



IRSN

INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Protection of the environment

// IRSN orientation

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// IRSN short view

The Institute for Radiological Protection and Nuclear Safety (IRSN), created by the law n°2002-254 of May 09, 2001, then by the decree n°2002-254 of February 22, 2002, is a public establishment of an industrial and commercial nature (EPIC), under the joint authority of the Ministers of Defense, the Environment, Industry, Research and Health."

IRSN employs more than 1,500 specialists, including engineers, researchers, doctors, agronomists, veterinarians and technicians, experts in nuclear safety and radiological protection and in the control of nuclear and sensitive materials

The Institute exercises specialist and research assignments in the following fields:

- nuclear safety ;
- safety in transporting radioactive and fissile materials ;
- protection of man and the environment against ionising radiation ;
- protection and control of nuclear materials ;
- physical protection of facilities and transport of radioactive and fissile materials.

Doctrine & synthèse

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Forward

The Institute for Radiological Protection and Nuclear Safety conducts research programmes and studies on nuclear and radiological risks ; it is responsible for public service activities in the prevention of these risks and provides technical support to the competent public authorities in nuclear and radiological protection safety and security. In this respect, the Institute is called on to develop a position on a certain number of scientific and technical issues.

Under its policy of transparency and its desire to make high-quality information available to all partners and stakeholders for use in developing their own views, IRSN publishes doctrine and summary documents that present the Institute's position on a specific subject.

IRSN specialists prepare these documents, if appropriate in conjunction with outside experts, which are then submitted to a quality assurance validation process.

They reflect the IRSN position on the day of their publication on its **internet site**. This position may reviewed in the light of progress in scientific knowledge, changes in regulations or a need for more in-depth discussion of the subject to respond to an internal requirement or external requests.

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1/

Changes in radiological practice

//and current challenges

Environmental protection within a radiological protection context has for some time been conditioned by the **ICRP** paradigm which states that if man is protected others species are not put at risk. During the last decade, the absence of any scientific demonstration of this affirmation, and the increasing importance given to environmental issues at a number of international conferences, have led to a reexamination of this paradigm.

The most widely voiced objections to the ICRP paradigm are as follows:

- This paradigm does not apply to those parts of the environment where there is no human presence (in the deep oceans, for example) and it may not be valid over all scales of time and space.
- The lack of harmonization between the methods of managing environmental radiological protection and the international recommendations for environmental protection in general is difficult to justify in the face of European legislation targeting:
 - The conservation and protection of habitats.
 - The conservation of biodiversity and the protection of endangered species.
 - Resource management, the prevention of pollution and pollution control at source.

ICRP, 1991. Recommendations of the International Commission on Radiological Protection, Publication 60, Pergamon Press, Oxford and New-York.

- The absence of proven methods and specific criteria for environmental protection with regard to radionuclides is difficult to justify given those existing for chemical substances. Moreover, this situation makes it difficult for the public to understand the impact of radionuclides released into the environment.

These considerations explain the evolution of radioecology. This discipline, historically bound to support human radiological protection, initially targeted the study of transfer of radionuclides towards humans. The field of radioecology has now expanded to better include an evaluation of the exposure and effects of these radionuclides on fauna and flora, together with the ecosystems of which they form part. In addition, while the distribution of radionuclides in the environment was supposed to be homogeneous and in equilibrium between the various compartments, study now takes account of their spatial and temporal variations in the environment.

Radiological protection of the environment is important from a number of points of view: It is the subject of vigorous and recurrent questioning associated with the various uses of radioactivity and due to the resulting increase in the stock of long lived radioactive products ; there are many domestic and international legislative and constitutional changes (French environmental charter) in progress or planned for the future ; the domestic situation in France is unique (highly nuclearized country with all the corresponding economic, industrial and social implications).

However, there is as yet no scientific proof of any effect on ecosystems from exposure to radionuclides during the normal operation of facilities making use of radioactive substances. This may be due to a too much limited distance view and/or the fact that the ecological monitoring carried out *in situ*, using current environmental monitoring strategies specified for the waste authorizations granted to nuclear facilities, do not allow to detect effects at the ecosystem scale and to identify their cause.

2/

Present limits of understanding

//and resulting constraints

An analysis of the current level of understanding, based on work by a number of international organizations and European research programs, has identified the following areas where knowledge is primarily lacking:

- The process of accumulation of radionuclides in abiotic (air, water, soil, sediments) and biotic compartments (fauna and flora) and the resulting potential effects.
- The effects of chronic low level internal exposure to α and β emitters on all types of species.
- The propagation of these effects from the individual to the population, communities and ecosystems.

The implementation of an environmental radiological protection system will inevitably come up against these knowledge limitations. A number of extrapolations will be necessary in order to overcome them, including those from the individual to the population and higher organizational levels, from a high dose regime to a low dose regime, from acute exposure to chronic exposure, and from external exposure to internal exposure.

3/

The general strategy proposed by the IRSN

//for a system of radiological protection of
the environment and associated objectives

The IRSN believes that an environmental radiological protection system must aim to preserve the structure and function of ecosystems. This will require consideration of 1) the biotic and abiotic compartments which form both the sources of exposure and the habitats of the living organisms, and 2) the interactions within and between these components.

