



General Assembly

Distr.: Limited
25 January 2001

Original: English

Committee on the Peaceful Uses of Outer Space

Scientific and Technical Subcommittee

Vienna, 12-23 February 2001

Item 7 of the provisional agenda*

Use of nuclear power sources in outer space

A database of international documents of potential relevance to nuclear power sources in outer space

Working paper submitted by the United States of America

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*A/AC.105/C.1/L.240.

I. Introduction

1. At the thirty-fifth session of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space, a work plan was developed for establishing a process and framework for developing information or data that would facilitate future discussions of safety processes and standards for nuclear power sources (A/AC.105/697, appendix). The work plan stated that objectives of future discussions on nuclear power sources should be:

(a) To identify current national and international processes and standards (space and terrestrial-related) pertinent to the use of nuclear power sources;

(b) To develop a relevant database as a source for the above information concerning nuclear power sources.

2. The Scientific and Technical Subcommittee reconvened its Working Group on the Use of Nuclear Power Sources in Outer Space and completed its first year of activities directed towards accomplishing those objectives during its meeting in February 2000. A number of actions were identified by the Working Group at that time (see A/AC.105/736, annex III), including a review of the following documents in order to identify with more specificity those documents or parts of documents which might be of particular relevance to nuclear power sources in outer space:

(a) The provisions of the Convention on Nuclear Safety,¹ the Convention on Early Notification of a Nuclear Accident² and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency;³

(b) The recommendations of the International Commission on Radiological Protection (ICRP);

(c) The relevant Safety Series publications of the International Atomic Energy Agency (IAEA);

(d) The reports of the United Nations Scientific Committee on the Effects of Atomic Radiation.

3. The Working Group welcomed the offer of IAEA to conduct a preliminary review of the documents and requested the Agency to report on the matter to the Scientific and Technical Subcommittee at its thirty-eighth session, in 2001.

4. The present draft working paper provides an initial database of international documents (conventions, standards, advisory group publications, recommendations and reports) as complementary information to the preliminary review performed by IAEA on this action item (see annexes I and II).

II. Relevant international organizations

5. The database focuses on those standards, recommendations and reports of three organizations that are generally recognized authorities in atomic energy and radiation matters at the international level, namely, IAEA, ICRP and the United Nations Scientific Committee on the Effects of Atomic Radiation. Descriptive summaries of the organizations are presented below.

A. International Atomic Energy Agency

6. IAEA, established under the aegis of the United Nations, is authorized to establish or adopt standards of safety in the field of atomic energy in collaboration with other organizations within the United Nations and special agencies concerned. IAEA establishes its safety standards based on advice provided by its safety standards advisory committees and the International Nuclear Safety Advisory Group; health effect estimates made by the United Nations Scientific Committee on the Effects of Atomic Radiation; and recommendations made by a number of international organizations, principally ICRP.

B. International Commission on Radiological Protection

7. ICRP is an international advisory body providing recommendations and guidance on radiation protection. It has official relationships with the World Health Organization and IAEA. An important impact of the Commission's work has been in the areas of (a) establishing a basic radiation protection philosophy; (b) establishing radiation dose limit guidelines for occupational workers and the general public; (c) providing guidance on the development and use of health effect estimators (relating radiation exposure and the potential for health effects); and (d) developing internal dosimetry models and internal dose conversion factors.

C. United Nations Scientific Committee on the Effects of Atomic Radiation

8. The United Nations Scientific Committee on the Effects of Atomic Radiation periodically evaluates the latest studies on the health effects of ionizing radiation and makes recommendations on values and application of health effect estimators in assessing the radiation risks.

III. Database development

9. As a first step in supporting the work of the Committee on the Peaceful Uses of Outer Space, an initial database was developed listing all available IAEA and ICRP citations of relevance to the entire nuclear industry. Since the intent of the database is to establish a contemporary listing of technical standards that can be used to facilitate potential future discussions concerning nuclear power sources in space, the next step was to reduce the size of the initial database by screening out those citations which were clearly not relevant to nuclear power sources in space. For the purposes of the present paper, a document is considered to be potentially relevant if it has the potential to provide a benefit or value as a technical resource or reference for flight nuclear safety activities for nuclear power sources in space.

