# Handbook on Nuclear Law

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IAEA
International Atomic Energy Agency

# HANDBOOK ON NUCLEAR LAW

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# FOREWORD

## by Mohamed ElBaradei
## Director General

The Statute of the IAEA authorizes the IAEA to promote the safe and peaceful uses of nuclear energy. The safe and peaceful use of nuclear energy in any given State can only be assured with the promulgation and implementation of an effective national nuclear legal infrastructure. Over the past three decades the IAEA's Office of Legal Affairs has provided assistance to Member States in the development of their individual national nuclear legal infrastructures.

The demand for legislative assistance has increased dramatically over the past 17 years, both in the area of nuclear safety — due to the adoption of six international legal instruments negotiated, under the auspices of the IAEA, in the wake of the Chernobyl accident — and in the area of non-proliferation — in response to the efforts to strengthen IAEA safeguards through the adoption of the Model Protocol Additional to Safeguards Agreements. The IAEA, its Member States and the public at large share a common interest in encouraging adherence to these instruments and to the establishment of the necessary implementation legislation.

Thus far the IAEA's assistance has taken the form of drafting new nuclear laws and reviewing existing laws and regulations, hosting fellowship trainees, providing advice on institutional frameworks and conducting training courses on specific legal issues. To be truly effective, however, this assistance must be complemented by self-assessments on the part of the States themselves, so that they may ensure that, in drafting new laws covering nuclear activities or in revising or consolidating existing legislation, their national nuclear legal infrastructures are in line with the relevant international undertakings and best practices in the field of nuclear law. This handbook has been developed to facilitate such a self-assessment. It is targeted not only at legislators, government officials, technical experts, lawyers, diplomats and users of nuclear technology, but also at the media and the general public, to assist them in understanding the basic requirements for an adequate nuclear legal infrastructure.

The handbook is an important step forward towards strengthening, in a consistent and coherent manner, the international legal framework governing the safe and peaceful uses of nuclear energy. I thank the authors of the handbook for their efforts in this regard and all those who have assisted in making this publication possible. I hope that the handbook will once again demonstrate the importance of continuing and enhancing the successful implementation of the IAEA's Nuclear Legislative Assistance Programme.

*EDITORIAL NOTE*

*The use of particular designations of countries or territories does not imply any judgement by the publisher, the IAEA, as to the legal status of such countries or territories, of their authorities and institutions or of the delimitation of their boundaries.*

# PREFACE

## Why a handbook on nuclear law?

For many years the IAEA assisted Member States, at their request, in developing their domestic legal arrangements for regulating the peaceful uses of nuclear energy and ionizing radiation, as mandated by the IAEA's Statute. With the expansion of the uses of nuclear techniques in a variety of fields, more States have come to realize that a well structured legal framework is necessary for meeting the technical and management requirements designed to protect public health, safety and the environment. As a result, the IAEA has received an increasing number of requests from Member States for assistance in drafting or reviewing their nuclear laws. For this reason, it was felt that a handbook on nuclear law could be useful in helping legislators, government officials, technical experts, lawyers, diplomats, users of nuclear technology, the media and the public of Member States to understand these requirements.

The primary audience for this handbook is expected to be persons in States with a less developed nuclear legislative framework who may be involved or interested in the development of a new law covering nuclear activities. A secondary audience would be persons in States interested in revising or consolidating existing laws so as to make them more consistent and efficient, or persons wishing to add legislation in a technical area (or technical areas) in which recent activity has revealed a deficiency in legal arrangements. Also, this handbook may be of interest to governments that wish to conform their national legislation to international instruments in the nuclear field. Even States with well developed legal structures may find some benefit in using this handbook as a means of confirming that all necessary legal issues in the nuclear area have been covered, or at least considered, in the framing of their legislation. In addition, it is expected that this handbook will be useful for teaching nuclear law, at academic institutions and in technical assistance programmes of the IAEA and of other relevant bodies, both international and national.

## Why was the handbook written as it was?

Since the primary audience for this handbook is expected to be legislators or other persons in States that are only beginning to develop their national legal frameworks for nuclear regulation, it was judged important to make it a reasonably concise, practical guide, rather than an exhaustive, theoretical text. Thus the handbook does not attempt to cover the enormous range of technical

requirements and rules that are necessary for regulating the many facets of nuclear energy. Neither does this handbook offer model or illustrative texts of nuclear laws. One of the major points made in this handbook is that each State must develop its own legislative framework based on its own situation, including its constitutional and legal framework, cultural traditions, scientific, technical and industrial capacities, and financial and human resources. Legal texts developed by other States can provide useful guides for understanding how some States have resolved issues of legislative drafting. However, such laws must be assessed in light of the drafting State's national conditions and experience, and adjusted accordingly. The IAEA, as part of its Nuclear Legislative Assistance Programme, is prepared to make available samples of national nuclear laws, at the request of Member States.

This handbook endeavours to explain the overall character of nuclear law and the process by which it is developed and applied. This is the subject of Part I (Chapters 1–3), which also contains material relating to institutional arrangements for implementing the law through a regulatory body (or regulatory bodies). Also, this handbook offers a summary overview of a number of areas involving the use of nuclear material or techniques, an attempt being made to identify the key principles and concepts important for the effective regulation of the activity in question. In essence, the material in Chapters 4–14 should be regarded as a checklist of matters that drafters of legislation need to consider for inclusion in national legislation. Where appropriate, this handbook identifies alternative ways in which key issues can be handled.

An important feature of this handbook is its references to technical standards and guidance documents developed by the IAEA. These documents represent an essential resource for drafters of legislation and regulatory officials in the preparation and application of nuclear laws. They reflect the IAEA's long standing and wide ranging process of developing an expert consensus on how technical and management issues in the regulation of a broad spectrum of nuclear related activities can be best handled. They are an indispensable basis for this handbook.

A central message of this handbook is that there is no definitive, single model of how to draft nuclear energy legislation or of which institutional framework can best implement a national nuclear law. That said, it is hoped that this handbook will contribute to the desirable harmonization of national nuclear laws: a process that has received added impetus through the conclusion or refinement of a number of international instruments in various fields (e.g. the safety of civil nuclear power reactors, spent fuel and radioactive waste management safety, nuclear liability and the physical protection of nuclear material). This handbook covers the spectrum of peaceful nuclear activities

being conducted by IAEA Member States. Thus it seeks to be reasonably comprehensive in scope, if not in detailed content.

An important issue in all areas of legislation, but especially in the highly technical field of nuclear law, is the necessity for clear, consistent and accurate terminology. The terms used in this handbook have been derived from the referenced documents and the bibliographies listed at the end of each chapter, which should be consulted as a basis for defining key terms in national legislation.

Finally, it should be noted that, except in the areas of nuclear non-proliferation, safeguards, and export and import controls, this handbook does not touch upon the potential military uses of nuclear energy. Although vitally important, legal issues concerning nuclear arms control and disarmament are left to other forums.

## ACKNOWLEDGEMENTS

The authors of this handbook are acutely aware that they have relied on the work of a very large number of people in shaping this publication. It is not possible to give credit to the many members of the IAEA's Secretariat and the many national experts who have contributed to the development of IAEA technical standards and guidelines over several decades. The documents developed by them form the essential basis for the material contained in this handbook. The support of Director General M. ElBaradei, Legal Adviser J. Rautenbach and former Legal Adviser L. Johnson for this effort has been much appreciated. L. Rockwood and M. de Lourdes Vez-Carmona of the Office of Legal Affairs have also offered valuable suggestions. In addition, we would like to thank M. Davies and J. Denton-MacLennan for editing the text, as well as A. Wetherall and A. Hickey for their indispensable assistance.

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# Part I

# ELEMENTS OF NUCLEAR LAW

# Chapter 1

# NUCLEAR LAW AND THE LEGISLATIVE PROCESS

## 1.1. CONCEPT OF NUCLEAR LAW

The objective of this handbook is to assist States in drafting national legislation that provides an adequate legal basis for pursuing the economic and social benefits of nuclear energy and ionizing radiation. At the outset, therefore, it is important to offer a basic concept of nuclear law. What is nuclear law? How is it different from other aspects of national and international law? What relationship should nuclear law have to other elements of a State's legal infrastructure? Answering these questions could involve a detailed and complex historical and analytical examination of efforts over more than six decades to develop legal norms governing what is a highly complex technology. However, this handbook confines itself to outlining the most basic and fundamental issues that need to be addressed by legislators and others.

### 1.1.1. Risks and benefits

As is well known, nuclear energy poses special risks to the health and safety of persons and to the environment: risks that must be carefully managed. However, nuclear material and technology also hold the promise of significant benefits, in a variety of fields, from medicine and agriculture to electricity production and industry. A human activity that involves only hazards and no benefits calls for a legal regime of prohibition, not regulation. Thus a basic feature of nuclear energy legislation is its dual focus on risks and benefits.

### 1.1.2. National legal hierarchy

It is important to recognize that legal norms for the regulation of nuclear energy are part of a State's general legal system. Nuclear law must take its place within the normal legal hierarchy applicable in most States. This hierarchy consists of several levels. The first, usually referred to as the constitutional level, establishes the basic institutional and legal structure governing all relationships in the State. Immediately below the constitutional level is the statutory level, at which specific laws are enacted by a parliament in order to establish other necessary bodies and to adopt measures relating to the broad range of activities affecting national interests. The third level comprises regulations; that is, detailed and often highly technical rules to control or regulate activities

specified by statutory instruments. Owing to their special character, such rules are typically developed by expert bodies (including bodies designated as regulatory authorities) empowered to oversee specific areas of national interest, and promulgated in accordance with the national legal framework. A fourth level consists of non-mandatory guidance instruments, which contain recommendations designed to assist persons and organizations in meeting the legal requirements.

Depending on which nuclear activities a State decides to sanction, the exploitation of nuclear technology can involve the application of a wide variety of laws primarily relating to other subjects (such as environmental protection, industrial safety, land use planning, administrative procedure, mining, transport, government ethics and electricity rate regulation). In general, deviations from the general framework of national legislation should be accepted only where the special character of an activity warrants special treatment. Therefore, to the extent that a nuclear related activity is adequately covered in other laws, it should not be necessary to promulgate new legislation. However, from the earliest days of its development, nuclear energy has been considered to require special legal arrangements in order to ensure that it is properly managed.

## 1.2. DEFINITION OF NUCLEAR LAW

In the light of these basic factors, nuclear law can be defined as:

**The body of special legal norms created to regulate the conduct of legal or natural persons engaged in activities related to fissionable materials, ionizing radiation and exposure to natural sources of radiation.**

This definition comprises four key elements. First, as a body of special legal norms, nuclear law is recognized as a part of general national legislation, while at the same time comprising different rules required by the special nature of the technology. Second, the element of regulation incorporates the risk–benefit approach that is central to managing activities that present both hazards and advantages for social and economic development. Third, as with all legal regimes, the special legal norms relate to the conduct of legal persons, including commercial, academic, scientific and governmental entities, as well as of individuals. The fourth element focuses on radioactivity (produced through the use of fissionable material or ionizing radiation) as the defining feature justifying a special legal regime.

## 1.3. OBJECTIVE OF NUCLEAR LAW

Before attempting to identify which special aspects of nuclear law distinguish it from other types of law, it is important to highlight briefly the fundamental reason why a State would decide to make the major effort necessary in order to promulgate such legislation. Simply stated, the primary objective of nuclear law is:

> **To provide a legal framework for conducting activities related to nuclear energy and ionizing radiation in a manner which adequately protects individuals, property and the environment.**

In light of this objective, it is particularly important that responsible authorities carefully assess their current nuclear energy activities and their plans for future nuclear energy development so that the legislation ultimately adopted is adequate.

## 1.4. PRINCIPLES OF NUCLEAR LAW

What are the characteristics of nuclear law that distinguish it from the other aspects of national law? A number of basic concepts, often expressed as fundamental principles, can be mentioned in this regard:

(a) The safety principle;
(b) The security principle;
(c) The responsibility principle;
(d) The permission principle;
(e) The continuous control principle;
(f) The compensation principle;
(g) The sustainable development principle;
(h) The compliance principle;
(i) The independence principle;
(j) The transparency principle;
(k) The international co-operation principle.

### 1.4.1. Safety principle

Numerous national laws, international instruments, regulatory documents and expert commentaries have emphasized that safety is the primary requisite for the use of nuclear energy and the applications of ionizing radiation. In

discussions on nuclear safety, a number of subsidiary principles have been articulated. One such principle has been labelled the 'prevention principle'. It holds that, given the special character of the risks of using nuclear energy, the primary objective of nuclear law is to promote the exercise of caution and foresight so as to prevent damage that might be caused by the use of the technology and to minimize any adverse effects resulting from misuse or from accidents. A complementary principle is the 'protection principle'. The fundamental purpose of any regulatory regime is to balance social risks and benefits. Where the risks associated with an activity are found to outweigh the benefits, priority must be given to protecting public health, safety, security and the environment. Of course, in the event that a balance cannot be achieved, the rules of nuclear law should require action favouring protection. It is in this context that the concept commonly referred to as the 'precautionary principle' (i.e. the concept of preventing foreseeable harm) should be understood.

In applying these related and overlapping safety concepts, it is always important to return to the fundamental requirement that both the risks and the benefits of nuclear energy be well understood and taken into account with a view to achieving a sensible balance in the framing of legal or regulatory measures. Fundamental safety principles codified in legislation may be applied to a wide variety of activities and facilities that pose very different types and levels of risk. Activities posing significant radiation hazards will obviously require stringent technical safety measures and, in parallel, strict legal arrangements. Activities posing little or no radiation hazard will need only elementary technical safety measures, with limited legal controls. The law should reflect the hierarchy of risk. Indeed, legal restrictions that cannot be justified by the risk posed by a certain activity may be deemed an undue limitation on the rights of the persons or organizations conducting that activity.

### 1.4.2. Security principle

In developing a legislative framework for peaceful nuclear activities, it may be useful to recall that the modern development of nuclear technology had its origins in the military programmes of several States. Just as certain nuclear material and technologies pose health and safety risks if diverted to non-peaceful ends, they also pose risks to the security of persons and social institutions. Lost or abandoned radiation sources can cause physical injury to persons unaware of the associated hazards. The acquisition of radiation sources by terrorist or criminal groups could lead to the production of radiation dispersion devices, to be used to commit malevolent acts. The diversion of certain types of nuclear material could contribute to the spread of nuclear explosives to both subnational and national entities. For these reasons, special

legal measures are required to protect and account for the types and quantities of nuclear material that may pose security risks. These measures must protect against both accidental and intentional diversion from the legitimate uses of these materials and technologies.

Several chapters of this handbook describe the kinds of legal measures that are necessary for the practical implementation of the security principle. Of special relevance is Chapter 14, Physical Protection. Also relevant are: Chapter 7, Emergency Preparedness and Response; Chapter 9, Transport of Radioactive Material; Chapter 12, Safeguards; and Chapter 13, Export and Import Controls.

### 1.4.3. Responsibility principle

The use of nuclear energy typically involves numerous parties, such as research and development organizations, processors of nuclear material, manufacturers of nuclear devices or sources of ionizing radiation, medical practitioners, architect–engineering firms, construction companies, operators of nuclear installations, financial institutions and regulatory bodies. With so many parties potentially engaged in a nuclear related activity, a question that arises is: "Who is primarily responsible for ensuring safety?" In a sense, of course, all entities having some control over a nuclear related activity bear at least part of the responsibility for safety. However, the entity that has been consistently identified as primarily responsible is the operator or licensee who has been granted the authority to conduct specific activities related to nuclear energy or ionizing radiation. As is discussed in Chapter 11, legal arrangements have been developed under which a part or all the financial liability for the damage that could result from nuclear related activities may be assigned (or 'channelled') to different parties. However, the starting point for such arrangements is the fundamental principle that the operator or licensee should bear the burden of ensuring that its activities meet the applicable safety, security and environmental protection requirements.

### 1.4.4. Permission principle

In most national legal systems, activities not specifically prohibited by law are considered to be free for persons to undertake without official authorization. Only if an activity poses an identifiable risk of injury to persons or to the environment is it appropriate for the law to require that prior permission be obtained before a person can conduct that activity. As a consequence of the special risks associated with nuclear technology, nuclear law normally requires that prior permission be obtained for activities involving fissionable material and radioisotopes. Various terms have been used for such

permission, including 'authorization', 'licence', 'permit', 'certificate' or 'approval'. In applying the permission principle, it is important for the law to identify clearly those activities or facilities that require an authorization, and those that do not. In cases in which the regulatory body has found that the risks associated with an activity are so low as to be below regulatory concern, a specific authorization may not be required. In such cases a general authorization can be issued in the form of an exemption set forth in a public document or in announcements. However, the regulatory authority always retains the ability to revoke such general authorizations if information comes to light suggesting that the risks of the activity are excessive. It must also be borne in mind that the issuance of an authorization to conduct a nuclear related activity can and typically does have practical and legal implications for third parties. For example, the rights of persons living in the vicinity of a proposed nuclear power plant could be affected by the issuance of a licence to construct the installation.

### 1.4.5. Continuous control principle

Even in circumstances in which an authorization (typically in the form of a licence) has been granted to conduct certain activities, the regulator must retain a continuing ability to monitor those activities so as to be sure that they are being conducted safely and securely and in accordance with the terms of the authorization. This principle means that national nuclear legislation must provide for free access by regulatory inspectors to all premises where nuclear material is being used and stored.

### 1.4.6. Compensation principle

Depending on various technical factors, the use of nuclear energy poses the risk of major damage to persons, property and the environment. As preventive measures cannot completely exclude the potential for such damage, nuclear law requires that States adopt measures to provide adequate compensation in the event of a nuclear accident. The special character of the arrangements in question is discussed in Chapter 11.

### 1.4.7. Sustainable development principle

A number of instruments in the field of environmental law have identified a duty for each generation not to impose undue burdens on future generations. The principle in question is that economic and social development can be 'sustainable' only if the world's environment is protected from

degradation. It has particular applicability in the nuclear field, because some fissile material and sources of ionizing radiation can pose health, safety and environmental risks for very long periods of time. However, the very long lived character of these materials has made it difficult to determine which current measures are necessary in order to protect generations adequately in the very remote and unpredictable future. One approach in applying the sustainable development principle in the nuclear field has been to urge that the current generation does whatever is possible for long term safety, but without foreclosing options for future generations and without relying unduly on long term forecasts, which are unlikely to be accurate over the extended timescales involved.

### 1.4.8. Compliance principle

Although many human activities taking place within the territory of a State can result in damage beyond its borders, nuclear energy has been deemed to involve particular risks of radiological contamination transcending national boundaries. Both regionally and globally, bilateral and multilateral instruments are building an international law of nuclear energy. To the extent that a State has adhered to the international legal regimes in question, national nuclear law must reflect the obligations that they contain. Furthermore, a principle of customary international law has emerged to the effect that the territory of a State must not be used in such a way as to cause damage in another State and that, consequently, control measures are necessary. In States in which national law automatically adopts treaties to which those States have adhered as self-executing, no separate legislation may be needed. In many other States, however, compliance with international obligations requires additional legislative action.

### 1.4.9. Independence principle

Chapter 2 discusses the role of the national nuclear regulatory authority in the control of nuclear energy. At this point it is sufficient to note that nuclear law places particular emphasis on the establishment of a regulatory authority, whose decisions on safety issues are not subject to interference from entities involved in the development or promotion of nuclear energy. Given the significant risks associated with nuclear technology, other interests must defer to the regulator's independent and expert judgement when safety is involved.

### 1.4.10. Transparency principle

Nuclear energy saw much of its early development in military programmes originating in the Second World War. At that time, and for a substantial period afterwards, information concerning nuclear material and technology was considered highly sensitive and was treated by governments as confidential. With the development of the peaceful uses of nuclear energy, however, public understanding of and confidence in the technology have required that the public, the media, legislatures and other interested bodies be provided with the fullest possible information concerning the risks and benefits of using various nuclear related techniques for economic and social development. The transparency principle requires that bodies involved in the development, use and regulation of nuclear energy make available all relevant information concerning how nuclear energy is being used, particularly concerning incidents and abnormal occurrences that could have an impact on public health, safety and the environment.

### 1.4.11. International co-operation principle

A final principle relates to the need for the users of nuclear techniques and the regulators of nuclear activities to maintain close relationships with counterparts in other States and in relevant international organizations. The international dimension of nuclear energy is based on several factors. First, in the area of safety and the environment, the potential for transboundary impacts requires governments to harmonize policies and develop co-operative programmes so as to reduce the risks of damage to their citizens and territories, the global population and indeed to the planet as a whole. Also, lessons learned in one State about how to enhance safety can be highly relevant to improving the situation in other States. It is vital to achieving improvements in the safety of nuclear activities and facilities worldwide that such lessons be promptly and widely shared. Second, the use of nuclear material involves security risks that do not respect national borders. Threats of terrorist acts and the threats associated with illicit trafficking in nuclear material and the proliferation of nuclear explosives have long been recognized as matters requiring a high level of international co-operation. Third, a large number of international legal instruments have been promulgated to codify the obligations of States in the nuclear field. Not only must governments comply in good faith with those obligations, but the terms of those instruments may limit the discretion of legislators in framing national legislation concerning some matters covered by them. Fourth, the increasingly multinational character of the nuclear industry, with frequent movements of nuclear material and equipment across national

borders, makes effective control dependent on parallel and joint approaches by both public and private entities. For all these reasons, national nuclear energy legislation should make adequate provision for encouraging public bodies and private users of nuclear energy to participate in relevant international activities in the nuclear field.

## 1.5. LEGISLATIVE PROCESS FOR NUCLEAR LAW

The processes of drafting national legislation establishing or revising a legal framework for the development and use of nuclear technology and the use of nuclear material are not significantly different from the process of lawmaking in any other field of national interest. Nuclear energy legislation, like any other legislation, must comply with the constitutional and institutional requirements of each State's political and legal system. However, the subject of nuclear energy is highly complex and technical, with some activities and materials posing unusual risks to human health, safety and the environment, and also national and international security risks. As a result, an extremely detailed and complex body of technical elements has been elaborated to ensure that nuclear related activities can be conducted in a safe, secure and environmentally acceptable manner. These technical elements comprise general principles, mandatory requirements or rules, non-binding guidelines or recommendations and informal practices. They cover a wide variety of technical areas, from nuclear power generation to the use of sealed radioactive sources in medicine, industry and agriculture. In addition, a growing structure of international treaty obligations and accepted rules of 'best practice' has been developed, providing opportunities for governments to harmonize their State's laws with the laws of other States, thereby contributing to the more efficient and consistent handling of matters of concern to the global community.

Faced with a broad spectrum of technical rules, how should the legislator approach the task of making them binding on the entities involved in the uses of nuclear energy, including individual persons, private commercial enterprises, academic institutions, professional organizations and governmental bodies? It is clearly undesirable, if not impossible, to incorporate even a small number of them into national law. Doing so would result in extremely long texts, unintelligible to most persons. Also, it might hamper safety related progress by imposing inflexible constraints on the application of useful advances in science, technology, management and regulation. In addition, technical rules do not always have general applicability (even in the nuclear field); they may apply only to a specific activity or facility, with adjustments based on its particular

characteristics and risks. As a matter of good practice in drafting legislation, laws should normally be framed in such a manner as to reflect generally applicable requirements covering a broad area of public interest.

Technical rules need to be assessed in order to determine whether they are of general importance or whether they focus on particular types of activities or facilities. The first category of technical rules should be codified in laws of general applicability. The second category of requirements is more appropriately dealt with at a lower level in the national legal hierarchy. This approach has the advantage of giving competent authorities the flexibility necessary in order to revise requirements in response to new developments without amending the law. The lower level technical rules may be made effective in a number of ways. For example, some States may prefer to adopt them as administrative directives requiring the competent governmental authority to apply them to persons engaged in relevant nuclear related activities, while other States may prefer to adopt them as non-binding guidelines or recommendations developed by private expert bodies. Also, specific technical rules can be made binding on persons or organizations using nuclear energy by making compliance with them a condition for receiving permission in the form of a licence, permit or other type of authorization.

In summary, the technical measures for safety, security and environmental protection in the nuclear field should take the form of:

(a) Basic principles adopted as generally applicable law and binding on all persons and organizations;
(b) Technical requirements (including regulations, guidelines and recommendations) that are not generally applicable and are made binding on specific persons or organizations by the regulatory authority or through specific licence conditions, binding only on the licence holder.

Sections 1.5.1–1.5.10 outline some elements and approaches that governments may wish to consider in developing their nuclear laws.

### 1.5.1. Assessment of nuclear programmes and plans

Whether a State is creating a framework for nuclear legislation or revising an existing framework, or merely updating one aspect of its nuclear legislation, the first step in the process should be an assessment of current and expected programmes and plans involving the use of nuclear techniques and material. Some States conduct activities across the full spectrum of nuclear technology applications, including nuclear power generation. Others only use radiation sources in medicine, agriculture and industry. Still others only engage in the

mining of uranium or thorium for export. Some States have decided not to make use of certain nuclear technologies, but need to establish legal arrangements for the possible transit of nuclear material or other radiation sources through their territories. Finally, some States are concerned about possible nuclear related activities in neighbouring States that may warrant co-operative arrangements or emergency planning for radiological events.

Whichever body is charged with conducting the assessment (whether a governmental body, a legislative committee or an independent panel of experts), the body should go beyond current and expected programmes and consider programmes that could emerge at some time in a rapidly changing global economy. It is always better to provide advance legislative guidance on how a particular area of nuclear related activity should be regulated (even if the guidance has to be revised later) than to leave that area without any regulatory requirements. Totally unregulated nuclear related activities, even if conducted in good faith, may raise health, safety, environmental or economic problems. Imposing rules after damage has been done or liabilities incurred is a very unsatisfactory approach. To the extent practicable, therefore, drafters of legislation should make the national regulatory arrangements for the conduct of nuclear related activities broad in scope.

Furthermore, it is not sufficient merely to assess alternatives or options that might be of interest. Governments must be prepared to make firm decisions on the scope and character of the type of nuclear energy development that they wish to support. Such decisions require a clear expression of national policy, something that may involve protracted debate and the adjustment of views. Some activities may generate considerable political involvement, while others may be totally non-controversial. A State's policy regarding nuclear energy development can take a variety of forms; however, three approaches are typical. First, a government may actively affirm the desirability of the broadest exploitation of nuclear material and techniques by adopting a 'promotional' policy involving, for example, support for research and development, financial assistance, and the streamlining of administrative and regulatory procedures. A second, contrasting approach is the discouragement or even the preclusion of nuclear energy development through legislative prohibitions, the withholding of financial resources for nuclear related projects and the imposition of burdensome administrative and regulatory requirements. Most States have adopted an approach somewhere between these two extremes. This neutral approach relies primarily on business judgements arrived at by private commercial entities and on the normal regulatory process. Each government, through its own legal policy making processes, will determine which of these approaches, or which variation of one of them, best meets the State's interests.

### 1.5.2. Assessment of laws and the regulatory framework

As a complement to the assessment of current and expected programmes mentioned above, new nuclear legislation would do well to include a comprehensive assessment of the status of all laws and regulatory arrangements relevant to nuclear energy. This task may not be a straightforward one. In most national legal systems, many provisions not specifically directed towards nuclear related activities can have an important bearing on how such activities are conducted. In addition to general environmental laws, legislation concerning economic matters (e.g. taxation, liability, regulatory fees, monetary penalties and the setting of electricity rates), worker health and safety, criminal enforcement, land use planning, international trade and customs, scientific research, and many other areas, may impinge on enterprises engaged in nuclear related activities. Furthermore, most States already have some laws applicable to nuclear energy and regulatory bodies that deal with nuclear matters. If a conscientious assessment determines that these laws and bodies are adequate for regulating the State's current and planned nuclear related activities, there should be no reason to alter them.

Of the many issues to be examined in an assessment of a State's nuclear law, the following are the most important:

(a) Does the current legislation make it clear that public health, safety, security and the environment are overriding considerations in the use of nuclear techniques and material?
(b) Are there major gaps or overlaps in the legal structure regarding the treatment of nuclear related activities or material, both those currently being conducted or used and those that can reasonably be expected?
(c) Have the most important terms used in the legislation been given clear and consistent definitions in the statutory documents? Does the use of different terms and definitions, or a failure to define certain terms, produce confusion about how nuclear related activities are to be regulated?
(d) Are the institutional responsibilities for regulating nuclear related activities clear and consistent, permitting efficient regulation without delays and bureaucratic conflicts?
(e) Does the present regulatory system involve unnecessary financial or administrative burdens on regulated entities or regulatory agencies that could be reduced in order to improve efficiency?
(f) Does the present system fully comply with the State's international legal obligations and reflect international best practice, as described in safety standards documents (such as the International Basic Safety Standards

for Protection against Ionizing Radiation and for the Safety of Radiation Sources (the Basic Safety Standards) [1]) promulgated by the IAEA or other relevant multinational bodies?

