

STRATEGIES AND GUIDANCE FOR ESTABLISHING A PRACTICAL RADIATION PROTECTION CULTURE IN EUROPE IN CASE OF LONG TERM RADIOACTIVE CONTAMINATION AFTER A NUCLEAR ACCIDENT: THE SAGE PROJECT

S. Lepicard¹, I. Fiedler², V. Nesterenko³, A. Nisbet⁴, A. Sudas⁵

¹ Centre d'étude sur l'Evaluation de la Protection dans le domaine Nucléaire (CEPN),
Route du Panorama, BP 48, 92263 Fontenay-aux-Roses Cedex, France.

E-mail: lepicard@cepn.asso.fr

² Forschungszentrum für Umwelt und Gesundheit (GSF), Germany.

³ The Belarusian Institute of Radiation Safety (BELRAD), Belarus.

⁴ National Radiological Protection Board (NRPB), United Kingdom.

⁵ Brest Branch of the Research Institute of Radiology (BB RIR), Belarus.

Abstract. The evaluation of the rehabilitation strategies implemented in the contaminated territories of the CIS countries affected by the accident at the Chernobyl Nuclear Power Plant highlighted the need and importance to involve the population in the day-to-day management of the radiological situation, to complement the rehabilitation programme implemented by public authorities. The ETHOS experience in Belarus has revealed that to be effective and sustainable, this involvement must rely on the dissemination of a practical radiological protection culture within all sectors of the population and especially within professionals in charge of public health. The objective of the SAGE Project is to contribute to the development of strategies and guidance for implementing and disseminating such a culture in Western Europe, in case of a nuclear incident or accident with long-term radiological consequences. The key output of the project will be a handbook for the general population, the administrations, the local elected representatives and the concerned professionals. National "stakeholders panels" have been set up in each participating country: Belarus, France, Germany and the United-Kingdom. These panels involve professionals from the public health sector (nurses, midwives, medical doctors, radiation protection experts, medical social workers, NGOs, ...), who will contribute to the elaboration of the handbook and to the evaluation of the practicability of the proposed strategies. A European "stakeholder workshop" will be organised at the beginning of 2005 with all interested parties. This workshop will disseminate the findings of the project to a wide audience, as well as facilitating discussion on ways to implement the strategies and guidance on a practical level. Recommendations will be prepared for further possible developments at the European level. This paper presents the objectives, the main work programme and the preliminary findings from the SAGE project.

1. Introduction

The evaluation of the rehabilitation strategies implemented in the contaminated territories of the CIS countries affected by the Chernobyl catastrophe pointed out the need and importance to involve the population in the day-to-day management of the radiological situation. This inclusion of local stakeholders complements the rehabilitation programme implemented by the public authorities, rather than replacing it.

The ETHOS experience in Belarus has revealed that to be effective and sustainable, this involvement of local stakeholders must rely on the dissemination of a practical radiological protection culture within all sectors of the population, and primarily with professionals in charge of public health. ETHOS findings have provided a concrete base for the development of such a practical culture in the specific context of Belarus. This has involved the combining of several factors:

- a basic knowledge about the mechanisms through which man is exposed
- direct access to monitoring equipment, by which the radiological quality of the environment can be evaluated and the levels of internal and external exposure of individuals and the whole population can be controlled.

Following the international seminar held in November 2001 in Stolya (Belarus) [1], a declaration was signed by Belarusian national representatives and by different international organisations, stating that such an approach was "efficient in practice" and "merited to be studied, developed and disseminated".

The SAGE Project supported by the European Commission [2], started in October 2002 for a 30 month duration, in order to develop strategies and guidance for implementing and disseminating a practical radiological protection culture in Western Europe, in case of a nuclear incident or accident with long-term radiological consequences. The eventual goal will be to have a system in place that could be applied throughout the European Union, but as a first step the proposed strategies and guidance will be elaborated on the basis of the three Member States involved in the Project – France, Germany and the United Kingdom.

2. The SAGE partnership and work program

The partnership of the Project is composed of five teams from the following institutions: BB RIR (the Brest Branch of the Research Institute of Radiology - Belarus), BELRAD (the Institute of Radiation Safety - Belarus), CEPN (France), GSF (Germany) and NRPB (United Kingdom). The expertise of this work group covers mainstream disciplines such as radiation protection (including public health issues), dose and risk assessment, radiation monitoring (including measurements of foodstuffs and body contamination), radioecology, environmental monitoring, economics, social management of risk, countermeasures after accidents, regulation and risk policies.

