilling equipment.

The main military use of DU is in projectiles designed to penetrate armour (for example, tanks). It is used because it has a high density, and is readily available. The ability of DU to self-sharpen as it penetrates armour is the main reason why it is more effective than the alternative, tungsten, which tends to mushroom on impact. DU is also used defensively, since its physical properties give advantages in armour plate.

There has been media interest in the testing of MOD's depleted uranium weapons at two firing ranges in the UK. Such situations will be covered by the Ionising Radiations Regulations 1999 (IRR99) which, amongst others, require MOD to undertake a risk assessment before they work with ionising radiation. Further requirements include ensuring that doses to employees and members of the public are restricted so far as is reasonably practicable.

If work is conducted in accordance with the requirements of IRR99 and other appropriate legislation, health risks to workers and members of the public will be adequately controlled.

Further information is available in the Royal Society report on *the Health Hazards of Depleted Uranium in Munitions*, available on its website: www.royalsoc.ac.uk

Control of sealed sources

The main issue of concern to HSE is that radioactive sources, if not properly controlled, have the potential to cause serious harm to people who may be exposed to them. The fact that radiation cannot be detected by human senses, and that a source's presence can only be established by specialist monitoring equipment, means that control arrangements must be robust and foolproof.

Sealed radioactive sources are usually housed in an outer casing or container which acts as a shield to the radiation. 'Orphan' sealed sources from redundant industrial plant can present an immediate hazard in the scrap yard if this shielding is missing or damaged on initial receipt. They may present little risk if the container is properly closed and locked. However, as soon as scrap is processed and sorted by fragmenting, shearing, milling, cutting, etc, there is a potential for loss of shielding and subsequent significant exposure of employees to external radiation.

There is also the hazard arising from possible rupture of the source encapsulation during processing of the scrap, or subsequent smelting. Loose radioactive material can then contaminate large areas of processing plant including scrap yards.

IRR99 establish a framework for controlling sources which, if followed, would ensure that the risks to workers and members of the public from uncontrolled exposure to radioactive sources are prevented.

The EC is currently preparing a draft Directive which would establish additional control measures for high activity sealed sources, but has not yet published any formal proposals. For further information, please contact:
bob.russ@environment-agency.gov.uk

Industrial radiography

Industrial radiography involves the use of intense radioactive sources to enable non-destructive testing (NDT) of welds to check for structural integrity. Doses for this sector remain higher than other CIDI* categories, despite targeted action by HSE. Indeed, though still small, CIDI figures for 1999 show an increase in the number of industrial radiographers who received exposures to ionising radiation greater than 15 millisieverts in the year, compared with 1998. The main concerns are that a significant number of NDT contractors fail to adopt routine working practices capable of keeping radiation exposures of employees as low as reasonably practicable: this is the main requirement of IRR99. Incidents occur because of poor job planning (most notably with site radiography); failure to use adequate local source shielding (collimation); or inadequate systems of work. HSE has produced a free leaflet, *Industrial radiography – managing radiation risks,* No. 1 (rev. 1), in the Ionising

Radiation Protection Series, which gives guidance to clients, contractors and employees on the need to focus on managing radiation risks. it is available on HSE's website at: www.hse.gov.uk/pubns/irp1.pdf

* CIDI is HSE's Central Index of Dose Information, maintained by NRPB under contract to HSE, which contains summaries of the annual doses received by classified persons. These are published annually, together with occasional trends reports – see:
www.hse.gov.uk/hthdir/noframes/hdjnls.htm#cidi

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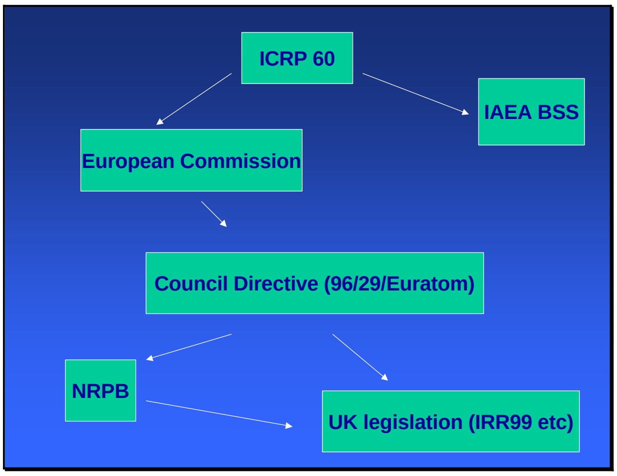
REVIEW OF INTERNATIONAL INFLUENCES