Without an assessment covering at least the issues above, an effort to draft new or revise current legislation involves a real risk of making a State's nuclear legislation more confusing, inefficient and less effective.

### 1.5.3. Input from stakeholders

A very important step in the development of nuclear legislation is to obtain a clear perspective on how a new or revised regulatory law could affect persons and institutions having an interest in the nuclear field (stakeholders). Perhaps equally important, it is necessary to understand how stakeholders believe they will be affected. In the nuclear field, perceptions may well be as important as reality.

Owing to the differing views on who has a genuine interest in a particular nuclear related activity, no authoritative definition of stakeholder has yet been offered, and no definition is likely to be accepted by all parties. However, stakeholders have typically included the following: the regulated industry or professionals; scientific bodies; governmental agencies (local, regional and national) whose responsibilities arguably cover nuclear energy; the media; the public (individuals, community groups and interest groups); and other States (especially neighbouring States that have entered into agreements providing for an exchange of information concerning possible transboundary impacts, or States involved in the export or import of certain technologies or material).

Stakeholder input can be obtained in various ways and at various stages of the legislative process. Depending on the culture and practices in a particular State, it is often wise to involve stakeholders early and at each stage of the process. For example, stakeholder input can be sought in making the assessments of programmes and laws discussed above. Also, in many States stakeholders have a right to provide input at some stage. Input can be in the form of written submissions or presentations to governmental agencies, legislative committees or special commissions, regardless of the entities making the assessment. Sometimes it is useful to prepare a document to which stakeholders can react; such a document helps focus comments, which otherwise might range widely over subjects of marginal relevance. However, comments made in response to a general request for views can be valuable, even if they require a greater review effort by the entities making the assessment.

### 1.5.4. Initial legislative drafting

Having reviewed the assessment results and any preliminary stakeholder input, the responsible party (whether a governmental body, a legislative committee or an independent panel of experts) will be in a position to prepare an initial draft of legislation. An important issue at the outset is whether the legislation will cover all aspects of nuclear energy, or whether it will cover different aspects in a number of separate laws. Other fields of law are bound to be affected by comprehensive regulation.

There is no uniform approach to this issue. Some States opt for a comprehensive Nuclear Energy Act, complemented by a set of regulations. Other States prefer to enact separate laws for the various fields to be covered, which also need to be complemented by regulations.

When considering this issue, legislators need to take into account national legal traditions. In States with a tradition of comprehensive regulation, for example, legislators may prefer to incorporate the nuclear legislation into, for example, the existing environmental protection legislation.

The manner in which States organize their nuclear legislation is not of overriding importance. What is important, however, is that the legislation be transparent, and clearly understandable, with easy access to relevant provisions both for stakeholders and the general public. This argues against the piecemeal addition of provisions to laws and regulations covering related fields. If, for example, the licensing procedures for nuclear power plants, for research reactors and for other nuclear facilities are set out as amendments to different laws, the objectives of transparency, clarity and easy access cannot be achieved.

Given these considerations, many States have found it convenient to adopt a single comprehensive nuclear law covering all the subjects addressed in this handbook.

The comprehensive law approach does not mean that certain nuclear related matters not central to nuclear safety may not be handled in separate legislation. If certain subjects (e.g. worker protection or waste disposal) are effectively and consistently treated under separate legislation, it would not be either necessary or efficient to include these matters in specific nuclear legislation. Special regulations on taxation should be inserted into a general tax law, criminal law provisions should be part of a criminal code and mining regulations should be part of a general mining law.

A number of States split the areas to be covered by nuclear legislation into two major parts, the first dealing with the prevention of accidents and incidents through, for example, licensing and control mechanisms, and the second dealing with nuclear liability. This two part approach is certainly

reasonable, although there is the minor drawback that the two parts may lose their mutual consistency if they are amended at different times.

Safeguards and export and import control provisions may also warrant special legislation for insertion into foreign trade legislation, as they differ substantially from the safety and liability provisions of nuclear legislation.

Later chapters in this handbook describe the fundamental elements that should be considered for inclusion in national legislation regulating various nuclear related activities. However, one structure for a comprehensive nuclear law that may provide useful guidance is:

(a) Title of law.
(b) Table of contents:
  I: Objectives of the law;
  II: Scope of the law;
  III: Definitions of key terms;
  IV: The regulatory authority;
  V: Authorizations (licences, permits, etc.);
  VI: Responsibilities of licensees, operators, users;
  VII: Inspection;
  VIII: Enforcement.
(c) Section IX to *X*: specific requirements (for each subject area, for example radiation protection, radioactive material and radiation sources, the safety of nuclear installations, emergency preparedness and response, mining and milling, transport, radioactive waste and spent fuel, nuclear liability and coverage, safeguards, export and import controls, and physical protection).
(d) Section *X*: final clauses (amendment, repeals of earlier laws, etc.).

The drafters of an initial legislative proposal should:

(a) Identify the key terms that require precise definition in a separate section;
(b) Clearly assign institutional responsibility for each regulated activity, in order to avoid confusion;
(c) Ensure that the legislative language is sufficiently clear about which activities are covered and which procedures must be followed in order to comply with the law;
(d) Ensure that the legislation contains clear provisions for dealing with disagreements and with violations of regulations (e.g. conflicts of jurisdiction between agencies, appeals by operators against regulatory decisions and the punishment of wilful violators of regulations);

(e) Ensure that the legislation makes it clear how the financial costs of various activities will be met (e.g. through general tax revenues, licence fees or financial penalties for violations);
(f) Ensure that the legislation provides for adequate involvement in the regulatory process of stakeholders (including local communities and, where transboundary issues may arise, neighbouring States);
(g) Ensure that the legislation contains provisions giving regulators the flexibility necessary in order to adjust to technological, social and economic changes;
(h) Ensure that the legislation contains provisions for the orderly implementation of new or revised arrangements (e.g. a delay period before entry into force or phasing in over an extended period);
(i) Ensure that the legislation contains provisions for the treatment of activities being carried out and facilities being operated in accordance with earlier standards (e.g. the exemption of certain activities and facilities from certain requirements (grandfathering)).

There may be other equally important things that the drafters of an initial legislation proposal should do, but a general handbook like this one cannot mention them all. However, the Secretariat of the IAEA is prepared, upon request, to conduct reviews of the draft nuclear legislation of Member States and to make suggestions for improving it (on a confidential basis, if so desired). Such reviews focus on whether the draft is consistent with relevant international legal instruments and with international best practice, as reflected in relevant IAEA safety standards. The IAEA's Secretariat is also ready to provide samples that have been adopted in various States and which provide an adequate legal framework for the regulation of nuclear energy.

### 1.5.5. First review of the initial draft

After the preparation of a reasonably detailed initial draft, many governments have found it useful to subject the draft to a review, in order to assess its adequacy and public acceptability. Here again, some form of stakeholder input can be useful, for example comments made in writing within a specified period or statements made at hearings conducted by a governmental agency or a legislative body.

### 1.5.6. Further legislative consideration

At this stage, national constitutional practice normally dictates how the legislative proposal will be handled; only a few points are emphasized here.

Throughout the legislative process, which may be long and complex, relevant expertise in nuclear technology and nuclear law needs to be available to the drafters of legislation. It is not always self-evident that terms having a precise special meaning within the nuclear energy community should be preferred to terms more familiar to the layperson (or vice versa). Efforts to make legislation less complex and more user friendly are to be applauded. However, changes in nuclear terminology can lead to uncertainty on how an activity is to be regulated. Also, drafters of legislation who are not nuclear energy specialists must consider the scientific validity and practicability of suggestions that other persons may make with a view to enhancing nuclear safety. Nuclear technology has proponents and opponents who hold strong views. Drafters of legislation need to bear in mind how proposed 'improvements' will affect nuclear energy development and to seek balance and objectivity.

### 1.5.7. Legislative oversight

Too often, after a difficult and contentious effort to enact nuclear legislation has been concluded, the legislative body moves on to other matters and fails to monitor the practical impact of its lawmaking. Many States have established mechanisms for helping determine whether a law is being implemented in a manner consistent with its objectives. Regulatory authorities and the users of nuclear energy must, of course, be given a reasonable opportunity to conduct their activities without disruptive interference. However, legislation containing reasonable provisions for reporting on implementation can help to maintain confidence in the regulatory process. Annual reports by regulatory authorities are a common mechanism in this regard, and it may be useful for the legislature to specify which matters should be covered in such reports.

### 1.5.8. Relationship to non-nuclear laws

When nuclear legislation is being drafted, legislators must consider the impact that national legal requirements in non-nuclear fields may have on achieving the objectives of the legislation. Those national legal requirements may derive from an enormous range of laws. In the case of nuclear installations, for example, a minimum list of related laws could well include laws relating to:

(a) Local land use controls;
(b) Environmental matters (e.g. air and water quality and wildlife protection);
(c) The economic regulation of electric power utilities;
(d) The occupational health and safety of workers;

(e) General administrative procedures of governmental bodies;
(f) Transport;
(g) The export and import of nuclear material;
(h) Intellectual property rights;
(i) Liability for non-nuclear damage;
(j) Emergency management;
(k) Taxation.

A thorough understanding of relationships is necessary, of course, in order to avoid conflicts and confusion in the application of laws. Another aspect, however, is the avoidance of duplication in the handling of issues within the national legal framework. If an issue is being handled adequately and if the existing legislation can be expected to deal effectively and efficiently with issues that may arise out of planned nuclear related activities, separate nuclear legislation is not needed. Legislative restraint may sometimes be as appropriate as legislative activism in the case of nuclear related activities.

### 1.5.9. Reflecting international conventions or treaties in national legislation

As noted above, a large number of international instruments (e.g. conventions and treaties) have been developed to cover specific nuclear related subjects. Adherence to these instruments has both an external and an internal aspect. As a matter of international law, States that take the necessary steps under their national laws to approve (or ratify) such an instrument are then bound by the obligations arising out of that instrument in their relations with other States Parties (assuming that the instrument has entered into force).

In addition, such States need to establish legal arrangements for implementing those obligations internally. There are two basic approaches to internal implementation. Most States require that the provisions of international instruments be adopted as separate national law. This approach is reflected in Article 4 of the Convention on Nuclear Safety [2], which states that:

> "Each Contracting Party shall take, within the framework of its national law, the legislative, regulatory and administrative measures and other steps necessary to implement its obligations under this Convention."

It normally involves, first, the translation of the international instrument into the national language and, second, the organization of key provisions in a manner consistent with the national legal framework. This makes the obligations easier to implement internally.

The second approach to internal implementation does not require the second step. The constitutional arrangements in some States make international agreements concluded in a manner consistent with national law a part of those States' legal frameworks, without further legislative action; the international instruments are deemed to be 'self-executing'. Even in such cases, however, it is important to translate the agreement into the national language and to publish the resulting text in the relevant compilation of national legal instruments, so as to give all affected Parties adequate notice of the requirements of the international instrument.

Some international instruments contain provisions that are not intended to be internationally binding. However, States may wish those provisions to be internally binding. In such cases, a State will need to adopt them as laws through its normal legislative procedures.

### 1.5.10. Incorporating international guidance documents or foreign law provisions into national legislation

For drafters of legislation unfamiliar with nuclear law and nuclear technology, a tempting approach in preparing national nuclear legislation is merely to incorporate into it the language of safety standards or guidelines developed by international organizations (primarily the IAEA) or the text of laws adopted by States with highly developed legal frameworks. This approach is tempting for a number of reasons. First, it reduces the amount of totally new legal texts that must be drafted. Second, it takes advantage of the technical or legal expertise of experienced organizations or States. Third, in the case of the incorporation of IAEA safety standards, it can help a State receive IAEA technical assistance to comply with the requirements of the IAEA.

However, these advantages are accompanied by difficulties that warrant careful consideration.

One difficulty concerns whether and how international or foreign requirements will fit into a State's legal structure. In some States, constitutional provisions prohibit the incorporation of external requirements (and even of references to them) into national law, particularly if those requirements have not been translated into the national language. Moreover, if a State's constitution permits incorporation, either directly or by reference, questions of application may nevertheless arise. For example, standards or guidelines prepared elsewhere may contain provisions that are inconsistent with or contradictory to important features of a State's legal structure. It is often difficult to identify the inconsistencies or contradictions without a thorough understanding of their implications, something that may not be evident to a drafter of legislation with only a limited background in nuclear matters.

Another question that may arise is that of translation. Foreign terms relating to nuclear energy that are not translated may be meaningless or confusing to persons expected to apply the national law or to comply with it. Therefore, even if external requirements are considered to be a good basis for a State's own requirements, experience suggests that they should be translated into the national language.

A second difficulty is that the documents containing external requirements may not be readily available, either to the national regulatory authorities or to licence applicants and licensees. For this reason, if it is decided to incorporate external requirements, they should be reproduced in a convenient form.

A third difficulty arises from the fact that the external requirements (e.g. international instruments) may be subject to change, sometimes on a regular basis. If they are changed, a State that has incorporated them into its national legislation faces the problem of how the changes, which may have been made without its participation, are to be handled. In many States, revising a national law can be a lengthy and laborious process. Furthermore, regulatory authorities and licensees cannot be expected to comply with changes they have not been informed about.

There are a number of methods for dealing with requirements derived from international or foreign sources. A common method is the adoption of legislation creating the basis for rules and regulations in the relevant area and authorizing the regulatory authority to adopt external requirements as binding rules or regulations. A second method (often used for requirements relating to quantities or activity levels of radioactive material) is to spell out the requirements in technical appendices or annexes to the law. If this is authorized in the legislation, these technical appendices or annexes can then be revised through an administrative procedure that does not require amendment of the law. A third method would be for the national law to authorize the regulatory authority to apply external requirements directly as licence conditions binding on a licensee.

## 1.6. SECURITY CULTURE AND SAFETY CULTURE IN NUCLEAR LAW

As has been discussed, the enactment of a national legislative framework covering the use of nuclear energy and ionizing radiation is a vital element in establishing the institutions and rules necessary for the safe management of these technologies. However, at the end of this discussion it is important to emphasize that laws alone, however well drafted, cannot ensure nuclear safety

and security, which are two complex goals with many facets: technical, legal, administrative, institutional, economic, social, political, informational, and even ethical and psychological. A useful concept in understanding this connection is the nuclear security and safety culture, defined as:

> **That assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance.**

Although nuclear law cannot itself create a nuclear safety culture, poor legal arrangements can impede the development and strengthening of a nuclear safety culture. Conversely, a strong legal framework can enhance a nuclear safety culture, for example by helping to ensure that the necessary regulatory resources are available, by facilitating transparent communications, by helping to avoid institutional conflicts and by ensuring that independent technical judgements are not blocked for extraneous reasons. During the development of national nuclear legislation, the participants in the legislative process would do well to consider carefully the issues associated with nuclear safety culture (e.g. by consulting Ref. [3]). In conclusion, it is important to recognize that legal measures for enhancing nuclear safety culture and security in a particular State must also take into account that State's national legal traditions.

# Chapter 2

# THE REGULATORY BODY

## 2.1. DESIGNATING THE REGULATORY BODY

A fundamental element of an acceptable national framework for the development of nuclear energy is the creation or maintenance of a regulatory body (or regulatory bodies) with the legal powers and technical competence necessary in order to ensure that operators of nuclear facilities and users of nuclear material and ionizing radiation operate and use them safely and securely. The central consideration in structuring a regulatory body is that it should possess the attributes necessary for correctly applying the national laws and regulations designed to protect public health, safety and the environment.

The regulatory body should be structured in such a way as to ensure that it is capable of discharging its responsibilities and carrying out its functions effectively, efficiently and independently. Several options exist: no single option is the most suitable for all States. Determining the best structure for a particular State requires a careful evaluation of many factors, including: the nature of the national legal infrastructure; the State's cultural attitudes and traditions; the existing governmental organization and procedures; and the technical, financial and human resources available in that State. In addition, the regulatory body needs a structure and size commensurate with the extent and nature of the facilities and activities it must regulate. Furthermore, it is important that the nuclear law contains provisions that ensure that the regulatory body is provided with adequate personnel, financing, office quarters, information technology, support services and other resources.

If the regulatory body consists of more than one authority, the law should prescribe arrangements that ensure that regulatory responsibilities and functions are clearly defined and co-ordinated, so as to avoid any omissions or unnecessary duplication and to prevent conflicting requirements being placed on the operator or licensee. If the regulatory body is not entirely self-sufficient in the technical or the functional area and consequently cannot discharge its review and assessment, licensing, inspection or enforcement responsibilities, the law should enable it to seek advice or assistance from outside sources. When such external advice or assistance is provided (e.g. by a dedicated support organization, by universities, by scientific institutes or by consultants), arrangements should be made to ensure that those providing it are effectively independent of the operator or licensee. It must be emphasized that receiving

external advice or assistance does not relieve the regulatory body of its responsibility for decision making.

## 2.2. INDEPENDENCE AND SEPARATION OF REGULATORY FUNCTIONS

One of the most important attributes of a regulatory body is its freedom from unwarranted interference in its regulatory functions; this concept has been developed in a number of IAEA documents (e.g. Ref. [4]) and in relevant international conventions (e.g. the Convention on Nuclear Safety [2] and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the Joint Convention) [5]). Article 8.2 of the Convention on Nuclear Safety [2] states that:

> "Each Contracting Party shall take the appropriate steps to ensure *an effective separation* [emphasis added] between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy."

It is understood that "any other body or organization" includes private and commercial entities. Article 20.2 of the Joint Convention [5] states that:

> "Each Contracting Party… shall take the appropriate steps to ensure *the effective independence of the regulatory functions* [emphasis added] from other functions where organizations are involved in both spent fuel or radioactive waste management and in their regulation."

No single approach can ensure effective independence and separation of the functions of the regulatory bodies in all States. An essential first step in determining the best approach is a careful assessment of the regulatory body's independence of judgement and decision making in the safety area. A sound regulatory structure presupposes legislation covering both the powers and capabilities of the regulatory body and also its relationships with other governmental bodies, the regulated industry and the public.

The first factor is the regulatory body's basic structure and composition. States with different governmental organizations and legal traditions will obviously structure their regulatory bodies in different ways. Some may designate a single director for a fixed term of office, others a board of directors who have staggered terms of office. Perhaps the head of the regulatory body can be removed only for a cause, or can be removed at the discretion of the

president, the cabinet or a minister without the showing of a cause; in the latter case, the real and perceived independence of that person will be affected. The process of designating and removing the head of a regulatory body is not determinative of the body's independence, but it is an indication of how the safety function is viewed in the State concerned.

Some States may place the regulatory body under the supervision of a parent organization, such as a government department or a ministry. The fact that the regulatory body is located within the administrative structure of another organization, or is supervised by it, does not necessarily mean that the regulatory body lacks independence. The question is whether the necessary effective separation or effective independence of key regulatory functions and decision making exists. That question can be answered only after an evaluation of the detailed provisions determining how the practical work of the two organizations is conducted.

If the parent organization has responsibilities regarding the conduct or promotion of nuclear related activities, the fact that it is supervising the regulatory body will raise issues of "independence" or "separation of regulatory functions". If it is responsible for nuclear energy development, situations could arise in which the parent organization is called upon to take decisions, for example, about the establishment of facilities using nuclear techniques. In such situations, administrative measures would have to be taken in order to ensure that safety related decisions of the regulatory body are effectively independent of or separate from developmental or promotional decision making.

One element related to organizational structure is the regulatory body's reporting arrangements. If a regulatory body cannot provide information on its safety judgements or about safety related incidents at licensed facilities without the approval of another organization, issues of independence and transparency will arise. The reporting arrangements should therefore be such that the regulatory body can provide safety related information to the government and the public with the maximum degree of directness and openness.

A second element concerns the need for an appeals process for disputes concerning regulatory judgements. A process must be provided for resolving such disputes that does not give the appearance that regulatory judgements are subject to a reversal for extraneous reasons. The national legal system should include a process whereby appeals are dealt with either through a hierarchy of administrative bodies or through the judiciary.

Crucial to the independence of the regulatory body are its technical capabilities. An organization charged with making complex technical judgements must have access to expert personnel who can make such judgements or who can assess those of others. If a regulatory body must rely entirely on the assessments of others, its independence may be compromised.

A related crucial factor is financial resources, which must be sufficiently predictable and reliable, adequate and not subject to undue control by external bodies. Therefore, to the extent feasible given the State's budgetary process, the regulatory body should have the ability to develop its own budget and make the case vis-à-vis the legislature or the government for the level of funding necessary for implementing its responsibilities.

Finally, a factor sometimes overlooked but that is important for the independence of the regulatory body is leadership. If the head(s) of the regulatory body is (are) recognized as having the highest level of competence (in nuclear technology, law, public administration or some other relevant discipline), the right kind of experience and a sound character, the judgements made by the regulatory body are likely to be respected and implemented. Regulatory bodies headed by persons who are perceived as lacking competence or as holding their position for purely political reasons will have difficulty in maintaining internal employee morale and external confidence.

## 2.3. REGULATORY FUNCTIONS

A State's nuclear law should set forth the regulatory functions essential for protecting public health, safety and the environment. Article 7 of the Convention on Nuclear Safety [2] and Article 19 of the Joint Convention [5] require Contracting Parties to establish and maintain a legislative and regulatory framework to govern the safety of, respectively, nuclear installations and radioactive waste management, identifying a number of functions to be performed by a regulatory body within such a framework. The two conventions group these functions into four categories: establishing requirements and regulations; licensing (including the prohibition of operations without a licence); inspecting and assessing; and enforcement. On a number of occasions, the IAEA has identified regulatory functions that should be explicitly provided in a State's nuclear law (see Ref. [4]). A fifth category, not mentioned in the two conventions, but considered essential by most regulatory bodies (and mentioned in Ref. [4]), is the provision of information on regulated activities to the public, the media, the legislature and other relevant stakeholders. Finally, a regulatory body should be permitted to co-ordinate its activities with the activities of international and other national bodies involved in nuclear safety.

### 2.3.1. Establishing safety requirements and regulations

A central function of a regulatory body is developing rules covering its areas of responsibility; the Convention on Nuclear Safety [2] and the Joint

Convention [5] refer to "the establishment of applicable national safety requirements and regulations", while Ref. [4], para. 2.6, states that "The regulatory body shall have the authority: (1) to develop safety principles and criteria; (2) to establish regulations and issue guidance; . . .". National legislation should clearly identify the governmental body that is finally responsible for issuing or adopting safety regulations.

### 2.3.2. Preliminary assessment

Early in any situation for which regulatory action is being contemplated, it is important to determine: first, whether a proposed nuclear related activity needs to be authorized, or is such that no regulatory control is required; and, second, where regulatory control is required, what level of regulatory control (licensing, notification or other) is appropriate and which competent authority or authorities should exercise the regulatory control. Applicants may have their own views and/or express preferences, but only the regulatory body can make a definitive determination.

### 2.3.3. Authorization (licensing, registration, etc.)

The Convention on Nuclear Safety (Ref. [2], Article 7.2(ii)) and the Joint Convention (Ref. [5], Article 19.2(iii)) prohibit the operation of nuclear installations and radioactive waste management facilities without authorization. In order to be consistent with such provisions and with accepted international practice, national nuclear legislation should clearly state that using nuclear energy without prior authorization is prohibited. Also, it should provide for the regulatory body to grant, amend, suspend and revoke authorizations and to set conditions for granting them. Note that the term licence condition has been used in different ways in different national systems and in IAEA guidance documents and that care must be taken by drafters of legislation to use the term consistently in their national laws. From a legal point of view, a distinction should be made between the prerequisites for obtaining a licence and the actual licence conditions, which may be imposed in connection with the granting of an authorization or even after an authorization has been granted. Further, as indicated above, the nuclear law itself need not and typically does not contain detailed technical requirements. These are usually promulgated by the regulatory body in the form of regulations or licence conditions.

### 2.3.4. Inspection and assessment

Licensing nuclear related activities and nuclear material would be useless without the power to determine whether licensees comply with the terms and conditions of the licences. Therefore, the regulatory body must have access to sites and facilities at which nuclear technology and material are being used, to ensure that public health and safety are being adequately protected. It must also be authorized to require operators to provide all necessary information, including information from suppliers (even proprietary information, where necessary). In addition, it must be authorized to obtain documents and opinions on matters involving public health, safety and the environment from persons and private and public organizations as may be necessary and appropriate. Furthermore, the law should provide for procedures whereby the regulatory body can require operators to carry out safety assessments, including safety reassessments or periodic safety reviews over the lifetime of a facility.

### 2.3.5. Enforcement

The legislative framework must provide for "the enforcement of applicable regulations and of the terms of licences, including suspension, modification or revocation" (see Article 7.2(iv) of the Convention on Nuclear Safety [2] and Article 19.2(v) of the Joint Convention [5]). Legislation should therefore clearly and explicitly assign enforcement powers to the regulatory body. Such powers can be exercised in several ways. Many regulatory bodies have internal enforcement sections that, acting independently, can compel compliance by issuing administrative orders or prohibitions directed to the licensee. Many have the power to levy monetary fines or other penalties. In any event, the regulatory authority must have the power to revoke a licence, thereby shutting down an operator's business. Also, many States authorize the imposition of criminal penalties for wilful or especially serious or persistent violations of nuclear safety laws or regulations.

### 2.3.6. Public information

Although it is not referred to in the Convention on Nuclear Safety or the Joint Convention, most regulatory bodies have programmes for the provision of information to other stakeholders (the public, the media, the legislature, local government and industry) about issues and activities relevant to nuclear and radiation safety. Indeed, public confidence that nuclear material and techniques are being used safely is closely linked to the regulatory body's track record of providing prompt, accurate and complete information on such issues

and activities. Independence is also relevant in this context. National legislation should make it clear that the regulatory body is authorized to communicate its requirements, decisions and opinions, and the basis for them, to the public independently. Furthermore, it should enable the regulatory body to communicate directly with high level governmental authorities when communication with them is considered necessary for the effective exercise of the regulatory body's functions. Finally, legal authority is needed in order to ensure that the regulatory body can make available, to other governmental bodies, international organizations and the public, information on incidents and abnormal occurrences, and other information, as appropriate.

### 2.3.7. Co-ordination with other bodies

The use of nuclear energy has become a truly global activity. It is important to recognize this not only because of potential transboundary health, safety and environmental impacts, but also because most nuclear related activities involve some international technical or commercial aspect (such as the purchase of at least some items from a foreign supplier or the use of foreign origin technology). A State's nuclear law should therefore enable the regulatory body to liaise with the regulatory bodies of other States and with international organizations, so as to promote co-operation and the exchange of regulatory information. Similarly, there are many stakeholders at the national level that need to be involved in regulatory decision making concerning nuclear energy. The nuclear law should also enable the regulatory body to liaise and co-ordinate with other governmental bodies and with non-governmental bodies having competence in areas such as health and safety, environmental protection, security and the transport of dangerous goods.

## 2.4. ADVISORY BODIES AND EXTERNAL SUPPORT

A final matter to be discussed briefly is how to ensure that the regulatory body can obtain the necessary technical support and policy advice.

If the regulatory body lacks the technical personnel necessary in order to discharge its responsibilities, the nuclear law should enable it to secure the services of technical experts or to arrange for the necessary technical work to be carried out under contract. It is, of course, important that the providers of the external expertise (e.g. contractors, universities, technical support organizations and scientific institutes) have the maximum degree of independence from the bodies engaged in the development or promotion of nuclear energy.

Many States have established mechanisms, within or outside the regulatory body, by means of which the regulatory body can obtain advice on issues that may affect national policies. Also, many States have created bodies to provide advice to the government on regulatory activities. Obviously, the structure, composition and relationships of an advisory body will depend on the kind of advice being provided. In any event, the members of the advisory body will need to include persons of recognized competence in the relevant field or fields. The role of bodies created to advise regulatory bodies is discussed in some IAEA safety standards (e.g. Refs [1, 4]), which emphasize that the advice provided by advisory bodies should be independent and that such advice does not relieve the regulatory body of its responsibility for decision making.