The SAGE work program is split into five work packages which encompass two major tasks:

- A “classical” review performed by the Project partners, of the existing regulatory and radiological monitoring infrastructures dedicated to long-term management of the contamination of the environment, in the three Member States involved as well as in Belarus, including the feedback from the ETHOS experience
- The elaboration, by the Project partners and by national “stakeholder panels” both in the contaminated territories of Belarus and in the three Member States, of strategies and guidance for the general population and for health care professionals. This will be done in the form of practical advice to follow in a contaminated territory in order to avoid unnecessary exposures in the course of day-to-day activities and to adopt a responsible and prudent attitude in regard to the protection of health.

The review of existing infrastructures aims at providing the European Commission and the involved Member States with a clear state of the art of the “readiness” of these countries to deal, in the long-term, with a contamination of the environment resulting from a nuclear accident or any other kind of contamination. An analysis of the potential of existing regulations and infrastructures to provide all concerned stakeholders in society with practical means to tackle the problems raised by living in a contaminated environment will be given. Gaps in national infrastructures will be highlighted as far as possible and recommendations made for new developments, particularly in view of the findings from the Belarusian experience, including ETHOS.

As regards the elaboration of strategies and guidance for the general population and health care professionals, the key output will be a handbook that will contain comprehensive guidance for an inclusive radiation monitoring, based on the findings from the ETHOS experience, and should provide the concerned actors of a contaminated territory with basic practical means to evaluate and directly participate in the management of the radiological situation. This handbook is to be accessible to the general population and the administrations, the local elected representatives and all concerned professionals but primarily the health professionals. The practicability of the proposed strategies will be evaluated by the "stakeholders panels" involving professionals from the public health area (nurses, midwives, medical doctors, radiation protection experts, medical social workers, NGOs, ...). General principles and preliminary contents of the handbook are presented below.

3. Audience and scope of the handbook

The inclusive system of radiation monitoring and protection is articulated around five main entities ('the householder', 'the health professional', 'the measurement professional', 'the stakeholder advisory board' and 'the measurement'). These provide the "entry points" of the handbook.

3.1. The householder

Following a nuclear incident or accident it is the householder who expresses concerns and raises questions about the presence of radioactivity and its effects on health, especially for children in the long term. The types of questions posed include:

- How is my environment contaminated?
- How am I exposed, and when in particular?
- Is my body contaminated?
- How can I measure the contamination?
- What can I practically do by myself, and with the help from somebody else:
 - To better protect myself and to avoid future exposures?
 - To mitigate, as far as possible, the consequences of past exposures?
- Who can inform me about the radiological situation, answer my questions, make recommendations about possible actions to improve the situation?

The handbook will provide the householder with practical information that can help in answering these questions. It will also enable the householder to get a grip on the situation. Examples of actions that can be taken by the householder include measurements of ambient dose rate and visits to monitoring stations where measurement professionals can assess contamination levels in foodstuffs and the body. The handbook will also suggest that the householder be given access to reference information and simple tools to interpret different radiological data, etc.

3.2. The health professionals

The health professionals are particularly well placed to help the householder tackle questions about radioactivity and its effects on health. They can assess the individual's situation in view of the results of radiological measurements (ambient dose rates, foodstuffs and body contamination), propose corrective actions, and make suggestions about making complementary measurements. Furthermore, they will have an understanding of the exposure mechanisms, and be able to put the individual's situation into perspective by reference to statistical data on the radiological situation at the local, regional or national levels. Health professionals can alert in case of critical situation. Thus they remain privileged interlocutors for the persons they meet, with regard to the elements of radiation protection culture.

It must be noted that the health professionals are not limited to the "doctors", but would include the staff of hospitals, nurses, pharmacists, as well as school doctors and company doctors.

3.3. The professionals with responsibility for measurements

These professionals have responsibility for measuring the contamination present in foodstuffs and in the human body. They immediately return the results to the householder via a "personalised measure sheet". If measurements indicate high levels of contamination the measurement professional can refer the householder towards other sources of information or points of contact (*i.e.* the health professionals, the stakeholder advisory board). Periodically the measurement data are also transferred to the stakeholder advisory board. It is important to note that the measurement professional must be able to obtain the necessary information for them to have a global vision of the situation (*i.e.* from feedback from the stakeholder advisory board). They can also provide information and advice about ambient dose rates at the local level.