EUROPEAN OBLIGATIONS

- The ‘Public Information’ Directive 89/618/Euratom
- The ‘Outside Workers’ Directive 90/641/Euratom
- The Basic Safety Standards (BSS) Directive 96/29/Euratom
- The ‘Medical Exposure’ Directive 97/43/Euratom

Presentations: IRAC's part in implementation: preparation of legislation and guidance - Dr R W Davies

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IRAC's Role in Process of Developing Regulation

EC Directive BSS 1996

↓

Update of IRR85

Modification of PIRER

↓

IRR99

REPPIR

30/08/01 RWD/GS123

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IRAC Process

Informal consultation	May 96
Establishment of Topic Groups	May 96
Draft consultation document	Oct 97
Formal consultation completed	July 98
Amendments following consultation	Nov 98
Submission to Europe	June 99
Regulations laid before Parliament	Dec 99

30/08/01 RWD/GS123

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IRAC Role

Expert advice
- cross sector
- employer/employee

Consultation/debate

Examples
- Dose limitation
- IRR85 provisions
- guidance

30/08/01 RWD/GS123

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Conclusions

Excellent process

Effective consultation

Cross sector input from IRAC

Maintaining and improving safety

30/08/01 RWD/GS123

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Guidance for expectant or breastfeeding mothers working with ionising radiation

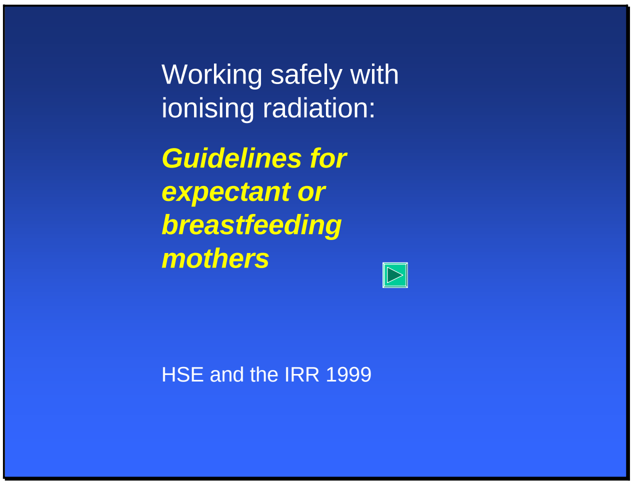
The HSC challenge

- **Why the need for guidance**
- **To whom it should be addressed**
- **Produced by whom**

IRAC Working Group

- First drafts - trial for comment
- IRAC feedback
- WG enlarged - trial and open consultation
- IRAC endorsement
- Publication by the HSE

Presentations: IRAC's part in implementation: preparation of legislation and guidance - Dr P J Allisy-Roberts OBE



Presentations: Radiological Protection, now and in the future: Current Position - Mr G Renn

Radiological Protection, Now and in the Future

Current Position

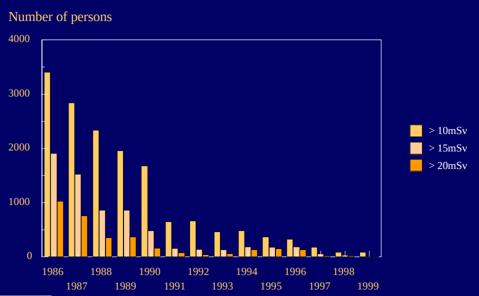
Ionising Radiations Advisory Committee

Overview

- The "ALARP" principle has promoted a continuing reduction in occupational radiation exposures
- Very few radiation workers now approach the statutory dose limits

