IAEA Nuclear Energy Series

No. NW-T-3.5

Basic Principles

Objectives

Guides

Technical Reports

Communication and Stakeholder Involvement in Environmental Remediation Projects

IAEA
International Atomic Energy Agency

IAEA NUCLEAR ENERGY SERIES PUBLICATIONS

STRUCTURE OF THE IAEA NUCLEAR ENERGY SERIES

Under the terms of Articles III.A and VIII.C of its Statute, the IAEA is authorized to foster the exchange of scientific and technical information on the peaceful uses of atomic energy. The publications in the **IAEA Nuclear Energy Series** provide information in the areas of nuclear power, nuclear fuel cycle, radioactive waste management and decommissioning, and on general issues that are relevant to all of the above mentioned areas. The structure of the IAEA Nuclear Energy Series comprises three levels: **1 — Basic Principles and Objectives**; **2 — Guides**; and **3 — Technical Reports**.

The **Nuclear Energy Basic Principles** publication describes the rationale and vision for the peaceful uses of nuclear energy.

Nuclear Energy Series Objectives publications explain the expectations to be met in various areas at different stages of implementation.

Nuclear Energy Series Guides provide high level guidance on how to achieve the objectives related to the various topics and areas involving the peaceful uses of nuclear energy.

Nuclear Energy Series Technical Reports provide additional, more detailed information on activities related to the various areas dealt with in the IAEA Nuclear Energy Series.

The IAEA Nuclear Energy Series publications are coded as follows: **NG** — general; **NP** — nuclear power; **NF** — nuclear fuel; **NW** — radioactive waste management and decommissioning. In addition, the publications are available in English on the IAEA Internet site:

http://www.iaea.org/Publications/index.html

For further information, please contact the IAEA at PO Box 100, Vienna International Centre, 1400 Vienna, Austria.

All users of the IAEA Nuclear Energy Series publications are invited to inform the IAEA of experience in their use for the purpose of ensuring that they continue to meet user needs. Information may be provided via the IAEA Internet site, by post, at the address given above, or by email to Official.Mail@iaea.org.

COMMUNICATION AND STAKEHOLDER INVOLVEMENT IN ENVIRONMENTAL REMEDIATION PROJECTS

The following States are Members of the International Atomic Energy Agency:

AFGHANISTAN
ALBANIA
ALGERIA
ANGOLA
ARGENTINA
ARMENIA
AUSTRALIA
AUSTRIA
AZERBAIJAN
BAHAMAS
BAHRAIN
BANGLADESH
BELARUS
BELGIUM
BELIZE
BENIN
BOLIVIA
BOSNIA AND HERZEGOVINA
BOTSWANA
BRAZIL
BRUNEI DARUSSALAM
BULGARIA
BURKINA FASO
BURUNDI
CAMBODIA
CAMEROON
CANADA
CENTRAL AFRICAN REPUBLIC
CHAD
CHILE
CHINA
COLOMBIA
CONGO
COSTA RICA
CÔTE D'IVOIRE
CROATIA
CUBA
CYPRUS
CZECH REPUBLIC
DEMOCRATIC REPUBLIC OF THE CONGO
DENMARK
DOMINICA
DOMINICAN REPUBLIC
ECUADOR
EGYPT
EL SALVADOR
ERITREA
ESTONIA
ETHIOPIA
FIJI
FINLAND
FRANCE
GABON
GEORGIA
GERMANY
GHANA
GREECE
GUATEMALA
HAITI
HOLY SEE
HONDURAS
HUNGARY
ICELAND
INDIA
INDONESIA
IRAN, ISLAMIC REPUBLIC OF
IRAQ
IRELAND
ISRAEL
ITALY
JAMAICA
JAPAN
JORDAN
KAZAKHSTAN
KENYA
KOREA, REPUBLIC OF
KUWAIT
KYRGYZSTAN
LAO PEOPLE'S DEMOCRATIC REPUBLIC
LATVIA
LEBANON
LESOTHO
LIBERIA
LIBYA
LIECHTENSTEIN
LITHUANIA
LUXEMBOURG
MADAGASCAR
MALAWI
MALAYSIA
MALI
MALTA
MARSHALL ISLANDS
MAURITANIA
MAURITIUS
MEXICO
MONACO
MONGOLIA
MONTENEGRO
MOROCCO
MOZAMBIQUE
MYANMAR
NAMIBIA
NEPAL
NETHERLANDS
NEW ZEALAND
NICARAGUA
NIGER
NIGERIA
NORWAY
OMAN
PAKISTAN
PALAU
PANAMA
PAPUA NEW GUINEA
PARAGUAY
PERU
PHILIPPINES
POLAND
PORTUGAL
QATAR
REPUBLIC OF MOLDOVA
ROMANIA
RUSSIAN FEDERATION
RWANDA
SAN MARINO
SAUDI ARABIA
SENEGAL
SERBIA
SEYCHELLES
SIERRA LEONE
SINGAPORE
SLOVAKIA
SLOVENIA
SOUTH AFRICA
SPAIN
SRI LANKA
SUDAN
SWAZILAND
SWEDEN
SWITZERLAND
SYRIAN ARAB REPUBLIC
TAJIKISTAN
THAILAND
THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA
TOGO
TRINIDAD AND TOBAGO
TUNISIA
TURKEY
UGANDA
UKRAINE
UNITED ARAB EMIRATES
UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND
UNITED REPUBLIC OF TANZANIA
UNITED STATES OF AMERICA
URUGUAY
UZBEKISTAN
VENEZUELA
VIET NAM
YEMEN
ZAMBIA
ZIMBABWE

The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world''.

IAEA NUCLEAR ENERGY SERIES No. NW-T-3.5

COMMUNICATION AND STAKEHOLDER INVOLVEMENT IN ENVIRONMENTAL REMEDIATION PROJECTS

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2014

COPYRIGHT NOTICE

Marketing and Sales Unit, Publishing Section
International Atomic Energy Agency
Vienna International Centre
PO Box 100
1400 Vienna, Austria
fax: +43 1 2600 29302
tel.: +43 1 2600 22417
email: sales.publications@iaea.org
http://www.iaea.org/books

Printed by the IAEA in Austria
May 2014
STI/PUB/1629

IAEA Library Cataloguing in Publication Data

Communication and stakeholder involvement in environmental remediation projects. — Vienna : International Atomic Energy Agency, 2014.
p. ; 30 cm. — ((IAEA nuclear energy series, ISSN 1995–7807 ; no. NW-T-3.5)
STI/PUB/1629
ISBN 978–92–0–145210–8
Includes bibliographical references.

1. Hazardous waste site remediation — Decision making — Citizen participation. 2. Radioactive waste sites — Cleanup. 3. Radioactive decontamination — Public opinion. I. International Atomic Energy Agency. II. Series.

IAEAL 14–00899

FOREWORD

One of the IAEA's statutory objectives is to "seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world." One way this objective is achieved is through the publication of a range of technical series. Two of these are the IAEA Nuclear Energy Series and the IAEA Safety Standards Series.

According to Article III.A.6 of the IAEA Statute, the safety standards establish "standards of safety for protection of health and minimization of danger to life and property". The safety standards include the Safety Fundamentals, Safety Requirements and Safety Guides. These standards are written primarily in a regulatory style, and are binding on the IAEA for its own programmes. The principal users are the regulatory bodies in Member States and other national authorities.

The IAEA Nuclear Energy Series comprises reports designed to encourage and assist R&D on, and application of, nuclear energy for peaceful uses. This includes practical examples to be used by owners and operators of utilities in Member States, implementing organizations, academia, and government officials, among others. This information is presented in guides, reports on technology status and advances, and best practices for peaceful uses of nuclear energy based on inputs from international experts. The IAEA Nuclear Energy Series complements the IAEA Safety Standards Series.

Implementers, as well as regulators, of environmental remediation (ER) projects generally face difficulties in explaining to the public the motives and objectives of this type of activity. One of the very first challenges that must be confronted by those in charge of providing information on ER projects is the idea that remediation implies returning the land to pre-existing conditions or background levels of radiation. This is not what is proposed by the IAEA, which, in the context of radiologically contaminated sites, defines remediation as actions that, following justification, will ultimately promote the reduction of existing or future exposures to ionizing radiation. Therefore, ideas related to restoration or rehabilitation of land are avoided in this context.

Experience has shown that remediation projects tend to be successful (i.e. implemented in a safe and cost effective manner) if an appropriate amount of comprehensible information is given to the general public. Even more significant are situations in which an effective process of stakeholder involvement and engagement takes place, beyond simple communication. In this way, the stakeholders become part of the decision making process. Therefore, they end up developing a kind of ownership of the solutions to be implemented.

This publication is aimed at aiding ER project implementers and regulators in explaining to laypersons the elements — technical and non-technical — of issues involved in ER projects. It starts by addressing these two dimensions in plain language. It then it offers approaches to communication and stakeholder involvement in ER projects, presenting some suggestions on how to proceed. Therefore, it is expected that this publication will contribute to the implementation of ER projects by IAEA Member States involved with this type of activity.

The IAEA technical officer responsible for this publication was H. Monken-Fernandes of the Division of Nuclear Fuel Cycle and Waste Technology.

EDITORIAL NOTE

CONTENTS

SUMMARY

The way in which members of the public perceive a contamination situation and an approach to the remediation of contaminated land will influence the decision making process in a variety of ways. Through communication between experts, decision makers and members of stakeholder communities, participatory processes and negotiation between different interest groups can sometimes be used effectively as mechanisms for improving the overall decision making process. The intention is to ensure a technically sound and socially acceptable decision that meets norms of adequacy or satisfactory performance in relation to a whole range of different concerns. Good communication strategies will encourage cooperation and understanding between different interested parties in remediation projects. Involvement of affected or interested persons can prevent fear driven reactions, which potentially damage public response and create undue expectations or unnecessary anxiety. For all environmental remediation (ER) cases, there is a risk that the process will fail if it does not respect social, environmental, political and economic dimensions. This requires open, clear and mutually agreed lines of communication among stakeholders within a well defined legal framework. A general recommendation is to involve them from a very early point in the process.

This publication presents ER in plain language in such a way that implementers and regulators can communicate the motives and objectives of remediation projects to a variety of stakeholder communities in order to improve mutual understanding and facilitate dialogue between interested parties. ER is considered from two perspectives: technical and non-technical. A section that gives general ideas on the strategies to deal with stakeholder involvement and which discusses different aspects of the communication approaches in ER is then included.

It is recognized that social, cultural and political situations are very diverse in different countries in the world, and even in different communities within the same country. The consequence of this is that there is not a single solution, nor a single approach, to implement stakeholder communication and involvement strategies. They will need to be tailored to address the specific situation.

1. INTRODUCTION

1.1. BACKGROUND

During the past few decades, significant improvements have been seen in environmental legislation and regulations. At the same time, nuclear and non-nuclear operations have improved their environmental performance considerably. However, many operations that have taken place in the past have led to contamination of large areas. By recognizing the need to reduce the (potential) exposure of members of the general public to ionizing radiation in these areas, several cleanup programmes have been implemented. Activities that have caused contamination by radioactive materials include uranium mining and processing, military operations and accidents, e.g. the accidents at the Chernobyl and Fukushima Daiichi nuclear power plants and the radiological accident in Goiânia.

Remediation of land is to be understood as any measure that may be carried out to reduce the radiation exposure from existing contamination of land areas through actions applied to the contamination itself (the source) or to the exposure pathways to human receptors [1]. The principles and requirements applicable to environmental remediation (ER) are laid down in the Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards [2].

It is important to note that remediation does not mean the complete removal of the contamination and that the terms 'rehabilitation' and 'restoration' are not synonyms for remediation, as they may imply that the condition that prevailed before the contamination can be achieved again; this is not normally the case and may not be necessary. However, whenever contamination of a site takes place, the affected community (and eventually other interested parties) will wish to see the contaminated land totally 'decontaminated' or fully 'cleaned up'. In other words, members of the public will generally push for the return of the environment to the prevailing conditions before the contamination took place.

The above situation may be seen as legitimate; however, the costs with environmental cleanup will generally increase significantly with the extent of remediation provided to a particular site. It can be demonstrated that beyond a certain point of remediation, no clear benefits, from the radiological point of view, will be obtained with further reduction of the residual contamination[1], and that the resources to be applied in the pursue of a 'cleaner' environment could serve better social purposes. Therefore, it is absolutely necessary that good communication between all involved parties is established. Lessons learned with a number of ER projects highlight the requirement for the implementation of appropriate communication and stakeholder involvement strategies.

However, it is necessary to recognize that social, political and economic situations will be quite different in different locations, and therefore no common solution or approach can be easily made available. Finding the appropriate approach to deal with a specific situation constitutes one of the most important challenges for regulators and implementers.

The way that members of the public perceive the contamination situation and the approach to remediation will influence the decision making process in a variety of ways. Good awareness of the perceptions of stakeholders and the public at large is important for the identification of issues and for the evaluation of risks and the acceptability of possible solutions. It is also the starting point for building participation processes. Through communication between experts, decision makers and members of the stakeholder communities, participatory processes and negotiation between different interest groups can sometimes be used effectively as mechanisms for exploring solutions. The intention is to ensure a technically sound and also socially acceptable decision that meets norms of adequacy or satisfactory performance in relation to the whole range of different concerns.

Despite this, it is imperative to note that whilst stakeholder participation itself does not always guarantee success, lack of participation may contribute to difficulties in implementing technically sound remediation solutions.

Good communication strategies will encourage cooperation and understanding between different interested parties in remediation projects. Involvement of affected or interested persons can prevent fear driven reactions, which potentially damage public response and create undue expectations or unnecessary anxiety. In all ER cases, there is a risk that the process will fail if it does not respect social, environmental, political and economic dimensions. This requires open, clear and agreed upon lines of communication among stakeholders within a well

[1] Residual contamination is the contamination remaining at the site (e.g. in the soil) after application of the cleanup measures.

defined legal framework. A general recommendation is to involve them from a very early point in the process. Public participation in decision making processes regarding the living environment is backed up by international agreements such as the Aarhus convention [3].

As providing the appropriate means to involve stakeholders in ER projects is an essential element for the success of these programmes and as communication strategies play a key role in this attempt, the provision of guidance material is a rather challenging task. While there is considerable experience on the application of such procedures in western and European contexts, there is far less experience in other parts of the world where ER needs to be implemented. Situations will be different and very site specific, encompassing the well being of the affected population, the legal background, the function and responsibility of communicators, and the motivation and role of regulators. Furthermore, the stakeholders in each process are different.

1.2. OBJECTIVES

Technical and scientific literature on the remediation of sites contaminated by radionuclides is abundant. Guidance is also widely available on how to involve stakeholders in nuclear issues [4, 5]; however, to date, there is very limited literature on communication and stakeholder involvement strategies in ER. This publication is an attempt to provide an integrated overview of the challenges and possible approaches to making stakeholder involvement and communication more effective in the design and implementation of remediation processes.

