The Radiological Protection of the Public and Environment: the International Context of the IAEA’s Programme

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Abstract. The development and application of international safety standards on radiation and nuclear safety are important statutory functions of the International Atomic Energy Agency (IAEA). The paper (a) gives the overview of the international legislative, scientific and practical context of the IAEA Safety Standards; (b) describes the current status of the IAEA International Safety Standards and the key supporting documents relevant to the radiological protection of the public and environment; (c) describes the relevant IAEA activities; and (d) presents the issues, which need further development.

KEYWORDS: radiological protection; public, environment; international safety standards; radioactive discharges; public exposure; environmental assessments; IAEA.

1. Introduction

The development and application of international safety standards on radiation and nuclear safety are important statutory functions of the IAEA and the significant contribution to the Global Nuclear Safety Regime [1]. The IAEA international standards on radiation safety have a broad legislative, scientific and practical basis, such as: scientific findings of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), principles of the radiological protection developed by the International Commission on Radiological Protection (ICRP), international treaties, extensive international and national experience in maintaining the Global Nuclear Safety Regime [2]. Figure 1 schematically illustrates the international legislative, scientific and practical context of the IAEA Safety Standards.

Figure 1. The legislative, scientific and practical context of the IAEA Safety Standards

This paper: (a) gives the overview of the international legislative, scientific and practical context of the IAEA Safety Standards; (b) describes the current status of the International Safety Standards and the key supporting documents relevant to the radiological protection of the public and environment; (c) describes the relevant on-going IAEA activities; and (d) presents the issues which need further elaboration and development. The discussion is limited to the issues which are explicitly associated with
radiological protection of the public and environment. Due to technical limitations, the list of reviewed documents and activities is not all-inclusive. Thus, the details of the international perspective on control of radiation exposure to non-human biota are given in [3] and the safety of waste management is discussed elsewhere.

2. Scientific basis of the radiological protection of the public and environment

2.1 United Nations Scientific Committee on the Effects of Atomic Radiation

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) was established by the General Assembly of the United Nations in 1955. Since its inception, UNSCEAR has issued 15 authoritative reports1. These reports form a solid source of the fundamental scientific information and underlie the modern system of radiological protection of the public and environment. The most recent publications were the UNSCEAR 2000 Report: “Sources and effects of ionizing radiation” [4] and the UNSCEAR 2001 Report: “Hereditary effects of ionizing radiation” [5]. It is expected that a new UNSCEAR Report will be published before the end of 2008. The IAEA discusses, assists and participates in the work of UNSCEAR and provides technical assistance by way of the online database on radioactive discharges to the environment2.

2.2 International Commission on Radiological Protection

The International Commission on Radiological Protection (ICRP) is an independent Registered Charity, established in 19283. Nowadays the ICRP is committed to the advancement, for the public’s benefit, the science of radiological protection, in particular by providing recommendations and guidance on all aspects of protection against ionizing radiation. The ICRP offers its recommendations and provides advice intended to be of help to management and professional staff with responsibilities for radiological protection. In 1960, when the IAEA’s Board of Governors first approved radiation protection and safety measures, it stated: “The Agency’s basic safety standards … will be based, to the extent possible, on the recommendations of the International Commission on Radiological Protection”. Since that statement was made, all revisions of the IAEA Basic Safety Standards have been based on ICRP recommendations. The basis of a system of radiological protection of the public and environment has been updated and its presentation was streamlined after publication of The 2007 Recommendations of the International Commission on Radiological Protection” (ICRP Publication 103) [6].

3. Binding international treaties

This section provides an overview of the international treaties related to protection of the public and environment. The IAEA is the depository of key international conventions and legal agreements. Additionally, the IAEA is entrusted with responsibilities under other treaties, such as the London and OSPAR Conventions, concerned with radioactive waste, radioactive discharges and the protection of the environment. These formal obligations require the IAEA to respond to specific requests made by international legal instruments.

3.1 Joint Convention

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management [7] entered into force in 2001 and as of January 2008 has 46 Contracting Parties. The Joint Convention applies to spent fuel, radioactive waste and to the planned and controlled radioactive releases to the environment from regulated nuclear facilities. The obligations of the Contracting Parties with respect to the protection of the public and environment include the

1 All UNSCEAR reports are available electronically from http://www.unscear.org/unscear/en/publications.html
3 See http://www.icrp.org/index.asp
requirement to establish and maintain a legislative and regulatory framework to govern the safety of spent fuel, radioactive waste management and radioactive discharges. The appropriate siting, design and construction of facilities, as well as provisions for ensuring the safety of facilities both during their operation and after their closure, are required. The Joint Convention has two sets of symmetrical obligations for the safety of spent fuel and radioactive waste.