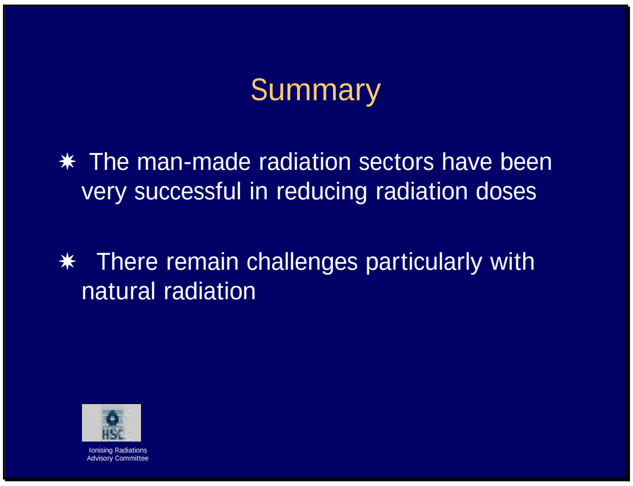
Ionising Radiations Advisory Committee

Trends in Occupational Exposure



Ionising Radiations Advisory Committee

Presentations: Radiological Protection, now and in the future: Current Position - Mr G Renn



Presentations: Radiological Protection, now and in the future: Challenges - Prof R H Clarke

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RADIOLOGICAL PROTECTION, NOW AND IN THE FUTURE

(ii) CHALLENGES

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BIOLOGICAL CHALLENGES

RISKS at LOW DOSES and LOW DOSE RATES

-is there a threshold below which repair is totally effective?

-are low doses more dangerous than we currently assume?

Epidemiology alone cannot answer these questions so we need support from molecular studies

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EFFECTIVE AND OPEN COMMUNICATION

The ‘stakeholder’ process of involving affected individuals is an important approach, for both

Setting standards

-to achieve a basic level of health care, and

Optimising protection

-leading to consensus on resulting levels of exposure

RADIOLOGICAL PROTECTION, NOW AND IN THE FUTURE

(iii) Uncertainties

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Uncertainties arise because of change

- new or changed work activities
- new sources of radiation
- new pathways and radiobiology
- new individuals or groups exposed as workers / patients / public
- new practices and procedures

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Some examples of change in the medical uses of radiation

New sources, pathways and radiobiology

- POSITRON EMISSION TOMOGRAPHY

New practices

- INTRAVASCULAR BRACHYTHERAPY

for non-malignant conditions

eg. clearing arterial stents in cardiovascular procedures

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What role can IRAC take in dealing with uncertainties ?

- Monitoring new practices as, and even before, they are brought into use
- Reviewing the implications of the latest risk models and radiobiological data
- Learning from and communicating experience
- Thinking laterally - perhaps there is not a single framework ? eg. Radon and NORMS

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What role can IRAC take in dealing with uncertainties ?

IRAC can provide a wide-ranging, independent overview of :

- radiation practices, legislation and guidance
- how radiation safety information is communicated

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Most people only receive low doses of ionising radiation but may be concerned about the likely effects. The following article is reproduced from NRPB's website.

It may be found, with hypertext links to other sources of information, at: www.nrpb.org.uk/topics/risks/risks_at_low_doses.htm

Cancer Risks at Low Doses of Ionising Radiation

Ionising radiation and how we are exposed to it

Ionising radiation is the energy produced from natural and man-made radioactive materials. It is present in the environment because of naturally occurring radioactive minerals remaining from the very early formation of the planet. This leads to exposure to gamma rays and radioactive radon gas from certain rocks and from radioactive material in our food and drink. We are also exposed to natural ionising radiation that comes from outer-space and passes through the atmosphere of the planet - so called cosmic radiation.

There are three main sources of man-made ionising radiation. First, it is used in medicine for treating cancer and for the diagnosis of many diseases. Second, radioactive materials are also used in industry, primarily for measurement purposes and for producing electricity. Both medical and industrial uses of radiation produce radioactive waste. Third, it is present as fall-out from previous nuclear weapon explosions and other accidents/incidents world-wide.