This publication has primarily been developed for implementers and regulators, but it can also be used by any stakeholder in the process. It provides scientific and technical information in plain language, and advises on successful approaches for communication and stakeholder involvement. Some case studies are also included. They should not be seen as examples to be followed literally as 'recipes'; they constitute examples of situations incurred in some countries and serve the purpose of depicting situations that may be recognized by the reader as pertaining to their own. The case studies provide details on the different dimensions of remediation, in order to enable regulators and operators to enter into an informed dialogue with stakeholders, and vice versa. This publication gives some general alternatives to regulators and operators on strategies to involve stakeholders in the communication process and approaches that might be useful in achieving effective communication with all relevant interested parties in a particular remediation project with heterogeneous educational or cultural backgrounds, or both.

1.3. SCOPE

The scope of this publication includes the sharing of experiences and lessons learned in stakeholder involvement and communication in ER projects. It addresses a topic that has not yet been covered by preceding IAEA publications in ER.

The scope of this publication includes those situations involving the contamination of land resulting from formally licensed facilities (such as facilities where mining and milling of uranium ore, uranium enrichment or fuel fabrication took place, nuclear power plants and spent fuel reprocessing facilities) and contaminated sites resulting from nuclear weapon production and accidents. Contaminations resulting from activities not developed under any sort of regulatory framework are also within the scope of the publication. Finally, the publication can also be used in the remediation of land resulting from the operation of naturally occurring radioactive material industries. This report does not cover emergency responses that may be necessary following accidental releases of radionuclides.

1.4. STRUCTURE

This publication is divided into five main sections. It begins with this brief introduction. Section 2 discusses the non-technical elements of ER that are also relevant to the decision making process. Section 3 covers the technical dimensions of ER projects. Section 4 gives general ideas of the strategies to deal with stakeholder involvement and discusses different aspects of the communication approaches in ER. Section 5 offers some general conclusions and highlights relevant topics. Attention must be paid to the fact that these suggestions are to be read as indicative and need to be carefully evaluated and tailored to the prevailing conditions being dealt with. Annexes I and II finalize the publication by presenting two case studies on communication and stakeholder involvement in remediation projects in Belgium and France, respectively.

2. NON-TECHNICAL DIMENSIONS OF ENVIRONMENTAL REMEDIATION PROCESSES

2.1. INTRODUCTION

The decision making process of remediation projects does not only take into account scientific and objective factors; non-technical factors will also play a significant role in the overall process. Members of the public (and sometimes their political representatives) may have personal and distinct views on radiation risks.

Social and political attributes, generally unrelated to radiological protection, usually influence the final decision on remediation. Therefore, while scientific inputs should be seen as a provider of decision aids, other societal concerns and considerations need to be taken into account. Therefore, the participation of relevant stakeholders, rather than radiological protection specialists alone, will be an integral part of the overall process.

Of particular interest is the situation in which people may live in contaminated areas after, for example, a nuclear accident or radiation emergency. The following challenges may arise:

(a) Consumer versus producer interest. The remediation goals will need to balance the requirement to protect individuals against the distribution of radioactivity and the requirement for the local economy to exist and be integrated in the global market.
(b) Local population versus national and international populations. The conditions in a contaminated territory may create a subsection of the national population where citizens from a contaminated region are treated differently from uncontaminated regions. ER strategies should favour the restoration of equity by taking into account national regulation and international guidance to facilitate the removal of any internal barriers (e.g. in the movement of goods and services).
(c) The multiple decisions taken by the inhabitants in their day to day life. There are many situations where the level of exposure is driven by individual behaviour. The authorities should facilitate processes to allow inhabitants to define, optimize and apply their own protection strategies if required. A positive aspect is that individuals regain control of their own situation. However, self-help protective actions may be disruptive (e.g. paying constant attention to food consumed, places visited, materials used and items touched in order to avoid, as much as possible, internal and external exposure). This supposes that affected individuals are fully aware of the situation and are well informed. To support this, various local individuals may also need to be properly equipped and possibly trained in the use of equipment (e.g. contamination monitoring) provided by the authorities. Authorities should also be prepared to assist segments of the population with particular needs (e.g. elderly, mentally handicapped).

In terms of the applicable technologies in ER programmes, the IAEA has issued a technical publication on the topic of non-technical factors to be considered in the decision making process [6].

A range of non-technical factors will influence the choice of technologies to be employed in remediation and the strategy for their implementation. These factors include:

(a) Economy, employment and infrastructure;
(b) Costs, funding and financing;
(c) Regulatory and institutional aspects;
(d) Stakeholder perception and participation;
(e) Project implementation related risks;
(f) Co-contamination issues;

(g) Future land use;
(h) Stewardship issues.

The IAEA has provided an illustration [6] of the way in which these factors, where significant, can be addressed in remediation decisions. Reference [6] outlines the range of formal decision aiding methods that can be useful for organizing information and making comparisons between different options, and emphasizes that a formal decision aiding tool is not a substitute for the judgement and deliberation that builds towards a decision. However, formal decision aiding methods can, in themselves, constitute an important element of quality control and quality assurance. The formalized process helps to make transparent decisions whether or not all relevant aspects of the process have been addressed and gives a framework for the documentation of inputs to and outputs from the process.

Table 1 lists a range of objectives and considerations that need to be taken into account for remediation decision making. Although non-technical factors influence remediation decision making, it is to be emphasized that there are always critical engineering and scientific considerations. If a technology is not viable or is not reasonably expected to perform for the problem in hand, this limits the solutions. However, failure to include relevant non-technical factors may derail an otherwise technically effective solution. Bringing together technical and non-technical factors is thus a critical element in successful implementation of a remediation solution.

TABLE 1. OBJECTIVES AND CONSIDERATIONS FORMING THE BASIS OF AN INTEGRATED ASSESSMENT FOR A REMEDIATION DECISION MAKING PROCESS

Objectives	Considerations
Consider a full range of possible effects, across health, environmental, sociocultural and economic areas	Combining all effects into a single metric is probably not possible
Apply a standard approach that reconciles different methodologies, includes data used previously, and which is anticipated to be used in the future	Tailor the assessment process to site conditions; no single approach is appropriate for all applications
Reflect on existing environmental, sociocultural and economic conditions	Focus on potential changes in levels rather than on attempting to establish absolute risk and impact levels of existing conditions
Employ a consistent approach for evaluating the same types of risks and impacts for different population groups	Do not assume common values for all affected groups; rather, solicit their input
Consider cumulative effects of multiple sources and interactive effects of multiple contaminants	Conduct screening analyses and establish cut-off points to exclude minor sources from the full assessment, and incorporate emerging toxicity data
Evaluate risks and impacts at several geographic scales: local to regional	Develop different conceptual models to capture local and regional effects
Evaluate risks and impacts in the near, intermediate and long term time frames	Address the near term quantitatively, while addressing the longer term for some risks and impacts qualitatively (at least for now)
Consider the individual and cumulative effects of uncertainties	Focus on major uncertainties, as determined by sensitivity analyses

2.2. INDIVIDUAL DIMENSIONS OF THE ENVIRONMENTAL REMEDIATION PROCESS — RISK PERCEPTION

Effective risk communication and management need to recognize the multitude of factors that can influence the perception of risks. There have been numerous studies of the psychological and psychometric factors that can influence risk perception, as well as evaluations of the differences between expert or technical assessment of risks compared to public perceptions [7–14].

The 'psychometric paradigm' was a milestone in risk research about public attitudes towards risks. It expands the factors that influence risk perception beyond the classic components of harm and probabilities of their occurrence into the realm of subjective judgement about the nature and magnitude of risk. Four characteristics of the psychometric paradigm are pointed out in Ref. [13]:

"1 establish 'risk' as a subjective concept, not an objective entity;
2 include technical/physical and social/psychological aspects in assessing risks;
3 accept opinions of 'the public'… as a matter of academic and practical interest;
4 analyse the cognitive structure of risk judgements, usually employing multivariate statistical procedures such as factor analysis, multidimensional scaling or multiple regression."

Since the psychometric model appears to be an effective tool for the prediction of risk perception, it has been widely tested empirically, and is still being developed in order to identify the risk attributes or dimensions supposedly underlying human preferences. This model has been used as a basis for extensive work on risk communication [8, 12–14], and is based on a number of explanatory scales or risk characteristics, which are empirically driven explanations of contextual characteristics that individual decision makers use when assessing and evaluating risks.

2.3. THE SOCIETAL DIMENSION OF THE ENVIRONMENTAL REMEDIATION PROCESS

Environmental remediation processes can lead to many positive consequences for the welfare of individuals and society. They can allow a return to a normal way of life, open up previously restricted areas for use, and provide employment and business opportunities. However, there can also be negative outcomes. The Chernobyl accident provided a number of well documented examples such as rural breakdown and stigma attached to communities living in contaminated areas. Remediation may also impact regional identity, cause short term disruptions through the actual remediation work (noise, dust, etc.) or long term changes in existing social and cultural patterns, such as those requiring changes in employment or community lifestyle [14]. The selection of areas for remediation may also result in producing social divisions and antagonisms, such as prioritizing the cleanup of wealthy suburbs or an industrial plant rather than schools, streets, homes and parks [14, 15].

Remediation can also influence the distribution of costs, risks and benefits and how they vary over space and time and between different members of a community. Dose distribution is obviously a main consideration for radiation protection, and many remediation measures that reduce collective dose may also change the distribution of dose, for example, from consumers or users to remediation workers or populations around waste facilities. Some remediation strategies can result in an equitable distribution of cost and dose reduction, such as investment by tax payers to reduce activity concentrations in a common food product; others are less equitable, for example, when a reduction of dose to the majority is only possible at the expense of a higher dose, cost or welfare burden, to a minority (e.g. banning access to wells or land used for gathering food). In addition, it may be possible that some sections of the population can make a profit from remediation, such as selling or hiring equipment, which can lead to further social inequity.

Remediation measures that produce waste will raise both equity and environmental risk issues. Waste disposal can lead to a 'redistribution' of radiation exposures, and the environmental impact of disposal sites will need to address both ethical and legal implications. Treatment of waste in situ can be positive as it avoids problems arising from 'dilute and disperse' or the redistribution of exposures to persons living close to disposal sites. Such issues were seen to be very important in some European countries after Chernobyl, but in situ treatment may also have negative side effects by complicating future waste removal.

2.4. THE POLITICAL DIMENSION OF THE ENVIRONMENTAL REMEDIATION PROCESS

Stakeholder involvement is covered in various pieces of environmental legislation. One of the first internationally recognized commitments is Principle 10 of the Rio Declaration [16]:

> "Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided."

Nearly 10 years later, the Aarhus convention [3] was legally ratified.

However, there are a number of levels and procedures for stakeholder involvement, and the procedures for involving stakeholders must be sensitive to the political and cultural nature of the Member State. The political question of who is a legitimate representative or spokesperson for stakeholders can vary from country to country. Procedures can be compromised by corruption, minority interest groups or even 'mob rule' [17]. In some cases, the participation of certain stakeholders (i.e. those directly interested or affected) in the actual decision making might contradict the ideal of an impartial or unbiased procedure. In such circumstances, a careful balance must be struck between respecting the rights of individuals to be heard and the requirement to come to a measured decision.

2.5. THE ECONOMIC DIMENSION OF THE ENVIRONMENTAL REMEDIATION PROCESS

The costs of remediation strategies are a central issue, but it is important to recognize that economic costs can go beyond those required to implement the strategy; likewise, remediation can realize a number of economic benefits, such as providing opportunities for local enterprises, changing the value of land or opening it up for tourism or recreational activities. The question of who is paying the monetary and social costs of remediation and who will receive the benefits must also be addressed; this includes identifying an underwriter of any financial or insurance risk associated with the remediation measures. In some cases, the financial and market consequences of consumer perception of products from the contaminated area can be considerable, even if the radiation exposures or risks are minimal. Boycotting of a product can bankrupt a business; restoring faith can increase profits. Compensation to affected communities could be a significant fraction of the project costs; investing in independent monitoring and surveillance can sometimes be a cost effective alternative to expensive site cleanup.

3. TECHNICAL DIMENSIONS OF ENVIRONMENTAL REMEDIATION PROCESSES

3.1. UNDERSTANDING RADIATION PROTECTION PRINCIPLES BEHIND ENVIRONMENTAL REMEDIATION

Radiation protection is driven by three main principles: justification, optimization and individual dose limitation. *Justification* is the process of determining whether a practice is beneficial overall, i.e. whether the benefits to individuals and to society from introducing or continuing the practice outweigh the harm resulting from the practice. *Optimization* is the process of determining what level of protection and safety makes exposures and the probability and magnitude of potential exposures 'as low as reasonably achievable, economic and social factors being taken into account' (the ALARA principle). Finally, the *limitation* principle is connected to the establishment of a quantitative dose to be used in certain specified activities or circumstances that must not be exceeded.

Within the context of remediation, the above fundamental principles can be formulated as justification of remediation, optimization of remedial actions and restriction of residual individual doses; these are described as follows:

- *Justification of remediation:* Any remediation should be justified, i.e. the changes in the prevailing exposure situation of the people living in the contaminated land should do more good than harm. Therefore, by reducing existing exposure through remediation, individual or societal benefit must compensate the detriment that the remediation may cause.
- *Optimization of remedial actions:* Remediation measures in a contaminated territory should be optimized, i.e. the level of protection to be achieved by the remediation should be the best under the prevailing circumstances, maximizing the benefit over harm. Optimization should result in the likelihood of incurring exposures, the number of people exposed, and the magnitude of their individual doses, all ALARA, taking into account economic and societal factors.
- *Individual dose restrictions:* In order to avoid severely inequitable outcomes of the optimization procedure, there should be restrictions on the doses or risks to individuals remaining in the contaminated territory. Restrictions are applied to doses to a nominal individual (or reference person). Protection options resulting in doses greater in magnitude than such restrictions should be rejected at the planning stage. Importantly, these restrictions on doses are applied prospectively, as with optimization as a whole. If, following the implementation of an optimized protection strategy, it is subsequently shown that the value of the constraint or reference level is exceeded, the reasons should be investigated, but this fact alone should not necessarily prompt regulatory action.

Explaining these concepts to laypeople is one of the most difficult tasks when an implementer or a regulator is faced with the challenge of communicating the goals and objectives of a remediation plan. It is likely that the following question will be posed: ‘Why can individuals living in a formerly contaminated and eventually remediated area be theoretically exposed to dose rates higher than those to be incurred by people living in the vicinity of a nuclear installation?’. In most existing exposure situations, the exposed individuals, as well as from the authorities, wish to reduce exposures to levels that are close or similar to situations considered ‘normal’. However, it must be made clear that the level of remediation needs to take into account the feasibility of controlling the situation, and past experience with management of similar situations.

