EUROPEAN COMMISSION

Community Research

Radiation Protection

Safeguarding of European Citizens

Man and the environment are constantly exposed to ionising radiation from many different sources. Radiation and radioactive materials occur naturally and are ubiquitous in the environment. Man-made sources of radiation are used extensively in industry and medical investigations and treatment and provide substantial benefits for health care and the economy. Radiation and radioactive materials are by-products of the generation of nuclear energy in all steps of the nuclear fuel cycle.

Radiation protection is highly multi-disciplinary and covers a diverse range of issues. The main focus of research over the past decade and for the foreseeable future is the better quantification and understanding of the risks of radiation at levels typical of those occuring in the workplace and the environment. This will be achieved by a combination of cellular and molecular biology research on the interaction between radiation and molecules (DNA), cells and organs, and epidemiological studies of exposed populations.

Other important areas of research include radioecology, protection of the environment from radiation, protection of the workplace, the assessment and management of natural radiation, emergency management and rehabilitation of contaminated areas and the optimisation and development of guidance for diagnostic uses of radiation in medicine.

SIXTH FRAMEWORK PROGRAMME

EURATOM

Background

Radiation and radioactive materials occur naturally and are ubiquitous in the environment. Artificial or man-made sources of radiation are used extensively in industry and medicine with substantial benefits for the economy and health care. These diverse sources, including radionuclides originating from the generation of nuclear energy, result in the exposure of people, both in workplaces and in the general environment, through various means. By far the largest contribution to the exposure of the population is from **natural sources** while exposure from **artificial sources** is largely due to the use of radiation and radioactive materials in medicine.

Other sources of potential exposure are of cosmic (cosmic rays) and terrestrial (radioactive elements from natural decay of uranium such as radon gas) origin to which all organisms are exposed, at differing levels, according to their habitat. Radionuclides (natural and artificial) may enter the food chain and expose man. They can also be concentrated during their transfer through the environment (bio-accumulation) resulting in higher exposures of some people (critical groups).

State of the art

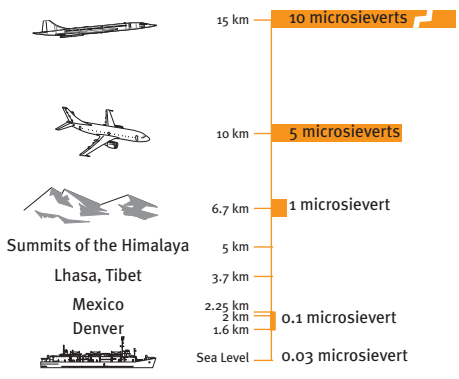
More than a century after the discovery of x-rays and radioactivity, radiation is one of the most intensively studied scientific domains particularly emphasising its carcinogenic effects in organisms. In-depth knowledge has been acquired on the effects of radiation on man in his environment.

Health Effects of Radiation:
Radiation effects on man have been studied in survivors of the atomic bomb explosions in Japan, accidentally exposed populations (eg, accidents at Mayak, Chernobyl), those exposed medically, nuclear workers and those exposed to enhanced levels of natural radiation. Considerable data (effects of radiation on cells and tissues) have been gathered and analysed and sustainable collaboration at a European level has been achieved with support from the Euratom programme.

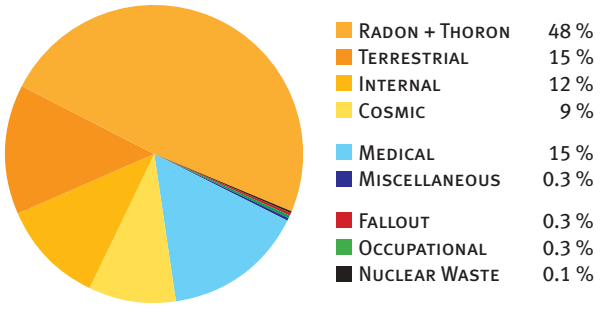
Radioecology:
Knowledge on the behaviour and transfer of radionuclides in the environment (terrestrial/aquatic) are prerequisites for the assessment of their impact and management. The transfer pathways of important radionuclides have been studied in the laboratory and the field, the latter due to the presence of radionuclides in the environment naturally, from controlled discharges and from accidents. Ecological models have been developed describing the interaction and behaviour of the most important radionuclides within ecological compartments, including transfer rates and ecological half-lives (persistence time in a certain environment). Decision Support Systems for helping decision-makers manage and restore contaminated environments have been developed.