Exposure of the UK population to man-made ionising radiation from medical and industrial activity is closely controlled and the estimation of all exposures, whether from natural or man-made radioactive sources, is undertaken by NRPB. These estimates show that, on average, doses from industrial activity plus weapons fall-out are a very small part of the total (less than 1%), doses from medical practices are greater (about 14%) and the remainder (about 85%) comes from natural sources. Similar figures are seen in other developed countries.

The damaging effects of ionising radiation come from the packages of high energy that are released from radioactive material. Although different types of ionising radiation have different patterns of energy release and penetrating power there is no general property that makes man-made ionising radiation different and more damaging than the ionising radiation that comes from natural radioactive material. This means that we can make direct comparisons between doses from man-made sources of ionising radiation and those from natural sources.

Finally it is important to know that the radiations in the environment that come from sunlight, power-lines, electrical equipment and mobile phone systems do not have enough energy to produce these ionisations. Therefore, they are called non-ionising radiations.

Ionising radiation damage and cancer

There is very strong scientific evidence that the energy from radioactive material affects the cells of the body, mainly because of the damage it can cause to cellular genetic material known as DNA. DNA controls the way in which each individual cell behaves. At high doses enough cells may be killed by damage to DNA and other parts of the cell to cause great injury to the body and even rapid death. At lower doses there will be no obvious injury but a number of the cells that survive will have incorrectly repaired the DNA damage so that they carry mutations. Some specific mutations leave the cell at greater risk of being triggered to become cancerous in the future. The body will already carry cells with these mutations from other causes but the ionising radiation exposure increases the number of these mutant cells. It therefore increases the chance of cancer development, usually after many years.

The scientific information that has been obtained worldwide leads NRPB to believe that even the lowest dose of ionising radiation, whether natural or man-made, has a chance of causing cancer. The extra cancer risk from very low doses will be extremely small and, in practice, undetectable in the population. However the extra cancer risk at higher doses may be detectable using statistical methods. Even after high dose exposure it is rarely possible to be certain that radiation was directly responsible for a cancer arising in an individual.

The estimation of cancer risk at low doses

The cancer-causing effects of ionising radiation at high doses have been known for many decades. Since then, there have been many large studies worldwide of cancer arising in people exposed to high and low doses. These studies include people exposed to the atomic bomb explosions in Japan, to fall-out from nuclear weapons tests and during radiation accidents. Information is also available from people irradiated for medical reasons, during their work or as a result of living in a region that has unusually high levels of radioactive radon gas or gamma radiation. From all of this scientific work published in peer-reviewed papers we know more about cancer risk after ionising radiation than for any other cancer-causing substance. However, because cancer is unfortunately a common disease with many causes it is extremely difficult to directly measure the small extra risk from ionising radiation when the doses are very low. National and international organisations worldwide constantly discuss the best way to use the cancer information that we have to make estimates of the risks at the low doses that are received by the general public and workers. Special attention is given to the risks from man-made ionising radiation that can be controlled and regulated. As mentioned earlier, it is also important to take account of the risks from natural radiation, most of which cannot be controlled.

At present the estimate of cancer risk at low doses recommended by NRPB for use in the UK predicts that a lifetime of exposure of the population to all sources of ionising radiation (natural plus man-made) could be responsible for an additional risk of fatal cancer of about 1% - this can be compared with a life-time risk of cancer of about 20-25% from all causes. The very small doses from non-medical, man-made radiation would be responsible for only a tiny fraction (about 1/100th) of this 1% radiation risk. Therefore, compared with other known cancer risk factors in the population such as cigarette smoking, excessive exposure to sunlight and poor diet, the risk to the population from non-medical man-made radiation is generally agreed to be very small indeed.