3.2. ETHICAL PRINCIPLES BEHIND ENVIRONMENTAL REMEDIATION

It should be recognized that exposure situations requiring remediation usually give rise to societal problems and related discussions about the ethical principles on which the radiation protection approach should be based. The principles on which its paradigm is based are an example of two commonly accepted ethical concepts. A deontological ethical view requires that adequate radiological protection of identified individuals be ensured; for instance, the principle of individual dose limitation ensures that deterministic effects are prevented and that individual risks of stochastic effects are restricted. On the other hand, a utilitarian view sees the overall guiding principles of optimization and justification to ensure the achievement of a positive benefit for the greatest number of people in society under the prevailing social and economic circumstances of the exposure situation. Consideration, careful understanding and establishment of appropriate lines of communication regarding both these types of ethical principles are critical elements for societal acceptability of the radiation protection approach in situations of contaminated land remediation.

3.3. DISRUPTIVE REMEDIATION

Disruptive remediation, i.e. restrictions in the normal living conditions of people, may be required after accidents that have released radioactive substances into the environment. Eventually, in order to return to ‘normality’, such actions may need to be discontinued at some stage in spite of the continuous presence of a residual prolonged exposure. The simplest basis for justifying the discontinuation of intervention after an accident is to confirm that the exposures have decreased to below the appropriate levels that triggered the intervention in the first place. If such a reduction in exposure is not feasible, the generic reference level of an existing annual dose below which intervention is not likely to be justifiable could provide a basis for discontinuing intervention. However, it may be difficult to discontinue protective actions that have been in force for many years; the decision may not be acceptable to the exposed population, and the social pressures may override the benefit of discontinuing the intervention. In these cases, participation of the stakeholders in the decision making process becomes essential. After intervention has been discontinued, the remaining existing annual dose should not influence the normal living conditions in the affected area (including decisions about the introduction of new practices), even if this dose is higher than that prevailing in the area before the accident.

3.4. ENVIRONMENTAL REMEDIATION STRATEGIES

There are well established procedures for executing remediation programmes. The IAEA publication [18] defines the process that should be implemented when remediating an area affected by past activities and accidents.

3.4.1. Environmental situation description

The environmental description of the problem, or problem formulation, will document the site contamination and dose assessment, and should involve different stakeholders and the public to ensure that the remediation solution is adapted and pertinent to the situation.

The problem formulation stage should include:

(a) Historical studies, to establish past activities on the site and radioactive elements potentially released to the environment. The first step is to carry out a historical assessment to obtain relevant information about the site. This activity will help in understanding the type of operations that took place in the past, the nature of radionuclides which may be present and their volume. Retired workers may possess valuable knowledge and interesting data in this area.
(b) Environmental measurements for mapping radioactivity hotspots on land and on water, both salt and fresh water (rivers, lakes, wells and underground water). This point can be controversial, and the results must be shared and discussed with environmental associations to reach a common agreement. Note that this stage should follow the historical study and the review of all available existing data; there is little to be gained from duplicating existing measurements.
(c) Identification of the specific ways of life of members of the community will lead to the assignment of appropriate protection measures. This phase has to be completed in cooperation with the communities living on or using the land. Information sought should include details of the food and drink consumed originating from the contaminated area and data on the lengths of exposures to the contamination by local groups.

The historical data and the geographic map showing all the environmental data will serve as a record of the site for future generations.

The next step will define the need for and extent of remediation, and will depend on the selection of remediation criteria that will be applied. This stage will also require the participation of different stakeholders.

3.4.1.1. Site contamination: history and origin

The origin of the contamination may result from different activities (see Section 1.3). It may have been caused by an accident (e.g. Chernobyl), or as a result of the operation of a facility outside the regulatory framework currently prevailing in the Member State. For example, operations may have taken place when the operational limits were different or even non-existent (e.g. legacy sites from uranium mining).

Site characterization starts with listing of the different radionuclide contributions to contamination, including chemical and radiological information such as half-lives, radiation types and daughter radionuclides. The history of the site (collated from the problem formulation stage) can give additional information about the production of radionuclides, or processing of radioactive materials (e.g. mining) and the mass of radioactive materials that may be present. This is essential to understand the release of radioactive material to the site and the different parts of the environment that are affected, such as soils or groundwater. It is important to consider that contamination may not be confined to solid and liquid phases, but that the exhalation of radon gas from a contaminated site may be significant.

3.4.1.2. Mapping contamination

Mapping the contamination should show the extent of contamination and the areas impacted. The map should also depict the spread of different radionuclides, as well as the use of the various territories by people. It is useful to compare measurements with natural levels of radioactivity close to the site. Water contamination should consider the hydrological system of the territory: water springs, catchment areas and drainage and groundwater systems and flows.

3.4.1.3. Public exposure characterization

The health impact of the site, namely the dosimetric impact, depends on the length of exposure and the ways in which people are exposed to radioactivity. If they live in a house built with or on radioactive tailings, radon inhalation is often the most important internal exposure pathway. Other internal exposure pathways include drinking or eating contaminated water or food. External exposure of skin can arise from contact with contaminated soil. In general, the level of external exposure will correlate with the time spent in the contaminated area for work or recreation. It is also important to consider the group or groups to be studied; the focus for an exposure characterization may be the collective exposure to the general local population, a characterization of a smaller target group that may have more exposure than others, or the study of both general and specific populations. The size of these populations, the social, political and economic aspects of these communities and an understanding of the different lifestyles will guide this consideration.

Some examples of possible scenarios include:

(a) Scenario 1: A self-sufficient farmer living close to a contaminated site. This man exclusively eats food he produces and drinks water under site influence. He spends much of his time outdoors near or on the site.
(b) Scenario 2: A fisherman. He consumes many fish that live in contaminated water.
(c) Scenario 3: Tourist, recreational or sporting groups. They spend long periods of time on river banks or by lakes on contaminated soil or sand, or swimming in contaminated water.

The dosimetric impact review for either specific exposed groups or the general population consists of the following steps:

(a) Source identification, questioning which radionuclides are present and how long a group can be exposed to this radioactivity in air, water or food.
(b) Exposure scenarios: Scenarios should consider the pathways to the human receptors, which may include:
    (i) Inhalation of active particulates or radon gas.
    (ii) Ingestion of food or water that has originated from a contaminated area. Note that this includes not only food grown or reared in a contaminated area, but also food items irrigated with, or living in, contaminated waters.
(c) Dose calculation: With these data, the total exposure of people is calculated according to their consumption habits and their use of the environment.

These steps will identify the most important sources and pathways of doses, thus allowing an evaluation of possible potential mechanisms for reducing doses to the population. Such information is vital to allow for selection of the most pertinent and adequate remediation strategy.

3.4.2. Discussion for the need of remediation

The implementation, extent and duration of the remediation measures will have to be evaluated according to relevant national or international legislation and regulatory frameworks. These can include nuclear safety and radiological protection standards (including radiological protection training for remediation workers or contractors), environmental legislation (e.g. national parks or conservation areas), pollution standards, cultural heritage, labour and human rights regulations. The issues will have to be addressed by the responsible authorities and decision makers for each specific case, as it is by no means certain that a single piece of legislation will be applicable in all situations, and the interpretation of international recommendations may vary from country to country.

3.4.3. Available remediation technologies

There are a number of remediation options and technologies, and it is important that stakeholders understand what these techniques can achieve, and also their limitations, side effects and costs that are associated with them. The list below divides the remediation approaches into four different categories. However, the description is not intended to provide a comprehensive review on the issue. Readers interested in a more detailed description are referred to more specialized literature. It is important to realize technologies are always evolving, and that there are a number of sources from which updated and detailed information can be obtained.

Remediation approaches can be divided into four major categories:

(a) *Separation.* Applicable to both contaminated soil and groundwater. Separation technologies, which can be carried out both in and ex situ (following excavation or removal of the contaminated medium), include:
   (i) Soil washing;
   (ii) Flotation;
   (iii) Chemical/solvent extraction.

(b) *Removal of the source.* Normally applied to contaminated soil, although contaminated ground or surface water can be removed by pumping. Removal of the contaminated medium may be followed by either:
   (i) Subsequent separation procedures;
   (ii) Disposal of the bulk material at another location.

(c) *Containment.* Barriers that may be installed between contaminated and uncontaminated media to prevent the migration of contaminants principally include:
   (i) Capping;
   (ii) Subsurface barriers.

(d) *Immobilization.* Materials may be added to the contaminated medium, in order to bind the contaminants and reduce their mobility, for example:
   (i) Cement based solidification;
   (ii) Chemical immobilization;
   (iii) In situ vitrification.

3.4.4. Monitoring and control

Monitoring requirements are usually science based, but also need to take into account stakeholder requirements in respect of timing and frequency, range of parameters studied and proposed duration of a programme. Therefore, programmes are risk based, and include social and political risks.

4. COMMUNICATION AND STAKEHOLDER INVOLVEMENT

4.1. INTRODUCTION

In terms of radiation protection, the ultimate objective of a remediation programme to be applied in a contaminated area is to reduce ongoing or future exposures to ionizing radiation (provided it is justified to do so) and, consequently, the risks incurred by members of the public of developing undesired health effects. Therefore, any communication to be performed in an ER programme will ultimately need to relay, among other points, the potential risks incurred by the exposed population and the operations that may lead to their justified reduction. At this stage, it is important to define that the type of risk referred to here, as per the IAEA Safety Glossary [1], is the probability of a specified health effect occurring in a person or group as a result of exposure to ionizing radiation. The health effects include risk of fatal cancer, risk of serious hereditary effects or overall radiation detriment.

It is also important to highlight the meaning of 'communication', which should not be seen solely as the activity of providing other people with 'correct' information through various channels, or collecting information from interested parties in the context of a remediation project, although such aspects are important. Communication should be an integral component of a broader strategy of creating a dialogue aimed at taking the different contributions from the various stakeholders of a remediation project into account in the decision making process. *Therefore, communication helps to establish stakeholder involvement, and is an integral part of it*.

The term 'stakeholder involvement' itself has a wider definition and not only encompasses communication, but can also include the partnering of the remediation actors with the economic, social and political life of the host community.

Drawing these themes together, it is obvious that communication on matters related to risks is a complex issue in the context of ER programmes.

There are several definitions of what risk communication is about. One of them defines it as "an exchange of information about risk among decision makers, stakeholders and the public which is intended to supply people with the information they need to make informed and independent judgments about risk" [19].

Within risk communication, there are several models of stakeholder involvement. In a very simple way, it can be taken to mean the involvement of key individuals and organizations in strategic decisions in a remediation project. This involvement may be the simple exchange of information described above, or it may lie on a spectrum of deeper involvement. However, in all these cases, a dialogue is an absolute precondition for the various actors to be able to solve the problem together.

4.2. DEFINITION OF A STAKEHOLDER

There are several definitions of 'stakeholder' in the literature. It can be proposed that stakeholders in the context of a project (ER or otherwise) are actors with a specific interest (formally articulated or not) in the development of the project.

4.3. IDENTIFYING THE STAKEHOLDERS IN AN ENVIRONMENTAL REMEDIATION PROCESS

The next step in the definition of a strategy for communication and stakeholder involvement in a remediation project is to identify the potential actors that might have an interest or a role to play in a remediation project.

It is important to note that each remediation project will have different stakeholders, and also that stakeholders may change at any phase of the ER process. All stakeholders can directly or indirectly become involved in the remediation project decision making process. Some are more clearly and directly affected by the potential outcomes and risks related to the contaminated area and consequently by the decisions made. Others may not be really exposed to the ionizing radiation from the radioactive materials present in the environment, but may claim, legitimately or not, to be affected in a subjective manner by the overall situation.

In order to facilitate identification of the potential stakeholders in a remediation project, the questions listed below can be used:

— Who is directly responsible for decisions about the ER process?
— Who is responsible for the contamination?
— Who has been involved in the history of pollution?
— Who knows the history of the pollution, geography, geology and hydrogeology of the site?
— Who is involved in measurements of contamination?
— Who is an opinion maker in the contaminated area or hosting community?
— Who is affected by contamination?
— Who will be affected by decisions related to the remediation?
— Who holds positions of responsibility in stakeholder organizations?
— Who are the decision and opinion makers in the stakeholder organizations?
— Who can promote decisions related to the ER process?
— Who can obstruct decisions related to the ER process?
— Who has been involved in the ER process and radiation protection in the past?
— Who has not had a voice in the decisions on cleaning up the site before, but should have?
— Who will remediate the contaminated area?
— Who will regulate the ER process?
— Who will be involved in long term surveillance?

In order to make it easier for the reader to have an idea of typical stakeholders in an ER project, some examples are listed in Table 2. The sequence of the table does not suggest any ranking or priority among them.

TABLE 2. DIFFERENT TYPES OF STAKEHOLDERS

Stakeholder group	Example stakeholders belonging to the group
Implementers of the ER process	Site/facility owners, funding entities, operations staff, managers
Regulators	Regulators, institutions, local authorities
Those cooperating or directly influencing the ER process	Local communities, trade unions, waste managers, real estate owners, local enterprises, international parties, contractors, nuclear industry, non-nuclear industry, non-governmental organizations
Those affected or indirectly influencing the ER process	General public, neighbouring countries, tribal nations, researchers and scientists, teachers and students, universities, tourists, archaeologists, historians, museums, archives, media, health workers, pressure groups, religious or secular groups

Within each group of stakeholders, the areas of interest and concern can be different. Some stakeholders in ER projects will be interested in economic aspects of the endeavour; others may set more focus on social, environmental, technical or political issues [20]. It is equally important to realize that some stakeholders may have multiple interests and concerns.

Table 3 groups the different stakeholders listed above according to their preferential area of interest.

4.3.1. The general public

It is beyond the scope of this publication to enter into detailed discussions on the specific characteristics of the different groups of stakeholders mentioned above. However, it is widely agreed that the general public is one of the most important groups of stakeholders, and includes the great majority of laypeople.

TABLE 3. EXAMPLES OF DIFFERENT STAKEHOLDER INTERESTS OR CONCERNS IN ENVIRONMENTAL REMEDIATION PROJECTS

Economic issues	Social issues	Environmental issues	Technical issues	Political issues
Site/facility owner	General public	Environmental regulators	Radiation protection regulators	Local authorities
Contractors	Local communities	Tourists	Waste managers	Elected officials
Funding entities	Tribal nations	International partners	Geological scientists	Trade unions
Managers	Researchers and scientists	Operations staff	Hydrogeological scientists	Government
Waste managers	Media	Neighbouring countries	Radiological protection service	Non-governmental organizations
Nuclear industry	Pressure groups	Wildlife protection organizations		Intergovernmental organizations
Non-nuclear industry	Teachers, students and universities			Labour associations
Partners	Health workers			

Because of this, the participation of the general public in the communication parts of stakeholder involvement strategies becomes vital for the success of the remediation process. This encompasses a wide range of activities that can be used to engage citizens in the decision making process, and can occur at many levels. It begins with outreach to build awareness and interest, and can evolve beyond basic communication to a fuller exchange of information and ultimately to in-depth discussions with recommendations to and from the public, moving, in some cases, into a full partnership and joint decision making. A metric for public participation is the extent to which people are actively involved in understanding, assessing or resolving issues of concern.

The first important driver in the move towards public involvement in contaminated site remediation is that ‘stakeholders have rights’: they want, need and demand to be involved in processes and decisions that will have an impact on their lives.