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# Chapter 3

# LICENSING, INSPECTION AND ENFORCEMENT

## 3.1. BACKGROUND

As discussed in Chapters 1 and 2, a State's nuclear legislation should provide for all the key elements needed for an effective regulatory system. Merely establishing a regulatory body, without ensuring that it possesses the ability to exercise the necessary regulatory functions, creates the illusion, not the reality, of such a system. Chapter 2 has already identified three basic functions of a regulatory body: licensing, inspection and enforcement. Paragraphs (i), (ii) and (iii) of Article 7.2 of the Convention on Nuclear Safety [2] mention:

(a) A system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;
(b) A system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences;
(c) The enforcement of applicable regulations and of the terms of licences, including suspension, modification or revocation.

Article 19.2 of the Joint Convention [5] contains a similar identification of functions. These two instruments create an international obligation to provide for these functions in national law only with regard to the operation of nuclear installations (civil nuclear power plants) and spent fuel and radioactive waste management. However, as numerous IAEA publications recognize (e.g. Refs [1, 4]), the functions are applicable to all other nuclear related activities.

These regulatory functions should apply to all important nuclear related activities, including:

(a) The production of radiation sources;
(b) The use of radiation and radioactive substances in science, medicine, research, industry, agriculture (including the irradiation of food and animal feedstocks) and teaching;
(c) The design, construction, operation and decommissioning of research and test reactors;
(d) All aspects of the use of nuclear energy for power production, including the siting, design, construction, commissioning, operation and decommissioning of power reactors and the entire nuclear fuel cycle, from

the mining and processing of radioactive ores, through the enrichment of nuclear material and the fabrication of nuclear fuel, to the management of spent fuel and radioactive waste;

(e) The use of radioactive material or equipment that generates radiation (e.g. accelerators) at research laboratories, universities and manufacturing facilities;

(f) Activities such as the underground mining of minerals that may increase exposure to naturally occurring radioactive material;

(g) The transport of nuclear material, including radioactive sources.

This chapter summarizes some of the basic features of each of the three basic regulatory functions.

## 3.2. LICENSING LEGISLATION

As indicated in Chapter 1, licensing or the issuance of an authorization[1] is one of the fundamental features of nuclear law. As noted in the discussion of the permission principle (Section 1.4.4), this principle holds that, unless specifically exempted, any activity related to the use of nuclear material and technology should be permitted only after competent authorities have determined that it can be conducted in a manner that does not pose an unacceptable risk to public health, safety and the environment. In this area, most States have adopted an approach based on two concepts: authorization and notification. Where a nuclear related activity is deemed to pose a significant health or safety risk, governments require that an explicit authorization be issued by the regulatory body following an application and review process. Such an authorization is typically issued in the form of a document, which may be called, for example, a licence, permit or certificate. For nuclear related activities that pose very small or no health and safety risks, the persons engaged in them may be required only to notify the regulatory body. The national legal infrastructure in each State will determine the conditions

[1] The Basic Safety Standards [1] define "authorization" as "A permission granted in a document by the Regulatory Authority to a legal person who has submitted an application to carry out a practice or any other action described in the General Obligations for practices of the Standards. The authorization can take the form of a registration or a licence." However, given the fact that different national laws use different terms for the same concept, this handbook distinguishes between authorization as defined in the Basic Safety Standards, notification and the process leading to an authorization, referred to as the licensing process.

and procedures applicable to such authorizations and notifications, including any limits on the regulatory body's power to impose additional requirements.

Before an authorization is issued, the applicant should be required to submit a detailed demonstration of safety (or of compliance with other relevant requirements). The application should be reviewed by an independent regulatory body in accordance with clearly defined procedures. The requirements of the authorization should reflect the regulatory body's assessment of the potential magnitude and nature of any hazards connected with the activity.

A licensing system must ensure that the regulatory body will provide guidance to potential applicants concerning the content and format of documents and other information material to be submitted in support of a licence application. In turn, the applicant should be required to furnish all necessary information, in accordance with a specified time schedule, such as to enable the regulatory body to evaluate the application.

In making its licensing decisions, the regulatory body should formally record both the basis for these decisions and the detailed terms of any authorization issued. Any conditions or limitations on the licensee's activities must be expressly set forth in the licence document or clearly referenced in regulations available to the licensee. Any subsequent amendment, renewal, suspension or revocation of a licence should be undertaken in accordance with clearly defined procedures.

### 3.2.1. Availability of a licence

An important threshold stage in the licensing process is a public announcement (usually in the form of regulations) by the regulatory body of which activities in the nuclear field require a licence or some other authorization. Such an announcement should include:

(a) A clear expression of the activity types for which a licence is required, and of their purpose;
(b) Reference to the legal basis establishing the licence requirements;
(c) A description of the procedure for applying for a licence;
(d) An indication of any fees to be paid for the licence;
(e) A statement of the documents and other information material to be provided in support of an application;
(f) A statement of any conditions that must be met or any qualifications that must be possessed by the applicant;
(g) An indication of any hearings or court or legal proceedings required (with time schedules, if possible);

(h) An indication of which factors will be considered by the regulatory body in reaching a licensing decision.

### 3.2.2. Application for a licence

It is useful for nuclear energy legislation to provide some guidance on the required contents of licence applications, although much of the information in question can be conveyed in regulations promulgated by the regulatory body. The required contents of licence applications will normally include:

(a) An identification of the applicant (whether an individual or an organization) who will hold the licence;
(b) Information on the technical qualifications, financial ability and ethical character of the applicant;
(c) Information on the activity for which the licence is being sought, including a statement of the quantities and types of nuclear material to be used;
(d) A detailed description of the locations or facilities at which nuclear material will be used or nuclear related activities conducted;
(e) A detailed timetable for the conduct of activities, including, for example, an indication of the duration of any construction work and of the dates of transfers of material;
(f) A decommissioning plan, for providing financial assurance, to be developed during the design phase of an installation;
(g) Information on the manner in which the licensee will conduct the authorized activities so as to protect public health, safety and the environment;
(h) An indication of any special circumstances that could be relevant.

### 3.2.3. Public participation

Each State will have its own practices and procedures for involving the public in regulatory activities, which will reflect that State's political structure, culture and social values. Public confidence in the use of nuclear material and technology can be enhanced by an authorization process that reflects a high degree of openness on the part of the authorities. For this reason, consideration should be given to including provisions related to public involvement in regulatory activities in national nuclear energy legislation. The level of public participation can be adjusted to the nature of the authorization in question. Typical provisions require that the public be informed about:

(a) Where the licence applications and the supporting documents can be consulted and the procedures for consulting them;
(b) How (e.g. by submitting written comments or appearing at public hearings) persons or organizations can participate in the licensing process;
(c) The time schedule in accordance with which public participation will take place.

The licensing process may involve hearings on the application. Legislation authorizing such hearings could include:

(a) A provision stating which Parties may participate in a hearing, either as a matter of right or at the discretion of the regulatory body;
(b) A requirement that the applicant be given advance notice of any hearings and an opportunity to appear or to provide information to the regulatory body;
(c) A requirement that hearings be held at reasonably convenient times and places;
(d) A requirement that hearings be open to the public and the media;
(e) A provision stating that the applicant may be represented by legal counsel;
(f) A requirement that a record of the hearing be kept as part of the licensing process.

### 3.2.4. Criteria for the issuance of a licence

The criteria for the issuance of a licence will depend on the nature of the activity to be licensed. The criteria in the case of a licence to possess a small quantity of radioisotopes for medical use will differ substantially from those in the case of a licence to construct a nuclear power plant. What is important is that, in each case, the law provide a clear indication of the basic requirements the applicant is expected to meet. Although it is not appropriate to include detailed technical requirements in legislation, the codification of general criteria is essential in order to guide the regulatory body in making its licensing decisions. Also, legislative criteria are essential for a review of contested licensing decisions, whether by independent judicial bodies or a governmental appeals process.

### 3.2.5. Issuance of a licence

Although the issuance of a licence may seem like a mechanical formality, certain common aspects of the process warrant mention and include:

(a) The payment of a fee to cover some or all of the costs of the licensing process and the deposit of some form of financial security to ensure due observance of any licence conditions;
(b) A determination by the regulatory body that all applicable licensing criteria have been met;
(c) A finding that, in carrying out the authorized activity, the licensee is capable of protecting public health, safety and the environment;
(d) The setting of a term for the licence, including a date for its expiration.

### 3.2.6. Suspension, modification or revocation of a licence

The enforcement of licence conditions is discussed in Section 3.3. At this point, it is simply pointed out that nuclear legislation should provide a basis for enforcement action by specifying that any licence issued under it may be suspended, modified or revoked in the event of a violation of its conditions or in any circumstance in which the regulatory body determines that continued activity under the licence would pose an unacceptable risk to public health, safety or the environment.

### 3.2.7. Review of licensing decisions

To ensure that the regulatory body is carrying out the licensing function properly, nuclear legislation should provide for a clear procedure whereby contested licensing decisions can be reviewed, whether by independent judicial bodies or in a governmental appeals process. It should also indicate the basis on which licensing decisions can be contested and the time schedule for proceedings.

## 3.3. INSPECTION AND ENFORCEMENT LEGISLATION

Although inspection and enforcement involve somewhat different processes, they are normally considered together because of their close relationship. In an effective and efficient system of nuclear regulation, the two functions will be conducted in a closely co-ordinated and mutually reinforcing

fashion. National legislation covering these functions should reflect this relationship.

### 3.3.1. Scope and objectives of inspection and enforcement

Before discussing these two functions, it is important to recall that regulatory inspections or enforcement actions do not diminish the responsibility of the licensee for ensuring the safety and security of its activities. With regard to scope, nuclear legislation should provide for regulatory inspections and enforcement actions to cover all areas of nuclear regulatory responsibility.

The main objectives of inspection and enforcement are to protect public health, safety and the environment by ensuring that:

(a) The use and transfer of nuclear material, the use of licensed facilities and of equipment and all work practices meet the necessary regulatory requirements;
(b) The relevant documents and instructions of the licensee are valid and are being complied with by the licensee's employees or agents;
(c) The persons engaged in licensee activities possess the competence and character necessary for the conduct of their functions;
(d) Deficiencies or deviations from licence requirements are corrected without undue delay;
(e) Lessons learned from licensee activities are communicated to other licensees, the regulatory body and any other relevant entities;
(f) Safety, security and environmental management activities are being conducted properly.

### 3.3.2. Inspection

Nuclear legislation should provide for the regulatory body to establish a systematic inspection programme, with the nature and intensity of inspections dependent on the potential magnitude and nature of the hazard associated with the material or activity.

It should authorize the regulatory body to conduct inspections as a continuing activity on both a planned and a reactive basis. Depending on the circumstances, both announced and unannounced inspections should be available to the regulatory body. For routine inspections, the licensee should be given reasonable notice that an inspection is to be carried out. In the event of emergencies or unusual occurrences, the regulatory body must have the authority to conduct immediate or short notice inspections.

Nuclear legislation should require that the results of inspections be documented and, in addition to the records of such inspections, these results should be made available to relevant officials and to the licensees as a basis for corrective or enforcement action.

It should also require that the regulatory body have access to all facilities, areas within facilities, licensee or contractor personnel and equipment and to all documents and any other aspect of a licensee activity that could be relevant to public health, safety and the environment. Further, the regulatory body should be guaranteed reasonable time in which to conduct inspections and to analyse the information obtained during them, prior to reporting the results.

Nuclear legislation should ensure that the regulatory body possesses the resources necessary for hiring, training, equipping, transporting, compensating and managing staff capable of performing the activities required by its inspection programme. The regulatory body should have the authority to obtain the services of other governmental bodies or private bodies in cases of necessity (e.g. following accidents).

It should also authorize the regulatory body to station on-site, resident inspectors permanently at locations where continual monitoring activities are needed.

Licensees and applicants should be required to give inspection personnel free and prompt access to all nuclear material and facilities or sites, for the purpose of regulatory inspection. Access should be limited only in cases in which it would jeopardize the safety or security of material or facilities.

In order to inform the public about the safety, security and environmental acceptability of licensee activities and about the effectiveness of the regulatory body, general inspection findings and regulatory decisions should be made available to the licensee, its personnel, the public and the media, except in the event that the release of such information would jeopardize public safety or security.

### 3.3.3. Enforcement

The primary purpose of enforcement is to prevent non-compliance with the health, safety, security and environmental requirements specified in the licence, either by the licensee or by other Parties, and to deter future non-compliance. Enforcement actions are designed to respond to incidents of non-compliance.

Enforcement legislation should include a clear grant of authority to the regulatory body to enforce compliance with its requirements as laid down in regulations and/or licences. It should reflect the fact that sanctions for non-compliance should be commensurate with the seriousness of the non-

compliance and should authorize a range of penalties. For unsatisfactory situations that pose minor or no safety risks, enforcement may involve merely a written warning to the licensee. Serious non-compliance could entail the imposition of civil monetary penalties. Repeated, intentional or especially serious non-compliance could entail revocation of the licence or even criminal penalties against the licensee or its personnel. Enforcement legislation should specify the available penalties for serious non-compliance (e.g. the maximum monetary penalties and the maximum prison sentence).

Enforcement legislation should recognize the primary responsibility of the licensee and authorize the regulatory body to require:

(a) That the licensee investigate all unusual occurrences promptly or within an agreed time period;
(b) That the licensee remedy any non-compliance;
(c) That the licensee take steps to ensure that the non-compliance is not repeated.

To the extent practicable, regulatory inspectors should be authorized to take enforcement measures immediately, at the location of a non-compliance, especially in cases in which public health, safety, security or the environment may be at risk.

Enforcement legislation should provide for the regulatory authority to formulate and issue regulations detailing the procedures for determining and taking enforcement measures and also the rights and obligations of the licensee. It should provide for all enforcement decisions to be confirmed to the licensee in writing. To ensure that the regulatory body is carrying out its enforcement responsibilities in a fair manner, enforcement legislation should also provide for a procedure whereby a licensee can seek a review of a contested enforcement action, either by an independent judicial body or through a governmental appeals process. It should make it clear that enforcement measures are not automatically suspended merely because a complaining Party has sought an administrative or judicial review of an enforcement agency action. Automatic suspension, sometimes permitted in other fields of law, could entirely defeat the purpose of enforcement.

## 3.4. DEFINITIONS

The list of possible definitions in the areas of licensing, inspection and enforcement could be extensive. Many definitions are probably best included in implementing regulations, rather than in legislation. Some expressions that

could be desirable to define in national law are: authorization; applicant; licence; licensee; licence fee; licence term; regulatory body (or regulatory authority); inspection; notice of inspection; short notice inspection; notification; accident; unusual occurrence; exemption; and exception.

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# Part II

# RADIATION PROTECTION

# Chapter 4

# RADIATION PROTECTION

## 4.1. BACKGROUND

Ionizing radiation can be detrimental to living organisms, as was realized very early in the twentieth century, when accidents began to occur with radioactive sources used in research and medicine. In addition, long term epidemiological studies of populations exposed to radiation, especially the survivors of the bombings of Hiroshima and Nagasaki in 1945, have demonstrated that radiation exposure also has a potential for delayed induction of malignancies. It is therefore essential that activities involving radiation exposure, such as the production and the use of radiation sources and radioactive material, the operation of nuclear facilities and radioactive waste management, be covered by measures to protect individuals exposed to radiation.

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) compiles, assesses and disseminates information on the health effects of radiation. For over 60 years, the International Commission on Radiological Protection (ICRP), a private organization, has developed recommendations in the area of radiation protection. The Basic Safety Standards [1] were published by the IAEA in 1996 and represent a broad international consensus on the appropriate handling of radioactive sources. These standards have been very generally adopted and are incorporated into the radiation protection laws and regulations of many States.

Ionizing radiation and radioactive substances are natural and permanent features of the environment, and the risks associated with radiation exposure can therefore only be restricted, not eliminated entirely. In addition, the use of human-made radiation is widespread. Sources of ionizing radiation are essential to modern health care: disposable medical supplies sterilized by intense radiation have been central to combating disease; radiology is a vital diagnostic tool; and radiotherapy is commonly part of the treatment of malignancies. The use of nuclear energy, applications of radioactive substances and ionizing radiation continues to expand. Also, the use of nuclear techniques is expanding in industry, agriculture, medicine and many fields of research. Irradiation is used around the world to preserve foodstuffs and reduce wastage. Sterilization techniques have been used to eradicate disease carrying insects. Industrial radiography is in routine use, for example to examine welds and detect cracks and to help prevent the failure of engineered structures.

Acceptance by society of the risks associated with radiation is conditional on the perceived relationship between these risks and the benefits to be gained from the use of radiation. It follows that the risks must be limited and adequate protection provided.

Humans have always been exposed to natural ionizing radiation (background radiation), because of the exposure of the Earth's surface to cosmic rays and the radioactivity contained in rocks that form the continental crust. The human body is itself naturally radioactive, owing to the potassium-40 contained in our bones. Radiation protection is not intended to protect individuals or the environment from all the effects of ionizing radiation, but to ensure that the amount of radiation absorbed by an organism does not have negative consequences.

Human activities that add radiation exposure to that which people normally incur from background radiation or that increase the likelihood of their incurring exposure are called 'practices'. Human activities that seek to reduce the existing radiation exposure or the existing likelihood of incurring exposure that is not part of a controlled practice are called 'interventions'.

For a practice, provisions for radiation protection can be made before its commencement, and the associated radiation exposures and their likelihood can be restricted from the outset. By contrast, in the case of interventions, the circumstances giving rise to exposure or the likelihood of exposure already exist and an exposure reduction can be achieved only by means of remedial or protective actions.

Practices include not only the production of radiation sources, the use of radiation and radioactive substances in medicine, research, industry, agriculture and teaching, and the generation of nuclear power (including the entire cycle of related activities, from the mining and processing of radioactive ores to the operation of nuclear reactors and fuel cycle facilities and the management of radioactive waste), but also activities such as the underground mining of coal and phosphatic and other minerals, should they enhance exposure to naturally occurring radioactive substances.

Situations that may require intervention include, on the one hand, chronic exposure to naturally occurring sources of radiation (such as radon in dwellings) and to radioactive residues from past activities and events, and, on the other hand, emergency exposure situations such as may result from accidents and from deficiencies in existing installations.

## 4.2. OBJECTIVES

Nuclear law must establish a legislative framework for the safe management of all sources and types of ionizing radiation. It should, in particular, ensure that individuals, society and the environment are adequately protected against radiological hazards, and it should cover not only practices but also interventions. It should, in addition, cover the medical uses of radiation, situations in which a patient may be voluntarily exposed to high doses of radiation for therapeutic purposes.

The general principles of radiation protection are broadly applicable to all nuclear related activities and to all facilities at which ionizing radiation is produced, from dental X ray equipment to power reactors. Radiation protection should thus be perceived as a 'chapeau' or envelope for all nuclear legislation.

In the case of practices, the law should ensure that they are 'justified': that they produce sufficient benefit for the exposed individuals and for society to offset the radiation detriment that they may cause (the principle of justification). It should also ensure that doses, the number of people exposed and the likelihood of incurring exposure are at all times kept as low as reasonably achievable (the ALARA principle of optimization). Finally, it should impose restrictions on the dose that an individual may incur (dose limits), so that no person is subject to an unacceptable risk attributable to radiation exposure (the principle of minimization).

In the case of interventions, the justification is that the proposed intervention will do more good than harm. The law shall provide for the form, scale and duration of any intervention to be such that the intervention is optimized, so that the net benefit is maximized.

The practice of the exposure of patients to ionizing radiation for therapeutic purposes is justified if the expected benefits are significantly greater than the radiation detriment that may result, account being taken of the benefits and risks of medical techniques that do not involve ionizing radiation exposure. The law should provide for the medical exposure of patients, with special provisions relating to the way in which the principle of optimization is applied.

## 4.3. SCOPE

Radiation protection is a concept applying to all activities and facilities in which ionizing radiation is emitted by radioactive material of any origin or generated by equipment. Consequently, the considerations in this chapter apply

to the entire content of Part III of this handbook, which should be read in conjunction with this chapter. In accordance with the protection principle (see Section 1.4.1), the purpose of radiation protection is to ensure that the hazards from radiation are kept ALARA, social and economic factors being taken into account.

### 4.3.1. Exclusion

The law should exclude those cases of exposure to ionizing radiation for which the magnitude or likelihood of the exposure is unamenable to control, for instance exposure to the natural radioactivity in the human body and to cosmic rays at ground level.

## 4.4. ROLE OF THE REGULATORY BODY

The regulatory body's role is described in Chapter 2. Nuclear legislation should prohibit the use of nuclear energy without prior authorization (see Section 1.4.4). One function of the regulatory body is to assess applications for permission to engage in practices that entail or could entail exposure to radiation. Besides setting the conditions for the issuance of a licence, the regulatory body determines which activities or materials may be exempted and which may be cleared from regulatory control.

### 4.4.1. Exemption

Exemption means that, although the practice or the material has not been excluded from regulatory control, it is considered to be of no regulatory concern. There are three exemption criteria:

(a) The radiation risk for individuals is sufficiently low to be of no regulatory concern;
(b) The collective radiological impact is sufficiently low not to warrant regulatory control;
(c) The practice, with any associated facilities, is considered to be inherently safe, with no likelihood of scenarios that could lead to a failure to meet criterion (a) or (b).

### 4.4.2. Absence of a justification

Absence of a justification is a reason for the regulatory body to refuse to issue a licence. Activities are deemed not to be justified if they would result in a deliberate increase in the activity of radioactive substances in the associated commodities or products. Such activities are:

(a) Activities involving food, beverages, cosmetics or any other commodity or product intended for ingestion, inhalation or percutaneous intake by, or for application to, a human;
(b) Activities involving the frivolous use of radiation or radioactive substances in products such as toys and personal jewellery or adornments.

### 4.4.3. Clearance

In this context, clearance is an important concept. It means the removal of radioactive material or radioactive objects involved in authorized practices from further control by the regulatory body. Clearance levels are values, established by the regulatory body, below which sources of radiation may be released from regulatory control. Clearance is thus the release of materials whose activity level is so low that no form of post-release regulation is required in order to ensure that the public is sufficiently protected. Thus clearance may apply to practices that have not been exempted. Its purpose is analogous to that of the exemption of practices, with the essential difference that clearance applies only to material that is already under regulatory control.

Clearance levels, as a rule, need to be higher than exemption levels, so that exempted material does not again become subject to regulatory control.

## 4.5. ACTIVITIES AND FACILITIES REQUIRING A LICENCE

The regulatory body should issue a licence only if the proposed activity is likely to produce sufficient benefit for the exposed individuals and for society to offset the radiation detriment that it may cause. Such activities are:

(a) The production of radiation sources and the use of radiation or radioactive substances for medical, industrial, veterinary or agricultural purposes, or for education, training or research, including any related activities that involve or could involve exposure to radiation or radioactive substances;

(b) The generation of nuclear power, including any nuclear fuel cycle activities that involve or could involve excessive exposure to radiation or radioactive substances;
(c) Activities that involve excessive exposure to natural radiation sources and which the regulatory body deems to require regulatory control;
(d) The transport of radioactive sources;
(e) Any other activity specified by the regulatory body.

Licences are required for:

(a) Radioactive substances (including consumer products that contain radioactive substances), devices that contain radioactive substances (e.g. sealed and unsealed radiation sources) and devices that generate radiation (including mobile radiographic equipment);
(b) Facilities that contain radioactive substances or devices that generate radiation, including irradiation facilities, radioactive ore, mines and milling facilities, installations processing radioactive substances, nuclear facilities and radioactive waste management facilities;
(c) Facilities and equipment for the transport of radioactive sources;
(d) Any other source or facility specified by the regulatory body.

## 4.6. CONDITIONS FOR THE ISSUANCE OF A LICENCE

Despite the large number of activities and facilities that involve the use of ionizing radiation, since radiation protection serves one overall aim (ensuring an appropriate standard of protection and safety for humans without unduly limiting the benefits of practices giving rise to radiation exposure and without incurring disproportionate intervention costs), the conditions set for the issuance of a licence are common to most of such activities and facilities. At the same time, the relative importance of those conditions will vary from one activity to another and from one facility to another, as is seen in Part III of this handbook.

To obtain a licence, the applicant must demonstrate that it has the qualifications necessary for conducting the proposed activity. In particular, it must convince the regulatory body that it:

(a) Has an adequate understanding of the basic principles of radiation protection;

(b) Will take all steps necessary for the protection and safety of workers and the public, preventing the occurrence of deterministic effects in individuals, by keeping doses below the relevant threshold and ensuring that all reasonable steps are taken to minimize the probability of stochastic effects in the population, at present and in the future;
(c) Will maintain effective defences against radiological hazards;
(d) Will take all necessary steps to prevent radiological accidents and, should such accidents nevertheless occur, to mitigate their consequences;
(e) Will draw up an action plan for dealing with emergencies;
(f) Will ensure compliance with the dose limits set by the regulatory body and will monitor the radiation exposure of workers;
(g) Will maintain a record of radiation measurements;
(h) Will plan and implement the technical and organizational measures necessary for ensuring adequate protection and safety;
(i) Will possess human and financial resources sufficient for the proposed activity, including financial assurance for decommissioning;
(j) Will have adequate liability insurance coverage;
(k) Will allow inspectors of the regulatory body to have free access to all facilities;
(l) Will not modify the conditions for obtaining the licence without prior approval of the regulatory body;
(m) Will submit, upon request, all information that the regulatory body considers to be necessary to evaluate.

## 4.7. SPECIFIC ISSUES

### 4.7.1. Doses and dose limits

Radiation sources emit energy in the form of ionizing radiation. The dose is a measure of the radiation received by a target.

The dose limit is a value of the effective or equivalent dose to individuals that may not be exceeded in activities under regulatory control.

The regulatory body sets the dose limits for various activities. Such limits sometimes figure in the nuclear laws, but more commonly in the accompanying regulations.

In setting dose limits, regulatory bodies rely on the Basic Safety Standards [1], which are recognized worldwide as reference standards.

### 4.7.2. Transboundary effects of radiation

If an activity or facility could cause public exposure in neighbouring States through the release of radioactive substances to the environment, arrangements should be made to ensure that the regulatory bodies of the State or States likely to be affected have been consulted and that they have been given general data enabling them to assess the likely safety impact within their national territory or territories. The regulatory body in the State of the licensee should take steps to ensure that the activity or facility will not cause greater public exposure in neighbouring States than in the State of the licensee.

The Convention on Early Notification of a Nuclear Accident (the Early Notification Convention) [6] and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (the Assistance Convention) [7] cover situations in which an accident involving activities or facilities in one State have resulted or may result in a transboundary release that could be of radiological safety significance for other States. National nuclear legislation should provide for the measures necessary for the implementation of these conventions.

### 4.7.3. Radiation from cosmic rays

Cosmic rays at ground level are not considered to warrant regulatory control. However, at high altitudes, where they have not been attenuated by the lower atmosphere, they undoubtedly pose a risk. As a consequence, personnel of aircraft should be informed about the risks and about the doses to which they may be exposed in the practice of their profession.

## 4.8. CROSS-CUTTING RELATIONSHIPS

As indicated in Section 4.3, radiation protection is an essential pre-condition for the handling of radioactive material and the operation of nuclear facilities. In all such activities, the same principles apply and the consequences of these principles must be accepted. Rather than cross-cutting relationships, we are faced here with dependency relationships, where all nuclear related activities are dependent on the proper application of radiation protection principles.

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# Part III

# NUCLEAR AND RADIATION SAFETY

# Chapter 5

# SOURCES OF RADIATION AND RADIOACTIVE MATERIAL

## 5.1. BACKGROUND

Chapter 4, Radiation Protection, indicates that, under certain conditions, ionizing radiation is dangerous to living organisms and must be protected against. It is therefore important to consider what may be a source of ionizing radiation. There exist two large groups of sources: (i) radioactive material (i.e. material that emits radiation through the spontaneous decay of some radionuclides); and (ii) equipment specially designed to generate radiation (e.g. dental X ray equipment). Radioactive material emits radiation continuously, whereas radiation generating equipment can be turned on or off at will.

### 5.1.1. Radioactive material

Radioactive material can be classified in many different ways, but for general and legal purposes it is either naturally radioactive (e.g. radon and uranium ore) or has been made radioactive, commonly after exposure inside a reactor (e.g. radioisotopes for medical use and radioactive waste). Some types of naturally radioactive material may be used in a reactor and become more radioactive as a consequence, which explains why irradiated nuclear fuel is a much more powerful source of radiation than unused, fresh fuel.