Risk and Emergency Management:
Community research on off-site emergency management increased greatly following the Chernobyl accident, in particular in order to remedy a number of deficiencies identified in the response to that accident at national, regional and global levels. The research was wide ranging and covered many of the important elements critical for effective emergency management. These include predicting the release of radioactive material and its dispersion in the environment, evaluation of the health, environmental, social and economic impacts and how they may be reduced by countermeasures, rehabilitation of contaminated areas, environmental monitoring, development of decision support systems, etc. Two of the major achievements in EC funded research have been the development of the RODOS decision support system for off-site emergency management and a decentralised approach to achieving sustainable improvements in living conditions in settlements in the Former Soviet Union contaminated as a result of the Chernobyl accident.

Exposure at different altitudes



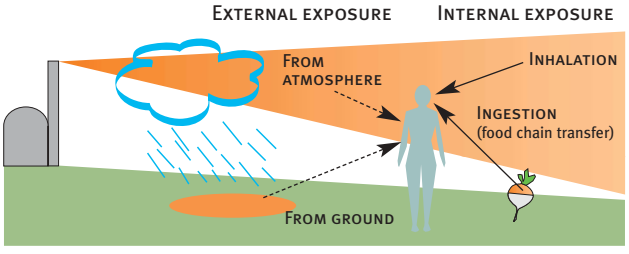
Average Radiation Exposure of the EC-population (natural and artificial)



Rationale and objectives for future RTD

Because radiation is a carcinogen, exposures of man, whether from natural or artificial sources, must be controlled and managed. Safety in the use of radiation and the management of exposures from natural sources is predicated on a sound radiation protection policy and its effective implementation. Community research underpins European policy and standards and has contributed to the high levels of protection achieved in practice. These standards must be maintained and further improved. Research has a key role in this process.

The main objectives for the future are to consolidate and advance European knowledge and competence in the radiological sciences that are essential for the safe and competitive use of nuclear fission and other industrial and medical uses of ionising radiation, including the management of natural sources of radiation. The research will also contribute to the harmonised implementation of the Basic Safety Standards for the protection of European citizens against ionising radiation and to their further consolidation.



RTD priorities for FP6

The main challenge is to resolve uncertainties in the risk from exposures to radiation at low and protracted doses typical of those encountered in the environment and in workplaces. This remains a controversial science and policy issue with important health and economic implications for the use of radiation and radioactive materials in both medicine and industry.

Community research will also continue to address natural and medical sources of radiation, radioecology, protection of the workplace and risk and emergency management.

Objectives:

▸ **Risk of low and protracted exposures to radiation**

- to better quantify and understand the risks of low and protracted exposures to ionising radiation of different forms or quality.

▸ **Medical exposures**

- to enhance the safety and efficacy of medical uses of radiation in diagnosis and therapy.

▸ **Natural sources of radiation**

- to better inform and promote common policies and practices in Europe for the management and control of natural sources of exposure.

▸ **Protection of the environment**

- to establish a robust conceptual and methodological basis for underpinning sound policy and standards for protection of the environment from radiation.

▸ **Radioecology and protection of the workplace**

- to promote the sustainable integration of European research in each of these areas, in particular to maintain critical mass and enable Europe to better respond to current and future needs.

▸ **Risk management**

- to develop new and improved approaches for risk assessment and management that can find broad technical and social acceptance and can contribute to the more effective and rational use of resources to nuclear safety.

▸ **Emergency management**

- to improve the efficacy and coherence of off-site emergency management in Europe including the long term management and rehabilitation of contaminated areas.

Overview of current EU RTD Actions

Achieving effective collaboration within Europe in Radiation Protection has been an important goal of the Euratom programme since its inception. Studies of the health effects of radiation continue to be the main focus but the programme remains diverse in both scope and content including important research areas such as protection of the environment from radiation, risk and emergency management and the rehabilitation of contaminated environments. The nature of research being carried in selected areas is summarised below:

▸ **Radiation and Health:** Understanding mechanisms of radiation-induced chromo-somal aberrations, mutations, genomic instability, bystander effects and cancer; identification of relevant genes for individual susceptibility to radiation; development of models for DNA-repair and carcinogenesis; assessment of cancer risk for populations exposed to low and protracted doses (Southern Urals, Chernobyl, radon in houses, uranium miners, nuclear workers).

▸ **Protection of the Environment:** Development of a framework for the assessment of the impact of radioactive contamination on the environment using reference organisms for evaluation dose rates and dose/effect relationships.

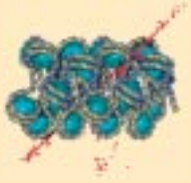
▸ **Restoration of Contaminated Areas:** Development of strategies for sustainable restoration and long-term management of contaminated rural, urban, and industrial ecosystems and food and agriculture restoration management after a nuclear accident involving stakeholders.