There are a wide variety of instruments that can be used to incorporate public views in decision making (including surveys, referendums, citizen panels and juries). Any can be used, depending on the objectives and circumstances. Most exercises on environmental assessment collect information from surveys sent to the general public. However, it has been indicated that society decides on issues such as health, security, environment and ethics based on community preferences (rather than on individual preferences). Therefore, do individuals’ survey answers reflect the community objectives (i.e. those of ‘responsible members’ of the local community), or do they only reflect personal objectives (i.e. those of self-interested individuals)? It is important to question what such surveys show: consumer preferences or citizen preferences?

Community attitudes in relation to specific environmental issues can vary in different contexts. For example, the repetition of crises affecting the food chain can cause consumers to become more sensitive; communities become increasingly less tolerant to any degradation in the quality of their food. Therefore, bans on and disposal of all contaminated, or even simply suspicious, material emerge as the most probable remedial action after an extensive contamination. Conversely, other countermeasures resulting in a reduction of the radioactive content below the intervention level will probably be acceptable only if complete bans are not possible owing to lack of alternative products or high prices for clean products.

In terms of general public involvement, the following aspects have to be taken into consideration:

- Identification of the stages of the project when involvement is required;
- Establishment of the project area’s impact (social, cultural, political, etc.);
- Identification of the various stakeholders who may be affected or would like to be involved and consulted;
- Consultation with the relevant union or worker body group;
- Identification of the statutory requirements in relation to consultation (as required by a development approval or the development process);
- Determination of the appropriate notices;
- Identification of potential language barriers.

4.4. REASONS FOR STAKEHOLDER INVOLVEMENT?

The last decade has seen an increased focus on the importance of stakeholder involvement and public participation in a number of policy areas, particularly those concerned with environmental issues or technology evaluation. Not least, stakeholder involvement has been used quite extensively in radiation and waste safety, for instance, with regard to decisions on siting waste disposal facilities. There are a number of arguments for involving stakeholders in the kind of decision making processes relevant here. These include:

— Empowerment: Affected people need to feel they have some form of control over how others affect their environment and well being.
— Democratization: The public and affected people have a democratic and moral right to take part in decisions that affect their lives.
— Efficiency: All stakeholders, including the public, have important knowledge of relevance to the decision making process and can input a range of issues that might otherwise be overlooked, undervalued or underutilized.
— Success: The public has the capacity to halt many projects, so the policy implementer should acknowledge the needs and desires of these people.
— Consensus building: All people involved in a project should be able to work towards common goals if there is a process whereby these common goals can be identified.

There are also strong ethical grounds for including stakeholder representatives in remediation assessments. As we live in pluralist societies and all moral theories are controversial, one cannot simply pick one stance from which to make moral judgements [21, 22]. When justifying a decision, one needs to consider all relevant arguments and balance a number of ethical concerns. The more thoroughly a proposal is assessed, the more justified it can be considered to be.

Experiences from different ER processes show that the appropriation of the contamination problem by key stakeholders, meaning their affirmation of willingness to take action and also the identification of a solution concept that they can live with, is a necessary ingredient for the economic, social and political viability of the remediation solution. Equally important is the engagement of the relevant national authorities, establishing a political/economic partnership bringing together complementary local and national resources and forms of authority.

Therefore, the driving force behind stakeholder involvement is clearly to facilitate a consensus between the public, the project owner and the regulatory agency on an acceptable remediation approach for the site. It must be remembered that the biggest challenge is for stakeholders with a range of technical and social backgrounds to come to some form of consensus on the implementation of the ER project. What can be obtained here is informed consent, i.e. the willingness of those initially sceptical to go along with a course of action based on information provided and assessed over the course of the process.

4.5. DIFFERENT TYPES AND LEVELS OF STAKEHOLDER INVOLVEMENT IN ENVIRONMENTAL REMEDIATION PROJECTS

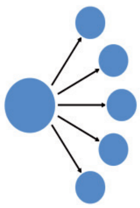
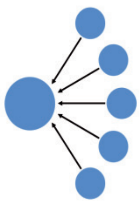
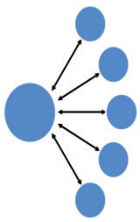
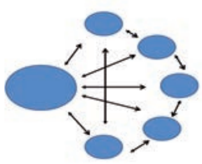
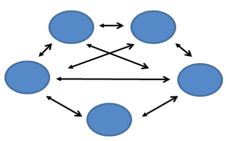
From past experience, it is known that levels and types of stakeholder involvement in ER processes may be different. They depend on different dimensions that influence ER, e.g. legal background and political, social, economic contexts of the environment of the remediation process, and range from straightforward provision of information through to full partnership in decision making. Table 4 gives an overview of selected types of stakeholder involvement.

Table 5 [22] defines the different levels of stakeholder involvement. As the degree of interaction increases (from level 1 to level 5), the degree of stakeholder influence also grows. In level 1, the type of interaction is only one way, i.e. information is given to the stakeholders, but with no feedback, and dialogue is not established at this point. In level 2, a one way approach still prevails. In this case, information is being gathered. In level 3, a dialogue (or discussion process) is established, and information is exchanged in both directions. The subsequent level is engagement, and the final level is a genuine partnering process in which all the participants have or share a common level relevance in the process, and in which the public exert a high level of influence.

TABLE 4. DIFFERENT TYPES OF STAKEHOLDER INVOLVEMENT

Type of involvement	Objectives	Tools
Inform and educate	Raise awareness, alert to involvement opportunities, inform a decision	Leaflets, web sites, public relations, open house, media, public hearings
Gather information	Fact finding for decision making, inform a decision	Surveys, web questionnaires, interviews, opinion polling, referendums
Consult	Consider and respond to proposals, assess different concerns and views, discuss options and broader implications	Focus groups, stakeholder forums, expert committees, proposal reviews
Build consensus	Share understanding, reach common agreement, identify reasons for disagreement	Small working groups or task forces, consensus conferences
Partnership	Share decision making	Representative decision making committees, cooperate social responsibility

TABLE 5. A MODEL FOR DESCRIBING THE DIFFERENT LEVELS OF STAKEHOLDER INVOLVEMENT

Level of stakeholder involvement		Stakeholder influence	Process	Result
1		Low level of public involvement and influence	Inform or educate	Communication
2			Gather information	Listening
3		Mid level of public involvement and influence	Discuss	Consultation
4			Engage	Engagement
5		High level of public involvement and influence	Partner	Partnership

Most of the time, the authorities will be the main information providers and educators for the rest of the stakeholders. As the stakeholders become more involved in the process, their views and opinions will become a more central part of it, in some cases, achieving full partnership in the decision making process.

4.6. STRATEGIES FOR STAKEHOLDER COMMUNICATION AND INVOLVEMENT

So far, the importance of identifying the stakeholders, defining those relevant to the process, their interests and the levels and types of engagement, has been discussed. This subsection deals with some strategies that can be used in order to develop stakeholder involvement in a remediation project.

These strategies are to be developed for the short and long term, which includes clear documented and agreed goals and objectives. As the remediation programme evolves, involvement strategies must be reviewed and updated, as necessary.

A communication strategy should aim to help in informing the relevant stakeholders quickly, appropriately and consistently throughout the remediation project, notably during crucial issues, such as litigation, and situations concerning health and safety.

In general, the following points must be addressed in order to build a structured stakeholder communication process:

(a) Once the stakeholders have been identified, the institutional and informal frameworks within which an exchange of information and opinions can take place are identified;
(b) The remediation site management must have a clear and well expressed opinion, preferably in line with the opinions of the management of other stakeholder actors, such as governmental authorities and regulators.

As the remediation project starts developing, existing stakeholders must continue to be engaged, new stakeholders should be identified, as necessary, and programmes for communication must be discussed and agreed as part of a set of strategies for the interaction programme. Examples of what may be considered within these programmes are:

(a) The several levels that form each group of stakeholders.
(b) Identification of the stakeholders' representatives: They must be brought to a minimum level of common understanding of the remediation process.
(c) Identification of the stakeholders' spokespersons: Whenever possible, they must be trained for that purpose, and must hold and maintain a common understanding of the remediation process.
(d) Identification of the various communication tools available, such as newspapers, television, radio, internet, public hearings, press releases, meetings in general, information centres, etc.
(e) Development of information material, such as brochures, periodic journals, web sites, frequently asked questions, 'questions and answer' booklets, films and mock-ups. It is important that material should be available through a variety of media, e.g. in print and on-line.
(f) Establishment of a communication crisis committee that may be formed primarily by remediation site management, governmental authorities and the regulator. The committee may gain effectiveness and credibility if it also includes representatives from other groups of stakeholders, notably the local residents.

In the list below, the reader will find some practical tips that may be useful in structuring a communication process within the scope of an ER project. It must be emphasized that the communication strategies, formats and approaches will always be very case specific. However, there are some general rules, and suggestions, which seem to be universally adequate and proper.

Practical suggestions for communication in environmental remediation processes

(a) Provision of information to stakeholders about the different phases of a project and when the different operations are likely to be carried out is an absolute minimum.
(b) Information will ideally be the same and will go out simultaneously to all of those involved.

(c) Stakeholders should be invited to a dialogue. A dialogue should not be regarded as something that obstructs and delays the project, but as something that improves it.
(d) Communicators should show that they take into account the suggestions and views of others. If their requirements cannot be met, it should be explained why.
(e) All requests for information should be followed up in a timely manner.
(f) Serious thought should be given as to whether it is suitable to apply risk comparisons. Risk comparisons give the impression of not taking the other side's experiences and concerns seriously.
(g) To place risk information in a greater context, a before and after scenario, rather than a risk comparison, can be used. The situation before remediation can be compared with the desirable situation after remediation and any natural background levels.
(h) General situations should not be discussed, but rather real situations relevant to the project under discussion.
(i) Communicators should be very clear in explaining and stating assumptions and uncertainties in investigations, proposals and discussions. Uncertainties should be managed and illustrated using different scenarios, for example 'in the best case', 'in the normal case' and 'in the worst case'.
(j) If there are several independent actors providing information about the project, it is a good idea to coordinate information projects. It is not necessary to always be in agreement, but it is nevertheless a good idea to coordinate which information is disseminated.

4.7. STRATEGIES FOR STAKEHOLDER INVOLVEMENT

Many tools are available to implement a stakeholder involvement plan and have been applied in a number of countries and cases, not only in nuclear issues. Some of the methods are presented in Table 6. As an illustration of some of the most important methods at each level of involvement, the following subsections describe in detail three of the most common methods: public hearings, focus groups and media relations.

4.7.1. Public hearings

A public hearing or seminar is a time limited meeting, convened to gather community input or convey information on a specific topic. The focus of a public hearing or seminar can be narrow or broad, purely technical or largely philosophical. Discussion can be orientated primarily towards experts or can incorporate a wider range of stakeholder interests and types of knowledge. Depending on the issue, the context and the time available, a public hearing process can involve a single event or several dozen separate meetings in one or many communities. The events can be structured as formal or semiformal hearings, where individuals and organizations make presentations to a panel and then engage in discussion with panellists, or as roundtable discussions.

Public meetings are frequently the key element to government stakeholder involvement or communication strategies. They are useful as a mechanism for developing support around a clear issue, particularly if the subject is relatively non-controversial. They can be an effective tool for summing up the results of a consultation process, allowing stakeholders an opportunity to provide final input to the process. However, there are a number of disadvantages of public hearings. In many cases, they are ineffective and can be counterproductive to stakeholder participation. There is a risk of generating conflict, and they rarely provide an opportunity to resolve the issues and opinions that are raised. The format usually involves experts and authorities on stage and the public in a mass audience, which is a difficult environment in which to facilitate full participation.

Attendance is often low, and only a small proportion of the audience is able to express an opinion. Those present do not necessarily represent the public as a whole, and the processes tend to be dominated by a vocal minority. However, as a relatively inexpensive mechanism of providing information, they can give citizens an opportunity to obtain information and have their say directly to authorities or policy makers, and, if held sufficiently early, could influence policy. Sloganeering tends to dominate over engagement, and usually only a small number of voters will have more than a superficial grasp of the issues [9].

TABLE 6. EXAMPLES OF CONSENSUS BUILDING METHODS

Extended involvement method	Description	Advantages	Disadvantages
Community advisory Committees/liaison groups	Small groups of people representing particular interests or areas of expertise, e.g. community leaders, meet to discuss issues of concern and provide an informed input	Can consider issues in detail and highlight the decision making process and complexities involved Promotes a feeling of trust	Not all parties may be represented Requires commitment from participants Longer term process requiring more resources than some other methods
Citizen's juries	A group of citizens selected to be representative of the community brought together to consider options or a particular issue Evidence is received from expert witnesses, and cross-questioning can occur At the end of the process, a report is produced, setting out the views of the jury	Can consider issues in detail and in a relatively short period of time Can also include differences of opinion	Not all interests may be represented Limited timescale may limit time available for participants to fully consider information received
Consensus conferences	A forum at which a citizens' panel elected from the general public, questions 'experts' on a particular topic, assesses responses, discusses the issues raised and reports its conclusions Also used to build consensus among experts	Can provide a unique insight into the ways in which issues are perceived by members of the public Suited to dealing with controversial issues	Not all interests may be represented, limited timescale for consideration
Pluralistic Expert Group	A group of experts from authorities, civil society, etc. can discuss and compare analysis or options and prepare support to present results Could be extended to include expert and laypeople groups	Provides scientific consensus on technical issues If well managed, can be useful to inform laypeople	Civil society opinions are often harder to incorporate Tends to focus on scientific issues Time and resources of experts may be limited
Stakeholder dialogue forums	A method involving active facilitation of groups with diverse knowledge and opinions The design of each dialogue process is unique to the issue at hand	Provide a focus on the process of engagement Ensure that all views are heard, and are flexible to the problem at hand Suitable for dealing with controversial issues, providing that tasks and groups are clearly defined	Not all interests may be represented The flexibility of the method can also be a weakness in that key issues can be compromised Need to ensure that it is clear what the stakeholders' involvement will achieve Need to ensure that the tasks for these groups are clearly defined

4.7.2. Focus groups

A focus group is a tool used to gather information. Focus groups provide data for analysis, but because the data are gathered using open ended questions, such discussions usually offer more in-depth opinions, and more subtle nuances of an individual's or group's opinion can be ascertained. The format of the focus group provides an opportunity for participants and the facilitator to exchange information related to the topic or group of topics for which the data are being collected. Focus group conversation is private and confidential. In a face to face setting, participants and their ideas must be treated with respect and integrity. Focus groups can be powerful tools for planning ER and decision making for ER. The insights and data produced by the interaction of participants in focus groups can provide feedback to initiate change in the ER process, confirm satisfaction with ER or help generate new ideas for ER.

The focus group approach is fast and easy to facilitate. It ensures direct interaction with participants, and gives priority to respondents and their experiences, values, requirements and problems. Furthermore, participants can be aware of their perspectives (through disagreement and consensus building upon discussion). The approach is flexible as it is used to examine and obtain data for a wide range of topics. Focus group results are easy to understand, but the analysis is time consuming. The disadvantage is that the small number of respondents limits the generalization of findings to a larger population, and that data collection is relatively chaotic owing to the open ended nature of responses, making summarization and interpretation of results often difficult.