The legislator should remember that, while most artificially radioactive material has been irradiated for specific purposes, some material will have become radioactive through contamination, for instance material such as steel and concrete used in the construction of a nuclear reactor. When the time comes to dismantle a nuclear reactor, this material will have to be handled as radioactive waste.

Some States have found it appropriate to distinguish nuclear material (mainly uranium and plutonium) from other radioactive material, or to treat nuclear fuel differently from other radioactive material. Much depends on the purpose of the legislation. From the standpoint of radiation protection, the key consideration remains the dose that individuals may be expected to receive from a particular activity (the dose being simply, in this context, a measure of the radiation absorbed by a target).

Radiation sources must also be kept secure to prevent theft or damage and to prevent any unauthorized person from carrying out illegal activities with

such sources. For example, the acquisition of a radiation source by terrorists poses the risk that a radiation dispersion device, or 'dirty bomb', could be developed to threaten or injure large numbers of people. The Code of Conduct on the Safety and Security of Radioactive Sources [8] outlines a number of measures that can be taken by a State to address this issue.

From the standpoint of non-proliferation (see Chapter 12), nuclear material that may be used to develop nuclear explosive devices requires enhanced measures of physical protection (see Chapter 14).

### 5.1.2. Irradiation equipment

Facilities and equipment that emit ionizing radiation are in common use in industry, agriculture and medicine, and their legal handling has to take their particular nature into consideration. As they vary considerably in size and the way in which they are used, specific rules are normally not contained in the law but in regulations (see Section 5.6).

### 5.1.3. Definition of radiation sources

According to the Basic Safety Standards [1], anything that can cause radiation exposure, for example by emitting ionizing radiation or releasing radioactive substances, is a radiation source. This is the sense that the term radiation source has been used so far in this chapter. In practice, however, the term has also been used in a more restricted sense to mean radiation sources outside the nuclear fuel cycle: nuclear fuel, reactors and radioactive waste are not radiation sources, but sealed and unsealed sources and equipment that generates ionizing radiation are. The legislator must therefore carefully define the terms to be used in the legislation.

## 5.2. OBJECTIVES

A law dealing with radiation sources should clearly define what is understood by that term. Furthermore, it should serve the following five purposes:

(a) To bring all radiation sources in the State under regulatory control;
(b) To provide that all radiation sources in the State be kept under regulatory control in such a way that they can be traced;

(c) To prevent the unlawful use of radiation sources within the territory of the State and to provide for the punishment of offenders in the event of unlawful use;
(d) To provide for an effective response in the event that radiation sources that have escaped regulatory control are discovered and reported;
(e) To plan for the mitigation of accidents.

## 5.3. SCOPE

This chapter deals with all radiation sources, with the exception of naturally occurring radioactive material, nuclear reactors, spent fuel and radioactive waste. Since the transport of radiation sources does not differ from that of other radioactive material, that subject is dealt with in Chapter 9.

Radioactive ore is considered in Chapter 8, nuclear fuel in Chapters 6, 9, 12 and 14, and radioactive waste in Chapter 10. Other radiation sources outside the nuclear fuel cycle are considered in this chapter, the purpose of which is to discuss radiation sources in the restricted sense.

## 5.4. ACTIVITIES AND FACILITIES REQUIRING A LICENCE

Numerous radioactive sources are used in industry, agriculture and medicine. The regulatory body should determine which activities and which sources can be exempted from regulatory control. In so doing, it will need to consider how to optimize the costs of regulatory control. Activities and activity concentrations given in the Basic Safety Standards [1] should be used (see Chapter 4).

To provide for the safe use of radiation sources, all persons who handle radioactive sources or equipment containing such sources must obtain an authorization from the regulatory body (see Chapter 3 for the different types of authorization), as must all persons who build, manufacture, sell or use equipment that generates ionizing radiation and all persons who apply such sources or equipment to the human body. The regulatory body should establish and maintain an inventory of all radiation sources within the State. Some sources and some equipment in general use, such as dental X ray equipment and industrial gauging equipment, can be exempted from licensing requirements, as long as they are registered with the regulatory body and the type and model of equipment in question has been licensed for use within the State.

## 5.5. LICENCE CONDITIONS

The applicant for a licence to use radiation sources must demonstrate that it possesses the appropriate qualifications, and in particular that it:

(a) Will ensure the safe use of the sources;
(b) Will make sure that all persons using the sources have been properly trained;
(c) Has adequate liability insurance;
(d) Will maintain an up to date source inventory.

Licences are limited in time but may be renewable. They shall describe the conditions and possible restrictions that apply. They may be suspended or withdrawn by the regulatory body if the conditions for obtaining them are modified without authorization or if the requirements of the regulatory body are not complied with.

## 5.6. SPECIFIC ISSUES

### 5.6.1. Irradiation equipment

As some irradiation equipment is in general use, the legislator must ensure that all applications are covered by the law. Some common applications are described briefly below:

(a) Industry. X ray equipment is used in carrying out security checks on luggage at airports and also in verifying the quality of welds in pipelines. Other kinds of irradiation equipment are used in gauging the thickness of paper, plastic films and metal sheets.
(b) Agriculture. Irradiation equipment is used with the sterile insect technique, whereby male insect pests are irradiated and made sterile. They are then released, but have no offspring when they mate. The technique has been used successfully against the tsetse fly in Zanzibar, the Mediterranean fruit fly in Mexico and the screw-worm in North Africa and the southern United States of America.
(c) Medicine. X ray equipment is used in, for example, dentistry, mammography and the diagnosis of fractures. More powerful radiation is used for therapeutic purposes, such as the treatment of cancer, in which the radiation is directed at the cancerous cells in such a way as to minimize damage to healthy cells.

(d) Sterilization and food preservation. Very strong radiation is used in sterilizing surgical instruments and surgical gloves, which would not withstand the temperatures involved in conventional sterilization. Certain drugs are also sterilized by means of radiation. The same technique is used in the preservation of food.

### 5.6.2. Orphan sources

A large number of portable sealed sources, most of them small and of low activity, are used in industry and medicine; about 1.8 million such sources are in use in the USA alone. Consequently, it is not surprising that, in spite of inventory keeping and controls, some sources are lost. The construction of most sealed sources is quite robust, so that accidents involving lost sources are usually due to human error. Nuclear legislation should require the finders of such orphan sources to report them to the regulatory body.

### 5.6.3. Disused sources

When a sealed source reaches the end of its useful life (becomes a disused source), it should be disposed of or returned to the manufacturer for recycling. Unfortunately, disused sources are often discarded. Sometimes discarded sources give rise to accidents. Such accidents, which occur even in States with adequate legislative and regulatory frameworks, have resulted in many people being irradiated, with fatal consequences in several cases. It is therefore essential that the regulatory body be provided with the means necessary for effectively controlling all major sources in the State. It is also essential that the regulatory body maintain effective communication with the holders of licences for these sources.

The return of disused sealed sources to the supplier, as envisaged in the Joint Convention (Ref. [5], Article 28), is in principle a good idea. In practice, however, there may be difficulties due to the structure of the State's legislation. The legislator should therefore indicate clearly what is to be done (when sources are being imported) with disused sources. Also, the legislator should ensure that the law is compatible with the legal obligations of supplying States (when sources are being imported), as the supplier may go out of business or may not be the manufacturer of the sources. Depending upon the situation, disused sources are best disposed of in the State in which they were used, returned to the supplier or disposed of in a third State willing to accept them.

### 5.6.4. Training

Modern sealed sources and modern equipment generating radiation are very safe. In most such equipment, for example, there are fail-safe mechanisms that prevent the operator from causing harm. However, accidents do occur, human error being the root cause in the majority of cases. The training and re-training of users (in medicine, industry, agriculture and research) are therefore essential for ensuring the safe use of radiation sources. Safety culture is particularly relevant, but it is difficult to legislate for (see also Section 6.6.1). Nuclear energy legislation must provide that training actually takes place and that appropriate tests are taken by licensees.

## 5.7. CROSS-CUTTING RELATIONSHIPS

The two main fields of the use of radiation sources are medicine and industry. Medical activities and other non-nuclear uses of radiation are often under the control of a ministry of health, while industry is dealt with by another ministry (e.g. a ministry for the economy or a ministry of labour). Whatever the structure of the State's administration, this division does not justify establishing one regulatory body for medical sources of radiation and another for industrial sources (see Chapter 2).

The regulatory body is bound to come into contact with other regulatory bodies handling the non-radiation aspects of medicine, industry, agriculture, etc. As each regulatory body is highly specialized in its field of expertise, it may have difficulty in understanding the views of other regulatory bodies. Personal contacts between members of different regulatory bodies are one of the best ways of solving problems that may arise.

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# Chapter 6

# SAFETY OF NUCLEAR FACILITIES

## 6.1. BACKGROUND

Nuclear facilities are those facilities associated with the nuclear fuel cycle (i.e. with the production of nuclear power). They include nuclear fuel fabrication plants, research and test reactors (including critical and subcritical assemblies), power reactors, spent fuel storage facilities, enrichment plants, reprocessing facilities, radioactive waste management facilities and radioactive ore mines and milling plants (for a discussion of mining and milling, see Chapter 8). In some nuclear facilities the large amounts of nuclear fuel or the energy produced could under certain conditions result in major, uncontrolled releases of radioactive material, entailing the risk of considerable radiation exposure of people. These facilities, essentially power reactors and reprocessing facilities, fuel fabrication plants and enrichment plants, and also some large research reactors, are the primary subject of this chapter.

Safety measures need to be adapted to the specific risks posed by particular facilities. As the risks are greatest with the facilities mentioned above, and as these are the more complex facilities, their safety is an important aim of nuclear legislation.

It also follows that particularly strict and numerous safety measures have to be taken. Many are technical measures that will be the subject of various regulations but that have no room in a nuclear law (see Section 6.2). For such facilities, the role of the regulatory body is not fundamentally different from that described in Chapter 3, and it is valid for all aspects of nuclear law. On the other hand, as the safety of such facilities is primarily the responsibility of the operating organizations, the operating organizations are very directly involved. The consequences of this situation are discussed in Section 6.6.

## 6.2. OBJECTIVES

With regard to nuclear facilities, the aim of nuclear legislation is to establish a legal framework encompassing all the measures necessary in order to minimize the risks posed by them, it being understood that each facility is unique.

The legislation should focus on the following three objectives:

(a) The general nuclear safety objective. It should ensure that individuals, society and the environment be protected from harm by providing for the establishment of effective defences against radiological hazards, and for monitoring (i.e. it should prevent accidents).
(b) The radiation protection objective (as covered in Chapter 4). It should ensure that, during normal operations, radiation exposure due to the facility be kept below prescribed limits, and ALARA, and that the consequences of any accident be mitigated.
(c) The technical safety objective. It should ensure that all reasonably practicable measures be taken to prevent accidents, and to mitigate the consequences of any accidents that may occur and ensure that measures be taken to make the likelihood of serious accidents very low.

The complexity of the necessary technical and administrative measures increases with the risks posed by the facility; it is greatest for power reactors. It is not practicable to provide for more than a small fraction of the necessary measures in nuclear legislation. Technical progress in the nuclear safety area would be hampered if rules reflecting the state of the art at a particular time were cemented into law. Nuclear legislation should contain only the principles and general technical rules that apply to all nuclear facilities. All detailed technical requirements should be reflected in rules, regulations, standards or guidance promulgated by the regulatory body.

## 6.3. SCOPE

This chapter covers mainly those nuclear facilities that, because of their large inventories of fissionable material or their complexity (or both), have the potential for causing major accidents. These are mainly power reactors, which contain a considerable amount of nuclear fuel and are of great technical complexity. They are relatively common (about 450 worldwide).

Of the other facilities belonging to the nuclear fuel cycle, reprocessing plants also pose relatively high risks, for similar reasons, but there are only a handful of them in the world; they are therefore of no interest for most States just developing nuclear legislation.

Fuel fabrication plants and enrichment plants are much less complex than power reactors, and it is unlikely that a State would operate such plants if it did not also operate at least one power reactor.

Radioactive waste management facilities are dealt with in Chapter 10 and radioactive ore mines and milling plants in Chapter 8. Industrial and medical

irradiation facilities are not part of the nuclear fuel cycle, and they are dealt with in Chapter 5.

Research facilities, such as laboratories engaged in nuclear fuel development and pilot enrichment plants, are subsumed in this handbook under research reactors. The complexity of such facilities is not very great and their nuclear fuel inventories are generally low. However, researchers working at such facilities may well test new approaches and apply new concepts, and in the process may neglect to comply strictly with the safety regulations. In practice, such facilities should be covered by the same general legal requirements as power reactors. However, the regulatory body may then wish to reduce the number or the complexity of the technical specific requirements imposed on the facility and its operating organization.

## 6.4. GENERAL REQUIREMENTS FOR POWER REACTORS

As explained above, power reactors pose greater risks than other nuclear facilities, except perhaps very large fuel cycle facilities. The legislation covering them will therefore be more complex and possibly more detailed. However, most of the regulatory requirements will appear not in the legislation itself but in accompanying regulations.

All facilities discussed in this chapter must meet two requirements: a nuclear safety requirement that the facilities be safe to operate with a very small probability of accidents; and a radiation safety requirement that the radiation exposures in normal operation be below certain limits for both personnel and for members of the public. The law will determine the framework that is most suitable for meeting both requirements. In so doing, it will take into account the State's particular attributes. No particular model is clearly superior to another unless it recognizes these attributes. While recognizing the general validity of technical requirements, the law will always have to reflect particular national circumstances.

Despite the size and complexity of such facilities, and despite the risks that they pose, the law needs to deal here with only two actors: the regulatory body and the operating organization. The regulatory body is responsible for setting safety standards and for enforcing them within the legislative framework. Its general role has been described in Chapter 3 and will not be considered in this chapter, although some aspects particularly relevant to nuclear facilities are mentioned. The second actor, the operating organization, bears the prime responsibility for the safety of the facility. It may delegate various functions to other bodies, but it cannot delegate the prime

responsibility for safety. This chapter examines the nature of the legal framework within which these two actors have to function.

## 6.5. ROLE OF THE REGULATORY BODY

### 6.5.1. Reactive approach

The regulatory body has to ensure that the operating organization abides by the law and complies with the constraints that the law creates. However, it should not unduly restrict the freedom of action of the operating organization. Experience has shown that one of the best ways of reconciling these two requirements is for the regulatory body to assume a reactive rather than a proactive attitude. With the reactive approach, the operating organization formulates plans, proposals or suggestions, and the regulatory body evaluates them and, on the basis of current safety criteria, determines to what extent they are acceptable.

### 6.5.2. Step by step licensing

Given the size and complexity of power reactors, and the fact that several years generally separate the planning stage from connection to the electric grid, it is not practicable for the regulatory body to grant one comprehensive licence. Some States require one licence, but subdivide it into several components. Other States require individual licences for different stages of construction and operation. The number and coverage of licences required vary from State to State, reflecting the legal framework and political culture of the State.

Many States have found it useful to have at least three licences, one for siting and construction, one for operation and one for the decommissioning of the power reactor. In other cases, there may be separate licences for siting and for construction, or the construction licence may consist of a building permit and a separate permit for the manufacture of major components, etc. For technical and economic reasons, the life of a power reactor is commonly subdivided into six stages:

(a) Siting;
(b) Design;
(c) Manufacturing and construction;
(d) Commissioning;
(e) Operation;
(f) Decommissioning.

The regulatory body will always proceed on the basis of a step by step authorization, whatever the nature and number of the licences required by law. The IAEA's International Nuclear Safety Advisory Group (INSAG) has presented a wealth of information on these six stages, which may be of interest to legislators (see Ref. [9]).

### 6.5.3. Continuous control

The operation of a power reactor usually spans a period of at least 30–40 years. The licence granted to the operating organization at the beginning cannot remain valid over such a long period. In the 1960s the operators of some power reactors built at that time were granted open ended licences conditional only on compliance with certain safety requirements. Since then, however, most States have found it preferable to grant an operating licence for a limited period, often ten years, at the end of which the power reactor is subjected to a thorough technical review and the licence may be extended for a further period once any necessary modifications have been made. Other States may extend the operating licence on a year by year basis, subject to specific requirements. In other cases, time limits have been set on the basis of political considerations, sometimes with different time limits for different power reactors in the same State.

In all cases, it is essential to inform the operating organization of the duration of its licence well before the licence is due to expire. Also, it is important in the interests of predictability and stability to give the operating organization some assurance that the duration of the licence will not be modified, except for safety reasons.

Whatever the duration of the licence, the regulatory body must be able to satisfy itself at all times that the safety obligations of the operating organization are being fulfilled. It must possess the necessary human and technical resources and must have free access to all relevant information. It must also have the legal right and the means to intervene if it considers that the obligations are not being fulfilled (see Chapter 3). The continuous control concept also applies in other areas, such as periodic safety reports, the consideration of lessons learned from exposure feedback, the establishment of backfitting programmes and the importance of maintenance programmes.

### 6.5.4. Modification, suspension or revocation of a licence

Nuclear legislation should give the regulatory body the right to modify, suspend or even revoke an operating licence. To preclude arbitrary decisions by the regulatory body and to give the operating organization guarantees on the

security of its investment, it is essential that the conditions under which such measures are justified be clearly specified in the legislation.

Given the current pace of technological progress, all nuclear power plants will reach a point at which, although they may still satisfy the requirements of their current licences, they will not reflect the most up to date safety standards. Backfitting will become necessary, and the regulatory body will have to determine which improvements are necessary from the safety point of view.

If safety backfitting is technically unfeasible or economically unacceptable to the operating organization, the latter may decide to close down the power reactor. If the regulatory body takes such a decision, however, that may be deemed to be expropriation and will require special legal procedures, depending upon the general legal system of the State. The situation will be different in the many States in which the State itself, or one of its agencies, is the operating organization.

In order to give the operating organization time to plan for and carry out the necessary backfitting, the regulatory body may extend the operating licence for a short period. This seems reasonable, but it is necessary to guard against the possibility that the operating organization will attempt to obtain a series of short extensions and thereby unduly extend the life of the power reactor.

## 6.6. ROLE OF THE OPERATING ORGANIZATION

As the operating organization bears the prime responsibility for safety, it must meet the three objectives set in the nuclear legislation: the general nuclear safety objective, the radiation protection objective and the technical safety objective.

The requirements of radiation protection are described in Chapter 4, and the principles referred to in that chapter are valid for all types of nuclear facility.

The requirements of nuclear safety are that the operating organization establish safety conditions, that it manage safety once it has been established and that it verify the way in which safety is managed. To do this, the operating organization has two groups of instruments at its disposal: technical ones, such as quality assurance and resort to proven engineering practice; and behavioural ones, such as safety culture. The importance of the latter instruments is now well established, although they can hardly be translated into legal obligations.

### 6.6.1. Management of safety

Regarding the first four stages in the life of a power reactor (siting, design, manufacturing and construction, and commissioning), the prime responsibility of the operating organization covers not only ensuring safety at present but also planning for safe operation after commissioning. The operating organization must take technical safety measures and comply with the binding provisions of the licence. In particular, it must apply the defence in depth principle, according to which, because of the presence of several physical barriers and several levels of protection, an unintended release of radioactivity into the environment cannot result from just a single failure, but requires multiple failures.

Once the power reactor has been commissioned, the operating organization must manage its safety continuously. It must:

(a) Establish policies for compliance with safety requirements;
(b) Establish procedures for the safe control of the plant under all conditions (including when the plant is undergoing maintenance);
(c) Maintain a sufficient number of competent and fully trained staff.

For the management of safety to be effective, the operating organization must have a very high level of commitment to safety, best expressed by a highly developed safety culture [3]. Safety culture places requirements upon the operating organization at three levels:

(a) Requirements at the policy level. The operating organization must make its responsibilities well known and understood in a safety policy statement. It must declare its objectives and the public commitment of its corporate management to safety.
(b) Requirements placed upon managers. It is the responsibility of managers to institute practices that foster attitudes conducive to safety. Managers should institute such practices in accordance with their organization's safety policy and objectives.
(c) Response of individuals. The response of all those who strive for excellence in matters affecting nuclear safety is characterized by:

    — A questioning attitude;
    — A rigorous and prudent approach;
    — Good communication.

The desired results are achieved only if the attitudes of individuals at all levels are responsive to the safety culture framework established by the management.

### 6.6.2. Verification of safety

Besides managing safety, as described above, it is essential that the operating organization verify it, by ensuring that events important for safety are reviewed in depth and that, when necessary, equipment is modified, procedures are revised and training is given in order to prevent a recurrence. Access to information on relevant experiences of similar facilities worldwide is essential for safety verification.

The operating organization must also carry out systematic reviews of safety in order to confirm that the safety analysis of the facility is still valid or, if necessary, to implement safety improvements. Such reviews must take into account the cumulative effects of technical modifications, changes to procedures, the ageing of components, operating experience and technical developments. Operational limits and conditions need to be reviewed at the same time and modified as required.

### 6.6.3. Other issues

Two other important aspects of safe management need to be mentioned. The first aspect is related to the management of radioactive waste. As soon as a facility has been commissioned, it starts producing radioactive waste. The proper management of this waste is dealt with in Chapter 10.

The second aspect is related to accident prevention. Despite following all safety measures, there is never a guarantee that accident prevention will be totally successful, even if the probability of an accident is extremely low. The operating organization must therefore make preparations for coping with accidents. In particular, it must prepare accident management procedures and on-site emergency plans before the commencement of operations. Such procedures and plans are dealt with in Chapter 7.

### 6.6.4. Decommissioning

All nuclear facilities will cease operation at some time and may be dismantled. Decommissioning is the process by which the facility is taken permanently out of operation. A facility that has been definitively shut down remains an operating facility and is subject to the normal control processes and

procedures in order to ensure its safety until it is decommissioned. The interim period that precedes decommissioning may last for several years.

The operating organization must consider, from the design stage, as far as reasonably possible, the radiation exposures and the releases of radioactive material to the environment that will accompany decommissioning. Similarly, during operation, the operating organization must give due consideration to the fact that the facility will ultimately be decommissioned. For example, good records of contamination incidents must be kept, as they will later facilitate characterization of the waste streams and planning for radiation protection during decommissioning.

## 6.7. CONDITIONS FOR A LICENCE

As explained in Section 6.3, the term nuclear facility covers facilities ranging from the simple to the very complex. In some cases, a single licence is granted for a given facility; in others, several licences are needed. Also, the validity of licences will vary considerably from case to case and from State to State.

Licence conditions are established by the regulatory body, often after consultation with the applicant. At present some States indicate in their nuclear energy legislation what the prerequisites are for a licence to be granted, but many do not. Given the fact that nuclear facilities and particularly power reactors are highly sensitive issues in many States, indicating the prerequisites in the legislation may be helpful as a means of increasing the transparency of the licensing procedure.

An organization applying for a licence must submit documents in support of its application, while the regulatory body must issue guidance relating to the content and format of such documents and to the deadlines for submission. The regulatory body may require that:

(a) The operating organization establish policies that give due priority to nuclear safety;
(b) All precautionary measures be taken on the basis of the present state of science and technology, to prevent damage due to the nuclear facility;
(c) A sufficient number of qualified staff with appropriate training be available for all safety related activities throughout the life of the nuclear facility;
(d) All necessary measures be taken to prevent and counter any interference by third parties (see Chapter 14, Physical Protection);

(e) Adequate financial resources be available to ensure the safety of the nuclear facility throughout its life;
(f) Human capabilities and limitations be taken into account throughout the life of the nuclear facility;
(g) Quality assurance programmes be established and implemented.

## 6.8. SPECIFIC ISSUES

As indicated above, the term nuclear facility covers several technically different types of facility. However, the need to ensure nuclear safety is common to all.

Whereas the nuclear safety goal may be attained through a variety of technical means, the necessary legal framework is the same for all. The most important point is that the legislation and regulations be commensurate with the nature of the risk to the public and the environment.

## 6.9. RESEARCH AND TEST REACTORS

At the time of preparation of this handbook, of the 651 research and test reactors that had been built worldwide, 284 were in operation and 109 had been decommissioned; the remaining 258 had been shut down but not decommissioned. Such reactors usually contain only a small amount of nuclear fuel, and many of them do not produce any power (zero power reactors). Some, however, contain high enriched uranium (i.e. material that is particularly suitable for making nuclear explosive devices). Most research and test reactors are located at universities or research centres in densely populated areas and are operated by teams of researchers who may be less familiar with the strict rules of the regulatory body than their colleagues at nuclear power plants.

The legislator should be aware of the safety issues raised by research and test reactors.

(a) Even though major accidents with very large releases of radioactivity can be excluded, the presence of such facilities in densely populated areas means that any uncontrolled release of radioactivity may have serious consequences.
(b) In many cases, the safety culture at such facilities is poor, as the academic and research environment does not lend itself to strict controls, which may be perceived as an obstacle to academic freedom, and researchers in

management positions often have other priorities than a strict adherence to the rules set by the regulatory body.

(c) Many of the 258 research and test reactors that have been shut down but not yet decommissioned are not really under strict control: they are not being monitored adequately, staff are moving away and documents are being lost.

From the point of view of the law, research and test reactors should be subject to stringent safety requirements, like those applicable to power reactors. The regulatory body may, however, wish to have simplified rules that will nevertheless ensure safe operation. A more important issue is that of the enforcement of such rules until decommissioning is completed (see Chapter 3). Once the conditions for the issuance of a licence have been established, they must be strictly adhered to for as long as the licence is valid.

## 6.10. CROSS-CUTTING RELATIONSHIPS

Besides safety in its broadest sense, the legal framework for nuclear facilities must take account of non-proliferation concerns, as many nuclear facilities contain fissionable material suitable for the fabrication of nuclear explosive devices, and liability concerns, as nuclear accidents can have enormous economic consequences. It follows that the co-ordination of a wide spectrum of legal instruments is necessary.

In the context of this handbook, the areas that need to be referred to are:

(a) Radiation protection (Chapter 4);
(b) Emergency preparedness and response (Chapter 7);
(c) Radioactive waste and spent fuel (Chapter 10);
(d) Safeguards (Chapter 12);
(e) Export and import controls (Chapter 13);
(f) Physical protection (Chapter 14).

Besides being related to each other, each of these chapters has cross-cutting relationships with areas outside the nuclear field, as indicated in each of them. These other cross-cutting relationships should not be neglected when nuclear legislation is being drafted.

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# Chapter 7

# EMERGENCY PREPAREDNESS AND RESPONSE

## 7.1. BACKGROUND

Nuclear and radiological emergencies and accidents may have a detrimental impact not only on the facilities in which they occur but also on the environment in the vicinity. Under certain circumstances, radioactivity may be transported by air or water to areas beyond the facility and may even cause long distance pollution, including pollution within the territories of other States.

This risk scenario applies especially to nuclear power plants and facilities with a similar risk potential, but it also may apply to the transport of nuclear material if, owing, for example, to a traffic accident, there is a release of radioactivity into the air or into water. Radioactive sources may also cause accidents. An accident with a radioactive source may be described as an event that leads to the loss of normal control over the source and which could entail the radiation exposure of individuals and the environment. The consequences may be trivial or, as the 1987 Goiânia accident proved, serious and requiring an emergency response.

Consequently, there must be a system in place designed to reduce the risk of emergencies and to mitigate their consequences. Such a system should provide the means necessary for dealing with the on-site and off-site effects of an emergency. Organizing emergency response at the international level requires co-operation with the competent bodies of other States. There has to exist an organizational and legal framework that makes possible and facilitates the establishment and implementation of emergency plans. There also have to be available trained staff, technical equipment and financial resources.

Emergency planning and preparedness are required for all human activities. It follows that in all States there already exist general organizational structures to deal with emergencies. Entities that carry out potentially hazardous activities are under a legal obligation to organize in-house emergency preparedness. State organizations like fire brigades step in if in-house measures cannot cope with the emergency. Special nuclear and radiological emergency planning may, as appropriate, be based on existing emergency organizations, which will probably need to be complemented by the provisions necessary for their specific purpose.

The obligation of the State to deal with emergencies derives from the State's overall duty to protect its citizens and residents against harm. The

obligation of the licensee to organize emergency planning and preparedness is part of its prime responsibility for nuclear and radiation safety.