The Articles 4 and 11 on the general safety requirements state (among other obligations) that each Contracting Party shall take the appropriate steps to:

- provide for effective protection of individuals, society and the environment;
- strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation; and
- aim to avoid imposing undue burdens on future generations.

The Articles 7 and 14 on the design and construction of facilities require that each Contracting Party shall take the appropriate steps to ensure that the design and construction of a facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases.

The Articles 8 and 15 on the assessment of safety of facilities state that each Contracting Party shall take the appropriate steps to ensure that before construction of a facility, a systematic safety assessment and an environmental assessment shall be carried out.

The Articles 9 and 16 on the operation of facilities require that each Contracting Party shall take the appropriate steps to ensure that the licence to operate a facility is based upon appropriate assessments and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements.

The Article 17 on the institutional measures after closure of a waste disposal facility, requires that each Contracting Party shall take the appropriate steps to ensure that:

- records of the location, design and inventory of that facility, required by the regulatory body, are preserved;
- active or passive institutional controls, such as monitoring or access restrictions, are carried out, if required; and
- if, during any period of active institutional control, an unplanned release of radioactive materials into the environment is detected, intervention measures are implemented, if necessary.

The Article 24 postulates the obligations of Contracting Parties in operational radiation protection, including the optimisation of protection, limitation of public exposure and prevention of unplanned and uncontrolled releases of radioactive materials into the environment.

The Convention is an incentive instrument. It is not designed to ensure fulfillment of obligations by Parties through control and sanction, but is based on their common interest to achieve higher levels of safety which will be developed and promoted through regular meetings of the Parties.

The IAEA is required to provide the Secretariat for the meetings of the Contracting Parties to the Joint Convention. In this capacity, the IAEA convenes, prepares and services meetings of the Contracting Parties and transmit information received or prepared to the Parties. The IAEA also developed the internet-based technical tools, such as the DIRATA\(^1\) and NEWMDB\(^2\) databases to assist Contracting Parties in the preparation of National Reports.

\(^1\) http://dirata.iaea.org/
\(^2\) http://www-newmdb.iaea.org/
3.2 London, Helsinki, Barcelona and OSPAR Conventions

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, the London Convention for short, is one of the first global conventions to protect the marine environment from human activities and has been in force since 1975. Its objective is to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter. Currently, 83 States are Parties to this Convention. In 1996, the London Protocol was agreed to further modernize the Convention and, eventually, replace it. Under the Protocol all dumping is prohibited, except for possibly acceptable wastes on the so-called “reverse list”. The Protocol entered into force on 24 March 2006 and there are currently 34 Parties to the Protocol. The detailed discussion of the role of the IAEA in the London Convention 1972 on Dumping of Wastes at Sea is given in [8].

The 1992 Convention for the Protection of the Marine Environment of the North-East Atlantic (known as the OSPAR Convention) is the basis for national laws governing the discharge of offshore drilling wastes in the waters of the OSPAR signatory states. It combined and updated the 1972 Oslo Convention on dumping waste at sea and the 1974 Paris Convention on land-based sources of marine pollution. The work under the convention is managed by the OSPAR Commission, which is made up of representatives of the Governments of 15 Contracting Parties and the European Commission [9].

The Radioactive Substances Strategy of the OSPAR Commission sets the objective of preventing pollution of the maritime area from ionizing radiation through progressive and substantial reductions of discharges, emissions and losses of radioactive substances, with the ultimate aim of concentrations in the environment near background values for naturally occurring radioactive substances, and close to zero for artificial radioactive substances. In achieving this objective, the following issues should, inter alia, be taken into account: legitimate uses of the sea; technical feasibility; radiological impacts on humans and biota. As its timeframe, the Radioactive Substances Strategy further declares that by the year 2020 the OSPAR Commission will ensure that discharges, emissions and losses of radioactive substances are reduced to levels where the additional concentrations in the marine environment above historic levels, resulting from such discharges, emissions and losses, are close to zero [10].

The Convention on the Protection of the Marine Environment of the Baltic Sea Area, 1992 (known as the Helsinki Convention) [11], entered into force on 17 January 2000 and currently has 10 Contracting Parties. The Convention covers the whole Baltic Sea area, including inland waters as well as the water of the sea itself and the sea-bed. Measures are also taken in the whole catchment area of the Baltic Sea to reduce land-based pollution.