However, for numerous reasons, we consider the focus group methodology to be particularly relevant before the startup of the ER process in contaminated sites in order to obtain an idea of the possible requirements or pitfalls for ER.

Through group interaction, a focus group can generate valuable information for ER that is based on the experience, knowledge and behaviour of different stakeholders, especially people living on the contaminated site. The considerations are made in a limited amount of time, thus the focus groups are cost efficient. The focus group methodology reveals the logic, the rationales, the perceptions, etc. of the stakeholders themselves, formulated in their own words. The methodology specifically allows the development of an interpretative understanding between different stakeholders.

4.7.3. Media relations

Mass media plays a dominant role at all levels of communication on ER issues. It is often the most prominent information channel for the general public. Media channels (e.g. television, radio, on-line, press and magazines) are used for communication by different stakeholders; in addition, the editors of such channels act as the 'watchdog' of society, monitoring the remediation implementers or other ER actors. Mass media are employed to communicate with the public at the time of an initial contamination period, as well as at the time of cleanup. Media will also form a link between the ER implementers and inform the risk perceptions among the population. However, media also have to fulfil the economic aspects of publishing or broadcasting, typified by the 'good news is bad news' phenomenon in journalism. Because of this, it can be expected that at the beginning of ER processes, possible conflicts among stakeholders, complications or lack of transparency in the ER process would certainly appear in the mass media.

Therefore, special consideration needs to be given to the media as stakeholders in any engaging process, and it will be necessary to build the media–project relationship.

In the ER process, media are:

(a) A major source of information;
(b) An aid for shaping public opinion;
(c) Significant in amplifying social process controversies over risk;
(d) An important part of communication;
(e) A bridge between ER process communicators and the general population.

4.7.3.1. How to develop media relations?

The person charged with the role of media contact in an ER process may help journalists to identify newsworthy topics, information sources and develop interesting stories. These activities benefit journalists and the ER process by increasing coverage of research information and accurate reporting. The key to developing mutual relationships is to establish and maintain credibility. Providing accurate and honest information over time earns the trust of journalists. Here are some suggestions on how to develop media relations:

— Decide who in the ER process is responsible for media contacts.
— Develop a media source book for your ER process. Keep a directory of reporters and other contacts at the media outlets in the area. Find out what the rules are for submitting materials to the media and enter that information in your media source book. This list must be kept updated.
— Provide materials to reporters on a regular basis. For example, send news releases, photographs, graphics and explanations.
— Get to know the reporters, particularly those who cover environmental topics. Contact the reporters personally and follow up with phone calls, emails and personal visits.
— Take time to provide opportunities for the journalist to increase their levels of expertise on the ER topic (e.g. site tours of the ER project if feasible).

As in Section 4.6, some suggestions to be applied in stakeholder involvement are given in the list below. The same observations made of communication issues are valid, i.e. it is important to be aware of the case specifics and to always bear in mind that there is no ‘one solution fits all’ approach.

Suggestions for designing a communication and stakeholder involvement strategy

(a) The target groups should be analysed and evaluated for communication, defining which parties are involved. Existing target groups can be used in order to identify other potentially interested parties.
(b) The goals of the risk communication, the most important information and the most important message should be made clear.
(c) The communication with other parties involved (for example, the regulators, the operators, expert bodies) should be coordinated and the different areas of responsibility defined.
(d) Lists of contact individuals for the different areas of responsibility should be drawn up. It must be clear who should be contacted concerning various issues. This also optimizes the opportunities of disseminating information.
(e) A framework (for example, an agenda) for risk communication should be prepared, inviting the parties to a dialogue.
(f) It should be determined how communication, both general and of risks, will be implemented. The best method might be a large meeting, written information, meetings with small groups, information via web sites, study visits to similar sites or a demonstration of equipment and technology. There are many opportunities, but it is likely that any standard methods communicated at an early stage will presumably have to be modified in each individual ER case.
(g) A dedicated expert communicator or information officer to prepare the risk communication and check information material may be required.
(h) Dedicated expert help in the risk communication, for example, with regards to environmental health issues, may be required.
(i) A conflict analysis should be carried out in advance, identifying where and why conflicts and concerns might arise (e.g. regarding cleanup, deposition, residue levels, type of contaminant, planning issues, etc.).
(j) Information on possible disturbances should be provided in advance.

4.8. INCREASED NEED FOR STAKEHOLDER COMMUNICATION AND INVOLVEMENT

There are also some situations in which the need for communication and stakeholder involvement with a remediation project may be increased. Such situations can be identified by asking the following questions:

(a) Is it urgent? Might situations arise when decisions have to be taken quickly and measures initiated at short notice?
(b) Who is affected? Are children and other sensitive groups among those exposed?
(c) Will nuisances occur? Do the contaminants, or the remedial measures, present a nuisance to people who live or are present in the neighbourhood?
(d) Is there any uncertainty about the risks? Is there uncertainty about the risk of contaminants or the disturbances that the remediation measures might lead to?
(e) Who can influence the project? Do people who are living or present in the neighbourhood have the opportunity to influence the design and implementation of the project?
(f) Have there been any earlier conflicts? Were there any earlier conflicts affecting the project or the site where it is being carried out?
(g) What type of contamination is involved? Is there any reason to believe that the current contaminants may create any additional concern?

In association with risk communication, it may also be worth bearing in mind to:

(a) Have realistic ambitions in risk communication. Be aware that even a perfectly implemented risk communication strategy cannot prevent all of the risk conflict involved in the project.
(b) Remember that project leaders and managers do not always know best! Risk communication is not about providing other people with ‘correct’ information, but about creating a dialogue. The dialogue is a precondition for the various actors to be able to solve the problem together.
(c) Take initiative rather than waiting for information and communication to be demanded by stakeholders and volunteer information and solutions to problems.
(d) Inform stakeholders in advance rather than give retrospective explanations.
(e) Remember to listen to what the other side is saying and respect everyone’s views.
(f) Be prepared for the unexpected — the routines for risk communication have to exist before the problems arise.
(g) Remember that a remediation project is a long process and to involve the various parties at an early stage of the process. An early dialogue builds confidence, which may be decisive, especially if problems later arise in the project.

4.9. INFLUENCE OF STAKEHOLDERS ON JUSTIFICATION AND OPTIMIZATION OF REMEDIATION

As discussed above, according to the principle of justification, the remediation work to be implemented in a contaminated site should do more good than harm, which means that the net benefit (benefit of the reduction in radiation detriment minus the harm and costs of the remediation) should be positive. According to the principle of optimization, among the justified remediation options, the strategy with the highest net benefit should be selected [10].

However, even at the most fundamental level, decisions on whether or not a remediation option is justified will require a balance of environmental cost against dose reduction, and there can be differences in opinion as to what a justifiable cost for dose reduction might be and who should pay. Including the above criteria adds an additional level of complexity to the situation and decision making process due to:

(a) The many dimensions to the criteria;
(b) The fact that different people will be affected in different ways;

(c) The complexity of the issues (many remediation strategies have both positive and negative social and ethical consequences);
(d) The various ‘trade offs’ that may be required when making choices;
(e) Possible lack of agreement within society on what is practical or acceptable, in particular, the pricing of non-monetary side effects;
(f) The lack of established procedures and experience in systematically incorporating these dimensions in decision making.

One of the techniques to help in making this decision is cost–benefit analysis. It involves a balancing of costs in order to establish optimum levels of radiation protection.

The principal characteristic of cost–benefit analysis is that the factors entering the analysis are commonly expressed in monetary terms. In these circumstances, the dose (collective) is transformed into a monetary valuation using a reference value of an avoided unit dose (collective). This quantity can be related to the risk per unit dose and the statistical loss of life expectancy per radiation induced cancer [11]

An alternative to cost–benefit analysis is multiattribute analysis (MAA). This methodology can be seen as a more mechanistic way to take into account the subjective components mentioned above in the decision making, a limitation that is associated with cost–benefit. In order to support the decision making, MAA takes into account several objective and subjective factors, including health, economic and social attributes. These major attributes are then divided into subattributes according to Ref. [21]. The essence of MAA is to use a scoring scheme (or multiattribute utility functions) for the relevant factors. As a basis for comparison between options or alternative strategies, a multiattribute value function approach can be used. A deeper discussion of this methodology is out of the scope of this publicaton, but it is important to state that the value of this methodology relies on the fact that the use of utility functions allows for the introduction of factors that are not easy to quantify in monetary terms, as is required in cost–benefit analysis. More information about this method is given in Ref. [23]

Alternatively, if the aim is to promote more transparent considerations of these issues in the decision making process, then another tool that is particularly useful in a multidisciplinary stakeholder process is the use of a value matrix. This methodology has been discussed in Ref. [14] and tested in a number of stakeholder involvement exercises to aid in the decision making of selecting remedial solution. In such a way, decisions made are systematic, transparent and publically justified.

5. CONCLUSIONS AND REMARKS

This publication has outlined that the development of ER work will depend on the consideration of various aspects of both technical and non-technical nature. Therefore, these dimensions have been discussed with the objective of providing implementers and regulators with adequate background — in plain language — that can be used to explain the motives and objectives of ER projects to laypeople.

It has been explained that from the radiation protection point of view, the return of the contaminated site to background conditions is not necessarily the optimum outcome. Therefore, terms that are usually employed as synonyms of remediation, i.e. restoration and rehabilitation, should be avoided. Resources deployed in cleanup efforts to background conditions might be the same resources (e.g. public funds) diverted from other more pressing social applications. However, the decision making process will be very much influenced not only by the scientific calculated risk, but rather by the perceived risks of the population. This is why communication with the different stakeholders in the remediation process is of crucial importance. However, communication in the context of this publication has a broader meaning and involves the concepts of involvement and engagement.

Stakeholders in ER will include a broad range of groups and individuals, for example, the site/facility owner, funding entities, operations staff, ER managers, government (at different levels of representation), regulators, local authorities, elected officials, trade unions, waste managers, real estate owners, local enterprises, contractors, security organizations, local communities, general public, researchers and scientists, teachers and students, visitors, media and pressure groups. Thus, their relevance in a specific situation needs to be carefully determined.

It is recognized that social, cultural and political situations will be very diverse in different countries in the world, and even in different communities within the same country. The consequence is that there is not a single solution, nor a single approach, to implement stakeholder communication and involvement strategies. Solutions and approaches will need to be tailored to address the specific situation faced. However, many tools are available to implement stakeholder involvement, which have been applied in a number of countries and a variety of cases (nuclear and non-nuclear). Some of these methods have been described in this publication. Experience reveals that the appropriation and ownership of a remediation problem by stakeholders, notably local people, and their identification of the concept solution that is acceptable to them, is a key element for success. Another relevant point deals with situations in which a widespread awareness of the unfortunate results of several past episodes where government agencies have not effectively involved stakeholders in contaminated site remediation plans has been observed. These facts, combined with the possible lack of trust in governments and the fierce media attention focused on instances of environmental contamination, will contribute and continue to make the implementation of environmental projects even more challenging.

REFERENCES

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, IAEA Safety Glossary: Terminology Used in Nuclear Safety and Radiation Protection — 2007 Edition, IAEA, Vienna (2007).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards — Interim Edition, IAEA Safety Standards Series No. GSR Part 3 (Interim), IAEA, Vienna (2011).

[3] Convention On Access To Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (1998),
http://www.unece.org/env/pp/documents/cep43e.pdf

[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Stakeholder Involvement Throughout the Life Cycle of Nuclear Facilities, IAEA Nuclear Energy Series No. NG-T-1.4, IAEA, Vienna (2011).

[5] INTERNATIONAL ATOMIC ENERGY AGENCY, An Overview of Stakeholder Involvement in Decommissioning, IAEA Nuclear Energy Series No. NW-T-2.5, IAEA, Vienna (2009).

[6] INTERNATIONAL ATOMIC ENERGY AGENCY, Non-Technical Factors Impacting on the Decision Making Processes in Environmental Remediation, IAEA-TECDOC-1279, IAEA, Vienna (2002).

[7] COVELLO, V.T., The perception of technological risks: a literature review, Technol. Forecast. Soc. **23** (1983) 285–297.

[8] SLOVIC, P., Perception of risk, Science **236** (1987) 280–285.

[9] RENN, O., “Perception of risks”, 41st Congress of the European Societies of Toxicology, Florence, Italy, 28 September–28 October 2003, Elsevier Science Ireland Ltd (2003) 405–413.

[10] HAVENAAR, J.M., et al., Perception of risk and subjective health among victims of the Chernobyl disaster, Soc. Sci. Med. **56** (2003) 569–572.

[11] KNIGHT, A.J., WARLAND, R., Determinants of food safety risks: a multi-disciplinary approach, Rural Sociol. **70** (2005) 253–275.

[12] SJÖBERG, L., Perceived risk and tampering with nature, J. Risk Res. **3** (2000) 353–367.

[13] RENN, O., Risk Governance: Coping with Uncertainty in a Complex World, Earthscan Risk in Society, Earthscan, London, UK (2008).

[14] HUNT, J., WYNNE, B. (Eds), Social Assumptions in Remedial Strategies, CSEC, Lancaster University, UK (2002).

[15] OUGHTON, D., FORSBERG, E.M., BAY, I., KAISER, M., HOWARD, B., An ethical dimension to sustainable restoration and long-term management of contaminated areas, J. Environ. Radioactiv. **74** (2004) 171–183.

[16] UNITED NATIONS, Report of the United Nations Conference on Environment and Development, Annex I (1992),
http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm

[17] SUNSTEIN, C.R., Infotopia, Oxford University Press, New York (2006).

[18] INTERNATIONAL ATOMIC ENERGY AGENCY, Remediation Process for Areas Affected by Past Activities and Accidents, Safety Guide No. WS-G-3.1, IAEA, Vienna (2007).

[19] MORGAN, M.G., et al., Risk Communication: A Mental Models Approach, Cambridge University Press, New York (2002).

[20] INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, The 2007 Recommendations of the International Commission on Radiological Protection, ICRP Publication 103, Elsevier, Amsterdam (2007).

[21] MISAK, C., Truth, Politics, Morality, Pragmatism and Deliberation, Routledge, New York (2000).

[22] HEALTH CANADA, Health Canada Policy Toolkit for Public Involvement in Decision Making, Minister of Public Works and Government Services Canada, Ottawa (2000).

[23] EUROPEAN COMMISSION, Investigation of a Possible Basis for a Common Approach with Regard to the Restoration of Areas Affected by Lasting Radiation Exposure as a Result of Past or Old Practice or Work Activity, Radiation Protection 115, Office for Official Publications of the European Communities, Luxembourg (2000).