10. Space nuclear power source operations can be viewed as consisting of two aspects: (a) terrestrial operations, including development, assembly, testing and transportation; and (b) system design and operations unique to space nuclear power sources affecting flight nuclear safety, including operations related to launch, deployment and use as part of a space mission. International technical standards

established for terrestrial nuclear operations would generally be relevant to the first set of activities. However, their potential relevance to the latter set deserves closer scrutiny, in particular since there is a good probability they may have been developed without space nuclear power sources in mind. In developing the database, the potential relevance of individual documents was assessed strictly with respect to the flight nuclear safety of nuclear power sources in space.

11. The documents included in this database are considered potentially relevant to the flight nuclear safety of nuclear power sources. The documents have been categorized in terms of (a) degree of relevance using a scale of 1 to 3; and (b) level of guidance or detail using an A or B designator. The criteria used in assigning these categories are as follows:

(a) Potential relevance:

(i) Level 1 indicates that the document is directly relevant only to nuclear power sources in space;

(ii) Level 2 indicates that the document is potentially relevant to any type of nuclear facility, system or material, including nuclear power sources in space;

(iii) Level 3 indicates that the document was developed specifically for terrestrial nuclear power sources, but may contain some elements potentially relevant to nuclear power sources in space;

(b) Level of guidance and detail:

(i) The designator "A" indicates that the document addresses high-level nuclear safety or radiation protection concepts, fundamentals, principles or philosophy. These documents also include high-level international conventions;

(ii) The designator "B" indicates that the document provides detailed information in the form of specific guidance; technical data; results of studies and analyses; and recommended methodologies, including modelling or analytical methods.

12. The category designator assigned to each document in the database was based upon review of topical areas addressed and current knowledge and/or information about the document. The category designators for particular documents and their retention in the database may be subject to change after more in-depth review and assessment.

13. Another feature of the database is the grouping of potentially relevant documents into the following topical categories:

(a) International agreements or recommendations;

(b) Nuclear safety (focusing on system safety);

(c) Radiation protection (focusing on individual safety);

(d) Emergency planning, intervention and mitigation;

(e) Potential exposure situations;

(f) Transportation.

14. A number of IAEA and ICRP documents prepared in the past have been clearly superseded by more recent documents, which in turn have been adopted by the technical community. In such cases, only the more recent documents are retained. There are some exceptions made to this approach, as follows:

(a) Any superseded document referenced in the Principles Relevant to the Use of Nuclear Power Sources in Outer Space (see General Assembly resolution 47/68) such as ICRP-26,⁴ is retained to track historical development and provide the rationale for its replacement by ICRP-60;⁵

(b) In some cases, the member States of IAEA have promulgated regulations in their own national regulations based on an earlier version of an IAEA document that is now superseded by a more recent document. In such a case, both the earlier version and the more recent version are retained with appropriate comments provided. One example of this is Safety Series No. 6 and its revisions until 1986 regarding the transport of radioactive materials.⁶ That document forms the basis of those parts of United States Department of Transportation regulations in Title 49 of the Code of Federal Regulations (CFR), which address the packaging and transport of radioactive materials.⁷ IAEA issued ST-1 in 1996, as an update.⁸ The United States Department of Transportation now has ST-1 under review and has proposed a revision to relevant parts of Title 49 in the Federal Register;⁹

(c) Another example is in the area of ICRP internal dosimetry models. The United States Environmental Protection Agency, the United States Nuclear Regulatory Commission and the United States Department of Energy perform radiation dose assessments based on the internal dosimetry model presented in ICRP-30, issued originally in 1979.¹⁰ While revisions to ICRP-30 dose factors were ongoing until the early 1990s based on subtle changes in metabolic parameter values and organ weighting factors, the federal agencies have not updated their factors concurrently. Another complication is that a new ICRP internal dosimetry model was presented in ICRP-66, which has had its own series of subsequent ICRP publications refining its use.¹¹ The historical web of ICRP documents dealing with internal dosimetry is retained.