It is the responsibility of NRPB to advise the UK Government on cancer risk estimates and standards for radiation protection. At present there are only small differences in the risk estimates used by different countries world-wide for the protection of their populations - almost all countries follow the recommendations made by the independent International Commission on Radiological Protection (ICRP). However, from time to time scientific advances make it necessary to consider an adjustment of these estimates and this can be done at a national as well as international level. To illustrate this, a review by NRPB in 1987 of newly published epidemiological studies led to a recommendation to increase the estimate of low dose cancer risk to be used in the UK. This was accepted by Government and within a few years other national and international bodies came to similar conclusions.

How reliable are estimates on cancer risks at low doses?

There are a number of scientific uncertainties in making these estimates of cancer risk at low doses. In its most recent report in the year 2000 the highly respected United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) suggests that uncertainties in cancer risk estimates may be about two fold higher or lower for acute doses where cancer risk can be directly assessed and a further factor of two (higher or lower) for the projection of these risks to very low doses and low dose rates.   In 1993, NRPB had suggested similar degrees of uncertainty on radiation cancer risks to be applied in the UK. For external radiations where the energy enters the body from the outside there is good scientific evidence to support this suggestion. However, for some internal radiations where radioactive material is taken into the body via food, water or air, the uncertainties (higher or lower) on risks may be somewhat greater. The main reason for this extra uncertainty is that some forms of internal radiation concentrate in different parts of the body and therefore the doses to different body organs are not the same. This uncertainty is in part dealt with by taking concentration effects into account so that the sensitive organs receiving the highest internal radiation dose are given the greatest risk. These estimates on risk have also been supported by research on humans and experimental animals exposed to internal radiations.

In the light of all the available information, the argument that risks from low dose man-made internal radiations have been greatly under-estimated is scientifically very weak. First, the doses to the general public from man-made internal radiations represent a small fraction of internal radiation dose from naturally radioactive material. On this point, the studies on people exposed to internal radiation via radon gas entering the body through the lungs do not provide evidence of unexpectedly high cancer risk at low doses. Second, markedly higher than expected cancer risk has not been seen in people exposed throughout Europe to man-made radioactive fallout from nuclear testing in the 1950s and 60s and from the Chernobyl accident. Third, the same conclusion is reached from research on populations in the former Soviet Union who received low dose internal radiation as a result of radiation accidents and incidents. Many of these studies are continuing. They have different strengths and weaknesses but taken together they do not suggest that internal radiations, whether natural or man-made, have special properties that make them particularly dangerous. Furthermore, these studies do not indicate that the cancer risks from these internal radiations have been greatly underestimated.

There certainly are well publicised scientific reports which claim that risks of cancer after low dose radiation are much higher than those provided by international scientific consensus. Equally, other reports claim much lower risks at low doses and even no risk at all because of an assumed low dose threshold for the process of cancer induction. It is usually the case that these extreme positions are taken using information from highly selected and often poorly designed studies. By contrast, the international scientific consensus on radiation risk has been built over many years by large numbers of scientists working in different countries who have considered the strengths and weaknesses of all available evidence before reaching conclusions.

Most of the studies mentioned here were reviewed by the United Nations UNSCEAR Committee in 2000 and this publication is the best recent example of international scientific agreement on cancer risks after ionising radiation exposure and the uncertainty on these risk estimates. NRPB contributes to the scientific discussions and reviews of UNSCEAR and agrees with the conclusions that this international committee has reached.

The scientific judgements given above are discussed in more detail in the following publications.

Living with Radiation (5th Edition). NRPB, ISBN 0-85951-419-6 (1998).

Interim Guidance on the Implications of Recent Revisions of Risk Estimates and the ICRP 1987 Como Statement. NRPB-GS9 (1987).

Estimates of Late Radiation Risks to the UK Population. Documents of the NRPB, Vol. 4, No. 4 (1993).

Risk of Radiation-induced Cancer at Low Doses and Low Dose Rates for Radiation Protection Purposes. Documents of the NRPB, Vol. 6, No. 1 (1995).

United Nations. Sources and Effects of Ionizing Radiation. Vols. 1 and 2. UNSCEAR 2000 Report to the General Assembly with scientific annexes. United Nations sales publications E.00.IX.3 and E.00.IX.4. United Nations, New York, 2000.