It is necessary to be in a position to carry out an assessment of the risk to the environment from radionuclides, both now and in the future, based on scientific standards. The IRSN believes that this should lead to the development, approval and implementation of an assessment methodology applicable to activities in which radioactive substances are used. This also implies a need for solid scientific understanding, minimizing the requirement for excessive safety margins resulting from lack of detailed scientific understanding, and for a corresponding development program aimed at the implementation of suitable protective measures.

The IRSN follows the approach adopted by the ICRP which aims to provide a degree of consistency between protection systems targeting the environment and that designed for humans. This consistency already emerges from the notion of reference animals and plants that is used in the same way as the reference man to provide a common

basis for simplified dose calculations. In this way, the environmental transfer pathways used in the analysis of human exposure are considered using concepts, methods and tools that are common to both areas of risk assessment.

The IRSN believes that it is essential that the method used to assess the risk to the environment from radionuclides should be consistent with that used for chemical substances. This consistency is all the more necessary as it is sometimes difficult to separate radiotoxicity and chemotoxicity in some particular cases of internal exposure. Moreover, current environmental monitoring strategies are not sufficient to provide an accurate determination of the causes of environmental changes that may be observed both temporally and spatially. This strengthens the case for consistency between the various assessment methods.

4/

The main principles

//of the proposed method for environmental risk assessment and the new scientific understanding that will be needed

Environmental risk assessment as developed for chemical substances is traditionally carried out in the following four stages:

- Identification of hazards.
- Analysis of exposure.
- Analysis of effects.
- Characterization of the risk. In its simplest form, this consists of a comparison of the actual exposure with predefined limits (quality criteria, limits derived from specific studies, etc.).

The most important, detailed aspects to be considered when applying this process to radioactive substances are:

- The reference to doses or dose rates received.
- The need to consider both external and internal exposure pathways.
- The absence of normalized tests for determining the ecotoxicity of radionuclides.

Present knowledge of the effects of ionizing radiation on fauna and flora is mainly concerned with gamma emitters. Additional research work is therefore needed to provide a robust determination of the biological effectiveness of the various types of radiation.

The development and implementation of laboratory assessment test protocols is particularly necessary in the case of radionuclides for the reasons stated above. Current ecological monitoring methods are, in the main, not sensitive enough to enable the effects to be detected. The IRSN believes that priority must be given to the design and development of chronic ecotoxicity tests extending over one or several generations.

In order to characterize the risk to fauna and flora, it is necessary to quantify the relationships between exposure and effects for each given species (dose-effect relationships). This is the foundation of the knowledge needed in order to develop radiological protection criteria. These may take the form of absolute or guidance limits corresponding to conditions under which the risk is negligible. It follows that particular emphasis should be given to work aimed at determining these criteria for radionuclides using clearly described methods.

The ideal situation would be to characterize disturbances at the ecosystem level. This is only partly possible, either through studying the effects on certain species in laboratory microcosms, through the use of more demanding approaches such as mesocosms, or *in situ*. As part of its ENVIRHOM project, the IRSN is carrying out a program of experimental research work on biological effects at both the sub-cellular level and at that of the individual. Today a modeling approach is being used to study the effects on populations. This approach will be further enriched as new knowledge concerning the higher organisation levels of ecosystems will become available.

5/

Consequences

//in terms of environmental monitoring

While an assessment is an essential prerequisite for the quantification of the risk to an ecosystem driven by a given substance, it is also necessary to carry out follow-up verification that the assessment is correct. Environmental monitoring (for example, by comparing the observed concentrations in the media concerned with the quality criteria) will be indispensable given the uncertainties associated with multiple pollutants and the complexity of the various biological and ecological levels at which any effects are likely to be expressed. The IRSN intends to study the suitability of, environmental monitoring strategies, techniques and associated metrology.

Given the complexity of the situations under consideration, the initial evidence of any correlation between ecological disturbance (for example, an increase or reduction in biodiversity within a community) and the concentration of a substance in the area concerned, will normally be supported by a program of in-depth studies before concluding on a causal relationship.

6/

The relationship

// of IRSN programs to chose of its partners

In addition to the work already carried out under the European ERICA program (6th FP), the IRSN will develop research partnerships and will also take an active part in the international programs to be managed by the ICRP (Committee 5 and specific working groups), the IAEA (who have established a specific action plan), and by the UNSCEAR. An important aspect of the IRSN participation in these programs will be the delivery to these organizations of the most recent results obtained by the Institute from work on the behavior of radionuclides and their biological effects on living organisms in ecosystems subjected to chronic exposure, in particular those results arising from the ENVIRHOM program. It is also possible that the conclusions reached by these working groups will result in the reorientation of some of the current programs being carried out by the Institute.

The IRSN notes that the work of the European Commission is now directed more towards the development of a regulatory framework than towards the discovery of new knowledge. The IRSN recommends that a more equal balance be struck between this regulatory work and research work aimed at improving our knowledge in the fields described above.

In France, the IRSN recommends testing on pilot sites, in collaboration with the operators and national authorities concerned, in order to validate the operational feasibility of the method developed by the Institute.