15. Following the document categorization scheme outlined above, the current reduced database is presented in annexes I and II. Annex I presents very high-level documents, consisting of international conventions. Annex II, section A, presents potentially relevant IAEA-related documents, including International Nuclear Safety Advisory Group publications, Safety Guides that present advisory or implementation guidance and documents that have undergone a formal IAEA review process and represent an international consensus. The latter documents include the IAEA safety standards. Sections B and C of annex II present relevant ICRP and United Nations Scientific Committee on the Effects of Atomic Radiation documents, respectively, that support and/or form the basis of a number of the IAEA documents presented in part A.

IV. Summary

16. The final database includes 57 documents that have been identified as potentially relevant to the flight nuclear safety of nuclear power sources in space. These consist of:

- (a) Three international conventions;
- (b) Twenty-four high-level IAEA advisory or guidance documents;
- (c) Twenty-six ICRP documents;
- (d) Four United Nations Scientific Committee on the Effects of Atomic Radiation documents.

17. The database is comprised of a mixture of high-level and detailed documents. Most of the documents (36) fell into relevance level 2 (potentially relevant to any type of nuclear facility, system or material, including space nuclear power sources). A lesser number of documents (20) fell into relevance category 3 (developed specifically for terrestrial nuclear power sources, but may contain some elements potentially relevant to nuclear power sources in space). Only one document, issued in the IAEA Safety Series, "Emergency planning and preparedness for re-entry of a nuclear powered satellite", was found to correspond to relevance level 1 (directly relevant only to nuclear power sources in space). The three international conventions examined are inherently high-level documents and consist of two conventions of a generic nature and one developed specifically for civilian land-based nuclear power plants. The IAEA documents contain a mixture of high-level and detailed documents, the majority of which are focused on terrestrial applications, in particular nuclear power plants. Finally, ICRP and United Nations Scientific Committee on the Effects of Atomic Radiation documents identified are primarily generic with respect to application, but detailed with regard to technical content.

Notes

- ¹ International Atomic Energy Agency, "Convention on Nuclear Safety" (INFCIRC/449).
- ² United Nations, *Treaty Series*, vol. 1439, No. 24404.
- ³ *Ibid.*, vol. 1457, No. 24643.
- ⁴ "Recommendations of the International Commission on Radiological Protection", Publication 26, *Annals of the ICRP*, vol. 1, No. 3 (1977).
- ⁵ "1990 Recommendations of the International Commission on Radiological Protection", Publication 60, *Annals of the ICRP*, vol. 21, Nos. 1-3 (1992).
- ⁶ International Atomic Energy Agency, "Regulations for the safe transport of radioactive material", Safety Series No. 6 (1985, amended 1990).
- ⁷ United States Department of Transportation, Code of Federal Regulations, Title 49, "Transportation" (1999).
- ⁸ International Atomic Energy Agency, "Regulations for the safe transport of radioactive material", Safety Standards Series ST-1 (1996).
- ⁹ United States Department of Transportation, "Hazardous Materials Regulations: Compatibility with the Regulations of the International Atomic Energy Agency", *Federal Register*, vol. 64, No. 248 (29 December 1999), pp. 72633-72636.
- ¹⁰ "Limits for intakes of radionuclides by workers", Publication 30, *Annals of the ICRP* (1979 and revisions).
- ¹¹ "Human respiratory tract model for radiological protection", Publication 66, *Annals of the ICRP*, vol. 24, Nos. 1-3 (1994).

Annex I

Database of potentially relevant international conventions

<i>Number</i>	<i>Reference</i>	<i>Title</i>	<i>Comments</i>	<i>Designator</i>
Nuclear safety				
1	International Atomic Energy Agency (IAEA) INF/CIRC/449 (1996)	Convention on Nuclear Safety	This Convention commits participating States operating land-based nuclear power plants to maintain a high level of safety by setting international benchmarks to which States would subscribe. The obligations are based to a large extent on the principles contained in the IAEA Safety Fundamentals document "The safety of nuclear installations" (annex II, sect. A, document No. 1) and cover siting, design, construction, operation, the assessment and verification of safety, quality assurance and emergency preparedness.	3A
Radiation protection				
[None identified.]				
Emergency planning, intervention and mitigation				
2	IAEA INF/CIRC/335 (1986); <i>United Nations Treaty Series</i> , vol. 1439, No. 24404	Convention on Early Notification of a Nuclear Accident	This Convention establishes a notification system for nuclear accidents that have the potential for international transboundary release that could be of radiological safety significance for another State. It requires States to report the accident's time, location, radiation releases and other data essential for assessing the situation.	2A
3	IAEA INF/CIRC/336 (1987); <i>United Nations Treaty Series</i> , vol. 1457, No. 24643	Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	This Convention sets out an international framework for cooperation among States and with IAEA to facilitate prompt assistance and support in the event of nuclear accidents or radiological emergencies. It requires States to notify IAEA of their available experts, equipment and other materials for providing assistance.	2A
Potential exposure situations				
[None identified.]				
Transportation				
[None identified.]				