## 7.2. GOALS AND ELEMENTS

On-site emergency preparedness comprises all measures necessary for detecting reliably and in a timely manner incidents likely to create an emergency, for keeping them under control and for bringing them to an end with as little damage done as possible. In the case of reactors, the main goal is to prevent core damage, to maintain or restore the cooling of the core and to bring the plant to a safe state. Mitigating measures may be necessary in order to avoid a serious radiation impact on the plant site and the environment. This applies, mutatis mutandis, to all nuclear facilities and nuclear and radiation activities.

Off-site emergency preparedness is aimed at minimizing the radiation exposure of the public and the environment. Basic elements are information exchange and assessment of the information available. It is especially important that on-site information be passed to off-site bodies, and vice versa. In the event of a release of radioactivity, information about the time of the release and the characterization of the activity released (the source term) is indispensable for decision making. In the event of a significant release of radioactivity to the environment, special measures to protect the population may be necessary, for example traffic control and limitation, appeals to the population to stay indoors, the evacuation of the population, the distribution of iodine tablets and the organization of immediate health care, including decontamination.

On-site and off-site emergency preparedness should be considered at all stages of the licensing procedure, and especially during the design and construction of facilities and radiation equipment in order to make possible and facilitate countermeasures.

## 7.3. IMPLEMENTATION OF EMERGENCY PREPAREDNESS

### 7.3.1. Legal framework

On-site and off-site emergency preparedness must be addressed in nuclear legislation.

With regard to the emergency measures to be prepared for by the licensee, there are two legal approaches that may be adopted alternatively or cumulatively: legislators may, in the nuclear legislation, expressly make it the

duty of the person responsible for the specific activity (the licensee) to organize and carry out the emergency response; and emergency preparedness can be made a prerequisite for the granting of a licence. In the licensing procedures, the respective concepts designed for the activity in question may be developed and established.

Emergency planning by State or local authorities also needs a legal framework. It may be necessary to amend and supplement existing legal provisions for emergencies, but existing structures and organizations should be maintained and the existing experience should be applied.

The law should provide for a single authority responsible for emergency response, including the notification of other entities. The authority should be the point of contact at which all information is collected and distributed. Overlapping or gaps between the competences of State and local authorities should be avoided. This is especially true for federal States, where conflicts may arise between the central government and the regional government. The legal framework should authorize the competent entities, in accordance with the constitution, to take measures that may interfere with the rights of persons, especially in the vicinity of an emergency. Countermeasures may require the evacuation of people and perhaps the enforcement of evacuation. There may have to be restrictions on the freedom of movement of people and on the use of or trade in contaminated food or animal feed.

State emergency response is not meant to replace the licensee's duty to react to emergencies, but is meant to supplement it if the licensee's resources are insufficient. The law should clearly define the fields to be covered by the licensee and those to be covered by State authorities. Responsibilities should be allocated in a way that excludes ambiguity.

There is one situation in which the State or local authorities have the prime responsibility for emergency preparedness, namely in the event that radioactive sources are not under the control of the person responsible for them but, for example, are lost or abandoned or in the State illicitly. As such sources may be discovered unexpectedly and in places far away from well equipped emergency response teams, the legal framework should ensure that the local police, fire-fighting or other services are trained and equipped to assess the situation provisionally and cope with it until special radiological emergency response teams arrive.

In order to respond to the transboundary consequences of a nuclear or radiological emergency, States should conclude appropriate arrangements with neighbouring States. Even States without programmes involving nuclear energy and radioactivity should conclude such arrangements in order to be able to cope with emergencies originating from neighbouring States.

### 7.3.2. Emergency plans

The principal means of ensuring adequate emergency preparedness and response is to establish and maintain on-site and off-site emergency plans.

The Convention on Nuclear Safety [2] and the Joint Convention [5] both require the Contracting Parties to take appropriate steps to ensure that they have in place on-site and off-site emergency plans that cover the actions to be taken in the event of an emergency. The plans should be tested before the nuclear installation goes into operation and subsequently be subjected to tests on a routine basis. Each Contracting Party is required to take appropriate steps to ensure that, insofar as it is likely to be affected by a radiological emergency at one of its nuclear installations, its own population and the competent authorities of the States in the vicinity of the nuclear installation be provided with appropriate information for emergency planning and response. Contracting Parties that do not have nuclear installations on their territories should also prepare emergency plans if they are likely to be affected by emergencies occurring in neighbouring States.

As required in, for example, the Basic Safety Standards (Ref. [1], Appendix V), competent authorities should ensure that:

(a) Emergency plans be prepared and approved for any facility, activity, practice or source that could give rise to a need for emergency intervention;
(b) Emergency intervention organizations be involved in the preparation of emergency plans, as appropriate;
(c) Emergency plans take into account the results of any accident analyses and any lessons learned from operating experience and from accidents that have occurred in connection with similar activities;
(d) Emergency plans be periodically reviewed and updated;
(e) Provision be made for training personnel involved in implementing emergency plans and that the plans be tested at suitable intervals;
(f) Prior information be provided to members of the public who could reasonably be expected to be affected by an accident.

Emergency plans should:

(a) Allocate responsibilities for notifying the relevant authorities and for initiating intervention;
(b) Identify operating and other conditions that could lead to a need for intervention;

(c) Specify intervention levels for protective actions and the scope of their application, with account taken of the possible degrees of severity of emergencies that could occur;
(d) Lay down procedures, including communication arrangements, for contacting emergency intervention organizations and for obtaining assistance from fire-fighting, medical, police and other services;
(e) Describe the methodology and instrumentation for assessing the accident and its consequences on and off the site;
(f) Describe the public information arrangements in the event of an accident;
(g) State the criteria for terminating each protective action.

Among the most important elements in emergency response is the early availability of the information necessary for evaluating the risk and choosing the right countermeasures. Procedures, including communication arrangements for contacting emergency intervention organizations and for obtaining assistance from various services, are therefore of particular importance. There should be a constantly updated list of relevant addresses with telephone and fax numbers and e-mail addresses.

In general, on-site emergency plans are implemented by the licensee, while the implementation of off-site emergency plans and of any transboundary emergency plan is the responsibility of State or local authorities.

## 7.4. INTERNATIONAL CO-OPERATION

### 7.4.1. Obligations under public international law and relevant conventions

Close co-operation with neighbouring States is essential for an effective regime for dealing with the consequences of a radiological accident.

It is a generally accepted principle of public international law that States that permit potentially hazardous activities within their territories must ensure that these activities do not have significant detrimental effects on the territories of other States. As a consequence of this principle, States are obliged to mitigate detrimental effects on the territories of other States and to pay compensation for damage suffered. One may conclude from this legal situation that States are obliged to offer to co-operate with an affected State in jointly organizing emergency response arrangements.

The obligations with regard to transboundary emergency planning established by the Convention on Nuclear Safety [2] and the Joint Convention [5] have already been mentioned in Section 7.3.2. Moreover, the Assistance Convention [7] and the Early Notification Convention [6] are

international instruments designed to establish a basis for international emergency response that takes into account the lessons learned from the Chernobyl accident.

The Contracting Parties to the Early Notification Convention undertake to provide exact information in order to facilitate the organization of countermeasures. Accordingly, most Contracting Parties have made known to the IAEA and to other Contracting Parties their competent authorities and the points of contact responsible for providing and receiving the information to be provided under this convention. The points of contact, and a corresponding focal point within the IAEA's Secretariat, are required to be permanently accessible.

The Early Notification Convention, which provides only a general framework, suggests that, where deemed appropriate, States should consider concluding bilateral or multilateral arrangements to establish detailed legal frameworks for the transboundary exchange of information on accidents.

The Assistance Convention is also a framework agreement, designed to establish a general basis for mutual assistance in the event of a nuclear accident or radiological emergency. A Contracting Party may call for assistance from any other Contracting Party, from the IAEA or from other international intergovernmental organizations. Contracting Parties are required to identify and notify the IAEA about experts, equipment and materials that they could make available for the provision of assistance to other Contracting Parties in the event of a nuclear accident or radiological emergency. They are also required to make known to the IAEA, and to one another, their competent authorities and points of contact authorized to make and receive requests for and to accept offers of assistance.

### 7.4.2. The IAEA's ENATOM

In 1989, in order to facilitate the practical implementation of the Early Notification Convention and the Assistance Convention through co-ordination of the measures taken by States pursuant to them, the IAEA issued an Emergency Notification and Assistance Technical Operations Manual (ENATOM, latest edition effective as of 1 December 2002) [10]. ENATOM provides guidelines for IAEA Member States Parties to the two conventions, for relevant international organizations and for other States regarding the development of mechanisms for co-operation with the IAEA within the framework of the conventions. In addition, it describes the IAEA's role in the regime established by the two conventions and the desired interaction between the IAEA and the States involved.

Legislators may wish to build upon the ENATOM concept when establishing a legal framework for emergency preparedness and response. ENATOM describes the objectives of the IAEA emergency response system as derived from the IAEA's statutory responsibilities and from the functions assigned to the IAEA in the two conventions. It underlines the importance of contact points at the national level and at the IAEA.

In order to ensure the rapid exchange of clear information, an emergency classification has been developed, which is spelled out in ENATOM.

For events inside nuclear facilities, three classes of emergency have been defined: Alert, Site Area Emergency and General Emergency. Events below the level of Alert are not considered to be emergencies; they are classified as unusual events, which may be reported but do not trigger response actions.

For events outside nuclear facilities, four classes of emergency have been defined: Radiological Accident, Missing Source, Satellite Re-entry and Elevated Radiation Levels.

If an event belonging to the first three classes constitutes a transboundary emergency of radiological significance, States Parties to the Early Notification Convention are required to notify the IAEA Emergency Response Centre.

The IAEA is prepared to send, immediately upon request, qualified personnel to requesting States for the purpose of helping to assess the radiation situation and for making recommendations.

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# Chapter 8

# MINING AND MILLING

## 8.1. BACKGROUND

Mining is the process of extracting materials from the Earth; milling is the operation whereby the extracted materials are finely ground in order to facilitate the separation of the valuable materials, primarily uranium and thorium ores in the case of materials intended for nuclear related activities. Besides uranium and thorium mines, there are mines in which radioactive ores are a non-negligible by-product of the mining of some other valuable material (e.g. gold or tin). Mining operations fall into three categories: open pit mining, underground mining and in situ leaching. Open pit mining is best suited for low grade ores and involves moving large volumes of material; underground mining is the usual way of extracting smaller volumes of higher grade ore; and in situ leaching is a process whereby a chemical solution is made to circulate underground and dissolve the ore, which is then extracted from the solution.

The air in underground uranium and thorium mines and in some other underground mines contains elevated levels of radon (a gaseous radionuclide), which may represent a health risk. Radiological exposure resulting from mining and milling can occur in a number of ways, including the inhalation of radon decay products, the inhalation of airborne dust, direct exposure to gamma radiation and the ingestion of material contaminated with radionuclides from the operation. Also, the residues from the milling operation (called tailings) will, if left uncovered, release radionuclides into the air and the aquatic environment.

Most States in which uranium is being mined have a mining tradition that goes back to before the discovery of radioactive ores and therefore already have in place an infrastructure of mining laws and regulations. These laws and regulations constitute the legal basis for most aspects of the mining of radioactive ores. The particular measures required for radiation protection are an addition to the existing legal basis. Before drafting new legal instruments, the legislator should take the existing legal basis into account.

## 8.2. OBJECTIVE

In the mining and milling context, the purpose of nuclear legislation is to ensure that the mine or mill workers, the public and the environment are

adequately protected against radiological hazards while the mine or mill is in operation. Such legislation must also provide for radiation protection before the opening of the mine (during the period of exploration) and after the closure of the mine or mill. Waste rock (from the operation of the mine) and mill tailings are forms of radioactive waste, which is dealt with in Chapter 10.

## 8.3. SCOPE

The scope of nuclear legislation cannot be limited to the mining and milling of uranium and thorium bearing ores; such legislation must cover all mining and milling operations that require radiation protection measures. Where the measures do not differ from those that generally apply, they are described in Chapter 4.

Mining is part of a chain of activities that starts with prospecting, continues with exploration and then the actual mining operations, and, once the mine has been closed, ends with decommissioning and the rehabilitation of the landscape. Prospecting, the initial search aimed at detecting the presence of radioactive ores, does not as a rule expose prospectors to radiological hazards and is therefore not discussed further in this chapter. By contrast, exploration commonly involves trenching and drilling, which can release radioactive dust and sludges (the drill cores may also represent a radiological hazard). Although exploration does not always lead to the development of a mine, it must at least be monitored.

Large volumes of water accompany mining operations (e.g. water from the dewatering of the mine) and milling (e.g. tailing ponds and tailings mud). This water is radioactive and cannot be allowed simply to escape into the environment. It is important therefore that legislation cover not only the mining and milling sites but also their surrounding environment.

Finally, after the end of operations and the closure of the mine or mill, the regulatory body will have to arrange for decommissioning and the rehabilitation of the land. The principle of not imposing an undue burden on future generations will then have to be observed (the sustainable development principle, as discussed in Section 1.4.7).

From exploration to rehabilitation, mining comprises a series of highly complex technological operations, often extending over several decades, which cannot be properly controlled without numerous regulations. However, nuclear legislation must be limited to those general principles that are necessary for building the framework in which such regulations are embedded. This handbook does not enter into the details of the regulations.

## 8.4. ACTIVITIES AND FACILITIES REQUIRING A LICENCE

A licence from the regulatory body is required for all uranium and thorium mining and processing operations, but also for all other mining and processing operations for which radiation exposure requires special control measures.

The licence must cover:

(a) Any exploration activity involving possible exposure to radiation;
(b) The removal of uranium or thorium ore from the site for testing or evaluation (unless exempted by the regulatory body);
(c) Excavation activities at a site with uranium or thorium ore;
(d) The siting, construction and operation of the mine or processing facility;
(e) The transport of the product of the mining or milling activities;
(f) The decommissioning of the mine or processing facility.

The facilities that require a licence include, besides the mine itself, all surrounding buildings located within the perimeter of the mine or of the mill, any systems transporting ore from the mine to the mill and from there to the waste dump or to the tailings pond (e.g. piping, pumping, conveyor belts and rail or road vehicles) and any other facilities designated by the regulatory body.

## 8.5. LICENCE CONDITIONS

The regulatory body may issue a licence for an activity or, in the case of a mine in which uranium or thorium is not the principal substance being mined and special control measures are not required (but where the radiation exposures should be reviewed periodically), simply register the activity.

A licence can be issued if the applying organization:

(a) Demonstrates that it and its staff are properly qualified;
(b) Has taken the measures necessary for the protection of the health of workers and the public;
(c) Has taken the measures necessary for maintaining physical security and preventing unauthorized access to the premises;
(d) Has provided a safety assessment covering the nature, magnitude and likelihood of exposure to radiation and of possible contamination of the environment;
(e) Has provided an environmental impact assessment;

(f) Has shown that there will be sufficient human and financial resources to ensure the safe closure and decommissioning of the mine;
(g) Has adequate liability insurance coverage;
(h) Has taken measures necessary for inspectors of the regulatory body to have access to the premises and to documents relevant to the licence conditions.

## 8.6. SPECIFIC ISSUES

### 8.6.1. Experts

Because of the importance of effective radiation protection in uranium and thorium mining and milling operations, the operating organization may be required to have a staff of qualified experts in at least three fields:

(a) Radiation protection and dosimetry;
(b) Ventilation;
(c) Occupational medicine.

The duties and qualifications of such experts are specified by the regulatory body.

### 8.6.2. Effluents

Permanent monitoring of the air and water in and around facilities is a necessity. A distinction should be made between mine drainage water and mill water, on the one hand, and surface drainage water, on the other, and the former, which is radiologically contaminated, should be kept away from the latter. The regulatory body should prescribe appropriate monitoring measures.

Air contamination has essentially two causes: radioactive dust and radon gas. Radioactive dust derives from milling operations and from dried out tailings ponds and, to a lesser degree, from underground drilling and blasting. The regulatory body should ensure that appropriate regulations are in place and are being complied with.

Radon gas escapes from the rock in mines and during milling operations. In underground mines and in mills, good ventilation is the most effective protection. Under certain conditions radon gas may also accumulate in the deeper sections of open pit mines; appropriate ventilation should also be provided.

### 8.6.3. Waste

The radioactive waste at a mine site is in principle no different from other radioactive waste, and therefore falls under the same legislation. However, mining waste and tailings represent large to very large volumes of variously radioactive material stored on the surface of the Earth. The legislation must ensure that the licensee applies appropriate measures to guarantee the safety of workers, the public and the environment not only during the operation of the mine but also after closure.

### 8.6.4. Closure and rehabilitation

A number of measures are necessary after the end of the useful life of a mining or milling facility. In particular, the legislation should make it an obligation for the licensee to ensure that the facility is kept in a safe and stable condition and that releases of radioactive contaminants are within regulatory limits and ALARA, social and economic factors being taken into account. If, after the closure of the facility, an unplanned release of radioactive material into the environment is detected, the licensee is still responsible for taking appropriate measures.

The regulatory body should ensure that, after decommissioning, the licensee restores the mine area to a state that is safe for future generations and in a form acceptable to the regulator. Where economically feasible, galleries, shafts and open pits should be filled with waste. The necessary financial resources required to achieve this should have been set aside in accordance with the terms of the original licence. When planning for decommissioning, one must decide to what degree long term site integrity will be maintained by passive design features or by continuing active surveillance.

With the passive design approach, reliance is placed on gentle slopes, substantial earth cover, rock armouring and, where appropriate, linings for groundwater protection. With the active surveillance approach, passive features (thinner earth cover, little or no rock armouring, etc.) are minimized and the integrity of the site is maintained through continuing surveillance, followed by maintenance and repair when required. The two approaches are not mutually exclusive, and the final design should represent the optimum balance between the two.

## 8.7. CROSS-CUTTING RELATIONSHIPS

Generally, mines are under the control of a mining regulatory body that ensures that mining and labour laws are respected. However, the nuclear safety or radiation protection regulatory body may be a separate authority that supervises all mines in which radioactivity may represent a health hazard. Given the nature of mining operations, the two regulatory bodies should collaborate closely. Such collaboration is not always easy to establish, and operators may try to exploit differences in the regulatory approach between different regulatory bodies. The legislation must determine which mechanism will apply if collaboration is not smooth. Many mechanisms are possible, depending on the legislative framework of the State.

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# Chapter 9

# TRANSPORT OF RADIOACTIVE MATERIAL

## 9.1. BACKGROUND

A special feature of the transport of radioactive material is the mobility of the risk source; that is, the mobility of the material being transported. Unlike the situation in a stationary facility, the environment of the material being transported is subject to change. Mobility creates safety problems, but it may at the same time provide a safety advantage, since the material can easily be removed from an endangered or a dangerous environment.

The two main technical means of protecting against hazards due to the transport of radioactive material are the containment of the material and the control of external radiation levels. Criticality and damage caused by heat must also be taken into consideration in the transport of nuclear fuel elements.

## 9.2. LEGAL MEANS OF ENSURING THE SAFE TRANSPORT OF RADIOACTIVE MATERIAL

### 9.2.1. National nuclear law provisions

Like all nuclear related activities, the transport of certain radioactive material requires a prior licence, sometimes called a competent authority approval. The licence holder is normally the carrier of the material. National legislation may, however, require that other persons involved in the transport operation, such as the consignor (the person who prepares the transport operation) or the consignee (the person who receives the consignment), also posses a competent authority approval. In addition, for the international transport of radioactive material, an export or import licence may be required (see Chapter 13).

In legal terms, the transport of radioactive material is a quite normal operation covered by the permission principle and the continuous control principle (as discussed in Chapter 1). The process of obtaining a licence for the transport of radioactive material is substantially identical to that of obtaining licences for other forms of nuclear related activities (see Ref. [4]). However, the procedure for determining the applicable safety provisions varies and is therefore explained in more detail below.

### 9.2.2. Model Regulations of the United Nations and the IAEA Regulations for the Safe Transport of Radioactive Material

A basic feature of all systems of rules to control the transport of dangerous goods is grouping on the basis of the hazards presented by the goods during transport; the intended use of the dangerous substance or article is seldom important in this context. This was a basic feature of the Recommendations on the Transport of Dangerous Goods, published in 1956 by the United Nations Committee of Experts on the Transport of Dangerous Goods [11].

These recommendations have been regularly amended and updated at succeeding sessions of the Committee of Experts. They now contain a nine class substance identification and classification system based on hazardous properties:

Class 1: Explosives.
Class 2: Gases.
Class 3: Flammable liquids.
Class 4: Flammable solids; substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gases.
Class 5: Oxidizing substances and organic peroxides.
Class 6: Toxic and infectious substances.
Class 7: Radioactive material.
Class 8: Corrosive substances.
Class 9: Miscellaneous dangerous substances and articles.

Thus in 1959 the necessity of co-ordination with the IAEA in the drafting of recommendations relating to the transport of radioactive, Class 7, material was recognized. This led to continuing co-operation between the Committee of Experts and the IAEA.

In the meantime, the Committee of Experts had adopted a first version of subsequent legislation, Recommendations on the Transport of Dangerous Goods: Model Regulations (the Model Regulations) [12]. In respect of radioactive material, the Model Regulations were developed on the basis of the 1996 edition of the IAEA Regulations for the Safe Transport of Radioactive Material (the IAEA Transport Regulations) [13]. As a result, the IAEA Transport Regulations are now both a standalone document and part of the Model Regulations.

### 9.2.3. International instruments

At the international level, the Model Regulations and therefore the IAEA Transport Regulations are implemented through incorporation into various mode related international instruments.

The Model Regulations have become mandatory for air transport through the International Civil Aviation Organization (ICAO) Technical Instructions [14], as annexed to the Convention on International Civil Aviation (the Chicago Convention) [15]; also, the International Air Transport Association (IATA) has made compliance with them a prerequisite for the transport of dangerous goods by air.

For sea transport, the International Maritime Dangerous Goods Code (the IMDG Code) [16] has been made mandatory through incorporation into the text of chapter VII of the International Convention for the Safety of Life at Sea (the SOLAS Convention) [17]. The IMDG Code implements the provisions of the Model Regulations.

For land transport, the Model Regulations of the United Nations Economic Commission for Europe embody the text of the Model Regulations and are reflected in, inter alia, the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) [18], the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID) [19] and international treaties dealing with the transport of dangerous goods by special means of transport.

Even States that are not Parties to these instruments may decide and are encouraged to use the aforementioned regulations as a basis for national legislation on the transport of radioactive material. A compilation of all relevant international instruments and regulations concerning the safe transport of radioactive material is provided in IAEA document GOV/1998/17, on the Safety of Transport of Radioactive Material [20].

### 9.2.4. IAEA Regulations for the Safe Transport of Radioactive Material

The IAEA Transport Regulations address all categories of radioactive material, ranging from very low activity material, such as ores and ore concentrates, to very high activity material, such as spent fuel and high level waste. As indicated above, they apply to the transport of radioactive (Class 7) material by all modes (i.e. air, sea and land). As defined in the IAEA Transport Regulations (Ref. [13], para. 106):

> "Transport comprises all operations and conditions associated with and involved in the movement of *radioactive material*; these include the

design, manufacture, maintenance and repair of *packaging*, and the preparation, consigning, loading, carriage including in-transit storage, unloading and receipt at the final destination of loads of *radioactive material* and *packages*."

The IAEA Transport Regulations establish requirements with regard to the marking, labelling and placarding of conveyances, documentation, external radiation limits, operational controls, quality assurance, notification and the approval of certain shipments and package types.

Under the IAEA Transport Regulations, a licence or "competent authority approval" is required for:

(a) The designs of packages;
(b) Special arrangements (i.e. arrangements whereby consignments that do not satisfy all the applicable requirements may be transported);
(c) Certain shipments, as specified in the Transport Regulations;
(d) Radiation protection programmes for special use vessels;
(e) The calculation of radionuclide specific values for the exemption and maximum content of Type A packages ($A_1$ and $A_2$).

Depending on the type of package used for the transport of radioactive material, different design requirements apply.

Finally, and most importantly, the material to be transported must be categorized on the basis of its activity concentration, total activity, fissile characteristics (if any) and other relevant characteristics. The packaging is then specified on the basis of the hazard posed by the package contents; it will range from normal commercial packaging (for low hazard contents) to packaging that meets strict design and performance requirements (for higher hazard contents).

Beginning in 2000, the IAEA Transport Regulations are being revised in a two-year cycle. As a consequence, adjustments will be made through the Model Regulations to the relevant, above discussed, mode related international instruments.

The IAEA Transport Regulations are complemented by Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material [21].

### 9.2.5. Incorporation of the IAEA Transport Regulations into national law

Legislators have to decide how they will incorporate the regulations described above into national law. If the constitution of the State permits,

legislators may make them binding by simple reference to them. However, most national legal systems require a translation into the national language of the State in question. In most cases, therefore, the regulations need to be translated in order to be implemented at the national level (see also Chapter 1).

For that reason, legislators very often create an interlink between the IAEA Transport Regulations and the relevant requirements of the national nuclear law, making compliance with them a prerequisite for the granting of a licence or "competent authority approval". For lower risk material, there exists national nuclear law provisions that state that no licence is necessary if transport of the material is conducted in compliance with the requirements of the IAEA Transport Regulations.

## 9.3. CROSS-CUTTING RELATIONSHIPS

### 9.3.1. Change of jurisdiction during international transport

The transport of radioactive material from one State to another entails a change of national jurisdiction. This fact, of course, is a serious impediment for transport. If the States involved in a transport operation, including any transit States, are Parties to the relevant conventions on the transport of dangerous goods, the problem is mitigated, since the conditions for transport are identical within the territories of the Contracting Parties. Nevertheless, additional licences may be necessary. Also, there is a question of liability in this context. However, if States are Contracting Parties to the same international nuclear liability convention (see Chapter 11), the potential problems are minimized. States should therefore consider adhering to both the relevant transport convention and to the relevant nuclear liability conventions in order to facilitate the transboundary transport of radioactive material.

### 9.3.2. Transboundary movement of spent fuel and radioactive waste

The Joint Convention [5] contains in Article 27 special regulations and obligations with regard to the transboundary movement of spent fuel and radioactive waste. It requires that the transboundary movement of such material should not take place without the consent of the State of destination, that the transboundary movement of such material through States of transit be subject to the international obligations relevant for the particular modes of transport utilized and that the State of origin of the material undertakes to ensure that the material is always subject to these international obligations.

Article 27 of the Joint Convention [5] facilitates the movement of spent fuel and radioactive waste. It is a complement to the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (the Basel Convention) [22]. The Basel Convention does not address radioactive waste in its annexes I–III, but rather excludes radioactive waste from its scope of application if it is subject to another control system. The States Parties to these two conventions have to ensure through their domestic legislation that the requirements of the conventions are met.

### 9.3.3. Physical protection of nuclear material

The Convention on the Physical Protection of Nuclear Material (CPPNM) [23] of 1979 provides for certain levels of physical protection to be applied to nuclear material used for peaceful purposes on the territories of Contracting Parties as well as to their ships and aircraft during international nuclear transport. The Contracting Parties commit themselves not to undertake, or authorize undertaking, such international nuclear transport unless assurances are provided that nuclear material will be protected at the required levels. Parties to the convention must also apply the agreed levels of protection to nuclear material that during transit from one part of their territory to another will pass through international waters or airspace. The Party responsible for receiving the assurances described above must provide advance notice of the transfer to the States through whose territory the nuclear material will pass (see also Chapter 14).

### 9.3.4. Other

Finally, the international transport of radioactive material may raise questions of liability (see Section 9.3.1 and Chapter 11). In addition, it may be subject to restrictions on nuclear non-proliferation grounds (see Chapter 13).

## 9.4. SUMMARY

The international and national transport of radioactive material is in many States a politically sensitive and complex matter. It involves issues of protection against risk where complex questions of nuclear liability have to be resolved if an incident occurs. However, a comprehensive corpus of rules has been developed with a view to ensuring safety during the transport of radioactive material. It is important that States comply with these rules, including States with only small amounts of radioactive material (non-nuclear

States); such States may, as transit States, be affected by the transport of radioactive material through their territories. A comprehensive domestic legal system that incorporates the aforementioned rules creates the legal certainty necessary for protection against risk and for increased safety during the transport of radioactive material.