▸ **Risk and Emergency Management:** Development of approaches to risk governance that are more able to gain broad social acceptance; further development of decision support systems for off-site emergency management.

KI-46-02-315-EN-D

Radiation Carcinogenesis:

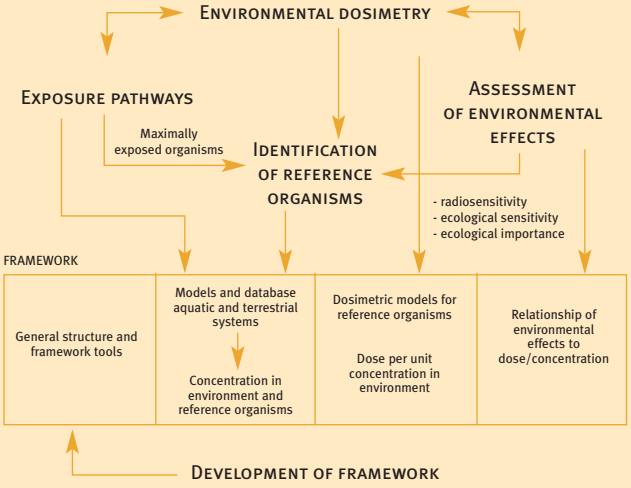
- The major pathways involved in the response of cells to radiation induced DNA damage are now much better understood. An intimate relationship between DNA repair capacity, the appearance of mutations and cancer development has been established.
- The mechanisms of certain radiation-induced cancers in mice have been characterized.
- Genetic factors operate in a complex fashion to influence individual sensitivity to radiation-induced cancer.
- New information has been obtained on genomic instability (radiation-induced cellular damage resulting in the expression of DNA instability over many cell divisions) and bystander effects (radiation-induced cellular damage resulting in an effect expressing in an unirradiated neighbouring cell). The links between these processes and the development of health effects have yet to be established.



Simulation of the track of a 1 MeV proton traversing a piece of the 30 nm chromatin fiber with a stochastic crossed-linker structure (red: ionisations and excitations by the proton and secondary electrons, blue: phosphate, white: sugar, gold: bases of the DNA, turquoise: histones).

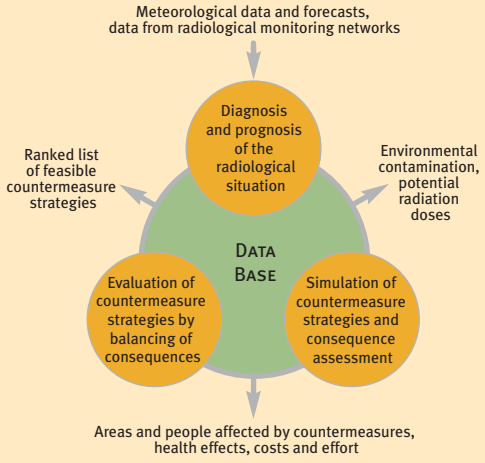
Radioecology:

Radiation protection is concerned not only with the effects on man but also on the environment. The **FASSET** project aims at a radiation protection framework for the environmental impact of ionising radiation. The framework will link together current knowledge about sources, exposure, dosimetry and environmental effects/consequences for reference organisms and eco-systems. Relevant components of the framework will be identified on an ecosystem basis through systematic consideration of the available data. The application of the framework in assessment situations will be studied involving decision-makers.



Emergency Management and Rehabilitation:

The **RODOS** decision support system for off site emergency management has been developed with Community support and is being installed in emergency centres in several EU, CEE and NIS countries. It provides a robust platform for achieving more effective and coherent response to any future accident that may affect Europe.



Airborne Gamma Spectrometry by equipped Helicopter.

In the **ETHOS** project a set of local measures have been tested to achieve sustainable improvements in living conditions in settlements contaminated as a result of the Chernobyl accident. Consequent upon its success, this approach is now finding a central role in Belarus policy for the long term management of contaminated areas.

Self-help on dose exposure measurements in Belarus settlements.

Information:

More information on the 5th FP activities can be found on the Community research homepage: http://www.cordis.lu/fp5-euratom/home.html
as well as the homepage of the Unit Nuclear Fission and Radiation Protection: http://europa.eu.int/comm/research/energy/fi/fi_en.html

OFFICE FOR OFFICIAL PUBLICATIONS
OF THE EUROPEAN COMMUNITIES
L-2985 Luxembourg