Annex II

Database of potentially relevant documents

A. International Atomic Energy Agency

<i>Number</i>	<i>Reference: document number</i>	<i>Title</i>	<i>Comments</i>	<i>Designator</i>
Nuclear safety				
1	Safety Series No. 110 (1993); STI/PUB/938	“The safety of nuclear installations	Safety Fundamental. Guideline on nuclear safety fundamentals. Presents an international consensus on the basic concepts underlying the principles for the regulation, management of safety and operation of nuclear installations. Forms a top-level publication in the hierarchy of the IAEA Safety Series. In conjunction with this publication, Safety Standards, Safety Guides and Safety Practices provide detailed requirements and recommendations for activities relating to siting, design, quality assurance, operation and regulation of nuclear installations. Addresses safety objectives, legislative and regulatory framework, management of safety, technical aspects of safety, verification of safety, the concept of risk, and methods of risk evaluation and limitation.	3A
2	75-INSAG-4 (1991); STI/PUB/882	“Safety culture”	Publication of the International Nuclear Safety Advisory Group. Describes the concept of “safety culture” in connection with nuclear plant safety in relation to both organizations and individuals engaged in nuclear power activities. Provides a basis for judging the effectiveness of the safety culture in specific cases in order to identify their potential improvements.	3A
3	75-INSAG-6 (1992); STI/PUB/916	“Probabilistic safety assessment	Advisory Group publication. Describes how probabilistic safety assessment (PSA) has contributed significantly to the understanding of how best to ensure the safety of nuclear power plants. Reviews general basis of PSA, emphasizing its merits and limitations as well as the general lines of future PSA developments and their applications.	3A
4	75-INSAG-10 (1996); STI/PUB/1013	“Defence in depth in nuclear safety”	Advisory Group publication. Addresses the concept of defence in depth in nuclear and radiation safety, discussing its objectives, strategy, implementation and future development.	3A

<i>Number</i>	<i>Reference: document number</i>	<i>Title</i>	<i>Comments</i>	<i>Designator</i>
5	50-C/SG-Q (1996); STI/PUB/1016	“Quality assurance for safety in nuclear power plants and other nuclear installations”	This revised Safety Code and its corresponding Safety Guides replace Safety Series Nos. 50-C-QA (Rev.1) and 50-SG-QA1-11. Presents basic requirements and implementation methods for quality assurance, recommendations to regulatory bodies in establishing requirements and verifying implementation, identifies the responsibilities of the licensee in achieving improved quality and safety performance and gives guidance on methods for fulfilling the basic requirements.	3B
6	Safety Series No. 100 (1989); STI/PUB/835	“Evaluating the reliability of predictions made using environmental transfer models: a safety practice”	Provides guidance on the available methods for evaluating the reliability of environmental transfer model predictions used in dose assessments. Provides an introduction to the subject and supplements existing IAEA publications on environmental dose assessment methodology.	2B
7	Safety Series No. 106 (1992); STI/PUB/911	“The role of probabilistic safety assessment and probabilistic safety criteria in nuclear power plant safety”	Establishes guidelines on the role PSA can play as part of an overall safety assurance programme in nuclear power plants. It describes a framework for probabilistic safety criteria (PSC) and provides guidance for the establishment of PSC values.	3A
8	50-P-1 (1990); STI/PUB/819	“Application of the single failure criterion”	Addresses the relationship between the single failure criterion (addressed in Safety Series No. 50-C-D (Rev.1)) and system performance reliability with respect to the scope of the criterion’s application. Discusses the application principles, the relation to common cause failures, exemptions to the criterion and single failure analysis methodology.	3B
9	50-P-4 (1992); STI/PUB/888	“Procedures for conducting probabilistic safety assessments of nuclear power plants (Level 1)”	Provides guidance on how to conduct a Level-1 PSA for a nuclear-power plant. Emphasis is placed on the procedural steps rather than on detailed methods. Addresses sources of radioactive releases and accident initiators, accident sequence modelling, parameter estimation, accident sequence quantification and documentation.	3B
10	50-P-8 (1995); STI/PUB/969	“Procedures for conducting probabilistic safety assessments of nuclear power plants (Level 2)”	Provides guidance on how to conduct a Level-2 PSA for a nuclear power plant. Emphasis is placed on procedural steps rather than on detailed methods. Addresses accident progression, containment analysis, source terms for severe accidents and documentation.	3B