Annex I

ENVIRONMENTAL SOIL REMEDIATION: COMMUNICATION WITH THE PUBLIC IN FLANDERS, BELGIUM

I–1. INTRODUCTION

The Federal Agency for Nuclear Control (FANC) is the Belgian nuclear regulator. Its mission is to protect population, workers and the environment against the negative effects of ionizing radiation. FANC is a federal institution that has the task of advising the population and the Government in a neutral and objective way. FANC reports to the Sub-commission for Nuclear affairs of the Belgian Parliament and the Federal Minister of Internal Affairs. FANC was founded in 1994, and the basic legislation came into force in 2001 (general regulation for protection against ionizing radiation). Its financing is generated through contributions from the nuclear sector.

To accomplish this mission, FANC developed a wide range of activities in different domains where there is a potential risk of exposure to ionizing radiation due to human action or to natural causes. Its approach is based on the ALARA principle.

Licensing and control of the use and applications of nuclear isotopes in the medical and industrial sectors, in nuclear installations and in nuclear power plants are one of the instruments used by FANC to reinforce and maintain a high level of safety. Another instrument is the surveillance of natural and cosmic radiation. The security of the transport of nuclear sources, of nuclear installations and nuclear power plants is also an important task of the FANC.

The primary scope of the control and licensing approach is prevention, in order to avoid any incident and/or unnecessary radiation exposure. Therefore, much effort is made to instil a general safety and security culture in all sectors concerned.

To achieve this goal, FANC deploys resources to educate and inform different sectors of the general population. Examples are educational initiatives (transport), informative campaigns (radiation and pregnant women) or long term actions (radon information campaign).

An important challenge in this area is to communicate in an understandable yet correct manner.

The nuclear industry still tends to use expert language and is very nuclear power plant oriented; therefore, communication with the public and professionals in non-nuclear fields is a developing and improving area. In the context of this IAEA initiative, where communication about environmental remediation (ER) is investigated, the example of Belgian industrial soil remediation is described. The IAEA is convinced that Member States can learn from this experience, as there are many parallels with the ER of radioactively contaminated sites. This is especially the case in Belgium, where this type of soil pollution usually occurs together with other, chemical industrial pollution.

I–2. THE BELGIAN CASE

I–2.1. Importance of a legal framework

In 1995, the Belgian region of Flanders was one of the first in the world to vote in a soil decree. This decree had the main goal of protecting property buyers by giving a ‘soil certification’. In the decree, discrimination was made between historical pollution (caused in the past) and new soil pollution. The latter has to be cleaned up immediately by the party who caused it. More problematic is the remediation of historic pollution, which is often only discovered following soil investigations. Furthermore, it is often not clear who caused the contamination and therefore who has to pay for the remediation.

To resolve this, in the first instance, an official inventory was compiled of all possibly polluted soils, for example, all (former) industrial sites. For all these soils, there is, from the moment it is mentioned in the inventory of high risk soils, an obligation to investigate, and, if necessary, to remediate the pollution before the land can be sold. The thus obtained information will be put on a ‘soil certificate’. This is an obligatory document without which no land can be sold. The certificate contains information about the state of pollution (or non-pollution) of the land for sale and thus protects the buyer from unforeseen discoveries of contamination following a purchase. This is important to reinforce the ‘polluter pays’ principle and places the financial liability for remediation with the correct party. Since 1995, about 22 500 high risk sites have been investigated out of an estimated total of 76 000 high risk sites in Flanders. In 2008, the decree was updated to remove some obligations to produce a certificate where land and property is transferred on a rental or lease basis.

All this had to be communicated to the public, especially to the concerned population. As Flanders is a small, very densely populated region where industry has been very important since the nineteenth century, many parties became directly concerned. This necessitated very difficult, often delicate, communication on many different levels between the population, industry, local governments, the environmental movement and, last but not least, the media.

It is unsurprising that from the moment the Government started communicating about *possible* soil pollution, the citizens of Flanders immediately had many questions, and in the first months, when this approach was totally new, a degree of alarm existed in the population. This was reinforced as people often did not realize fully until the publication of the pollution inventory that contamination was present in their environment, and, more importantly, that this problem often had a direct impact on their daily way of life.

In the first contact with the population, health questions set the agenda. Once this information was communicated, often with guidelines on how negative health effects can be mitigated, people were most interested in what the impact would be on their property and who would carry out and pay for remediation and the resulting inconveniences.

The Belgian example illustrates that whatever means and emphasis are put into communication efforts, it is essential to have a legal framework that clearly defines where the responsibility lies in a remediation effort.

I–2.2. Radioactive soil remediation in Belgium

In Belgium, radioactive soil pollution often goes hand in hand with chemical and industrial pollution. Belgium has no uranium mines, but was a leading radium producer until the 1960s. The extraction of radium took place in a factory located in Olen (Antwerp province). This activity led to significant radioactive contamination, both inside the factory premises and outside. The contamination affected the dumping sites of the factory, the banks of a nearby river and a few streets of the neighbouring town. Parts of the contamination have already been remediated, but the remediation of the dumping sites still remains to be carried out.

Moreover, Belgium had and still has several industries processing naturally occurring radioactive materials, in particular, the phosphate industry, and also some branches of the metal industry and other sectors. The dump sites from these industries (such as phosphogypsum stacks) may also present some risks from the radiation protection point of view.

Belgium has not yet formulated a detailed legal framework for coping with radioactively contaminated sites, but such a comprehensive regulation, following the principles of the Flemish legal framework, is under development. Due to the entanglement of radioactive and purely chemical contamination, FANC will set up conventions with the regional authorities to cooperate in order to avoid unnecessary repeat investigations of soils. The requirement to ensure the coherence between the approaches for radioactive contamination and for chemical contamination is obvious; this consistency is necessary from the technical point of view (the risk characterization methodology and the remediation techniques must fit both radioactive and chemical aspects) and from the decision making and administrative points of view (coherence in administrative procedures, timing and project planning for remediation, etc.).

I–2.3. Learning from Belgium: communication

Radioactive contamination will likely continue to have a very negative connotation for a long time, partly due to a lack of knowledge about ionizing radiation and its impact on human health, and partly due to a lack of confidence in the organization which is communicating, particularly if it is the operator or the regulator. This is similar to the case of chemical soil pollution, and it is a non-negligible factor that has to be taken in account when setting up the communication plan. Therefore, it is necessary to invest time and effort in building the credibility of the body charged with public communication; this can only be achieved through an ultratransparent approach on a permanent, systematic basis, and through constant engagement with the (many) stakeholders of the remediation project.

The above mentioned legal framework made it possible to do this, as it created an environment where all stakeholders knew exactly how contamination would be remediated and by whom. Furthermore, the credibility of the Government was enhanced by starting to communicate from the first indication of possible contamination and throughout the inventory formulation stage. Whilst this created some disquiet and concern among the public (reinforced by media attention), at the same time, it created an important opportunity to inform and explain what might be the problem, how it may or may not affect health and environment, and which actions will be taken by whom and within which time frame. In other words, if this phase is approached in a real spirit of openness, it creates much willingness among stakeholders to engage. Key learning points are to:

(a) Have a clear, time scheduled communication approach;
(b) Start communicating at a very early stage (pollution inventory formulation);
(c) Be aware that communication includes what stakeholders want to know and not only what is considered important by authorities.

The Belgian case proved that a communicator (in this case, a regulator) must be willing and able to answer many questions from the public that extend beyond purely scientific or technical discourse. Of course, there were many questions about the implied chemical substances and their impacts on health and the environment, and about the proposed remediation techniques. Alongside these, many more subjective questions were posed, including:

(a) What are the health and/or environmental risks of this pollution for children?
(b) Who caused it?
(c) Who will clean it up?
(d) Who will pay for the cleanup?
(e) Why is this problem only being addressed now?
(f) What does this pollution mean for the everyday life of the population living in the neighbourhood or on polluted sites?
(g) What is the impact on house prices?
(h) What are possible health effects?
(i) How can the risks be minimized while waiting for the remediation (which often takes years)?
(j) How can the risks be minimized during the remediation?

In some cases, there was also opposition against the remediation; people refused access to their land for remediation, although this is a legal obligation.

I–2.4. Learning from Belgium: define the stakeholders

The Belgian experience illustrates the requirement to identify the concerned stakeholders and to have a clear view of who is involved, on what level, which type of information they need (and when) and what is or will be their role in the process. It is most important to tailor and adapt the information and language provided to suit the understanding of each stakeholder group about the remediation process.

Stakeholders in cases of remediation can be many, and can vary according to the evolution of the project:

(a) Population (neighbourhood groups, etc.);
(b) Media;
(c) Local authorities;
(d) Other concerned governmental institutions (e.g. health and environment departments);
(e) Industry and concerned enterprise(s);
(f) Private actors (remediation companies, workers).

Further advice on identifying stakeholders is provided in Section 4.3.

I–2.5. Learning from Belgium: timing of communication

In the Belgian case, it proved most effective to start communicating from the moment the regulator had an indication (not necessarily a proof) of possible risks for the health of the population. Even if, afterwards, the case was shown to be insignificant, communicating was seen as a sign of transparency, and, more importantly, as proof of public responsibility from government and industry, even if it had caused unnecessary public unease. Waiting until the pollution was completely analysed and quantified in detail enhances the risk of media leaks and speculation, resulting in public anger that something was being hidden. This places the communicator in a defensive position, from which it is most difficult to gain the necessary trustworthiness and public confidence. Therefore, communication has to be an integral part of every phase of the remediation.

I–2.6. Learning from Belgium: organizing communication

It is important to engage with local stakeholders in a personal manner, especially in the first instance. This can be achieved by organizing information meeting(s) for the concerned population, together with, if possible, other relevant bodies such as local authorities or an independent health authority. If several parties are to be present at such a meeting, a preparatory meeting should be set up to agree which organization communicates each point, to portray a coherent and organized approach, avoiding discussions and differences in presentation of data in front of the public.

The media are also a very important source of information for the general public. Therefore, organizing a press conference for national and local media (perhaps one hour before the information meeting, under embargo until the beginning of the meeting) is certainly worthwhile. On the other hand, it is often not appreciated by the population when the media attend meetings intended for the public. In the Belgian case, the media were not allowed into the meetings themselves, out of respect for the privacy of the concerned population. This never posed difficulties, and the press respected the privacy of local people.

Of course, it is not necessary to organize a new meeting or press conference when each new piece of information is to be disseminated. However, it is important from the outset to ensure that stakeholders know how and when they will be informed about project developments. Meetings are useful at the moment of the first announcement and in the important stages of the remediation: when pollution and its extent can be quantified, when soil investigation starts, when remediation techniques are known and when remediation itself starts. Between meetings, well established communication instruments can be useful, such as maintaining an updated web site, producing personal letters, mass mailing (e.g. brochure updates) or taking queries by telephone and email.

I–2.7. Learning from Belgium — the message: the importance of coherent, objective communication

It has already been mentioned that trustworthiness of the messenger is very important. Therefore, it is necessary to ensure that all official actors present one message, and that coherent declarations are given: who will do what, at what time, etc.

In the Belgian case, national or local government institutions and regulators proved to be better placed to bring neutral messages to the public than the industry or site operator, who caused the pollution, and may be unable to portray a credible message. For local authorities, the role they can play in communication often depends on the involvement they previously had with the organization which caused the pollution. A local authority which permitted or underregulated a polluting entity may experience similar communication difficulties to the polluting operator themselves.

I–2.8. Learning from Belgium — preparing the content of the message

It is not necessary for the local population to become experts in the remediation process; however, they should be aware of the nature of the pollution, the means that will be employed to remediate it and, most importantly, what measures can be taken on an individual or family level to mitigate risk. Section I–2.3 suggests some questions around which to structure communications.

Secondly, it is important to have answers for more administrative questions such as whom can be contacted for further questions and how the public will be kept informed. In addition, more retrospective questions may be posed concerning what harm may already have resulted from exposure. Such retrospective questions are often emotive, concerning how contamination was permitted by the authorities or regarding the (de)valuation of property; these issues must be handled with particular sensitivity.

In the field of ionizing radiation, it is key to explain what contamination and exposure mean. Furthermore, providing information on dose rates without context is often meaningless, e.g. if exposure from a contaminated site is 1 mSv/a, this should be accompanied by information about what such a dose means, e.g. in the form of increased latent cancer risk.

When communicating these messages at public meetings, it is important to have both radiological and communications experts present to ensure that any technical information is articulated and understood by the attendees.

Commonly, in industrial pollution cases, there will be disagreements about the identity of those liable for the cleanup. The discussions to resolve these disputes are often long and difficult, and must be held in an appropriate context. This may differ from project to project, but it is important to note that a public meeting is unlikely to be an ideal environment to resolve disagreements between actors. However, in the spirit of openness, it may be beneficial to acknowledge these differences at a public meeting and explain the stance of the organizations involved.

As soon as the contractor or body undertaking the work is known, they should be formally introduced to the communication process. Prior to this, during the tendering process, the public should be informed and should have an opportunity to express opinions about the remediation techniques proposed.

During the planning and scheduling of the remediation, significant local events, such as school examinations, holidays or festivals, should be taken into account, along with the normal pattern of life in the community, e.g. it is unlikely to be best practice to undertake movements of large equipment or vehicles around the beginning and end of the school day. During the implementation phase, a point of contact that communities can turn to if they have questions (e.g. a contact number) should also be available. This individual need not always have all the answers, but should be able to answer day to day queries and direct more complex questions to an appropriate individual.

Often, remediation is not limited to the site, and it may be necessary to remediate private land, e.g. homes and gardens. Personal contact between the owner or occupier of each property affected is required to facilitate this.

It is also helpful for the regulatory body overseeing the remediation project to produce a set of clear guidelines for the project. This empowers the regulator, remediation operator and local community to benchmark the performance of the remediation project.

I–3. CONCLUSION

Primarily, the identification and involvement of all stakeholders is imperative to implement the remediation project in a structured way. It is very important that there is a clear, legal framework for the remediation that contains precise regulations about the whole approach to be applied and to reassure the stakeholders that remediation will happen, and will not be at their expense.

On the other hand, communication has to be an integral part of every phase of a remediation: to gain the trust of the population and to give an understanding of the necessity of the remediation; openness and transparency at every stage of the project plays an important role, as does the use of an understandable and upfront way of explaining concepts and issues.

Annex II

FRENCH CASE STUDY: PLURALIST EXPERTISE GROUP ON URANIUM MINES IN LIMOUSIN

II–1. INTRODUCTION

The uranium mining and milling industry once played a major strategic and economic role in France. After the definitive cessation of mining and milling activities in 2001, more than 200 sites are currently in the closure and post-closure phases. Decisions required in this frame raise particular difficulties because of the sensitivity of some technical issues and the strong scrutiny and requirements of local and national non-governmental organizations. This is particularly true in Limousin, the region that stands at the heart of the national uranium history. In order to deal with this complex and disputed topic, the ministries of environment, health and industry recently decided to set up a Pluralist Expertise Group (GEP) with the aim of analysing and providing a critical point of view on the various technical documents prepared by the operator, AREVA NC, about the surveillance and control of its former mining sites in the department of Haute-Vienne in the Limousin region, and then providing recommendations to public authorities to improve the current situation.

This expert group presents their reports to the local committee for nuclear information.