# Chapter 10

# RADIOACTIVE WASTE AND SPENT FUEL

## 10.1. BACKGROUND

As a by-product of non-radioactive ore mining, radioactive waste accumulated for centuries before radioactivity was discovered. The first use of radium for medical treatment and of uranium for watch dials produced a new kind of radioactive waste, but large volumes of such waste have been accumulating only since the middle of the twentieth century, with the development of nuclear power.

For instance, in the Russian Federation alone the solid radioactive waste associated with nuclear power generation would represent a block 200 metres high and one square kilometre in area. However, highly radioactive waste represents only a small fraction of that volume.

The Joint Convention [5], which entered into force in June 2001, created an international legal framework for national laws. Like all legislation in this area, the Joint Convention addresses three major difficulties: the first is that radioactive waste will need to be managed safely well beyond the present generation. The second is that one State's radioactive waste may be another State's resource (in the Joint Convention, radioactive waste is defined as "radioactive material… for which no further use is foreseen by the Contracting Party…"). The third difficulty follows from the second one, in that some States reprocess nuclear fuel that has been irradiated in and then removed from nuclear reactors, and others do not: for those States that reprocess, the spent fuel is a resource, while for those that do not, it is radioactive waste.

Implicitly or explicitly, many States consider that radioactive waste should be disposed of in the State in which it was generated. Most of these States also consider that whoever was responsible for the generation of the waste should bear the responsibility for its disposal.

## 10.2. OBJECTIVE

The objective of nuclear legislation in this area should be to provide for ways and means of achieving and maintaining a high level of safety in the management of radioactive waste and spent fuel, and also to ensure that during all stages of radioactive waste and spent fuel management there exist effective defences against potential hazards, so that individuals, society and the

environment are protected from the harmful effects of ionizing radiation (see Article 1 of the Joint Convention [5]).

## 10.3. SCOPE

This chapter applies to all liquid, gaseous and solid radioactive waste resulting from human activity, within or outside the nuclear fuel cycle, including liquid and gaseous effluents cleared by the regulatory body before being released into the environment; radioactive sources for use in medicine, agriculture, research and industry that are to be disposed of; and spent fuel that has been declared to be radioactive.

Some industries handle bulk quantities of naturally occurring radioactive material (NORM), whose radioactivity is incidental to the use to which the material is being put (see Chapter 8). When NORM represents a non-trivial risk to the population, it is treated as radioactive waste.

This chapter also applies to radioactive waste resulting from past practices and to all radioactive waste management facilities, past, present and future.

Waste material that is radioactive but of no regulatory concern, because of the low risk it presents to individuals, society and the environment, lies outside the scope of this chapter (see Section 4.4).

## 10.4. ACTIVITIES AND FACILITIES REQUIRING A LICENCE

Any owner of and any person handling radioactive waste must be licensed.

Siting, designing, constructing and operating a radioactive waste management facility can be authorized only if the owner and the operator of the facility have been licensed by the regulatory body. All licences should be limited in time. In the case of disposal facilities, however, the licence should not expire with the closure of the facility, but only when the regulatory body decides that active institutional control of the facility is no longer required.

The primary responsibility for the safety of radioactive waste management facilities rests with the holder of the relevant licence. Where there is no such holder, as in the case of some past practices, the responsibility rests with the State, as administered by the relevant regulatory body.

Licence conditions will vary with, for example, the type of waste, its radioactivity, its volume and the method of storage or disposal that is planned for it. In all cases, however, the regulatory body:

(a) Will only license facilities that are adequately justified (i.e. that are expected to produce sufficient benefit to offset the radiation detriment that they may cause);
(b) Will, if appropriate, set operating limits (e.g. limits on the volumes to be handled) and limits on the doses that any individual may incur;
(c) Is entitled to receive all information that it considers to be necessary for arriving at a balanced judgement regarding the activity or facility to be licensed.

The requirements of the regulatory body should reflect the potential magnitude and the nature of the hazard presented by the activity or the facility to be licensed.

## 10.5. CONDITIONS FOR THE ISSUANCE OF A LICENCE

The regulatory body may issue a licence if the potential licensee:

(a) Has the necessary qualifications.
(b) Guarantees the safe operation of the facility.
(c) Demonstrates, at the design and construction stages, that:
  — Adequate measures have been taken to limit the potential radiological impact on humans and the environment;
  — A systematic safety assessment has been carried out;
  — An appropriate environmental assessment has been carried out.
(d) Has completed, before the operation of the facility starts, a commissioning programme demonstrating that the facility complies with the safety requirements.
(e) Has prepared, in the case of a disposal facility, a plan for the closure of the facility that will allow for active and passive institutional controls.
(f) Has the knowledge necessary to ensure at all times the safety of workers, the public and the environment.
(g) Has sufficient financial means for the task to be accomplished, including appropriate liability insurance.
(h) Can rely on qualified staff for safety related activities during the operating lifetime of the facility.
(i) Has prepared an appropriate decommissioning plan (for all facilities other than disposal facilities).
(j) Has developed an emergency preparedness plan.
(k) Maintains proper records of the location, volume or mass and activity of the radioactive waste that has been stored or disposed of.

(l) Has made adequate efforts to minimize the volume of the radioactive waste wherever possible.

## 10.6. SPECIFIC ISSUES

### 10.6.1. Storage and disposal

The difference between storage and disposal is that the first implies an intention to retrieve the radioactive waste and the second implies an intention not to retrieve it. The licensed owner of the waste has, by law, an obligation to dispose of it; this applies to low level waste (e.g. from hospitals) as well as to waste from power reactors. The law cannot specify the maximum duration of storage, but it should ensure that an extended storage does not become de facto disposal.

### 10.6.2. Long term planning for disposal sites

Since the radioactivity of some elements in radioactive waste decreases extremely slowly, the management of some existing radioactive waste will extend over several thousand years. The institutional control of disposal sites must therefore be planned for 10 000 years or more. However, since extrapolation into the future over such periods has little predictive value, relatively short intervals between the examination of the conditions at disposal sites will be necessary. As the technical safety of disposal sites can reasonably be guaranteed for a few hundred years, safety reviews every hundred years or so have been suggested as one way to ensure that no undue burden is placed on future generations.

The safety of disposal sites for high level waste must be independent of institutional control. Records should be kept and the regulatory body may require that monitoring be carried out, but the safety of the disposal site should not rely on such measures.

It is possible that gradual releases of radioactivity from disposal sites will occur at some time in the future. The regulatory body should ensure that the predicted doses to individuals in a critical group[2] are less than the dose upper band[3] that it has determined.

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[2] A group of members of the public that is reasonably homogeneous with respect to its exposure and typical of individuals receiving the highest dose.

[3] Upper limit of the annual doses that members of the public should receive from the planned operation of any controlled source.

### 10.6.3. Past practices

Legislation on radioactive waste must take into account not only the future but also the past. For example, large volumes of radioactive waste from former mining and milling operations must be placed under regulatory control. The law should specify that the legal owner of the waste is responsible for its safe disposal. If the legal owner is unknown or has ceased to exist, responsibility for disposal will rest with the State. Before any intervention is decided, the regulatory body should compare the risks created by an intervention with those resulting from the existing situation. Given the numerous possibilities, and the variability of geographical, economic, radiological and other factors, no general recommendation can be formulated in this regard (see Chapter 4).

### 10.6.4. Sorting and packaging of radioactive waste

Since the radioactivity of radioactive waste covers such a broad spectrum and the half-lives of elements extend from a few seconds to billions of years, the radioactive material making up the waste should be segregated in such a way as to ensure the compliance of waste packages with the requirements for storage and disposal. In most cases, the radioactive waste from a facility will undergo pretreatment, treatment and conditioning before disposal.

### 10.6.5. Export and import of radioactive waste

Every State has the right to ban the import of foreign radioactive waste into its territory and the export from its territory of radioactive waste generated there. If a State decides to participate in the transboundary movement of radioactive waste, it must ensure that individuals, society and the environment are adequately protected from the possible hazards associated with such movement. In order to do so, the State should ensure that the provisions of the Joint Convention [5], and particularly those of its Article 27, are complied with (see also Section 9.3.2).

### 10.6.6. Radioactive waste as an end product

Unlike most other nuclear related activities (such as the operation of a reactor or a teletherapy unit), the generation of radioactive waste is only the last stage of a series of activities. As far as possible, the effects on future radioactive waste management should be taken into account when any nuclear related activity is being contemplated. The interdependencies among all steps in radioactive waste generation and management must be taken into account.

## 10.7. CROSS-CUTTING RELATIONSHIPS

Given the nature of radioactive waste and the interdependencies referred to above, most topics considered in this handbook are linked in one way or another to radioactive waste. This is particularly true for radiation sources (discussed in Chapter 5), mining and milling (discussed in Chapter 8) and transport (discussed in Chapter 9). As nuclear non-proliferation measures are applied to nuclear fuel, spent fuel is important in the context of safeguards (Chapter 12) and physical protection (Chapter 14). As some States consider spent fuel to be radioactive waste, co-ordination of these aspects with the issues dealt with in this chapter must also be taken into consideration by these States.

In some States, mining laws (if applicable) and environmental laws are relevant to some aspects of legislation regarding radioactive waste.

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# Part IV

# NUCLEAR LIABILITY AND COVERAGE

# Chapter 11

# NUCLEAR LIABILITY AND COVERAGE

## 11.1. BACKGROUND

### 11.1.1. Need for a special regime

Nuclear related activities create risks of a specific character.

The 1986 Chernobyl accident confirmed prior theoretical assessments that a nuclear accident might cause damage of an extreme magnitude. The detrimental effects of such an accident do not stop at State borders; they may extend into regions far beyond the territory of the accident State. There may be damage to individuals, to property and to the environment in several States.

The damage caused by ionizing radiation to living cells, especially human cells, may not be immediately recognizable; it may be latent for a long time. Since the radiation doses received by living cells have cumulative effects, there may be damage caused by different sources of radiation. In many cases there is no typical radiation injury. Moreover, cancer may result from a radiological accident or from, for example, smoking.

Even in situations for which the highest standard of safety has been achieved, the occurrence of nuclear and radiological accidents cannot be completely excluded. Legislators must therefore provide legal regimes to compensate for nuclear damage.

The first step in this procedure is to determine whether the existing tort law is appropriate for dealing with questions of compensation for nuclear damage. All States that engage in nuclear related activities have concluded that general tort law is not an appropriate instrument for providing a liability regime adequate to the specifics of nuclear risks, and they have enacted special nuclear liability legislation.

Further, States recognized at an early stage that the possibility of transboundary nuclear damage required an international nuclear liability regime. International nuclear liability conventions are necessary in order to facilitate the bringing of actions and the enforcement of judgements without hindrance by national legal systems.

### 11.1.2. International nuclear liability conventions

The following international nuclear liability conventions have been concluded, at the worldwide level (open to all States):

(a) The 1963 Vienna Convention on Civil Liability for Nuclear Damage [24], revised in 1997 (the Vienna Convention): 32 Contracting Parties to the 1963 Vienna Convention; the 1997 Protocol revising it [25] is not yet in force.
(b) The 1997 Convention on Supplementary Compensation for Nuclear Damage [26] (not yet in force).
(c) The 1988 Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention (the Joint Protocol) [27]: 24 Contracting Parties (see below).

The following international nuclear liability conventions have been concluded at the regional level (open to Organisation for Economic Co-operation and Development (OECD) States; open to other States only if all Parties give their consent):

(a) The 1960 Paris Convention on Third Party Liability in the Field of Nuclear Energy (the Paris Convention) [28]: 15 European Contracting Parties, revised in 1964, 1982 and 2003 (2003 revision not yet in force).
(b) The 1963 Brussels Convention Supplementary to the Paris Convention (the Brussels Supplementary Convention) [29]: 13 European Contracting Parties, revised in 1964, 1982 and 2003 (2003 revision not yet in force).

The Vienna Convention and the Paris Convention establish comprehensive and almost identical regimes for civil liability for nuclear damage. The purpose of the Brussels Supplementary Convention is to provide for additional compensation out of national and international public funds in cases in which the compensation under the Paris Convention is not sufficient to cover all damage. The Convention on Supplementary Compensation for Nuclear Damage, which is based on either the Vienna Convention or the Paris Convention or national legislation in compliance with the Annex to the Convention, also provides for additional compensation out of international public funds. The Joint Protocol links the Vienna Convention and the Paris Convention for the purpose of ensuring that the benefits of one convention are also extended to the Parties to the other convention.

The main principles and the essential content of the nuclear liability conventions are today internationally accepted as appropriate legal means for dealing with nuclear risks. They form the international yardstick for assessing whether nuclear liability legislation is risk adequate. National legislators should consider the advantages of aligning their domestic nuclear legislation with these conventions.

Given the potential international dimensions of nuclear damage, a State may also wish to consider adherence to one or more of the nuclear liability conventions. Possible options are:

(a) The Vienna Convention and the Joint Protocol and/or the Convention on Supplementary Compensation for Nuclear Damage;
(b) The Paris Convention and the Joint Protocol and/or the Convention on Supplementary Compensation for Nuclear Damage and/or the Brussels Supplementary Convention;
(c) National nuclear liability legislation and the Convention on Supplementary Compensation for Nuclear Damage.

Provided that all the conventions are in force, any of these options would create treaty relations between that State and a number of other States. A State may wish to consider options that create treaty relations with as many States in its respective region as possible.

States have two options for the implementation of the conventions at the domestic level. They may transform the content of the conventions into a national liability law. This has the advantage that national legislative techniques and language can be used, but there is a risk of a misinterpretation of the treaty language. The other option, which avoids that risk, is to implement the conventions directly as self-executing instruments. The structure and language of the operative parts of the Vienna Convention and the Paris Convention and of the Annex to the Convention on Supplementary Compensation for Nuclear Damage provide for this option. This option has already been chosen by a number of States.

## 11.2. NUCLEAR LIABILITY PRINCIPLES

### 11.2.1. Main definitions

Application of the international nuclear liability regime created by the conventions and the corresponding national legislation will be triggered if a nuclear installation causes a nuclear incident. The terms ‘nuclear installation’ and ‘nuclear incident’ therefore form the core of the regime.

The definition of a nuclear installation in the nuclear liability conventions, which differs from that in the Convention on Nuclear Safety, is as follows:

> “any nuclear reactor other than one with which a means of sea or air transport is equipped for use as a source of power, whether for propulsion thereof or for any other purpose;

any factory using nuclear fuel for the production of nuclear material, or any factory for the processing of nuclear material, including any factory for the reprocessing of irradiated nuclear fuel; and
any facility where nuclear material is stored, other than storage incidental to the carriage of such material; provided that the Installation State may determine that several nuclear installations of one operator which are located at the same site shall be considered as a single nuclear installation."

A nuclear installation must have a person in charge: the operator. In the nuclear liability conventions the operator is the person designated or recognized as the operator of a nuclear installation by the Installation State (in the conventions, a 'person' is an individual or any other private or any public entity having a legal personality). Normally, the operator will be the person responsible for safety, namely the licence holder. However, States have discretion to designate any other person who is linked to the installation, for example the owner of the installation.

The term 'nuclear incident' means any occurrence, or any series of occurrences having the same origin, that causes nuclear damage or, but only with respect to preventive measures, creates a grave and imminent threat of causing such damage.

Since the occurrence has to cause nuclear damage, this concept is of decisive importance and must be defined. Of course, in general tort law the general concept of compensable damage already exists. It may be broader or narrower than the definition of nuclear damage in nuclear legislation. If States seek to obtain the benefits of a nuclear liability convention, however, they have to accept its definitions.

The definition of 'nuclear damage' in the revised Vienna Convention [25] reads as follows:

" "Nuclear damage" means:
(i) loss of life or personal injury;
(ii) loss of or damage to property;
and each of the following to the extent determined by the law of the competent court -
(iii) economic loss arising from loss or damage referred to in sub-paragraph (i) or (ii), insofar as not included in those sub-paragraphs, if incurred by a person entitled to claim in respect of such loss or damage;
(iv) the costs of measures of reinstatement of impaired environment, unless such impairment is insignificant, if such measures are

actually taken or to be taken, and insofar as not included in sub-paragraph (ii);

(v) loss of income deriving from an economic interest in any use or enjoyment of the environment, incurred as a result of a significant impairment of that environment, and insofar as not included in sub-paragraph (ii);

(vi) the costs of preventive measures, and further loss or damage caused by such measures;

(vii) any other economic loss, other than any caused by the impairment of the environment, if permitted by the general law on civil liability of the competent court,

in the case of sub-paragraphs (i) to (v) and (vii) above, to the extent that the loss or damage arises out of or results from ionizing radiation emitted by any source of radiation inside a nuclear installation, or emitted from nuclear fuel or radioactive products or waste in, or of nuclear material coming from, originating in, or sent to, a nuclear installation, whether so arising from the radioactive property of such matter, or from a combination of radioactive properties with toxic, explosive or other hazardous properties of such matter."

Finally, there must be a causal link between a certain nuclear installation and a certain occurrence and the damage suffered. The causal link has to be proved by the person claiming compensation. The conventions do not contain any provisions regarding causality; this issue is left to the law of the competent court (i.e. to national law), so States may apply the principles of causality applied in their national law. In most States not all causes of damage are legally relevant; remote causes are not considered. In many States the law requires 'adequate causality', which means that a cause is only legally relevant if that cause is generally likely to cause damage of the kind suffered.

### 11.2.2. Strict liability

The operator of a nuclear installation is held liable, regardless of fault. This is called strict liability, or sometimes absolute liability or objective liability. It follows that the claimant does not need to prove negligence or any other type of fault on the part of the operator. The simple existence of causation of damage is the basis of the operator's liability. Strict liability, which is an adequate basis for claims also in other potentially hazardous fields of activity, facilitates the bringing of claims by or on behalf of the victim.

### 11.2.3. Legal channelling of liability on to the operator

The operator of a nuclear installation is exclusively liable for nuclear damage. No other person may be held liable, and the operator cannot be held liable under other legal provisions (e.g. tort law). Liability is legally channelled solely on to the operator of the nuclear installation. This concept is a feature of nuclear liability law unmatched in other fields of law.

The Exposé des Motifs of the Paris Convention (as revised and approved by the OECD Council on 16 November 1982) [30] justifies this concept as follows:

> "Two primary factors have motivated in favour of this channelling of all liability onto the operator as distinct from the position under the ordinary law of torts. Firstly, it is desirable to avoid difficult and lengthy questions of complicated legal cross-actions to establish in individual cases who is legally liable. Secondly, such channelling obviates the necessity for all those who might be associated with construction or operation of a nuclear installation other than the operator himself to take out insurance also, and thus allows a concentration of the insurance capacity available."

With the exceptions of only Austria and the USA, all States that have enacted nuclear liability laws have accepted the concept of legal channelling. The USA has a system of economic channelling, which produces substantially the same result as legal channelling.

Legal channelling is today one of the principal aims of international harmonization. Some States may be reluctant to accept the concept, because they feel that it is unjust to exempt, for example, suppliers from any liability. However, those States should take into account the obvious benefits in terms of legal certainty that legal channelling brings for victims, and also the perhaps less obvious benefits in terms of legal certainty (an important cost factor) that it brings for operators.

The international conventions support the channelling concept by additional legal means. The main example is that the operator is also held liable for the transport of nuclear material from and to its installation. Unless approved in a special procedure, the carrier is not held liable for such transport damage, but the transport liability is also channelled to the operator. This approach also is a simplification of the legal situation.

### 11.2.4. Exonerations from liability

The operator is held liable even if the incident is caused by force majeure (i.e. 'an act of God'). Only certain kinds of special circumstances exempt the operator from liability. The operator will be exonerated from liability if it proves, for example, that the nuclear incident was directly due to an armed conflict, hostilities, civil war or insurrection, or that it resulted wholly or partly either from gross negligence of the victim or from an act or omission of the victim committed with intent to cause harm.

### 11.2.5. Limitation of liability in amount

The nuclear liability conventions permit contracting States (i.e. States that are Parties to them) to limit the liability of the operator of a nuclear installation in amount. Without express limitation, the liability of the operator would be unlimited. Only a few States apply the concept of unlimited liability of the operator of a nuclear installation, namely Austria, Germany, Japan and Switzerland. Other States limit the liability of the operator. The minimum liability amount under the revised Vienna Convention is 300 million Special Drawing Rights (SDRs) of the International Monetary Fund; the minimum amount under the revised Paris Convention is 700 million euros.

Limitation of liability in amount is clearly an advantage for the operator. Legislators feel that unlimited liability, or very high liability amounts, would discourage people from engaging in nuclear related activities. Operators should not be exposed to financial burdens that could entail immediate bankruptcy.

The liability amount has always been a major issue in the international nuclear liability debate. Whatever figure is established by the legislator will seem to be arbitrary, but, in the event of a nuclear catastrophe, the State will inevitably step in and pay additional compensation. Civil law is not designed to cope with catastrophes; these require special measures.

Consequently, the Brussels Supplementary Convention and the Convention on Supplementary Compensation for Nuclear Damage provide for the payment of additional compensation out of public funds in the event of damage in excess of the operator's liability amount.

### 11.2.6. Limitation of liability in time

In all legal systems there is a time limit for the submission of claims. In many States the normal time limit in general tort law is 30 years. Claims for compensation for nuclear damage must be submitted within 30 years in the event of personal injury and within 10 years in the event of other damage. The

30 year period in the event of personal injury is due to the fact that radiation damage may be latent for a long time; other damage should be evident within the 10 year period.

### 11.2.7. Congruence of liability and coverage

The nuclear liability conventions require that the operator maintain insurance or provide other financial security covering its liability for nuclear damage in such amount, of such type and in such terms as the Installation State specifies. This congruence principle ensures that the liability amount of the operator is always covered by an equal amount of money. The congruence principle is to the advantage both of the victims of a nuclear incident and of the operator. The victims have the assurance that their claims are financially covered, and the operator has funds available for compensation and does not need to convert assets into cash.

As unlimited financial coverage is not possible, the congruence principle will not apply where there is unlimited liability of the operator. For that reason, the nuclear liability conventions require that the operator, if liable without limitation, provide financial security up to an amount that is at least equal to the minimum liability amount under the convention in question (300 million SDRs under the revised Vienna Convention; 700 million euros under the revised Paris Convention).

In most cases the coverage is to be provided by the insurance industry. Since the capacity of the international insurance market is limited, the congruence principle sometimes seems to be an impediment to increasing the liability amount substantially. Very often, liability amounts are fixed on the basis of the coverage available on the insurance market.

Insurance against nuclear risks is to a certain extent different from insurance against other risks. There are not many nuclear clients of the insurance industry, but the amounts to be covered are relatively high. Legislators therefore sometimes encourage domestic insurance companies to organize nuclear insurance pools, in order to bring together the financial capacities of several companies. Moreover, nuclear insurance pools normally make use of the international insurance market by concluding reinsurance contracts. Today, most national nuclear insurance pools are able to provide coverage of 300 million SDRs per nuclear installation and incident. As such coverage is per nuclear installation and incident, if a nuclear incident entailing the payment of compensation occurs, the insurance policy must be reinstated.

If the yield of the financial security is inadequate to satisfy the claims for compensation, the Installation State must ensure payment out of public funds

up to the operator's liability amount or, in cases of unlimited liability, up to the coverage amount.

In some States the insurance industry does not have the capacity to provide coverage up to an amount of 300 million SDRs. The revised Vienna Convention offers two options for such cases: the amount of the operator's liability to be covered by insurance may be fixed at not less than 150 million SDRs provided that the State covers the difference between that amount and 300 million SDRs; or, for a maximum of 15 years from the entry into force of the Protocol to the Vienna Convention, a transitional amount of not less than 100 million SDRs is considered sufficient.

Coverage of the operator's liability may be provided by financial security other than insurance, but operators have not chosen this option very often. In States with a substantial number of nuclear installations, operators may pool their financial capacities in order to provide coverage jointly. This solution is used in Germany and in the USA. Another solution is for the State to provide coverage and charge the operator a fee.

Theoretically, there are further ways of covering the operator's liability (e.g. bank guarantees or the capital markets). However, they are not widely used, as they are apparently either too expensive or, from the point of view of regulatory bodies, too insecure.

### 11.2.8. Equal treatment

One of the leading principles of the nuclear liability conventions is the non-discrimination principle: the conventions and the national laws applicable under them must be applied without discrimination based on nationality, domicile or residence. This ensures in particular that victims in States other than the accident State are treated in the same way as victims in the accident State.

### 11.2.9. Jurisdiction

General procedural law may provide that many courts have jurisdiction to deal with the claims arising out of a major nuclear incident. This would, of course, be most problematic. For that reason, the nuclear liability conventions (as a general rule, with only a few exceptions) provide, firstly, that only courts of the State in which the nuclear incident occurs have jurisdiction and, secondly, that each State Party shall ensure that only one of its courts has jurisdiction in relation to any one nuclear incident. The concentration of procedures within a single court not only creates legal certainty but also excludes the possibility that victims of nuclear incidents will seek to submit their claims in States in which

their claims are more likely to receive favourable treatment. Such forum shopping is costly for operators and may result in the financial resources available for compensation being quickly exhausted, leaving other victims without compensation.

## 11.3. LIABILITY FOR NUCLEAR DAMAGE OCCURRING DURING TRANSPORT

It is mentioned in Section 11.2.3 that liability for nuclear damage occurring during transport is channelled on to the operator of a nuclear installation. The basic approach of the nuclear liability conventions to such transport liability is, in principle, clear and simple: for nuclear incidents involving nuclear material during transport, either the operator of the nuclear installation from which the material comes is liable or the operator of the installation to which the material is being sent is liable. In other words, either the sending or the receiving operator is held liable. By a written contract, the sending and the receiving operator agree at which transport stage the liability shifts from one operator to the other. In the absence of such a contract, the liability shifts from the sending operator to the receiving operator being liable when the receiving operator takes charge of the nuclear material. The storage of nuclear material incidental to transport has no influence on the transport liability, even if the storage takes place at a nuclear installation of a third operator.

If the nuclear material is being sent to a person within the territory of a non-contracting State, the sending operator remains liable as long as the material has not been unloaded from the means of transport by which it arrived in the territory of that State. If the nuclear material is being sent by a person within the territory of a non-contracting State to a receiving operator in the territory of a contracting State, with the receiving operator's written consent, the receiving operator is liable only after the material has been loaded on to the means of transport by which it is to be carried from the territory of the former State.

With regard to transport from and to non-contracting States, the legal situation is more complex than these two liability rules suggest: nuclear liability conventions apply only if the general principles of private international law permit. Private international law may also point at the law of the non-contracting State or at the law of the States of the victims of the incident as the applicable law. This situation creates legal uncertainty, and it is an additional reason why it is desirable that as many States as possible become Parties to the nuclear liability conventions.

The nuclear liability conventions allow contracting States to make the carrier the person liable instead of the sending and/or the receiving operator, subject to the consent of the operator or operators who will be replaced and the approval of the competent national authority or authorities. If the carrier is made liable, it is treated like the operator of a nuclear installation. In practice, this option is not chosen very often. It is chosen mostly for railway companies or other carriers that transport nuclear material on a regular basis.

## 11.4. LIABILITY FOR OTHER RADIATION DAMAGE

The nuclear liability conventions cover neither radiation damage caused by radioisotopes used for scientific, medical, commercial and other purposes nor radiation damage caused by X rays, as the use of radioisotopes and X ray equipment does not present risks comparable to those for which the conventions were designed. The regime created by the conventions with their very specific concepts is meant for dealing with extraordinary nuclear risks only. Most States deal with liability for radiation damage caused by radioisotopes and X rays under general tort law.

Nevertheless, experience has shown that radioisotopes and medical irradiation equipment can also cause serious damage if not handled properly (e.g. the 1987 Goiânia accident). For that reason, States may wish to enact, at the national level, special liability laws also for damage caused by radioisotopes and X rays. There are such laws, providing for modified strict liability (i.e. there is liability without fault), but the person liable may be exonerated if he or she proves that he or she could not prevent the occurrence of the damage even though he or she complied with all radiation protection requirements and if he or she proves that any equipment used was not defective.

In cases of medical treatment with radioisotopes or X rays, other liability principles should be applied. Such medical treatment will normally take place only if the patient has agreed after being informed about the risks. In that case, even modified strict liability is not justified. The rules of general tort law, with the principle of liability on the basis of fault, should apply.

States establishing special regimes of liability for radiation damage caused by radioisotopes and X rays should ensure that financial arrangements are made for covering such liability.