<i>Number</i>	<i>Reference: document number</i>	<i>Title</i>	<i>Comments</i>	<i>Designator</i>
11	50-P-12 (1996); STI/PUB/1009	“Procedures for conducting probabilistic safety assessments of nuclear power plants (Level 3)”	Provides guidance on how to conduct a Level-3 PSA for a nuclear power plant. Addresses approaches to and current developments in probabilistic consequence analysis. Discusses the relative importance of accident prevention and mitigative measures with respect to accident consequences, the relative effectiveness of emergency response planning aspects of off-site accident management and their economic impacts.	3B
Radiation protection				
12	Safety Series No. 115 (1996); STI/PUB/996	“International basic safety standards for protection against ionizing radiation and for the safety of radiation sources: a safety standard”	Current IAEA recommendations regarding radiation protection. Jointly sponsored by the Food and Agriculture Organization of the United Nations, IAEA, the International Labour Organization, the Organisation for Economic Cooperation and Development/Nuclear Energy Agency and the World Health Organization and its Pan-American Health Organization. The standards are based on the latest assessments of the biological effects of ionizing radiation made by the United Nations Scientific Committee on the Effects of Atomic Radiation and the recommendations of the International Commission on Radiological Protection (ICRP) and the IAEA 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. Consensus guidance is also given on occupational radiation protection, medical exposure, protection of members of the public from exposure to radioactive materials released to the environment, prevention of incidents giving rise to potential exposure and intervention in a radiological emergency.	2B
13	Safety Series No. 120; STI/PUB/1000	“Radiation protection and the safety of radiation sources: a safety fundamental”	Safety Fundamental. Provides a set of objectives and principles for protection against ionizing radiation and ensuring safety in the use of radiation sources. The principles applied to achieve protection and safety objectives provide the basis for the requirements in IAEA Safety Standards for the control of occupational, public and medical exposures and for the safety of sources.	2A

<i>Number</i>	<i>Reference: document number</i>	<i>Title</i>	<i>Comments</i>	<i>Designator</i>
14	Safety Series No. 57 (1982)	“Generic models and parameters for assessing the environmental transfer of radionuclides from routine releases: exposures of critical groups”	Presents simple models intended to be applied for use at the pre-operational stage of a nuclear installation to assess local doses from planned releases. Directed at national regulatory bodies and technical personnel responsible for performing environmental impact analyses, in particular for generic assessments of doses to most exposed individuals from routine radioactive releases to the environment.	3B
15	IAEA-TELDOC-976 (1997)	“Conference on Low Doses of Ionizing Radiation: Biological Effects and Regulatory Control”	Addresses the latest research regarding low-level radiation dose effects.	2B
Emergency planning, intervention and mitigation				
16	INES-92/01 (1992)	“INES: The International Nuclear Event Scale User’s Manual”	User’s Manual to be used as part of the reporting requirements under the Convention on Early Notification of a Nuclear Accident.	2B
17	Safety Series No. 72 (1985); STI/PUB/708	“Principles for establishing intervention levels for the protection of the public in the event of a nuclear accident or radiological emergency”	Outlines principles for establishing intervention levels for the protection of the public in the event of a nuclear accident or radiological emergency.	2A
18	Safety Series No. 73 (1985)	“Emergency preparedness exercises for nuclear facilities: preparation, conduct and evaluation”	Provides guidance for operating organizations and public authorities on planning, organizing and conducting emergency preparedness exercises and utilizing their results to improve current emergency plans and preparedness. It also provides guidance for reviewing emergency plans, procedures, equipment and facilities with a view to maintaining a satisfactory level of emergency preparedness.	3B
19	Safety Series No. 81 (1986); STI/PUB/751	“Derived intervention levels for application in controlling radiation doses to the public in the event of a nuclear accident or radiological emergency: principles, procedures and data”	Provides practical support to the guidance contained in IAEA Safety Series No. 72 (document No. 17 above). Provides guidance on relating measurement results made in environmental materials and in foodstuffs following a nuclear accident or radiological emergency to levels of projected dose at which it may be necessary to introduce relevant protective measures. These derived intervention levels (DILs) need to be determined for the radionuclides of potential radiological importance. Guidance is provided on the principles, procedures and methodologies relevant to the evaluation of DILs.	2B