II–2. URANIUM MINES IN FRANCE

II–2.1. Historical perspective

Uranium exploration and exploitation started in France soon after the end of the Second World War. It then gradually grew in importance up until the 1980s. From the end of the 1980s, it rapidly declined owing to the combined effects of exhaustion of reserves and fall of uranium market prices. Activity came to a definitive end with the closure of the last mine in 2001.

During more than 50 years, over 200 sites scattered over a large part of the country were prospected and put into production. Most, and the most significant in terms of quantity of uranium produced, are localized in four main districts: le Limousin in the western part of the Massif Central, la Vendee in the west of France, l'Herault in the south of the country and le Forez in the eastern part of the Massif Central.

French sites yielded a total of 76 000 t of uranium, which represents more than 10 years of the current requirements of national power plants. The milling of ores involved the operation of uranium processing plants and produced more than 50×10^6 t of tailings. These tailings were disposed of in 17 specific repositories.

Closure works have now been completed at most sites, and the remaining activity mainly consists of surveillance and control of the maintenance of several water treatment facilities.

II–2.2. The Limousin region

Among the various districts that contributed to French uranium production, the Limousin region clearly played a particular role. Limousin is the cradle and grave of the national uranium history. It was in this region that the first exploited ores were found in 1946, and it also hosted the last mine to close in 2001. The Limousin region also played a leading position throughout the 50 years of activity. It yielded nearly one third of the total national production and hosts 5 of the 18 tailings repositories (which represent roughly half of the total mass of tailings produced). One of its former mining sites also hosts a storage facility for depleted uranium produced by the French fuel cycle facilities.

The Limousin region witnessed several of the media crises experienced by the French uranium mining industry. It also hosted the first prosecution of a nuclear operator before a criminal court after a judicial inquiry was initiated against AREVA NC for ‘pollution, abandonment and dumping of waste containing radioactive substances’ at several sites located close to old uranium mines in the Haute-Vienne department.

II–3. STAKEHOLDER POSITIONS AND EXPECTATIONS

II–3.1. AREVA NC

Following the acquisition and merger of the different companies involved in the exploitation of uranium ores, AREVA NC (formerly known as Compagnie générale des matières nucléaires, or COGEMA) has become the only industrial actor in this sector in France. Practically, it is now responsible for the management, monitoring and surveillance of the approximately 200 sites mentioned earlier.

Uranium mining is still at the core of AREVA industrial activities; however, production is entirely located abroad nowadays. In France, practical involvement of the group in the former mining districts consists of addressing social and environmental legacies. From this point of view, sites can be considered as a burden; the question is then raised of how the sites can be definitively closed and relieved from regulatory control.

From another point of view, the social and environmental legacies are also a potential threat to AREVA's image as a sustainable company. This aspect is all the more significant given that in addition to its mining activity, the AREVA group is also one of the major companies in the nuclear business, both in France and worldwide. As a nuclear actor, it is at the centre of strict scrutiny from various stakeholders, including environmental NGOs, politicians and the media. This context encourages AREVA to fully respect its duties and even to act in a proactive manner.

II–3.2. National and local non-governmental organizations

Concerns and interests of NGOs in the former uranium mines find their roots, on the one hand, in environmental protection and attempting to defend the local quality of life, and, on the other hand, in an attempt to stress the failures of an industrial actor considered as a member of the 'nuclear lobby', and in this way to shift to a general debate about nuclear energy.

Uranium mining is thus often pointed out today as the weak point of the nuclear industry. It is notably acknowledged to account for the largest part of public exposure due to fuel cycle facilities, far behind the exposure usually attributed to nuclear power plants or even spent fuel reprocessing. Moreover, the management of uranium mining and milling waste and, particularly, the long term safety issues associated with the 17 tailings repositories and the 50×10^6 t they contain have found a natural place in the national debate about nuclear waste and the most adequate national framework to regulate and control nuclear activity.

Not surprisingly, the topic has progressively become a particular topic of concern and interest for national NGOs involved in the world of radioactivity.

In addition to this general context, the last decades of the French uranium mining experienced a series of local disputes between NGOs and AREVA. These disputes, which eventually came to the attention of the media or even received judicial attention globally, contributed to raise suspicion and weaken the trust of the local population towards AREVA.

Transport and disposal of wastes from other regions, other steps of the nuclear fuel cycle or other technologically enhanced naturally occurring radioactive material industries were, on several occasions, denounced as unfair and unacceptable practices. They were considered to be an attempt by mining companies to take benefit of overly weak regulations and accommodating enforcement of laws to convert old mining sites into national nuclear waste disposal facilities.

In parallel, NGOs (along with official reports written in answer to administrative bodies or parliamentary offices) challenged the regulatory status of several tailings repositories, and argued that they should be regulated as nuclear installations based on the total amount of activity they contained.

Finally, several cases of enhanced levels of radioactivity in the vicinity of mining sites were pointed out as proof of inadequate management of mining and milling wastes or inappropriate control and treatment of water discharges. Dissemination of spent rocks (or very low grade ores) and their reuse as construction materials were thus acknowledged to cause high radon concentrations (locally up to 10 000 Bq/m^3) in an industrial building. In other places, the sediments of several ponds, including a lake dedicated to recreational activity and ponds used to produce drinking water, were found to contain high concentrations of uranium.

II–3.3. Local populations

Local populations are mainly rural, and uranium mining and milling were once a major source of wealth and employment.

These aspects have been reviewed by psychologists who highlighted the importance of the management of environmental surveillance in an opinion poll. From the point of view of the interviewees who contributed to this study, the surveillance of the sites for storage is the most important aspect of site management activities. They expressed a particular interest in water surveillance. However, the effective distribution of responsibilities and the guarantees offered in radiological surveillance remain vague, in the opinion of local residents. As long as the question of possible health effects due to the presence of mining residues remains sensitive, better information about the surveillance devices used is indicated.

Nevertheless, there is no consensus on the identity of the actor that could assume this responsibility in the risk management system. The majority of interviewees think that as a rule, the technical, administrative and cost burden should return to the former owner of the mine, following the 'polluter pays' principle. However, certain interviewees question whether the former operator can be neutral enough to be in charge of surveillance. The third subgroup answers these two levels of concern (responsibility and neutrality) by suggesting that 'governmental authorities' are charged with surveillance. Moreover, some interviewees recognize that state institutions are likely to be more stable than commercial entities that are subject, for instance, to takeover and merger.

These findings show that social and economic impacts were therefore significant, and expectations from AREVA NC to support new industrial development during a transition phase were high. More than 5 years since the last site closed and several decades after French uranium production peaked, this question is probably not as pertinent today as in the past.

Local people are highly likely to have concerns, or at least questions, about environmental impacts and their potential economic side effects. Green tourism, for instance, often plays a particularly important role, and could easily suffer if the area is associated with pollution, particularly of a radioactive nature, thus reducing the territory's attractiveness.

II–3.4. Local and national authorities

Several national administrations are involved in the old uranium mining issue. As any mining activity, the issue first falls under the responsibility of the ministry of industry, and, more particularly, to the department in charge of defining the guidance and regulations relative to the closure and post-closure management of mining sites. However, it also lies within the remit of the Ministry of Ecology and Sustainable Development, because tailings repositories are regulated as installations significant for environmental protection purposes. In this particular field, the Ministry played an active role in defining guidance for the control and surveillance of the sites concerned, but it also gave strong incentives to improve public information and promote the independent review of AREVA NC reports. Lastly, the Ministry of Health and the Nuclear Safety Authority are also involved in the issue through their general competence to propose nuclear policy and regulations.

At local levels, authorities struggle between the requirement that the post-closure works and administrative procedures proceed and the claims from NGOs and local populations to obtain a clear statement about actual impacts on humans and the environment before any decision to proceed is made. One particular difficulty they encounter is linked to the accusations by some NGOs of being too close to AREVA NC.

II–4. THE PLURALIST EXPERTISE GROUP

II–4.1. General framework

II–4.1.1. The Nord-Cotentin radioecology group experience and the opening up of the expertise of the French Institute for Radiological Protection and Nuclear Safety

In 1996, an epidemiology study published in a scientific journal established the existence of a trend towards an excess number of leukaemia cases in the canton of Beaumont-Hague, close to an AREVA NC reprocessing plant. The study suggested a relationship between the consumption of seafood and time spent on the local beach, and led public authorities to ask for a more detailed radioecological analysis in order to produce a direct and best estimate of the radiological exposure of the population and corresponding predicted effects on health.

Annie Sugier, director of radiation protection at the French Institute for Radiological Protection and Nuclear Safety (IRSN) was commissioned to form and preside over the group of experts in charge of carrying out this work. The group, known as the Nord-Cotentin radioecology group (GRNC) included experts from a wide range of organizations (inspectors, operators, governmental experts and experts from non-governmental laboratories as well as foreign experts). After several years of work, it submitted its conclusions to the Ministers of the Environment and Health, and concluded by issuing a series of detailed reports now considered reference documents.

This rather unique experience in France marks the beginning of a resolute IRSN strategy to open up its expertise to civilian society in order to deal with complex or disputed topics. This approach of involving the interested parties is largely consistent with the guideline adopted by the French Government for greater transparency in the field of nuclear and radiological risk management.

The implementation of such a group can be sought, in particular, in contexts of debates or strong questioning by the public in response to a situation of industrial risk. This approach can also be joined into a process of statutory decision making (as is the case of the GEP mines). It requires an engagement by letter from public authorities (i.e. ministries) that specifies the scope of the mission and provides the necessary resources for the exercise.

II–4.1.2. The operating procedures of the Pluralistic Expertise Group

A GEP (group of pluralistic expertise) is a gathering of technical dialogue allowing scientific experts of varied origin (institutional, industrial, NGOs, French and foreign) to express opinions in aid of public authorities, of local or territorial authorities or in any structure of dialogue concerned.

Other peculiarities of the composition of the GEP include the plurality and the willingness to take into account all the sensitive issues and the available information sources. The members of the GEP are representatives of French public bodies, primarily the IRSN, but also other institutions such as GEODERIS (geology specialists), In VS (health specialists) and INERIS (chemical risk specialists), university laboratories, representatives of local or national NGOs and independent experts, as well as representatives of the industrial operator AREVA NC and of foreign experts.

II–4.1.3. The Pluralistic Expertise Group informs public actors and the general population

As was explicitly required by the ministers, providing information to the public actors and the general population is one of the missions of the group. Therefore, the GEP works in total transparency, and the group members present the progress of their work when meetings on the topic of interest are organized in the locality concerned. Generally, they convene regularly in front of the local CLI committees created for the dialogue with society. CLI is the structure of information prescribed in the law of 31 July 2003 concerning the management of natural and industrial major risks. For nuclear risks, the remit of these local committees was specified in the 2006 law on the transparency of information.

II–4.1.4. Pluralistic Expertise Group mines: origin, objectives and organization

Following the GRNC experience, a discussion was initiated between IRSN and interested public administrations to engage a new initiative of pluralist expertise on potentially interesting topics, including the question of old uranium mines. This proposal raised interest from the three competent administrative bodies in charge of this issue: the Ministry of Ecology and Sustainable Development, the Ministry of Industry and the Ministry of Health.

Practically, it led to two different initiatives: one from the local administration in charge of regulating the sites, and another from national administrative bodies.

At the local level, the Prefect of Haute-Vienne requested that AREVA NC prepare a 10 year environmental report on the surveillance and control of mining sites located in the department. This report was issued between the end of 2004 and the beginning of 2005. In order to obtain an expert opinion on its content, the Prefect then asked AREVA NC to produce an independent review of the report, with the aim of giving a particular focus on four different topics:

(a) The sufficiency of the closure and post-closure works already completed on the sites regarding middle and long term radiological safety issues;
(b) The assessment of environmental impacts associated with mining activities, especially those linked to water discharges and the sufficiency of solutions implemented by AREVA to prevent and/or limit them;
(c) The adequacy of radiological calculations by AREVA NC to evaluate the added exposure received by populations living around the sites and the soundness of control and surveillance provisions with regard to the occurrence of enhanced levels of radioactivity in specific areas of the environment;
(d) The potential dissemination and use of mining and milling wastes for private or public works.

IRSN has been entrusted to carry out a corresponding review. At the national level, the ministers asked the new GEP to analyse and give a critical point of view on the various technical documents prepared by AREVA NC on the surveillance and control of its mining sites in the department of Haute-Vienne in the Limousin region. One particular document being considered is the 10 year environmental report mentioned above.

According to the mandate given to the group, one particular expected output is to assist public authorities to identify the available options for post-closure plans and to provide recommendations on the possible solutions to minimize existing impacts on the environment and the local population.

In order to fulfil these objectives, the group is expected to carry out its own work, but also to steer and benefit from the review of the AREVA NC 10 year environmental report entrusted to IRSN.

After necessary consultations of local and national administrations, potential experts and the main stakeholders (including leading national and local NGOs), a list of a dozen members was established, and a first meeting was organized in late June 2006. The scientific backgrounds of the members of the expert group related to earth sciences (hydrogeology, geochemistry, mining, metrology of environmental radioactivity, radioecology and radiation protection). The group included experts from French public organizations, foreign experts, experts from NGOs and representatives from AREVA NC.

Then, the experts decided to form four working groups, each dedicated to a specific topic. The first one dealt with source terms, discharges and transfer to the environment. It aimed to review the main processes involved and the way AREVA NC took them into account in its studies and reports. The second working group dealt with environmental and health impacts. The group examined the approach handled by AREVA NC to evaluate impacts to humans and the environment around its sites, but also aimed at providing guidance on the need and feasibility of setting up health surveillance provisions to complement the dose assessments currently carried out by AREVA NC. The third group intended to provide a broader view to the experts' work by addressing the questions of regulatory framework and adequate requirements to ensure health and environmental surveillance, today and in a long term perspective. The fourth group reviewed the measurements from different laboratories.

II–5. TECHNICAL QUESTIONS AND NON-TECHNICAL EXPECTATIONS

Unlike the GRNC or other international initiatives dedicated to old mining sites, the question addressed by GEP mines is not heavily focused on one single technical issue. Rather, it is a combination of many concerns, stakes and objectives that form a complex and disputed situation. Among this complexity and diversity of issues, a few points can be stressed as key questions. From a technical point of view, these key questions generally relate to the evaluation of an added dose in the context of the natural radioactive background, to the occurrence of locally enhanced concentrations of radioactivity in the environment and their potential impacts on humans and biota, and to the necessary provisions to ensure long term safety, especially as far as a tailings repository is concerned.

The questions mentioned above are quite generic, and have already been addressed in a theoretical (and sometimes practical) manner on different occasions by international organizations and in a few other countries. In the case of the GEP mines, they have to be tackled in a particular context where technical positions supported by AREVA NC and sometimes regulatory practices have been challenged by local and national NGOs and a climate of mistrust has progressively developed. This clearly requires particular care to listen to and understand various opinions and concerns and to properly inform and explain technical positions that will be taken. This information and explanations are not only required by the administrations that initiated the creation of the expertise group, but also by the various other stakeholders. In order to more fully answer these expectations, the third working group decided to enlarge its composition to more closely involve the various points of view expressed in the successive debates, including legal and policy aspects.