The measurement professionals provide a service of measurement and advice for the population, and for the whole society through the stakeholder advisory board (see below). These functions are relatively new in our societies and need to be further concretely defined.

3.4. The stakeholder advisory board

The stakeholder advisory board is organised at the level of a village or a municipality. It has a social function to collate and integrate the data on the local radiological situation, and to interpret these data in the context of the more global situation. Specific functions of the stakeholder advisory board are:

- To collect data on the radiological situation from the different measurement sources (ambient dose rates, radiological quality of foodstuffs, whole body measurements).
- To perform statistical analyses at the local, regional and possibly national levels.
- To elaborate useful reference situations for the interpretation of the data by the various stakeholders.

The work of the stakeholder advisory board is not only of a technical nature. It works with representatives from administrations, local elected representatives and non-governmental organisations to facilitate the exchange of information about the radiological situation for the whole of society and to better adjust the strategies of the various sectors. It also oversees the proper functioning of the radiation monitoring system. It makes sure of the availability, the reliability (quality insurance) and the pluralism of the sources of measurements. Furthermore it ensures the adaptation of the system according to the social demand and to the evolution of the legal and regulatory frameworks.

3.5. The measurement

The radiological measurement constitutes a key point of the whole system of radiation monitoring and protection. It provides information on the situation and its evolution with time. The measurement must be reliable and accepted by all affected stakeholders. It must reveal to them practical information that opens possibilities for action and improvement. Several criteria are essential to meet requirements for the provision of reliable measurements including:

- The proximity of food measuring points close to households and easy access to whole body monitoring equipment, including mobile systems
- The existence of several independent sources of measurement (*e.g.* pluralism)
- The coherence of the used measurement units

The measurement should not only be used to prove compliance with statutory regulations (*e.g.* 'maximum permitted levels' in foodstuffs or 'dose limits') but also to supply quantitative information to stakeholders and affected individuals on where, when and how they are exposed to radiation, even when levels of contamination are relatively low.

4. Preliminary structure and contents of the handbook

The handbook has four entry points depending on the user (*e.g.* the householder, health professional, measurement professional, stakeholder advisory board). Each entry point is subdivided into a number of key topics based on the concerns of the user. These topics are linked to technical sheets which contain more detailed information often of a practical nature (see section 4.1). Fig. 1 presents the preliminary structure and contents of the draft handbook. The handbook will be produced in a loose-leaf modular format to facilitate revisions and updates.

It is important to note that the handbook contains frequent reference to radiocaesium. This radionuclide still significantly contributes to the radiological exposures in the countries that were most affected by the Chernobyl accident, *e.g.* the former USSR and certain countries of Western Europe. It is also relatively easy to detect unlike radiostrontium which like radiocaesium is also readily transferred in the environment to Man. However, the methodology and the principles presented in the handbook should be broadly adaptable to any radionuclide, and thus transferable to other types of contamination.