<i>Number</i>	<i>Reference: document number</i>	<i>Title</i>	<i>Comments</i>	<i>Designator</i>
20	Safety Series No. 109 (1994); STI/PUB/900	“Intervention criteria in a nuclear or radiation emergency”	Provides international consensus and understanding on principles for intervention and numerical values for generic intervention levels. The recommendations are the basis for the standards and numerical guidance related to intervention contained in Safety Series No. 115 (document No. 12 above).	2B
21	Safety Series No. 119 (1996); STI/PUB/1014	“Emergency planning and preparedness for re-entry of a nuclear powered satellite”	Prepared to assist States in planning for possible re-entry events involving nuclear-powered satellites and to provide international consensus guidance for responding to such a situation. Provides guidance on specific actions to be taken from the time of the announcement of an impending re-entry event through the locating, monitoring and recovery phases.	1B
Potential exposure situations				
22	Safety Series No. 104 (1990); STI/PUB/834	“Extension of the principles of radiation protection to sources of potential exposure”	The principles of radiation protection recommended by ICRP in ICRP-60 (document No. 2 in sect. B below) for the normal operation of a radiation source constitute a dose limitation system that has three components: the justification of a practice, the optimization of radiation protection and the limitation of individual doses. This report describes how the application of those principles may be extended to unexpected or accidental (potential exposure) situations by changing from the dose-based system of radiation protection to a unified approach within a probabilistic framework.	2A
23	75-INSAG-9 (1995); STI/PUB/992	“Potential exposure in nuclear reactor safety”	Advisory Group publication. Addresses the concept of potential exposure in nuclear and radiation safety, policy aspects, safety assessments, risk considerations and probabilities. Discusses the implications of low probabilities and includes a section on probability theory and its application in PSAs.	3A
Transportation				
24	Safety Series No. 6 (1990); STI/PUB/866	“Regulations for the safe transport of radioactive material: 1985 edition (as amended 1990)”	Presents international regulations on the packaging and transport of radioactive materials for shipment by truck, rail, ship and air. Current packaging and transport regulations of the United States Department of Transportation, the United States Nuclear Regulatory Commission and the United States Department of Energy are based on this document. Superseded by ST-1 (document No. 25 below), currently under consideration by the Department of Transportation as the basis for a proposed revision to 49 CFR (Code of Federal Regulations).	3B

<i>Number</i>	<i>Reference: document number</i>	<i>Title</i>	<i>Comments</i>	<i>Designator</i>
25	ST-1 (1996); STI/PUB/988	“Regulations for the safe transport of radioactive material (1996 ed.)”	Supersedes Safety Series No. 6 (document No. 24 above). Presents the latest IAEA regulations and standards for the packaging and transport of radioactive materials. Currently under consideration by the Department of Transportation as the basis for a proposed revision to 49 CFR.	3B

B. International Commission on Radiological Protection

<i>Number</i>	<i>Reference</i>	<i>Title</i>	<i>Comments</i>	<i>Designator</i>
Recommendations and guidelines				
1	ICRP-26 (1977)	“Recommendations of the International Commission on Radiological Protection”, 2nd ed.	Superseded by ICRP-60 (document No. 2 below).	2A
2	ICRP-60 (1991)	“1990 Recommendations of the International Commission on Radiological Protection”	Current ICRP recommendations on radiation protection and health effects of ionizing radiation. Addresses three principles of radiation protection in terms of justification of a practice, the optimization of radiation protection and the limitation of individual doses. Presents recommendations on dose limits for workers and the general population for normal operations. Presents health effect estimators for workers and the general population based on latest health effect studies as of 1990.	2A

Nuclear safety

[None identified except in terms of the other areas covered by the database.]