The Barcelona Convention for Protection against Pollution in the Mediterranean Sea (Barcelona Convention) of 1976, amended in 1995, is a regional convention to prevent and abate pollution from ships, aircraft and land based sources in the Mediterranean Sea. This includes, but is not limited to, dumping, run-off and discharges. Signatories agreed to cooperate and assist in dealing with pollution emergencies, monitoring and scientific research [12].

The IAEA participates in the Conventions’ international activities and coordinates its own activities with the Conventions’ legal institutions and Contracting Parties.

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6 http://www.iaea.org/Publications/Documents/Infircs/Others/inf205.shtml
7 http://www.londonconvention.org/
3.3 Conventions on nuclear safety, early notification and assistance

The Convention on Nuclear Safety was adopted in 1994 and currently has 62 Parties. It contains the legal commitments of the participating States operating land-based nuclear power plants to maintain a high level of safety by setting international benchmarks to which States would subscribe [13].

The Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency were adopted in 1986 following the Chernobyl nuclear plant accident, and now have 102 and 100 Parties, respectively. These Conventions establish a notification system for nuclear accidents which have the potential for international transboundary release and set out an international framework for cooperation among States Parties and with the IAEA to facilitate prompt assistance and support in the event of nuclear accidents or radiological emergencies [14,15].

The obligations of the Parties listed in this section on Conventions, are based to a large extent on the principles contained in the IAEA Safety Fundamentals documents and the IAEA facilitates the activities and periodic review meeting of these Conventions.

3.4 Other treaties

The Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991) sets out the obligations of Parties to assess the environmental impact of certain activities at an early stage of planning. It was adopted in 1991 and entered into force on 10 September 1997. Currently, 45 States are Parties to this Convention. The Convention lays down the general obligation of States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries. The Convention includes such facilities as nuclear power stations, other nuclear reactors, installations solely designed for the production or enrichment of nuclear fuels, for the reprocessing of irradiated nuclear fuels, or for the storage, disposal and processing of radioactive waste [16].

The United Nations Convention on Biological Diversity (CBD), is an international treaty that was adopted in Rio de Janeiro in June 1992 and aims to ensure the conservation of biodiversity (i.e., the complete variety of life on Earth), and its sustainable use. Currently, the Convention has 190 Parties and could potentially have a huge impact, but relies heavily on action at the national level and other related treaties. The Convention covers such issues as general measures for conservation and sustainable use (Article 6), identification and monitoring (Article 7), impact assessment and minimizing adverse impacts (Article 14). The Convention is often seen as the key document regarding sustainable development [17], the extended discussion of the 1992 Rio de Janeiro UN Conference on Environment and Development is given in [3].

The Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (The Aarhus Convention) 1998, has 46 Parties and plays an important role to ensure ‘environmental democracy’ in European and Central Asian regions [18].

4. Non-binding international documents

The Code of Conduct on the Safety and Security of Radioactive Sources was approved by the IAEA Board of Governors in 2003 and in resolution GC(47)/RES/7 the IAEA General Conference welcomed the Board's approval. The Guidance on the Import and Export of Radioactive Sources was approved by the IAEA Board of Governors in September 2004, and in resolution GC(48)/RES/10.D the IAEA General Conference welcomed the Board's approval and endorsed the Guidance [19]. Since approval, many countries have written to the IAEA Director General, expressing their support for the Codes.

The Revised Codex Guideline Levels for Radionuclides in Foods Contaminated Following a Nuclear or Radiological Emergency for Use in International Trade, was developed with the participation of the
IAEA and adopted by the Codex Alimentarius Commission (CAC) in 2006 [20]. The document contains the main principles and procedures which are used and recommended by the CAC in dealing with contaminants in foods and feeds, and lists the maximum levels of contaminants which are recommended by the CAC to be applied to commodities moving in international trade.

The third edition of the Guidelines for Drinking-Water Quality was also developed with the participation of the IAEA and published by the World Health Organization (WHO) in 2006 [21]. The Guidelines are used by developing and developed countries worldwide as the basis for regulation and standard setting to ensure the safety of drinking-water. The document recommends the formal guidance values for radionuclides in drinking water, based on the screening of drinking-water for gross alpha and gross beta radiation activity. While finding levels of activity above screening values does not indicate any immediate risk to health, it should trigger the further investigation into determining the radionuclides responsible and the possible risks, taking into account local circumstances. The recommended values are given for planned and existing exposure situations and are not applicable to drinking-water supplies contaminated during emergencies arising from accidental releases of radioactive substances to the environment.