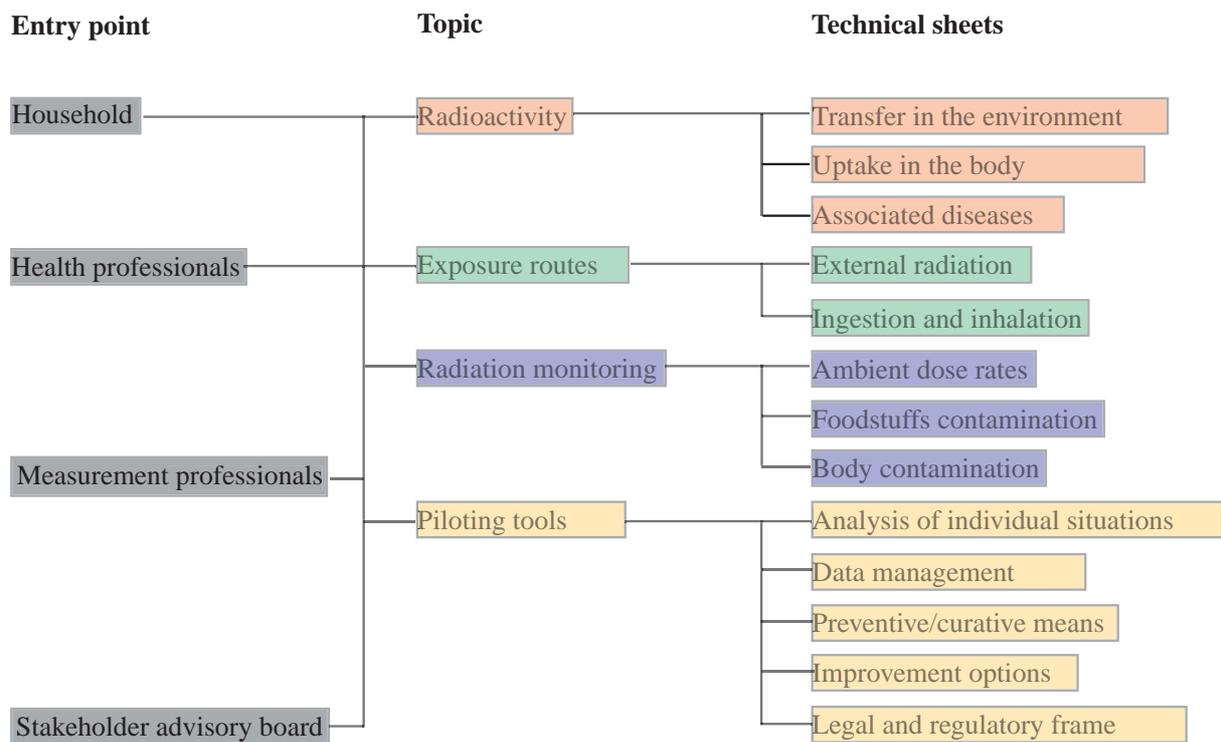


FIG. 1. Structure and contents of the preliminary version of the handbook.

4.1. Examples of technical sheets

4.1.1 Analysis of the individual's situation

The objective of this technical sheet is to use information on whole body contamination to decide on the adoption of corrective actions. The whole body measurement provides information about the radiological situation of an individual at one point in time. However, contamination in the body has accumulated from previous exposures either through inhalation or ingestion of ^{137}Cs . Whole body measurements can be used "to reconstruct", in a more or less precise way, a "theoretical history" of the incorporation of ^{137}Cs (Fig. 2). This can then be related to the degree of contamination of food products consumed by the individual, if historical measurements are available. Otherwise new measurements of contamination levels in the most frequently consumed foodstuff must be made. If these prove to be a major source of contamination, corrective actions can be recommended to improve the individual's situation.

This technical sheet provides any interested person, from the general population to health professionals, with all the basic information (general methodology, mathematical formulas, look-up tables) to proceed to an interpretation of whole body measurements and illustrates this through realistic examples. The method necessitates a good dialogue between the person and the health professionals involved and may require several iterations before the optimum strategy is reached.

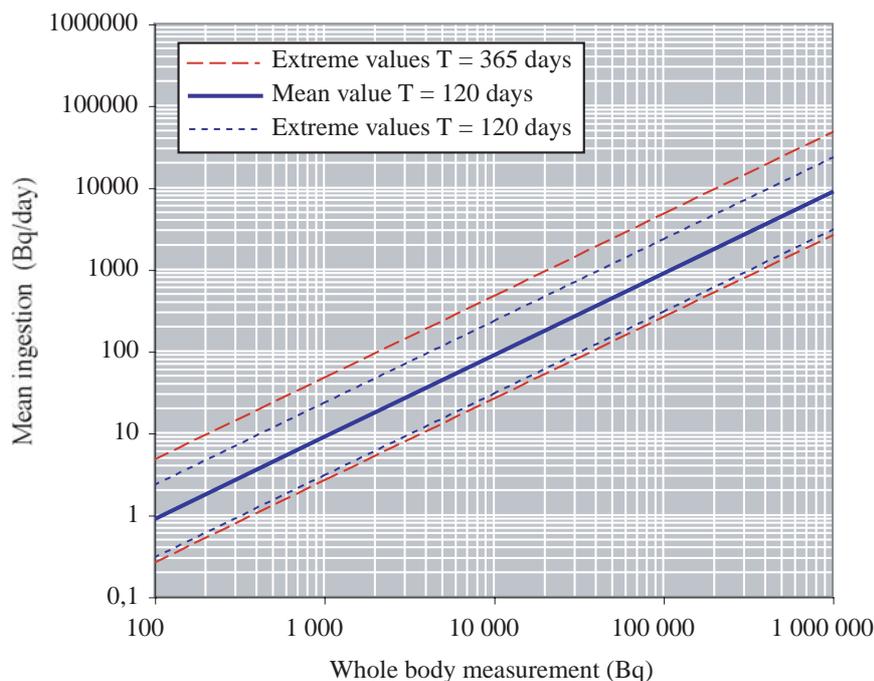


FIG. 2. Look-up table showing the relationship between the quantity of ^{137}Cs measured in the body (Bq) and the quantity ingested (Bq/day) during the whole period (T days) preceding the body measurement; values corresponding to an adolescent (10-15 years).