Radiation protection

3	ICRP-29 (1979)	“Radionuclide release into the environment: assessment of doses to man”	Outlines a high-level methodology for assessing the consequences of planned and unplanned releases of radioactive materials to the environment. Addresses the use of dose predictions in decision-making.	2B
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<i>Number</i>	<i>Reference</i>	<i>Title</i>	<i>Comments</i>	<i>Designator</i>
4	ICRP-30 (1979-1989)	“Limits for intakes of radionuclides by workers” (8-vol. set with index)	Presents a detailed methodology for estimating radiation doses resulting from the inhalation and ingestion of radionuclide materials. Dose factor results by radionuclide are presented for the adult worker. The results are used to derive worker annual limits on intake (ALI) values for each radionuclide. Source of internal dose factors currently used by the United States Environmental Protection Agency, the United States Nuclear Regulatory Commission and the United States Department of Energy.	2B
5	ICRP-37 (1983)	“Cost-benefit analysis in the optimization of radiation protection”	Addresses the use of cost-benefit analyses in evaluation alternative approaches to radiation protection and optimizing the approach selected.	3B
6	ICRP-38 (1983)	“Radionuclide transformation: energy and intensity of emissions”	Basic data on radionuclide-specific transformations used in radiation protection, monitoring, internal dosimetry and external dosimetry.	2B
7	ICRP-41 (1984)	“Non-stochastic effects of ionizing radiation”	Reviews non-stochastic biological and health effects of ionizing radiation, with reference to their implications for dose limits in radiation protection.	2B
8	ICRP-42 (1984)	“A compilation of the major concepts and quantities in use by ICRP”	Basic definitions of quantities used in radiation protection, monitoring and dosimetry.	2B
9	ICRP-43 (1984)	“Principles of monitoring for the radiation protection of the population”	Describes the general principles on which monitoring programmes should be based, consistent with current radiation protection philosophy, and extends the scope to all types of monitoring affecting the public outside the workplace.	3A
10	ICRP-45 (1986)	“Quantitative bases for developing a unified index of harm”	Outlines approaches to establishing acceptable levels of risk. Develops dose limit recommendations for normal operations based on a risk-based approach.	2B
11	ICRP-48 (1986)	“The metabolism of plutonium and related elements”	Forms basis for the parameters used to describe the metabolic characteristics of plutonium compounds (and those of related elements) in internal dosimetry models presented in ICRP-30 and ICRP-66 (documents Nos. 4 above and 16 below, respectively).	2B
12	ICRP-51 (1988)	“Data for use in protection against external radiation”	Presents basic data used in external radiation monitoring, dose estimates and protection.	2B