5. The international safety standards

A big part of the IAEA’s statutory mandate is the establishment and promotion of advisory international standards. Standards are issued as series publications and cover nuclear safety, radiation protection, radioactive waste management, the transport of radioactive materials, the safety of nuclear fuel cycle facilities and quality assurance. The complete list and full texts of the IAEA safety standards and supporting documents are available from the IAEA web site. This section gives a brief overview of the most important IAEA documents explicitly relevant to the protection of the public and environment.

5.1 Structure of international safety standards

The IAEA safety standards, comprising Safety Fundamentals, Safety Requirements and Safety Guides (see Figure 2), are binding for the IAEA in its own operations, are applied by other sponsoring organizations for their own operations, and are recommended for use by States and national authorities in relation to their own activities. International conventions and the IAEA safety standards, appropriately supplemented by industry standards and detailed national requirements, establish a consistent and comprehensive basis for the proper protection of people and the environment against radiation risks.

5.2 Fundamental Safety Principles about the protection of the public and environment

A new primary IAEA safety standard, Fundamental Safety Principles, was approved for publication by the IAEA's Board of Governors in 2006 and constitutes the conceptual basis for the IAEA's entire safety standards programme, and provides the rationale for its wider safety and security related programme. The Fundamental Safety Principles are jointly sponsored by the European Atomic Energy Community (EURATOM), the Food and Agriculture Organization of the United Nations (FAO), the International Labour Organization (ILO), the International Maritime Organization (IMO), the Nuclear Energy Agency of the OECD (OECD/NEA), the Pan American Health Organization (PAHO), the United Nations Environment Programme (UNEP) and the World Health Organization (WHO). The safety objective and the ten safety principles provide the grounds for establishing requirements and measures for the protection of people and the environment against radiation risks, and for the safety of facilities and activities that give rise to radiation risks. The ten principles cover: responsibility for safety; role of government; leadership and management for safety; justification of facilities and activities; optimization of protection; limitation of risks to individuals; protection of present and future  

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8 [http://www.codexalimentarius.net/](http://www.codexalimentarius.net/)
10 [http://www-ns.iaea.org/standards/safety-glossary.htm](http://www-ns.iaea.org/standards/safety-glossary.htm)
generations; prevention of accidents; emergency preparedness and response; and protective actions to reduce existing or unregulated radiation risks. All ten principles are aimed at the protection of the public and environment; particularly:

- Principle 5, on optimization of protection states that: the protection must be optimized to provide the highest level of safety that can reasonably be achieved;
- Principle 6, on limitation of risks to individuals states that: the measures for controlling radiation risks must ensure that no individual bears an unacceptable risk of harm; and
- Principle 7, on protection of present and future generations states that: the people and the environment, present and future, must be protected against radiation risks.

Figure 2. The schematic structure of the IAEA international safety standards

5.3 Basic safety standards

“The International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources” (BSS), cosponsored by FAO, ILO, OECD/NEA, PAHO and WHO, are based on assessments of the biological effects of irradiation made by UNSCEAR, and on the recommendations of the ICRP and the International Nuclear Safety Advisory Group. The Standards represent an international consensus on qualitative and quantitative requirements for protection and safety for: planned practices such as nuclear power generation and the use of radiation and radioactive materials in medicine and industry; intervention in existing situations such as chronic exposure to natural sources of radiation or exposure following an accident; control of radiation sources, including notification and authorization, and criteria for exemption [22].

In accordance with its statutory functions and recommendations of its Member States, the IAEA initiated the process of review and revision of the BSS in 2005. The work is conducted in collaboration with the present and potential cosponsoring organisations, ICRP and IAEA Member States. The new BSS will include the reviewed and updated, where needed, requirements on protection of the public and environment in planned, existing and emergency exposure situations. Additional clarifications will be introduced into requirements on the constrained optimisation of the radiological protection of members of the public, assessments of exposure to a representative person, potential exposure, authorisation of radioactive discharges, radioactive waste management, consumer products, protection of the environment, and demonstration of compliance with regulatory requirements. Specific emphasis will be given to the delineation of responsibilities of the Responsible Parties at the design, operational and post-operational stages of a facility’s life cycle. Modifications of the set of current requirements and their contents will be limited and in each case, a justification of the modification will be provided.
5.4. Thematic safety requirements, guides and supporting publications

Control of radioactive discharges and environmental assessments

The “Safety Guide Regulatory Control of Radioactive Discharges to the Environment” [23] is concerned with the regulatory control of radioactive discharges to the environment in planned exposure situations. It interprets the Fundamental Safety Principles and elaborates on the requirements specified in BSS.