In addition, GEP mines must contribute to the expectations of public authorities by providing practical guidance to proceed with closure and post-closure administrative procedures in a manner that is widely discussed and accepted.

Given the many different sites and situations to cope with, both IRSN and GEP mines decided to first focus their technical work on two specific issues. One was related to the tailings repository of Bellezane, the other to the environmental impact at the scale of the watershed of a local stream, the Ritord. The expertise about the Bellezane repository notably addressed the question of hydraulic functioning of the disposal system and the potential existence of leaks; it also assessed the efficiency of the waste rock cover with regard to the attenuation of external gamma dose rates and radon exhalation rates. The expert review on the Ritord watershed assessed the question of the origin and evolution of the sediment enhanced uranium concentrations (up to several 10 000 Bq/kg) measured in the estuary of a stream leading into an artificial lake. It also examined the information available to evaluate the potential impact of mining activities to species and biota.

The second stage of the work of the GEP comprised a more detailed investigation of the sites, ponds and hillsides not previously assessed. The most important sites dealt with were those storing residues. This study included:

(a) The evaluation of the radiological impacts on the populations;
(b) The relevance of the modalities of site surveillance of sites, in particular towards the radiological markers observed in the environment and their possible evolution.

In July 2009, the third report of the GEP was published, giving the results of these investigations.

CONTRIBUTORS TO DRAFTING AND REVIEW

Baumont, G.	IRSN/DEDRE/DOS, France
Caruso, M.	National Atomic Energy Commission, Argentina
Costa Barreto, A.	Brazilian Nuclear Industries, Brazil
Daflon Antonio, G.G.	Ministério do Trabalho e Emprego, Brazil
De Beulle, K.	Federal Agency for Nuclear Control, Belgium
Diaz Francisco, J.M.	Eletrobras Termonuclear S.A., Brazil
Falk, E.	Université de Versailles Saint-Quentin-en-Yvelines, France
Ferdosi, N.	Nuclear Science and Technology Research Institute, Islamic Republic of Iran
Iskakov, M.	Kazatomprom, Kazakhstan
Karim, B.	Ministry of Land Planning, Environment and Tourism, Algieria
Lecossois, B.	International Atomic Energy Agency
Li, J.	China Institute for Radiation Protection, China
Machado, L.	National Nuclear Energy Commission, Brazil
McKee, M.	Canadian Nuclear Safety Commission, Canada
Molina, M.E.	Centro de Informacion CNEN San Rafael, Argentina
Monken-Fernandes, H.	International Atomic Energy Agency
O'Connor, M.	Université de Versailles Saint-Quentin-en-Yvelines, France
Oughton, D.	Norwegian University of Life Sciences, Norway
Perko, T.	SCK•CEN, Belgium
Rehmann, M.	WM Symposium, United States of America
Riazantsev, V.	State Nuclear Regulatory Committee of Ukraine, Ukraine
Touat, L.	Ministry of Energy and Mines, Algiers
Yevhen, S.	Verhovna Rada Ukraine, Ukraine

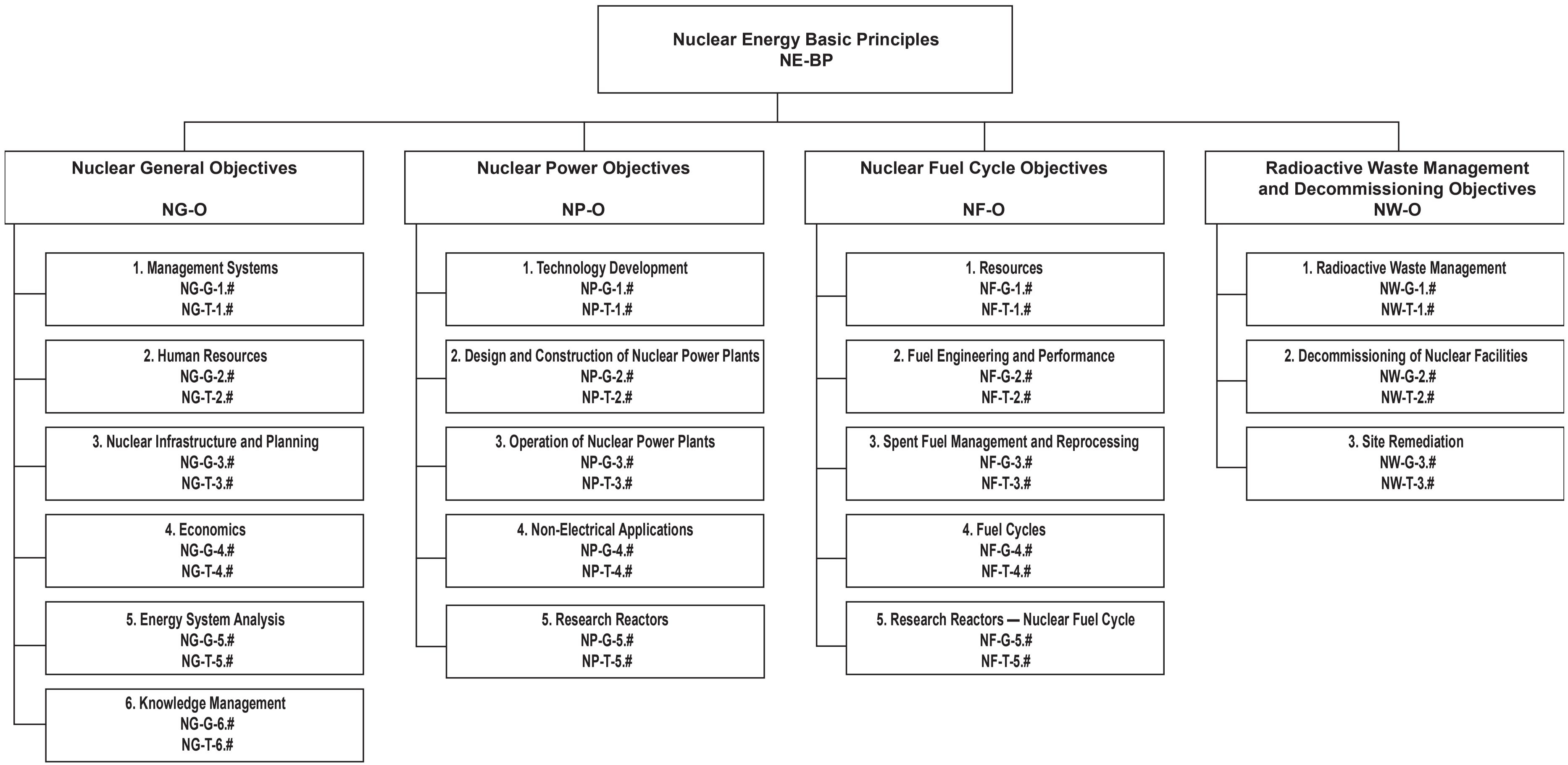
Consultants Meetings

Vienna, Austria: 5–9 November 2007, 7–11 July 2008, 2–6 November 2009

Technical Meeting

Vienna, Austria: 31 August–4 September 2009

Structure of the IAEA Nuclear Energy Series



Key

BP: Basic Principles
O: Objectives
G: Guides
T: Technical Reports
Nos 1-6: Topic designations
#: Guide or Report number (1, 2, 3, 4, etc.)

Examples

NG-G-3.1: Nuclear General (**NG**), Guide, Nuclear Infrastructure and Planning (topic **3**), **#1**
NP-T-5.4: Nuclear Power (**NP**), Report (**T**), Research Reactors (topic **5**), **#4**
NF-T-3.6: Nuclear Fuel (**NF**), Report (**T**), Spent Fuel Management and Reprocessing (topic **3**), **#6**
NW-G-1.1: Radioactive Waste Management and Decommissioning (**NW**), Guide, Radioactive Waste (topic **1**), **#1**

IAEA
International Atomic Energy Agency

No. 23

ORDERING LOCALLY

In the following countries, IAEA priced publications may be purchased from the sources listed below or from major local booksellers.

Orders for unpriced publications should be made directly to the IAEA. The contact details are given at the end of this list.

AUSTRALIA
DA Information Services
648 Whitehorse Road, Mitcham, VIC 3132, AUSTRALIA
Telephone: +61 3 9210 7777 • Fax: +61 3 9210 7788
Email: books@dadirect.com.au • Web site: http://www.dadirect.com.au

BELGIUM
Jean de Lannoy
Avenue du Roi 202, 1190 Brussels, BELGIUM
Telephone: +32 2 5384 308 • Fax: +32 2 5380 841
Email: jean.de.lannoy@euronet.be • Web site: http://www.jean-de-lannoy.be

CANADA
Renouf Publishing Co. Ltd.
5369 Canotek Road, Ottawa, ON K1J 9J3, CANADA
Telephone: +1 613 745 2665 • Fax: +1 643 745 7660
Email: order@renoufbooks.com • Web site: http://www.renoufbooks.com

Bernan Associates
4501 Forbes Blvd., Suite 200, Lanham, MD 20706-4391, USA
Telephone: +1 800 865 3457 • Fax: +1 800 865 3450
Email: orders@bernan.com • Web site: http://www.bernan.com

CZECH REPUBLIC
Suweco CZ, spol. S.r.o.
Klecakova 347, 180 21 Prague 9, CZECH REPUBLIC
Telephone: +420 242 459 202 • Fax: +420 242 459 203
Email: nakup@suweco.cz • Web site: http://www.suweco.cz

FINLAND
Akateeminen Kirjakauppa
PO Box 128 (Keskuskatu 1), 00101 Helsinki, FINLAND
Telephone: +358 9 121 41 • Fax: +358 9 121 4450
Email: akatilaus@akateeminen.com • Web site: http://www.akateeminen.com

FRANCE
Form-Edit
5 rue Janssen, PO Box 25, 75921 Paris CEDEX, FRANCE
Telephone: +33 1 42 01 49 49 • Fax: +33 1 42 01 90 90
Email: fabien.boucard@formedit.fr • Web site: http://www.formedit.fr

Lavoisier SAS
14 rue de Provigny, 94236 Cachan CEDEX, FRANCE
Telephone: +33 1 47 40 67 00 • Fax: +33 1 47 40 67 02
Email: livres@lavoisier.fr • Web site: http://www.lavoisier.fr

L'Appel du livre
99 rue de Charonne, 75011 Paris, FRANCE
Telephone: +33 1 43 07 50 80 • Fax: +33 1 43 07 50 80
Email: livres@appeldulivre.fr • Web site: http://www.appeldulivre.fr

GERMANY
Goethe Buchhandlung Teubig GmbH
Schweitzer Fachinformationen
Willstätterstrasse 15, 40549 Düsseldorf, GERMANY
Telephone: +49 (0) 211 49 8740 • Fax: +49 (0) 211 49 87428
Email: s.dehaan@schweitzer-online.de • Web site: http://www.goethebuch.de

HUNGARY
Librotade Ltd., Book Import
PF 126, 1656 Budapest, HUNGARY
Telephone: +36 1 257 7777 • Fax: +36 1 257 7472
Email: books@librotade.hu • Web site: http://www.librotade.hu

INDIA
Allied Publishers
1st Floor, Dubash House, 15, J.N. Heredi Marg, Ballard Estate, Mumbai 400001, INDIA
Telephone: +91 22 2261 7926/27 • Fax: +91 22 2261 7928
Email: alliedpl@vsnl.com • Web site: http://www.alliedpublishers.com

Bookwell
3/79 Nirankari, Delhi 110009, INDIA
Telephone: +91 11 2760 1283/4536
Email: bkwell@nde.vsnl.net.in • Web site: http://www.bookwellindia.com

ITALY
Libreria Scientifica "AEIOU"
Via Vincenzo Maria Coronelli 6, 20146 Milan, ITALY
Telephone: +39 02 48 95 45 52 • Fax: +39 02 48 95 45 48
Email: info@libreriaaeiou.eu • Web site: http://www.libreriaaeiou.eu

JAPAN
Maruzen Co., Ltd.
1-9-18 Kaigan, Minato-ku, Tokyo 105-0022, JAPAN
Telephone: +81 3 6367 6047 • Fax: +81 3 6367 6160
Email: journal@maruzen.co.jp • Web site: http://maruzen.co.jp

NETHERLANDS
Martinus Nijhoff International
Koraalrood 50, Postbus 1853, 2700 CZ Zoetermeer, NETHERLANDS
Telephone: +31 793 684 400 • Fax: +31 793 615 698
Email: info@nijhoff.nl • Web site: http://www.nijhoff.nl

Swets Information Services Ltd.
PO Box 26, 2300 AA Leiden
Dellaertweg 9b, 2316 WZ Leiden, NETHERLANDS
Telephone: +31 88 4679 387 • Fax: +31 88 4679 388
Email: tbeysens@nl.swets.com • Web site: http://www.swets.com

SLOVENIA
Cankarjeva Zalozba dd
Kopitarjeva 2, 1515 Ljubljana, SLOVENIA
Telephone: +386 1 432 31 44 • Fax: +386 1 230 14 35
Email: import.books@cankarjeva-z.si • Web site: http://www.mladinska.com/cankarjeva_zalozba

SPAIN
Diaz de Santos, S.A.
Librerias Bookshop • Departamento de pedidos
Calle Albasanz 2, esquina Hermanos Garcia Noblejas 21, 28037 Madrid, SPAIN
Telephone: +34 917 43 48 90 • Fax: +34 917 43 4023
Email: compras@diazdesantos.es • Web site: http://www.diazdesantos.es

UNITED KINGDOM
The Stationery Office Ltd. (TSO)
PO Box 29, Norwich, Norfolk, NR3 1PD, UNITED KINGDOM
Telephone: +44 870 600 5552
Email (orders): books.orders@tso.co.uk • (enquiries): book.enquiries@tso.co.uk • Web site: http://www.tso.co.uk

UNITED STATES OF AMERICA
Bernan Associates
4501 Forbes Blvd., Suite 200, Lanham, MD 20706-4391, USA
Telephone: +1 800 865 3457 • Fax: +1 800 865 3450
Email: orders@bernan.com • Web site: http://www.bernan.com

Renouf Publishing Co. Ltd.
812 Proctor Avenue, Ogdensburg, NY 13669, USA
Telephone: +1 888 551 7470 • Fax: +1 888 551 7471
Email: orders@renoufbooks.com • Web site: http://www.renoufbooks.com

United Nations
300 East 42nd Street, IN-919J, New York, NY 1001, USA
Telephone: +1 212 963 8302 • Fax: 1 212 963 3489
Email: publications@un.org • Web site: http://www.unp.un.org

Orders for both priced and unpriced publications may be addressed directly to:

IAEA Publishing Section, Marketing and Sales Unit, International Atomic Energy Agency
Vienna International Centre, PO Box 100, 1400 Vienna, Austria
Telephone: +43 1 2600 22529 or 22488 • Fax: +43 1 2600 29302
Email: sales.publications@iaea.org • Web site: http://www.iaea.org/books

13-49251

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA
ISBN 978–92–0–145210–8
ISSN 1995–7807