<i>Number</i>	<i>Reference</i>	<i>Title</i>	<i>Comments</i>	<i>Designator</i>
13	ICRP-55 (1989)	“Optimization and decision-making in radiological protection”	Considers various techniques associated with optimization and decision-making in radiation protection and their application to problems at different levels of complexity.	2B
14	ICRP-56 (1990)	“Age-dependent doses to members of the public from intake of radionuclides: Part 1”	The internal dosimetry models and radionuclides presented in ICRP-30 (document No. 4 above) are for the adult worker. This report extends the ICRP-30 methodology to members of the general public and presents age-dependent internal dose factors by radionuclides.	2B
15	ICRP-58 (1990)	“RBE for deterministic effects”	Summarizes information used to provide the latest estimates of the relative biological effectiveness (RBE) of each type of radiation.	2B
16	ICRP-66 (1994)	“Human respiratory tract model for radiological protection”	New ICRP internal dosimetry model that could replace the ICRP-30 model in the future.	2B
17	ICRP-67 (1994)	“Age-dependent doses to members of the public from intake of radionuclides: Part 2, Ingestion dose coefficients”	Age-dependent ingestion dose factors. Uses revised organ weighting factors based on ICRP-60.	2B
18	ICRP-69 (1995)	“Age-dependent doses to members of the public from intake of radionuclides: Part 3, Ingestion dose coefficients”	Extends the age-dependent ingestion dose factors originally developed in ICRP-56 and -67 to include additional radionuclides.	2B
19	ICRP-72 (1996)	“Age-dependent doses to the members of the public from intake of radionuclides: Part 4, Inhalation dose coefficients”	Revised age-dependent inhalation dose conversion factors based on the ICRP-66 model, updating the factors presented in ICRP-56 based on the ICRP-30 model.	2B
20	ICRP-72 (1996)	“Age-dependent doses to the members of the public from intake of radionuclides: Part 5, Compilation of ingestion and inhalation dose coefficients”	Summarizes and updates age-dependent inhalation and ingestion dose factors originally presented in ICRP-56, -67, -68, -69 and -71 (documents Nos. 14, 17, (not listed here), 18 and 19 above). Adopted by IAEA in Safety Series No. 115, International Basic Safety Standards for Protection Against Ionizing Radiation”, and for the “Safety of radiation sources: a safety standard”.	2B
21	ICRP-74 (1996)	“Conversion coefficients for use in radiological protection against external radiation”	Provides an extensive and authoritative set of data related to the measurements and estimates used for radiation protection against external radiation.	2B
22	ICRP-79 (1999)	“Genetic susceptibility to cancer”	Provides an extensive discussion of hereditary variations in the susceptibility to cancer and the possible implications of such susceptibility variations for radiation protection.	2B

<i>Number</i>	<i>Reference</i>	<i>Title</i>	<i>Comments</i>	<i>Designator</i>
Transportation				
		[None identified.]		
23	ICRP-63 (1993)	“Principles for intervention for protection of the public in a radiological emergency”	Presents general principles for planning intervention after an accident over short times generally near the accident location, continuation following periodic review over prolonged timescales lasting years and intervention over larger areas. Supersedes ICRP-40 (not listed here).	2A
24	ICRP-82 (2000)	“Protection of the public in situations of prolonged radiation exposure”	Addresses the application of radiation protection principles to the control of prolonged exposures resulting from practices and intervention in the case of prolonged exposure situations. The report considers, among others, the intervention following an accident releasing radioactive materials and the global marketing of commodities for public consumption that contain radioactive substances.	2A
Potential exposure situations				
25	ICRP-64 (1993)	“Protection from potential exposure: a conceptual framework”	ICRP recommendations presented in ICRP-60 (document No. 2 above) primarily address normal exposure situations. ICRP-64 supplements ICRP-60 regarding potential exposure situations, reflecting the probabilistic aspects of unplanned events and accidents. Addresses radiation protection aspects of potential exposure situations in terms of probability of exposure, dose received given the exposure and approaches to establishing acceptable envelopes of probability of exposure versus dose received as part of design objectives.	2A
26	ICRP-76 (1997)	“Protection from potential exposures: application to selected radiation sources”	Expands approach to potential exposure situations addressed in ICRP-64 (document No. 25 above). Addresses potential exposure primarily affecting individuals who are also subject to exposures in normal practices, either occupationally, as members of the public or as patients. As such, it deals with “common smaller accidents”.	3B

C. United Nations Scientific Committee on the Effects of Atomic Radiation

<i>Number</i>	<i>Reference</i>	<i>Title</i>	<i>Comments</i>	<i>Designator</i>
Nuclear safety				
		[None identified.]		
Radiation protection				
1	UNSCEAR (1988)	“Sources and effects of ionizing radiation, 1988 Report”	Forms part of the basis for the health effect estimators presented in ICRP-60 (document No. 2 in sect. B above).	2B
2	UNSCEAR (1994)	“Sources and effects of ionizing radiation, 1994 Report”	Addresses research on the effects of ionizing radiation at low levels.	2B
3	UNSCEAR (2000)	“Sources and effects of ionizing radiation: 2000 Report”	Addrsses the latest information on the sources and effects of ionizing radiation.	2B
Transportation				
		[None identified.]		
Emergency planning, intervention and mitigation				
		[None identified.]		
Potential exposure situations				
		[None identified.]		