The Safety Guide “Environmental and Source Monitoring for Purposes of Radiation Protection” [24] provides international guidance on the strategy of monitoring in relation to the control of radionuclide discharges in planned, existing and emergency exposure situations. The Safety Guide also provides general guidance on assessment of doses to the population due to the presence of radioactive materials or radiation fields in the environment.

The draft Safety Report “Design and Operation of Source and Environmental Radiation Monitoring Programmes and Systems” will provide the detailed practical information in relation to:
- the control of radionuclide discharges from both nuclear and non-nuclear installations, including hospital and research establishments; and
- situations requiring intervention, such as a nuclear or radiological emergency or the past contamination of areas with long-lived radionuclides.

The target users of the document are designers and operators of radioactive monitoring systems, but the document should also be useful to national regulatory bodies with responsibilities for regulating the introduction and conduct of any practice involving the discharge of radioactive material, whether of natural or artificial origin.

The Safety Report “Generic Models for Use in Assessing the Impact of Discharges of Radioactive Substances to the Environment” [25] is dedicated to the screening assessment procedures for the environmental impact analysis. The Safety Report provides simple methods for calculating doses to members of general public arising from radioactive discharges into the environment, for the purpose of evaluating suitable discharge limits and in order to allow comparison with the authorised levels specified by the Regulatory Body.

Remediation

The Safety Requirements “Remediation of Areas Contaminated by Past Activities and Accidents” (WS-R-3) [26], and the Safety Guide “Remediation Process for Areas Affected by Past Activities and Accidents Safety Guide Safety Standards Series” [27] establish requirements and provide guidance on implementing requirements for the remediation of areas contaminated by past activities and accidents. During the process of revision of the BSS, the BSS Technical Meeting (held July 2007) proposed to integrate the requirements of WS-R-3 into the new BSS, which will be implemented by the BSS drafting groups.

5.5 Application of international safety standards for the protection people and the environment

The application of the International Safety Standards is a substantial part of the IAEA’s permanent efforts in the protection of the public and the environment. The IAEA continues its work on the development of supporting and complementary components of the system of international safety standards, such as safety reports and technical documents (TECDOCs). The broad international cooperation in the area of protection of public and the environment includes, but is not limited by:
- cooperation on the level of UN organisations: Chernobyl Forum[11], UN Chernobyl Action Plan until 2016[12] and ICRIN project[13];

- coordination and participation in international and national R&D activities on environmental modelling, assessment of public exposure, model validation and intercomparison: IAEA EMRAS Programme and its follow-up EMRAS II\textsuperscript{14}; the EC’s FUTURAE\textsuperscript{15} and PROTECT\textsuperscript{16} Projects;
- the radiological assessments, review, advisory and appraisal missions on the request of Member States: including IAEA IRRS missions, IAEA Radiological Assessment Report Series documents\textsuperscript{17};
- technical assistance to Members States in upgrading national capabilities in controlling public exposure\textsuperscript{18}.

6. Conclusions and outlook

The IAEA has a long tradition of establishing and applying International Safety Standards related to the protection of the public and environment, including the control, assessment and monitoring of discharges of radioactive substances to the environment. Nowadays the broad majority of the IAEA’s Member States use, and effectively implement, the systems of protection which are coherent with the ICRP Recommendations and the IAEA International Safety Standards. Nevertheless, the growing use of nuclear technologies, the advances in science, the accumulated national experience in the application of the safety standards and the increasing public interest regarding environmental issues, are the driving forces for the further improvement, development and application of the safety standards. Particularly, the following issues should be elaborated upon and developed:

- further harmonization of the national legislations and regulations on the protection of the public and environment with the International Safety Standards;
- legislative approaches to the regulation of the transboundary exposure of the public due to authorized radioactive discharges;
- graded approach in the environmental impact assessments;
- scientific and methodological basis for the assessment of the exposure of future generations (e.g. due to management of radioactive waste);
- guides and reports on the implementation of the constrained optimisation of the protection of the public and environment in planned exposure situations;
- reports for the implementation of safety requirements and new ICRP recommendations on the optimisation of protection in existing exposure situations, particularly, on the territories contaminated after past practices and accidents; and
- an integrated concept and methodology for the protection of humans, biota and the environment as whole.

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