4.2. Radiological data management

The objective of this technical sheet is to collate radiological measurement data and to present the information in such a way that it can be understood by different stakeholders of society.

Radiological measurement data (ambient dose rates, contamination of foodstuffs and body contamination) help to characterise an individual's situation, and put it in the context of measurements carried out on other members of the household.

At an individual level, the results on ambient dose rates can be kept in a simple way because the measurements can be performed directly by the interested person. Thus he can keep a simple plan of his environment (house, garden, workroom) on which ambient dose rates are directly reported in various places. For foodstuffs and whole body measurements, there could be a separate result sheet for each type of measurement that is returned from the monitoring professional to the individual. This result sheet may contain the most recent results, together with a summary of the previous results and a comparison with information at a more collective level (*e.g.* comparison with the quality of products at the regional scale for example).

At a more collective level, the results of measurements such as described above can be used to present the radiological situation in a more global context [4]. The objective here is not to present exhaustive statistical analyses which would be conducted for scientific research purposes, but rather to identify methods to analyse and to display the information in a way that would be useful, both for the population and for the local and national authorities. Taking ambient dose rates as an example, results from individual measurements can be aggregated into a local (village, city), or even regional scale, to give an enlarged vision of the radiological quality of the environment. The production of maps from these data would further assist the householder in putting his/her situation in context. Similarly, information on levels of contamination in foodstuffs can be aggregated on a larger scale by grouping for example food by categories, from the most sensitive to the least sensitive in terms of contamination (see Table I). Aggregation of whole body measurements might be useful for epidemiological follow-up studies.

Table I. “Map” of radiological quality of foodstuffs at a village scale over 2000-2001 period (source ETHOS, Belarus).

Product	Nb mesures	Contamination ¹³⁷ Cs (Bq/kg)		
		Minimum	Maximum	Average
<i>Sensitive</i>				
Milk	322	0	466	35
Dried mushrooms	4	1 800	36 222	12 016
Fresh mushrooms	20	36	1 160	411
Bilberries	13	98	375	223
Cranberries	11	30	1 617	293

<i>Less sensitive</i>				
Carrots	6	0	37	11
Meat	1	56	56	56
Potatoes	52	0	43	16

5. Dissemination of SAGE outputs

A European “stakeholder workshop” will be organised at the beginning of 2005 with all interested parties. This workshop will disseminate the findings of the project to a wide audience and will facilitate discussion on ways to implement the strategies and guidance on a practical level. Recommendations will be prepared for further possible developments at the European level.

4. Conclusion

The SAGE project has reached its mid-term point. A review has been carried out of the existing infrastructures in France, Germany and the UK, giving a clear state of the art of the “readiness” of these countries to deal, in the long-term, with a contamination of the environment resulting from a nuclear accident or any other kind of contamination. A handbook providing strategies and guidance for an inclusive system of radiation monitoring and protection is under development based on feedback from iterative consultations with stakeholder panels set up in the participating Member States. A workshop scheduled for the final year of the project will disseminate the findings of the project to a wide audience and investigate ways to implement the strategies and guidance on a practical level.

A dozen of technical sheets have been elaborated with the Project partners and through national stakeholder panels meetings. The final proposed strategies and guidance will give a better view of the basic elements which are at stake when dealing with long-term management of a situation of contamination of the environment, and for disseminating such a practical radiological culture among the population of Western Europe.

References

1. Réhabilitation des conditions de vie dans les territoires contaminés par l'accident de Tchernobyl: la contribution de l'approche ETHOS, Actes du Séminaire International de Stolyn, Biélorussie, 15-16 novembre 2001, <http://www.cepn.asso.fr/fr/ethos.html>.
2. <http://www.ec-sage.net/>
3. INSTITUT DE PROTECTION ET DE SURETE NUCLEAIRE, Le césium de l'environnement à l'homme, Collection IPSN, EDP Sciences, (2000).
4. Lepicard S., Hériard Dubreuil G., Practical improvement of the radiological quality of milk produced by peasant farmers in the territories of Belarus contaminated by the Chernobyl accident, Journal of Environmental Radioactivity, Vol. 56, N° 1-2, pp. 241-253, (2001).