## BIBLIOGRAPHY FOR CHAPTER 11

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# Part V

# NON-PROLIFERATION AND PHYSICAL PROTECTION

# Chapter 12

# SAFEGUARDS

## 12.1. BACKGROUND

### 12.1.1. Basic character of safeguards

International safeguards, as implemented by the IAEA, represent a key means of verifying the compliance by States with commitments not to use nuclear material or technology to develop nuclear weapons or other nuclear explosive devices. The foundations of the safeguards system lie in the IAEA's Statute (a multilateral treaty, which is binding on both the IAEA's Secretariat and the IAEA's Member States). Article II of the Statute requires the IAEA to ensure that assistance provided by or through it is not used to further any military purpose. Article III.A.5 authorizes the IAEA to establish and administer safeguards, so as to ensure that nuclear energy projects carried out by the IAEA or under its auspices do not further any military purpose. Article XI.F.4 establishes the detailed framework for safeguards implementation and Article XII requires safeguards on all IAEA sponsored projects. Article III.A.5 also authorizes the IAEA to apply safeguards, at the request of the Parties, to any bilateral or multilateral arrangement and, at the request of a State, to any of that State's activities in the field of atomic energy.

In broadest outline, safeguards comprise three functions: accountancy, containment and surveillance, and inspection. Accountancy measures require a State to report to the IAEA the types and quantities of fissionable material under its control. The ability of a State to provide accurate information in a timely manner depends on the establishment of a State system for accounting and control (SSAC) capable of tracking relevant material. Containment and surveillance measures are applied by the IAEA through the use of seals on nuclear material containers and filmed or televised recordings of key areas at nuclear facilities to determine whether unauthorized movements of material have occurred. Inspections are conducted by IAEA inspectors to verify that the declared quantities of nuclear material are where they are declared to be, and that there is no undeclared nuclear material in the State. Inspection activities include checking seals and instruments, reviewing facility records and independently measuring material or other items listed in accountancy documents subject to safeguards.

The ability of the IAEA to perform the three functions described, and the scope of material and facilities to be covered by IAEA safeguards, are

determined by the legal obligations that a State has assumed through treaties and by the type of safeguards implementation agreement that the State has negotiated with the IAEA.

### 12.1.2. Non-proliferation treaties and agreements

Through a number of international, regional and bilateral instruments, States have undertaken to accept the application of safeguards to nuclear material and activities under their jurisdiction or control. Chief among the international instruments is the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (the NPT) [31], now ratified by 187 States. To ensure compliance with the basic commitments in Articles I and II of the NPT (not to transfer or to acquire nuclear weapons or other nuclear explosive devices), Article III codifies the undertaking of all non-nuclear-weapon States Parties "to accept safeguards, as set forth in an agreement" to be negotiated with the IAEA "for the purpose of verification of the fulfilment of its obligations assumed under this Treaty with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices."

This international instrument is supplemented by a number of regional non-proliferation treaties, providing for additional measures that reflect the political aspirations of States in the regions in question. The following treaties are in force or in the process of ratification:

(a) The Treaty for the Prohibition of Nuclear Weapons in Latin America (the Tlatelolco Treaty) [32], which was opened for signature in 1967;
(b) The South Pacific Nuclear Free Zone Treaty (the Rarotonga Treaty) [33], which entered into force in 1986;
(c) The Southeast Asia Nuclear Weapon-Free Zone Treaty (the Bangkok Treaty) [34], which entered into force in 1997;
(d) The African Nuclear-Weapon-Free Zone Treaty (the Pelindaba Treaty) [35], which was opened for signature in 1996.

In addition to the international and regional non-proliferation instruments, a large number of bilateral agreements on peaceful nuclear co-operation have been concluded between States for the purpose of facilitating the transfer of nuclear material and technology. Most of these agreements provide for the application of IAEA safeguards to any transferred nuclear material.

Furthermore, European States have created a system of safeguards administered by the European Atomic Energy Agency (Euratom), and in 1990

Argentina and Brazil concluded an arrangement creating a bilateral inspectorate to apply full scope safeguards in both States [36].

It is beyond the scope of this handbook to discuss the various provisions of these regional and bilateral instruments. Some of them contain provisions prohibiting the testing of nuclear explosive devices, the sea dumping of radioactive material, the stationing of nuclear weapons and various other activities. All contain a requirement that all nuclear activities within the relevant regions be covered by IAEA safeguards (the full scope or comprehensive safeguards concept).

### 12.1.3. Basic safeguards documents

In implementing the safeguards related provisions of its Statute and the provisions of international treaties and agreements calling for safeguards, the IAEA has developed a number of documents setting out the principles, procedures and requirements in accordance within which its safeguards system operates. Although these documents are too detailed for even a summary review, it is important that drafters of domestic safeguards legislation be aware of their basic features. The most relevant documents should be reviewed to ensure that the State's legal framework is compatible with IAEA practices and procedures.

Since most States are Parties to the NPT, the most relevant IAEA document for the drafting of domestic safeguards legislation is Ref. [37], The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons. Adopted by the IAEA Board of Governors in 1972, this document is used by the IAEA in negotiating comprehensive safeguards agreements with non-nuclear-weapon States.

The earliest IAEA safeguards document, INFCIRC/66/Rev.2 [38], is a guideline for the negotiation of safeguards agreements that cover only specified items, such as certain facilities, equipment, nuclear material and non-nuclear material. The document contains two annexes, which extended its coverage to reprocessing plants (Annex I, 1966) and conversion and fuel fabrication plants (Annex II, 1968). A related document, approved by the Board of Governors in 1961 (GC(V)/INF/39, Annex) [39], known as the Inspectors Document, is reflected in agreements based on document INFCIRC/66/Rev.2 (often called INFCIRC/66 type agreements). The Inspectors Document covers the designation of inspectors, the notification of inspections, the conduct of inspections, and the rights of access and the privileges and immunities of inspectors. The application of safeguards under most INFCIRC/66 type agreements has been suspended, as most non-nuclear-

weapon States have concluded comprehensive safeguards agreements that provide for such suspension as long as the comprehensive safeguards agreement remains in force.

Finally, mention should be made of a third type of safeguards agreement, the voluntary offer agreements for the application of IAEA safeguards concluded between the IAEA and the nuclear weapon States. Since the terms of the voluntary offers made by the nuclear weapon States to accept IAEA safeguards differ from State to State, each agreement is somewhat different from the rest in scope and content, and there is no model to be used as guidance in implementing agreements in nuclear weapon States.

A recent IAEA safeguards document that will have increasing importance is Ref. [40], Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards, which was approved by the IAEA Board of Governors in 1997. It serves as the standardized model for protocols to comprehensive safeguards agreements, as well as the basis for protocols to INFCIRC/66 and voluntary offer agreements. This document was, in part, a response to perceived deficiencies in the IAEA's safeguards system. With a view to strengthening the system, it includes:

(a) Requirements regarding the early provision by the State to provide broader and earlier information on its nuclear fuel cycle, research efforts, locations where nuclear material may be used and the export and import of sensitive nuclear related technologies.
(b) Provisions regarding expanded IAEA access to detect the presence of undeclared material.
(c) Administrative arrangements for increasing the efficiency of inspections, including simplified inspector designation procedures, the issuance of long term multiple entry visas and the use of modern means of communication (such as communication satellites).

### 12.1.4. Using safeguards instruments and documents in drafting legislation

When drafting safeguards legislation, it is important that the drafters examine the terms of all international instruments to which their State is a Party in order to ensure that nothing in the legislation is inconsistent with obligations arising out of those instruments. In addition, drafters must review the relevant IAEA safeguards documents that implement these obligations. Admittedly, this can be a complex task. However, most details of safeguards implementation need not be explicitly included in legislation; they can be reserved for regulations, guidance documents and instructions for reporting by

the regulatory body. As in other areas of nuclear legislation, the important feature is to provide a framework of principles and general provisions that enables authorized governmental entities to exercise the necessary regulatory functions and that regulates the conduct of any person engaged in regulated activities.

## 12.2. OBJECTIVES

Regardless of the legal basis in a particular case, the fundamental objective of all safeguards is to help ensure that nuclear material is not diverted for use in the production of nuclear weapons or other nuclear explosive devices, safeguards being the primary means of verifying compliance by States with undertakings not to use safeguarded items for unauthorized purposes. A subsidiary objective is to enable a State and the IAEA to satisfy the basic technical requirements of the IAEA international safeguards system, in accordance with the terms of the applicable safeguards agreement. Also, safeguards enable the IAEA to review information, reports and records provided by or available in a State for the purpose of preventing the unauthorized use of nuclear material.

## 12.3. SCOPE

The scope of a national legal framework for safeguards is determined by the type of safeguards agreement concluded between the State and the IAEA, and whether it has an additional protocol thereto. As already indicated, the three basic IAEA documents from which these types of safeguards agreement are derived are INFCIRC/66/Rev.2 [38], INFCIRC/153 (Corrected) [37] and INFCIRC/540 (Corrected) [40]. Safeguards measures typically apply to all nuclear material and to all nuclear facilities, even those containing no nuclear material, those not currently in operation and those that have been decommissioned. The safeguards agreement will specify the nuclear activities within the jurisdiction under the control of the State that are subject to safeguards. It is important that the national legislation or the regulations promulgated by the authorized regulatory body clearly identify the nuclear activities, installations, facilities and material to which safeguards will be applied. Such identification is normally accomplished through general definitions, with detailed references to specific materials, quantities and facilities set forth in regulations.

## 12.4. KEY ELEMENTS OF SAFEGUARDS LEGISLATION

This section briefly outlines some of the elements that may usefully be included in national legislation for the implementation of IAEA safeguards. Some States may prefer to have these elements set forth only in regulations. To avoid confusion, the elements have been divided into those applicable to comprehensive safeguards agreements based on INFCIRC/153 (Corrected) and those applicable to additional protocols under document INFCIRC/540 (Corrected). For States with both a comprehensive safeguards agreement and an additional protocol in force, both sets of elements will be relevant. Separate elements applicable to item specific safeguards agreements based on IAEA document INFCIRC/66/Rev.2 have not been outlined; such agreements exist with only a few States, and those elements are not likely to be relevant for States using this handbook.

### 12.4.1. The comprehensive safeguards agreement

— Basic undertaking: to ensure compliance with the NPT, the safeguards agreement and any regional non-proliferation agreements in respect of all source or fissionable material in all peaceful nuclear activities within the State's territory or under its jurisdiction or control anywhere. The IAEA, under the comprehensive safeguards agreement, has the right to apply safeguards.
— Application of safeguards: gives the IAEA the right to apply safeguards under the safeguards agreement.
— Co-operation: commits all agencies of the government to full co-operation with the IAEA in implementing safeguards.
— State system of accounting and control (SSAC): mandates the establishment and maintenance of a system of accounting for and control of all nuclear material subject to safeguards, including: a measurement system; a system for the evaluation of instrument accuracy; procedures for reviewing measurement differences; procedures for carrying out physical inventories; a system for the evaluation of unmeasured inventories; records and reports systems for all material balance areas; and a system for reporting to the IAEA.
— Provision of information to the IAEA: mandates the prompt provision of all necessary information by all agencies and operators to the IAEA so as to ensure the effective implementation of safeguards.
— IAEA inspectors: mandates co-operation with IAEA inspectors so that they may effectively discharge their functions.

— Privileges and immunities: confirms that the IAEA (including its property, funds and assets), its inspectors and officials will be extended the privileges and immunities set out in IAEA document INFCIRC/9/Rev.2 [41].
— Transfer of nuclear material out of the State: requires notification to the IAEA of transfers; if above specified quantities, the notification must be made in advance of the transfer.
— Non-nuclear uses: recognizes the need for prior IAEA agreement to exempt nuclear material from safeguards, or terminate safeguards on it, for non-nuclear uses.
— Non-peaceful activities: sets forth the procedures to be applied in the event that a State exercises its discretion to use safeguarded material for non-explosive, non-peaceful nuclear activities, including notification to the IAEA, provision of an assurance that the activity does not conflict with the State's peaceful use commitments, provision of an assurance that no nuclear explosive device(s) will be made, provision of information concerning the activity, provision of information on the quantity and composition of the material.
— Finance: contains a commitment to fully reimburse the IAEA for its expenses.
— Third party liability: provides that any third party liability protection applying to nationals of the State will apply also to the IAEA and its officials.
— International responsibility: provides that damage claims against the IAEA, other than claims for damage arising out of a nuclear incident, will be settled in accordance with international law.
— Dispute settlement: mandates consultations on questions of the interpretation or application of the safeguards agreement.
— Amendment: mandates consultations between the IAEA and the State, at the request of either, regarding proposed amendments to the safeguards agreement.
— Starting point of safeguards: provides for notification to the IAEA of exports or imports of nuclear material that is not of a composition or purity sufficient to trigger inspections.
— Exemptions: authorizes the State to request the IAEA to exempt nuclear material from safeguards for specified uses or within certain quantity limitations.
— Termination: authorizes the State to request the IAEA to terminate safeguards on nuclear material in certain circumstances.

— Subsidiary arrangements: authorizes the State to agree with the IAEA on subsidiary arrangements that detail the measures necessary for the IAEA to fulfil its responsibilities.
— Design information: mandates the State to provide information on the design of nuclear facilities to the IAEA.
— Nuclear material outside nuclear facilities: mandates the State to provide the IAEA with information (and details of any changes in the information) on nuclear material outside nuclear facilities, including its location, the user's name, and the procedures for accountancy and control.
— Records system: mandates the State to maintain a material accountancy and operating records system.
— Reports: mandates the regulatory body to provide reports to the IAEA as foreseen in the safeguards agreement, including: material accountancy reports; inventory change reports; and special reports, in the event of any unusual incident leading to a loss of safeguarded nuclear material.
— Inspections: confirms the legal right of IAEA inspectors to have access to necessary locations; provides for facilitating the performance of inspectors' tasks; provides for the prompt issuance of visas for inspectors; and provides for the rendering of services needed by inspectors.
— Transfers: mandates the State to provide notice to the IAEA of transfers out of the State and to confirm completed transfers.

As mentioned above, legislation should ensure compliance with the NPT, the safeguards agreement and any regional non-proliferation agreements in respect of all source or fissionable material in all peaceful nuclear activities within the State's territory or under its jurisdiction or control anywhere. To this end, all agencies of the government are required to co-operate fully with the IAEA, in particular to provide promptly all necessary information to the IAEA so as to ensure the effective implementation of safeguards.

The State's nuclear regulatory system should normally consist of:

(a) A regulatory body designated in the State's domestic legislation for the purposes of implementing and applying the safeguards agreements concluded.

There should also be corresponding provisions of:

(b) Licensing;
(c) Inspection and assessment;
(d) Enforcement.

The comprehensive safeguards agreement requires a State to establish and maintain a system of accounting for, and control of, all nuclear material subject to safeguards, including:

(1) A measurement system;
(2) A system for the evaluation of accuracy;
(3) Procedures for reviewing measurement differences;
(4) Procedures for carrying out physical inventories;
(5) A system for the evaluation of unmeasured inventories;
(6) A records and reports system for all material balance areas;
(7) A system of reporting to the IAEA.

The regulatory body mentioned in (a) above should liaise with the IAEA on an ongoing basis as regards, inter alia:

(1) The furnishing and updating of information regarding the design of nuclear installations;
(2) The furnishing of reports required by safeguards agreements and subsidiary arrangements;
(3) The submission of requests for exemption from or termination of safeguards relating to nuclear material;
(4) The notification of exports and imports of nuclear material;
(5) The provision of facilities and support to the IAEA inspectors;
(6) The accompaniment of IAEA inspectors during their inspections and visits.

The State's licensing provisions mentioned in (b) above should provide, inter alia:

(1) That specific nuclear activities require a licence or authorization by the regulatory authority (e.g. the possession and/or use of source or fissionable material);
(2) For prescribed reports at prescribed times and/or intervals (including material accountancy reports and special reports in the event of any unusual incident leading to a loss of nuclear material);
(3) For the subsequent reporting of inventory changes (including exports, imports and production);
(4) For the provision of design information on any nuclear installation;
(5) For the keeping of records (including an accountancy and operating records record system);
(6) For the performance of prescribed measurements of nuclear material;

(7) For prior notice of transfers out of the State and the confirmation of completed transfers and of prior notice of the import or export of nuclear material;
(8) For co-operation with inspectors (in particular with IAEA inspectors).

The State's inspection and assessment provisions mentioned in (c) above should include the right of inspectors (in particular IAEA inspectors) to have access to any locations necessary to verify, inter alia:

(1) The consistency of the reports with the records;
(2) Changes in the situation;
(3) The location, quantity and composition of nuclear material subject to safeguards;
(4) Information on the possible causes of material unaccounted for and shipper–receiver differences;
(5) Information in special reports.

The State's enforcement provisions mentioned in (d) above should be established, inter alia, to:

(1) Provide the regulatory body with powers to enforce compliance with the requirements laid down by the legal frameworks governing the safeguards;
(2) Provide for the rights and obligations of individuals and organizations (e.g. cases in which a court warrant may be required to ensure compliance, for example search or seizure measures);
(3) Provide for detailed procedures for determining and exercising enforcement actions (e.g. powers to seize and detain, and to bar or restrict access);
(4) Establish offences and penalties for violations of the requirements (e.g. failures to report, refusals to provide information, obstructions of inspections, evasions of inspections or collections of samples and giving false or misleading information).

In addition, legislation should provide that the IAEA (including its property, funds and assets), its inspectors and officials performing functions under the safeguards agreements will be extended the privileges and immunities set out in IAEA document INFCIRC/9/Rev.2 [41].

### 12.4.2. Additional Protocol to the safeguards agreement

— Additional Protocol and main agreement: provides that elements of safeguards agreements will apply to the protocol to the extent relevant and compatible, and that Additional Protocol provisions will be prevailing in the event of conflict.
— Provision of information: mandates the State to provide to the IAEA a declaration with detailed information on, inter alia, any nuclear fuel cycle research and development not involving nuclear material; information requested by the IAEA on locations outside facilities in which nuclear material is customarily used (LOFs); all buildings on the site of each facility and LOF; the estimated annual capacities of uranium and thorium mines and concentration plants; source material that has not reached the composition and purity suitable for enrichment or fuel fabrication; exempted material; intermediate and high level radioactive waste on which safeguards have been terminated; and specified equipment and non-nuclear material.
— Information updates: mandates the State to provide the IAEA with: annual updates of the information contained in the declaration; information, at quarterly intervals, on any exports of nuclear equipment and non-nuclear material of the kinds listed in Annex II to the Additional Protocol and, at the request of the IAEA, on imports of such material and equipment; information on changes in the location of intermediate and high level radioactive waste; and advance information on the intended processing of such material.
— Complementary access: provides that the IAEA may have access to any location specified in the Additional Protocol; mandates the State to grant the IAEA such access upon the receipt of an advance notification from the IAEA.
— Environmental sampling: provides that the IAEA may carry out environmental sampling activities at any location in the State; mandates the State to grant the IAEA access to the locations specified by the IAEA in that connection.
— Managed access: authorizes the State to devise, together with the IAEA, arrangements for managed access, when appropriate.
— Designation of inspectors: provides that the inspectors notified to the State by the IAEA will be considered designated unless the regulatory body informs the IAEA within three months of the receipt of the notification that designation has been refused.
— Inspector visas: provides that, where visas are required, the State will, within one month of an IAEA request, provide the designated inspectors

with appropriate multiple entry/exit and/or transit visas, valid for at least one year.
— Communications: mandates the State to permit free communications between IAEA inspectors and the IAEA's headquarters and/or regional offices, including the attended and unattended transmission of information generated by IAEA containment and surveillance and measurement devices, and to protect such communications.

In those States that have concluded an Additional Protocol with the IAEA, their domestic legislation needs to be enhanced to enable the State concerned to comply with the additional obligations under the Additional Protocol. In particular, the State's domestic legislation should be revised to expand the responsibilities and powers of the regulatory body. Based on the aforementioned, a State's nuclear regulatory system should normally consist of:

(a) A regulatory body designated in the State's domestic legislation for the purposes of implementing and applying the safeguards agreements concluded.

There should also be corresponding provisions of:

(b) Licensing;
(c) Inspection and assessment;
(d) Enforcement.

The increased functions of the regulatory body mentioned in (a) above should include, inter alia:

(1) The responsibility for assuring that individuals and organizations comply with the legal framework related to the Additional Protocol;
(2) The provision of information and updates to the IAEA;
(3) The approval of inspectors nominated by the IAEA;
(4) The provision of support to IAEA inspectors while implementing complementary access;
(5) The accompaniment of IAEA inspectors while implementing complementary access.

As a consequence of its increased responsibilities, the regulatory body should liaise with the IAEA on the furnishing and updating of information on, inter alia:

(1) State controlled nuclear fuel cycle related research and development not involving nuclear material;

(2) Operational activities at facilities and LOFs;
(3) Buildings on relevant sites;
(4) Activities functionally related to the nuclear fuel cycle (Annex I activities);
(5) Uranium mines and thorium concentration plants;
(6) Inventories, imports and exports of nuclear material not currently required;
(7) Exempted material;
(8) The location and further processing of terminated intermediate and high level waste;
(9) Exports of specified equipment and non-nuclear material;
(10) Nuclear fuel cycle research and development not involving nuclear material specifically related to enrichment, reprocessing (fuel) or processing (waste), not authorized, controlled or carried out by or on behalf of the State;
(11) The description of activities and the identification of entities carrying out activities at locations possibly functionally related to the activities of a site.

Further, under the Additional Protocol, a State's licensing provisions mentioned in (b) above should include:

(1) The appropriate extension of nuclear activities requiring licensing and/or authorization by the regulatory body.
(2) Additional requirements for persons or organizations obliged to provide information to the regulatory body, such as: (a) the provision of information included in Article 2 of the Additional Protocol; (b) the provision of updates of this information to comply with requirements of Articles 2 and 3 of the Additional Protocol; and (c) the provision of amplifications or clarifications of any information provided under Article 2 of the Additional Protocol so as to enable the regulatory body to respond to the IAEA's possible requests.

The State's inspection and assessment provisions mentioned in (c) above should be revised to provide for:

(1) The right of inspectors (in particular IAEA inspectors) to have access to: (a) any place on a site and in other places at which nuclear material is declared to be, in order to assure the absence of undeclared nuclear material and activities; (b) decommissioned facilities and LOFs to confirm their decommissioned status; and (c) other locations declared by

the State (research and development, functionally related) and other locations specified by the IAEA for environmental sampling to resolve questions or inconsistencies.

(2) The obligation of individuals or organizations to grant access within the time provided for under Article 4 (b) of the Additional Protocol.

Further, the State's overall regulatory system under the Additional Protocol should be revised to provide, inter alia, for:

(1) The right of State inspectors to monitor compliance with the legal framework governing the Additional Protocol.
(2) The right of IAEA inspectors, when implementing complementary access, to carry out activities as specified in Article 6 of the Additional Protocol, (e.g. the examination of relevant records, visual observation, the collection of environmental samples and the application of seals and other identifying and tamper indicating devices).
(3) The right of access of IAEA inspectors to locations specified by the IAEA for the purposes of Article 9 of the Additional Protocol when approved by the IAEA Board of Governors (e.g. procedural arrangements for wide area environmental sampling).
(4) The obligation of individuals or organizations to allow State or IAEA inspectors to carry out the above mentioned activities.

The State's enforcement provisions mentioned in (d) above should be revised, inter alia, to:

(1) Extend the authority of the regulatory body to enforce compliance with the requirements laid down by the legal frameworks governing the Additional Protocol;
(2) Provide for the rights and obligations of individuals and organizations (e.g. cases in which a court warrant may be required to ensure compliance, for example search or seizure measures);
(3) Provide for detailed procedures for determining and exercising enforcement actions (e.g. powers to seize and detain, and to bar or restrict access);
(4) Establish offences and penalties for violations of the requirements (e.g. failures to report, refusals to provide information, obstructions of inspections, evasions of inspections or collections of samples and giving false or misleading information).

Finally, a State's domestic legislation implementing the obligations under the Additional Protocol should provide for:

(1) The right of the regulatory body to request any person to provide information of the kind described in Article 2 (b) of the Additional Protocol, and to set out procedures for the provision of such information;
(2) The permission of free communications between IAEA inspectors and the IAEA's headquarters and/or regional offices, including the attended and unattended transmission of information generated by IAEA containment and surveillance and measurement devices, and to protect such communications;
(3) The granting of multiple entry/exit and/or transit visas valid for at least one year for IAEA designated inspectors, to be issued within one month of an IAEA request (if such a visa is required);
(4) The conditions for the disclosure of information required in connection with the Additional Protocol.

## 12.5. DEFINITIONS

In the safeguards area of nuclear law, as in other areas, clear and precise definitions are necessary for clarity and efficiency in the application of legislation. The IAEA safeguards documents INFCIRC/153 (Corrected) [37] and INFCIRC/540 (Corrected) [40] contain large numbers of definitions that may be considered for inclusion in national legislation. Among the basic and frequently used terms defined in these documents are: facility; site; decommissioned facility; closed down facility; nuclear material; and high enriched uranium. Many of the highly technical terms used in safeguards documents are probably best reserved for regulations promulgated by the regulatory body.

## 12.6. CROSS-CUTTING RELATIONSHIPS

As seen in Chapter 13, safeguards bear an important relationship to export and import controls. Virtually all multilateral non-proliferation treaties and bilateral nuclear supply agreements prohibit the transfer of certain nuclear material and technology in the absence of assurances that they will be covered by IAEA safeguards. Therefore, the law dealing with safeguards and the law dealing with export controls must be compatible with each other and provide for consistent organizational arrangements.

# Chapter 13

# EXPORT AND IMPORT CONTROLS

## 13.1. BACKGROUND

In a world where no State is self-sufficient in the development and use of nuclear material and technology, the monitoring and control of nuclear transfers between and among States is an essential element of the global non-proliferation system. Nuclear export and import controls implement State commitments under the NPT [31], particularly under Article I (for nuclear weapon States) and Article II (for non-nuclear-weapon States), not to assist non-nuclear-weapon States in acquiring nuclear weapons or to seek or receive assistance in acquiring them. Also, export controls are essential for meeting the NPT Article III.2 obligation (discussed in Chapter 12) not to provide source or special fissionable material, or equipment or material especially designed or prepared for the processing, use or production of source or special fissionable material to a non-nuclear-weapon State, even for peaceful purposes, unless the source or special fissionable material is subject to IAEA safeguards. Parallel commitments and obligations are provided for in regional non-proliferation treaties: the Tlatelolco Treaty, the Rarotonga Treaty, the Bangkok Treaty and the Pelindaba Treaty.

In addition to providing a barrier against nuclear explosives development and nuclear terrorism, nuclear export and import controls also support a State's fundamental regulatory task of preventing unauthorized persons in that State from acquiring material and technology that they are unable to manage safely and securely.

Export and import controls are also necessary in order that a State may comply with its obligation under Article 4 of the CPPNM [23] to permit exports and imports of material covered by the convention only after receiving assurances that the material will be protected at levels described in Annex I to the convention. Article 27 of the Joint Convention [5] requires Contracting Parties to participate in the transboundary movement of covered material only when specified conditions are met.

Establishing an adequate legislative framework for nuclear export and import controls is important for all States. Even States that are neither exporters nor importers of nuclear material or technology need a basis for controlling any nuclear transfers through their territories. The purpose of transit jurisdictions is to ensure that States do not become unwitting accessories to improper nuclear transfer schemes.

Nuclear transfers can take place in diverse ways. The most obvious way is the simple export of commodities such as equipment, instruments, components or nuclear material from one State to another, often involving transfers of technology or information in the form of assistance in using such commodities. A second way involves private commercial transfers of technology, which can take place:

(a) Through direct foreign investment in one State by a company licensed in another State;
(b) Through the licensing of technology by a company in one State for use by companies or governmental entities in another State;
(c) Through technical assistance (such as engineering or managerial services) provided by a company from one State to an entity in another State;
(d) Through turnkey projects, in which nuclear facilities in one State are designed, constructed and even initially operated by companies from one or more other States.

A third way, outside the commercial sphere, is either through intergovernmental arrangements or through technical training provided by academic or professional bodies. The IAEA's technical co-operation programme is an example of how intergovernmental arrangements can work in this field.

Nuclear export and import controls must obviously be implemented within a State's general legal framework for regulating foreign commerce. In most cases, it will be neither necessary nor desirable to create new or separate institutions or licensing procedures for the management of nuclear transfers. Rather, what is needed is a clear set of requirements for nuclear exports and imports, and institutional arrangements that ensure that proposed nuclear transfers receive appropriate scrutiny, including, where necessary, technical and policy review by experts.

## 13.2. OBJECTIVES

A State's basic law for nuclear export and import controls should focus on a few important objectives. The first objective is to ensure that transfers of nuclear material, equipment and technology (whether into or out of the State) take place in a secure, safe and environmentally responsible manner. The second objective is to ensure that such transfers do not directly or indirectly assist any non-nuclear-weapon State or any unauthorized person in developing or acquiring nuclear explosive devices or using nuclear material for

unauthorized purposes. These two objectives subsume a third objective, namely to provide for the fulfilment of the State's legal obligations under international instruments such as the NPT, the CPPNM, the Joint Convention or one of the regional non-proliferation treaties (instruments such as bilateral agreements for nuclear co-operation with other States). Responsible nuclear supplier States will insist on reasonable assurances that their nuclear exports will not be diverted to non-peaceful or unsafe activities. Therefore, recipient States that do not apply adequate export and import controls cannot expect to receive the fullest measure of nuclear trade and co-operation.

## 13.3. SCOPE

While it is important that a State's nuclear export and import controls focus primarily on the commodities and information most likely to be transferred from or to it, legislation that too narrowly restricts the scope of such controls would not provide an adequate framework. As indicated in Section 13.1, this is because virtually any State can become a transit jurisdiction for nuclear related commodities or information. Persons seeking to evade the export controls of major nuclear suppliers will seek to channel illegal or unauthorized transfers through States in which they expect the import and export controls to be weak. Therefore, in defining the scope of export controls, it would be wise to cover the commodities and information identified in the guidelines of established nuclear supplier groups. For NPT Parties, a logical starting point would be the guidelines of the Nuclear Exporters' Committee (informally referred to as the Zangger Committee, after its first Chairman, a Swiss official). INFCIRC/209/Rev.1 [42] contains a list of items identified as falling under the terms of the NPT's safeguards triggering requirement. A similar list is published as INFCIRC/254/Rev. 1/Part 1 [43].

## 13.4. KEY ELEMENTS OF NUCLEAR EXPORT AND IMPORT CONTROL LEGISLATION

Many of the key elements of national nuclear export and import control legislation parallel those, already discussed, of legislation governing domestic nuclear related activities.

### 13.4.1. Requirements for the issuance of a licence

As with all other activities involving nuclear material and technology, a transfer of such commodities and information across national boundaries should be permitted only after the issuance of a licence (or permit or other authorization) that clearly states the essential features of the transfer. These include: the identity of the licensee; the precise subject matter of the transfer (in terms of the types and quantities of material or the character of the information or technology); the destination of the transfer; the end use or (if different from the destination) the end user of the material or information; the duration of the licence; and any relevant limitations or conditions (such as the mode of transport and the required physical protection measures).

### 13.4.2. Governmental organization for export and import control

A State's legal framework must contain a clear assignment of responsibilities to the agencies or officials responsible for conducting the export and import control process. While some States may find it convenient to establish a separate organizational body for dealing with export and import licence applications, many will find it more efficient to assign such responsibilities to an existing body, such as a ministry or department for international trade, commerce or foreign affairs. The export licensing function typically involves issues of concern to several governmental agencies (e.g. ministries or departments of defence, foreign trade, energy, foreign affairs, environment, science and health). This can result in complicated interagency reviews, which may be costly, time consuming and inefficient. Therefore, in structuring the export and import control process, legislation should set out a clear division of responsibilities among the interested agencies. Also, it should provide for action forcing mechanisms (such as time limits or reporting requirements) for the various steps in the process.

In the event that nuclear transfers are to be licensed by an entity that also exercises export promotion functions, the principle of regulatory independence (discussed in Chapter 2) must be borne in mind. It is important that the licensing function be shielded, to the maximum extent possible, from the influence of officials involved in functions other than protecting public health and safety or ensuring that non-proliferation objectives receive the highest priority.

### 13.4.3. Requirements for the issuance of export or import licences

The substantive requirements for authorizing transfers of nuclear material or technology will parallel a State's obligations under the relevant international instruments and that State's national policies regarding non-proliferation, nuclear safety and radioactive waste management.

The following are some typical requirements:

(a) That the receiving State have made a binding commitment to use transferred material and information for peaceful purposes only;
(b) That international safeguards be applied to the transferred item;
(c) That the receiving State place all its nuclear material and nuclear facilities under international safeguards (the full scope safeguards requirement);
(d) That retransfers of previously transferred material and technology to a third State be subject to a right of prior approval by the supplying State;
(e) That any reprocessing of supplied nuclear material or alteration of the material in some other way be subject to a right of prior approval by the supplying State;
(f) That the levels of physical protection that will apply to the international transport of nuclear material be consistent with those given in Annex I to the CPPNM (Article 4 of the CPPNM);
(g) That, in the case of certain material, the State of destination have received prior notification of and have consented to the transfer (see the Joint Convention [5], Article 27(1)(i));
(h) That, in the case of certain material, the State of destination have the administrative and technical capacity and the regulatory structure needed to manage the material in a safe and secure manner (see the Joint Convention [5], Article 27(1)(iii));
(i) That transfers of certain material be not to the Antarctic region (see Article 27(2) of the Joint Convention [5]).

In addition to these requirements, which relate to fundamental non-proliferation, physical protection, safety or environmental considerations, many of them reflected in international instruments, States are at liberty to impose export or import requirements of their own in the light of their domestic nuclear energy policies, their economic development aims, their international political and trade relations, and other factors. However, such factors are beyond the scope of this handbook. In any event, when contemplating the imposition of additional requirements for the authorization of nuclear transfers, States should bear in mind the general obligation under NPT Article IV "to facilitate… the fullest possible exchange of equipment,

materials and scientific and technological information for the peaceful uses of nuclear energy."

### 13.4.4. Inspection and monitoring

As discussed in Chapter 3, an essential feature of any nuclear control regime is that the responsible authorities have clear powers to inspect and monitor licensed activities. The field of export and import control is no exception. One of the most important functions of the authority charged with implementing export and import control laws is to examine goods destined for transport out of and into the State. For this function, typically performed by officials of the State's customs service, it is necessary to have access to all items that are to be transported. However, transfers of nuclear material and technology and dual use items can raise complicated technical issues. Therefore, it is essential both that customs officials be well trained in recognizing uncontrolled transfers and that they be able to call upon nuclear experts from other governmental organizations (to assess the nature of an item being exported or imported). Also, it is important that some governmental body be charged with compiling general information on the activities of the State's nuclear exporters and importers. Such monitoring and record keeping are vital for identifying patterns and practices that indicate potential violations of export or import controls.

### 13.4.5. Enforcement

As also discussed in Chapter 3, a State's export and import legislation must contain clear provisions to ensure the enforcement of its requirements and procedures. These provisions should include: defined penalties for violations (from licence suspension or revocation to monetary fines, and even criminal penalties for especially serious or intentional violations); a clear assignment of enforcement responsibility to appropriate governmental bodies; and a clear procedural framework for enforcement action (with an indication of the means by which licensees may appeal against enforcement decisions that they believe to be unwarranted).

### 13.4.6. Illicit trafficking

The subject of illicit trafficking in nuclear material and technology is discussed in Chapter 14. However, export and import controls obviously play a central role in preventing the unauthorized acquisition of licensed material and information. Provisions that are contained in export and import control

legislation regarding illicit trafficking should be carefully reviewed to ensure their consistency with the laws dealing with physical protection. Discrepancies in the scope of coverage, requirements, definitions or procedures between, on the one hand, export and import control legislation and, on the other hand, legislation against illicit trafficking, can lead to inefficiency and confusion in these two closely related fields. Finally, as stated in Chapter 14, a State's export and import control laws should authorize relevant governmental agencies and officials to provide relevant information to the IAEA's Illicit Trafficking Database for the purpose of helping the international community to prevent unauthorized transfers of potentially dangerous material and technology.

## 13.5. CROSS-CUTTING RELATIONSHIPS

Export and import controls affect and are affected by legislative provisions in several other areas. Foremost among these are safeguards (see Chapter 12) and physical protection (see Chapter 14). As the transport of nuclear material in international commerce could have an impact on domestic arrangements, legislation in that area should be compatible with that related to transport conducted solely within the State's territory (see Chapter 9). For certain quantities or radioactivity levels of nuclear material in international commerce, the legislation may need to authorize emergency preparedness and response co-operation for dealing with incidents or accidents (see Chapter 7).

## 13.6. DEFINITIONS

Given the fact that a State's nuclear export and import control legislation should be consistent with any applicable international agreements to which that State is a Party, consideration should be given to defining in the national legislation the most basic terms used in those agreements. The NPT does not contain definitions, but some terms used in it have acquired fairly precise meanings through the activities of the Zangger Committee. NPT terms that might usefully be defined in national legislation include: source or special fissionable material; equipment or material especially designed or prepared for the processing, use or production of special fissionable material; non-nuclear-weapon State; and transfer.

If the State is Party to the CPPNM [23], which also does not contain definitions, consideration should be given to defining terms such as: export; import; and levels of protection (see Annex I to the convention).

States that are Party to the Joint Convention [5] should consider incorporating in their national legislation the definitions contained in Article 2, including those of: transboundary movement; State of destination; State of origin; and State of transit.

National legislation may also usefully include definitions of terms associated with the institutional and procedural aspects of nuclear export and import controls, such as: licence application; export licence (or authorization to export); import licence (or authorization to import); authorized person or licensee; and licensing authority or regulatory authority.

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# Chapter 14

# PHYSICAL PROTECTION

## 14.1. BACKGROUND

Protecting nuclear material and facilities from the risk of theft or other unauthorized diversion and of sabotage has traditionally been considered a matter particularly within the domestic jurisdiction of sovereign States. Applying the measures of protection necessarily involves central national functions (e.g. law enforcement and the control of access to information). States are understandably reluctant to expose their sovereign security and law enforcement practices to external scrutiny, let alone to anything resembling external regulation. However, it has also long been recognized that the manner in which a State is meeting (or not meeting) its responsibility to protect nuclear material and facilities is not a matter of indifference to other States: nuclear material stolen in one State could obviously be used for terrorist purposes in another State; and the sabotage of a nuclear facility in one State could have transboundary effects in other States. The events of 11 September 2001 dramatized the potential dangers posed by terrorist groups, and highlighted the need to upgrade weak or ineffective physical protection measures for nuclear material and facilities. The increasingly global nature of nuclear commerce and cascading developments in fields as diverse as transport, communications and information technology make it essential that States follow international best practice in trying to limit threats directed at nuclear material and/or facilities.

Over the past three decades a number of international instruments have been developed both to help strengthen physical protection in individual States and to encourage greater consistency in requirements and procedures among States in this important area.

### 14.1.1. Convention on the Physical Protection of Nuclear Material (CPPNM)

The most important legal instrument is the CPPNM [23] of 26 October 1979. At the time this handbook was written, the CPPNM had 81 Parties, including most States with significant nuclear related activities. The CPPNM focuses primarily on nuclear material being shipped in international commerce, but it also contains other important requirements related to domestic physical security measures. In summary, the CPPNM requires Parties to:

(a) Make certain physical protection arrangements and ensure specific defined levels of physical protection for international shipments of nuclear material;
(b) Co-operate in the recovery and subsequent protection of stolen nuclear material;
(c) Make specified acts (e.g. thefts of nuclear material and threats or attempts to use nuclear material to harm the public) punishable offences under national law;
(d) Prosecute or extradite those accused of committing such acts.

An important feature of the CPPNM is its categorization of nuclear material by type and quantity for the purposes of applying physical protection levels. As a consequence of its rather limited scope, proposals have been made to amend the CPPNM to give it broader scope and to include additional obligations for States in enhancing physical protection measures for nuclear material and facilities. Drafters of legislation should seek the latest available information on the status of the CPPNM amendment process to be sure that any changes in it are properly taken into account in formulating their national legislation.

### 14.1.2. IAEA physical protection recommendations

Besides the CPPNM, a fundamental resource for the drafting of national legislation concerning physical protection are non-binding but authoritative recommendations developed by experts in co-operation with the IAEA Secretariat. These guidelines, The Physical Protection of Nuclear Material and Nuclear Facilities, the latest version of which is contained in IAEA document INFCIRC/225/Rev.4 (Corrected) [44], pre-date the CPPNM (having been first developed in 1972) and provide elements for the CPPNM text. They have been regularly updated, on the latest occasion in 1998. They reflect international consensus, procedures and definitions going beyond those in the CPPNM.

For example, document INFCIRC/225/Rev.4 (Corrected) is much more comprehensive than Annex I to the CPPNM. It describes, inter alia, the:

(a) Elements of a State's system for the physical protection of nuclear material and nuclear facilities;
(b) Requirements for physical protection against the unauthorized removal of nuclear material in use and storage;
(c) Requirements for physical protection against the sabotage of nuclear facilities and against sabotage involving nuclear material during use and storage and during transport;

(d) Requirements for the physical protection of nuclear material during transport.

### 14.1.3. IAEA project and supply agreements

Physical protection commitments have been included in IAEA project and supply agreements and in the Revised Supplementary Agreements concerning the Provision of Technical Assistance by the IAEA (applied since the mid-1980s). These commitments are limited in nature (e.g. they do not apply to all nuclear material, equipment and facilities in a State and do not especially call for the establishment of appropriate regulatory structures governing physical protection).

### 14.1.4. Objectives and fundamental principles of physical protection

In connection with the CPPNM amendment process discussed above, the IAEA Board of Governors endorsed a set of objectives and principles for physical protection that can provide additional guidance to States in developing their practices and procedures for preventing the theft, misuse or sabotage of nuclear material and facilities. This document was subsequently welcomed by the IAEA General Conference [45]. These objectives and fundamental principles do not substitute the CPPNM and INFCIRC/225 (as revised), but are supposed to supplement those instruments through a distillation of key physical protection concepts. The four objectives and 12 fundamental principles of physical protection are set out below.

The physical protection objectives are to establish and maintain conditions to:

(a) Protect against unauthorized removal of nuclear material in use and storage, and during transport;
(b) Ensure the implementation of rapid and comprehensive measures by the State to locate and recover missing or stolen nuclear material;
(c) Protect against sabotage of nuclear facilities and sabotage of nuclear material in use and storage, and during transport;
(d) Mitigate or minimize the radiological consequences of sabotage.

The physical protection fundamental principles have to be considered as the basis for achieving the physical protection objectives.

These fundamental principles are:

(a) Responsibility of the State;

(b) Responsibilities during international transport;
(c) Legislative and regulatory framework;
(d) Competent authority;
(e) Responsibility of the licence holders;
(f) Security culture;
(g) Threat;
(h) Generic approach;
(i) Defence in depth;
(j) Quality assurance;
(k) Contingency plans;
(l) Confidentiality.

### 14.1.5. Other instruments

It is important to note the link between physical protection measures and the safety of nuclear facilities. The Convention on Nuclear Safety [2] does not contain express obligations related to physical protection. However, in recognition of the importance of protecting power reactors against threats to their physical security, preambular paragraph (v) refers to the CPPNM. Further, the Basic Safety Principles for Nuclear Power Plants [9] states the following principle in para. 242:

> "The design and operation of a nuclear power plant provide adequate measures to protect the plant from damage and to prevent the unauthorized release of radioactive material arising from unauthorized acts by individuals or groups, including trespass, unauthorized diversion or removal of nuclear materials, and sabotage of the plant."

## 14.2. OBJECTIVES

The fundamental objective of legislation in this area is to prevent the illegal or unauthorized acquisition of nuclear material and interference with the authorized uses of nuclear material and facilities through acts such as theft, diversion, threats and sabotage. This objective is achieved both through protective measures that deny potential wrongdoers access to the nuclear material and facilities and through measures that deter attempted theft, diversion and sabotage.

The objectives of physical protection legislation are, inter alia:

(a) To provide for the implementation of the State's relevant international obligations (the most relevant being those in the CPPNM and in bilateral agreements committing the State to protect nuclear material in accordance with the guidelines contained in INFCIRC/225 (as revised));
(b) To establish or designate a regulatory body with the powers and resources necessary for implementing the legislative and regulatory framework relating to physical protection;
(c) To promulgate a clear and comprehensive set of basic obligations that authorized persons must fulfil in order to ensure the effective physical protection of nuclear material and facilities;
(d) To establish the requirements that must be met in order to protect against the unauthorized removal of nuclear material in use and storage, and during transport;
(e) To establish the requirements that must be met in order to protect against the sabotage of nuclear facilities and against sabotage involving nuclear material in use and storage, and during transport;
(f) To establish the requirements for the preparation and exercise of contingency plans for a rapid response to any cases of the unauthorized removal of nuclear material, including the location and recovery of missing or stolen nuclear material (and in the event of sabotage).

## 14.3. SCOPE

Although, as has been noted, the CPPNM focuses primarily on nuclear material being shipped in international transport, national legislation should in addition cover all domestic activities involving nuclear material and facilities that could pose a risk to public health and safety, to national security or to the environment, and to any facilities in which relevant types and quantities of such nuclear material are used. A categorization of nuclear material is included in Annex II to the CPPNM [23] and in Part 5 of INFCIRC/225/Rev.4 (Corrected) [44], the two tables being identical. This categorization reflects the definitions of the nuclear material to be covered by the CPPNM and thus establishes the scope of application of physical protection levels.

## 14.4. KEY ELEMENTS OF PHYSICAL PROTECTION LEGISLATION

The purpose of this section is not to offer detailed drafting suggestions, but to point out the main elements that should be contained in a State's

physical protection legislation. Guidance on the drafting of particular provisions can be found in Refs [44–49].

### 14.4.1. Assessment of the threat

Legislation should provide for the establishment, by relevant governmental authorities (e.g. ministries of defence, energy and the interior; intelligence agencies; nuclear regulatory bodies; police and fire departments), of a design basis threat of the diversion and unauthorized use of nuclear material or sabotage, to serve as a common basis for physical protection planning and implementation by authorized persons and for the reviewing, approving and monitoring of measures to be taken by the relevant governmental authorities. It should also provide for regular reviews of the design basis threat, which may have to be modified from time to time in the light of the nuclear material types and quantities and the facilities to be taken into account. The regulatory body should have the flexibility to alter regulatory requirements in the light of technological developments and of changes to the design basis threat. In establishing the design basis threat, the relevant governmental authorities should bear in mind the possible diversion of nuclear material for use in nuclear explosives development.

### 14.4.2. Governmental organization for physical protection

As a threshold matter, it must be recognized that the responsibility for the establishment, implementation and maintenance of a physical protection regime within a State rests entirely with that State. A State should establish and maintain a legislative and regulatory framework to govern physical protection. The legislation should designate a regulatory body responsible for the implementation of the legislative and regulatory framework. If the regulatory body has that responsibility assigned to it, it should be structured along the lines discussed in Chapter 2, with effective independence and with its functions separated from those of the organizations involved in the promotion or utilization of nuclear energy. If the responsibility is divided between two or more agencies, there should be clear demarcation lines and arrangements for overall co-ordination. Article 5 of the CPPNM [23] requires Parties to identify and make known to other Parties, directly or through the IAEA, a "central authority and point of contact" having responsibility for the physical protection of nuclear material and for co-ordinating recovery and response operations in the event of any unauthorized removal or threat of unauthorized removal of nuclear material. In practice, this "central authority and point of contact" will probably be the body to which responsibility for the physical protection system

has been assigned by the legislation. Article 5 sets forth other responsibilities of the central authority that might also be usefully provided for in national legislation.

### 14.4.3. Authorization through licensing or permits

As previously discussed in general terms, a State's legislation should provide for the regulation of physical protection and include a licensing requirement. The legislation should place responsibility for the licensing function on a regulatory body, as discussed in Chapter 2. The State should license nuclear related activities only when they comply with the requirements established for physical protection.

### 14.4.4. Requirements for physical protection

On the basis of its assessment of relevant threats, the State, through the regulatory body, should define the general requirements for ensuring the effective physical protection of nuclear material and facilities. Although general requirements may be codified in legislation, detailed requirements are typically promulgated by the regulatory body in regulations or rules. The following are some general requirements that may be considered for inclusion in legislation:

(a) A categorization of nuclear material.
(b) A provision that primary responsibility rests with the holders of the relevant licences or with the holders of other authorizing documents (e.g. operators or shippers).
(c) A provision that the responsibility for physical protection during international transport should be the subject of agreement between the States concerned, with a clear definition of the point at which the responsibility is transferred from one State to another.
(d) A provision that the operator or some other authorized person should prepare plans for effectively countering the design basis threat through, inter alia, the actions of an emergency response force.
(e) A provision that the State's system for physical protection should ensure that competent authorities consider the following in establishing detailed requirements for physical protection:
    — The category and location of the nuclear material (and whether the material is being used, stored or transported);
    — The need for taking into account possible radiological consequences when establishing physical protection requirements against sabotage;

— The attractiveness of the nuclear material, but also its self-protecting nature and the containment measures applied for safety reasons;
— The value of defence in depth through a combination of preventive and protective measures based on the appropriate facility design, hardware (security devices) and procedures (including the use of guards);
— Whether there is a credible threat of the malevolent dispersal of nuclear material.

### 14.4.5. Authorized persons

Physical protection measures can be implemented by the State itself, by an authorized person (e.g. the operator) or by any other entities authorized by the State (e.g. governmental organizations, the police or other response agencies). Legislation should make it clear that the authorized person in the possession or control of nuclear material bears the primary responsibility for its physical protection. In the event that the control of nuclear material or of a nuclear facility has been entrusted to other entities, the legislation should make their responsibilities clear. These responsibilities should include limiting access to the materials or the facility to a minimum number of persons and establishing and maintaining clearly defined protection areas. Other responsibilities of authorized persons are typically set forth in regulations promulgated by the regulatory body, rather than in legislation.

### 14.4.6. Inspection and quality assurance

The State (through the regulatory body or otherwise) should verify continued compliance with physical protection requirements through periodic inspections and other monitoring procedures. It is important that the State be able to conduct inspections of nuclear facilities and of vehicles used for the transport of nuclear material. A quality assurance policy and programmes should be implemented to provide confidence that specified physical protection requirements are satisfied.

### 14.4.7. Enforcement

The designated authority should be provided adequate authority to enforce physical security requirements. There need to be sanctions of two kinds: first, a range of administrative sanctions for the unauthorized removal or use of nuclear material and for non-compliance with physical protection requirements; and, second, for more serious violations (such as sabotage), a

range of criminal sanctions. A State that is Party to the CPPNM needs to ensure that the actions listed in Article 7 of the CPPNM [23] are offences punishable by appropriate penalties under its national legislation. Further, in accordance with Article 11 of the CPPNM [23], the legislation should provide that any such offences are extraditable offences under any extradition treaty in force with other States Parties.

### 14.4.8. State system of accounting and control (SSAC)

Essential for an effective physical protection system is the establishment by legislation of a well designed and well supported State system for recording and monitoring the quantities and locations of the nuclear material under the State's jurisdiction or control. Such an SSAC serves two important functions: first, through the timely detection of any cases of missing nuclear material, it helps to deter unauthorized activities involving the missing material, particularly illicit trafficking; and, second, through its accurate record of nuclear material quantities and locations, it enables the State to make realistic, up to date assessments of possible threats to material under its jurisdiction or control.

### 14.4.9. Contingency (emergency) plans

Legislation should contain provisions requiring the development and implementation of contingency (emergency) plans for responding to the unauthorized removal and subsequent unauthorized use of nuclear material, the sabotage of nuclear facilities and attempts to perpetrate such acts. It should make clear the respective responsibilities of operators and governmental bodies at various levels with regard to such plans, provide for co-operation and co-ordination among all relevant bodies and designate the entities having the primary responsibility for various functions. It should provide for the plans to be implemented by all licence holders and authorities concerned.

### 14.4.10. Confidentiality

Legislation should provide for protecting the confidentiality of information whose unauthorized disclosure could compromise the physical protection of nuclear material and nuclear facilities (see Article 6 of the CPPNM [23]). It should also provide for sanctions in the event of breaches of confidentiality, including breaches of confidentiality concerning the transport of nuclear material.

### 14.4.11. International transport

Legislation should also reflect that the State is responsible for ensuring that nuclear material is adequately protected in international transport, until that responsibility is properly transferred to another State. In this regard States Parties to the CPPNM shall include in their legislation its provisions implementing the obligations in Articles 3 and 4.

### 14.4.12. Security culture

Although not a matter that can readily be reflected in legislation, the fostering of a security culture is an important element in ensuring the adequate physical protection of nuclear material and facilities. Similar to the concept of safety culture in the nuclear safety field, a security culture includes characteristics and attitudes in organizations and individuals that establish that physical protection issues receive the attention warranted by their significance. Legislation should be drafted to give due priority to a security culture by all relevant persons and organizations.

## 14.5. ILLICIT TRAFFICKING

A matter of increasing concern related to physical protection is the problem of illicit trafficking in nuclear material. A widely accepted working definition of illicit trafficking reads as follows:

> **A situation which relates to the unauthorized receipt, provision, use, transfer or disposal of nuclear materials, whether intentional or unintentional and with or without crossing international borders.**

Thus an illicit trafficking situation may arise when physical protection measures have failed. The IAEA General Conference has adopted a resolution [50] calling on Member States of the IAEA to "take all necessary measures to prevent illicit trafficking in nuclear material." In this regard, co-ordination at the national and the international level and the provision of appropriate information were identified as key elements in combating illicit trafficking. As indicated earlier, a State Party to the CPPNM is required to make the unauthorized possession of nuclear material a punishable offence under national law. Vigorous enforcement of the relevant laws can help to deter illicit trafficking. However, States should go further and authorize responsible authorities to promptly share with other States and with international bodies

all relevant information concerning illicit trafficking and plans or attempts to procure nuclear material illicitly. The IAEA has an Illicit Trafficking Database for the collection and analysis of information received from Member States on cases of illicit trafficking in nuclear material and other radioactive sources. A State's physical protection legislation should include a provision authorizing governmental authorities to participate actively in the relevant IAEA programme.

## 14.6. CROSS-CUTTING RELATIONSHIPS

The drafters of physical protection legislation should bear in mind the relationship between the physical protection and the safety of nuclear facilities (see Chapter 6). A major breach of physical security, such as the sabotage of a nuclear facility, could pose serious safety risks. Chapter 7, Emergency Preparedness and Response, is also relevant, since the need to take emergency measures could result from breaches of physical security as well as from safety related accidents. The subject of illicit trafficking in nuclear material obviously bears an important relationship to the subject of export and import controls discussed in Chapter 13. Also, export controls are important for meeting the requirements of Article 4 of the CPPNM [23]. Finally, it is important that experts in the fields of the radiological consequences of diversion or sabotage provide complete and accurate information on these consequences to experts in physical protection so that they may establish adequate physical protection levels.

## 14.7. DEFINITIONS

As in any area of nuclear energy legislation, definitions in the physical protection area need to be clear and consistent. If the State for which legislation is being drafted is a Party to the CPPNM, serious consideration should be given to incorporating into the legislation the definitions of nuclear material, uranium enriched in the isotope 235 or 233 and international nuclear transport, as contained in Article 1 of the CPPNM [23].

Further, the definitions section (or some other section) of the legislation should include a table showing the levels of protection to be accorded to nuclear material during international transport, as indicated in Annex I to the CPPNM, and a categorization of nuclear material by type and quantity, as per the table in Annex II to the CPPNM. However, a word of caution is in order on this point. Some States have found it preferable to set forth the levels of

protection and the categorization of nuclear material in regulations promulgated by the regulatory body, rather than in laws, so that these technical features may be more easily amended in the event of changes in technology or in the character of the national or international threats. An alternative would be to place definitions, together with the levels of protection and the categorization, in a section of the law that can be amended in an expedited manner, without all the normal legislative procedures being followed. This will depend on each State's physical protection practice.

Also, if a State draws on the recommendations in INFCIRC/225/Rev.4 (Corrected) [44] when framing the basic elements of its physical protection legislation, it should consider incorporating some or all of the definitions of the following terms contained in Part 2 of that document:

— Assessment;
— Central alarm station;
— Defence in depth;
— Design basis threat;
— Guard;
— Inner area;
— Intrusion detection;
— Patrol;
— Physical barrier;
— Protected area;
— Response forces;
— Sabotage;
— Security survey;
— Transport;
— Transport control centre;
— Unauthorized removal;
— Vital area.

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