

IAEA Safety Standards

for protecting people and the environment

Control of Orphan Sources and Other Radioactive Material in the Metal Recycling and Production Industries

Specific Safety Guide

No. SSG-17



IAEA

International Atomic Energy Agency



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IAEA SAFETY STANDARDS

Under the terms of Article III of its Statute, the IAEA is authorized to establish or adopt standards of safety for protection of health and minimization of danger to life and property, and to provide for the application of these standards.

The publications by means of which the IAEA establishes standards are issued in the **IAEA Safety Standards Series**. This series covers nuclear safety, radiation safety, transport safety and waste safety. The publication categories in the series are **Safety Fundamentals**, **Safety Requirements** and **Safety Guides**.

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The site provides the texts in English of published and draft safety standards. The texts of safety standards issued in Arabic, Chinese, French, Russian and Spanish, the IAEA Safety Glossary and a status report for safety standards under development are also available. For further information, please contact the IAEA at PO Box 100, 1400 Vienna, Austria.

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CONTROL OF ORPHAN
SOURCES AND OTHER
RADIOACTIVE MATERIAL
IN THE METAL RECYCLING
AND PRODUCTION INDUSTRIES



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

IAEA SAFETY STANDARDS SERIES No. SSG-17

CONTROL OF ORPHAN SOURCES AND OTHER RADIOACTIVE MATERIAL IN THE METAL RECYCLING AND PRODUCTION INDUSTRIES

SPECIFIC SAFETY GUIDE

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2012

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Marketing and Sales Unit, Publishing Section
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PO Box 100
1400 Vienna, Austria
fax: +43 1 2600 29302
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FOREWORD

by Yukiya Amano
Director General

The IAEA's Statute authorizes the Agency to “establish or adopt... standards of safety for protection of health and minimization of danger to life and property” — standards that the IAEA must use in its own operations, and which States can apply by means of their regulatory provisions for nuclear and radiation safety. The IAEA does this in consultation with the competent organs of the United Nations and with the specialized agencies concerned. A comprehensive set of high quality standards under regular review is a key element of a stable and sustainable global safety regime, as is the IAEA's assistance in their application.

The IAEA commenced its safety standards programme in 1958. The emphasis placed on quality, fitness for purpose and continuous improvement has led to the widespread use of the IAEA standards throughout the world. The Safety Standards Series now includes unified Fundamental Safety Principles, which represent an international consensus on what must constitute a high level of protection and safety. With the strong support of the Commission on Safety Standards, the IAEA is working to promote the global acceptance and use of its standards.

Standards are only effective if they are properly applied in practice. The IAEA's safety services encompass design, siting and engineering safety, operational safety, radiation safety, safe transport of radioactive material and safe management of radioactive waste, as well as governmental organization, regulatory matters and safety culture in organizations. These safety services assist Member States in the application of the standards and enable valuable experience and insights to be shared.

Regulating safety is a national responsibility, and many States have decided to adopt the IAEA's standards for use in their national regulations. For parties to the various international safety conventions, IAEA standards provide a consistent, reliable means of ensuring the effective fulfilment of obligations under the conventions. The standards are also applied by regulatory bodies and operators around the world to enhance safety in nuclear power generation and in nuclear applications in medicine, industry, agriculture and research.

Safety is not an end in itself but a prerequisite for the purpose of the protection of people in all States and of the environment — now and in the future. The risks associated with ionizing radiation must be assessed and controlled without unduly limiting the contribution of nuclear energy to equitable and sustainable development. Governments, regulatory bodies and operators everywhere must ensure that nuclear material and radiation sources are used beneficially, safely and ethically. The IAEA safety standards are designed to facilitate this, and I encourage all Member States to make use of them.

THE IAEA SAFETY STANDARDS

BACKGROUND

Radioactivity is a natural phenomenon and natural sources of radiation are features of the environment. Radiation and radioactive substances have many beneficial applications, ranging from power generation to uses in medicine, industry and agriculture. The radiation risks to workers and the public and to the environment that may arise from these applications have to be assessed and, if necessary, controlled.

Activities such as the medical uses of radiation, the operation of nuclear installations, the production, transport and use of radioactive material, and the management of radioactive waste must therefore be subject to standards of safety.

Regulating safety is a national responsibility. However, radiation risks may transcend national borders, and international cooperation serves to promote and enhance safety globally by exchanging experience and by improving capabilities to control hazards, to prevent accidents, to respond to emergencies and to mitigate any harmful consequences.

States have an obligation of diligence and duty of care, and are expected to fulfil their national and international undertakings and obligations.

International safety standards provide support for States in meeting their obligations under general principles of international law, such as those relating to environmental protection. International safety standards also promote and assure confidence in safety and facilitate international commerce and trade.

A global nuclear safety regime is in place and is being continuously improved. IAEA safety standards, which support the implementation of binding international instruments and national safety infrastructures, are a cornerstone of this global regime. The IAEA safety standards constitute a useful tool for contracting parties to assess their performance under these international conventions.

THE IAEA SAFETY STANDARDS

The status of the IAEA safety standards derives from the IAEA's Statute, which authorizes the IAEA to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property, and to provide for their application.

With a view to ensuring the protection of people and the environment from harmful effects of ionizing radiation, the IAEA safety standards establish

fundamental safety principles, requirements and measures to control the radiation exposure of people and the release of radioactive material to the environment, to restrict the likelihood of events that might lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation, and to mitigate the consequences of such events if they were to occur. The standards apply to facilities and activities that give rise to radiation risks, including nuclear installations, the use of radiation and radioactive sources, the transport of radioactive material and the management of radioactive waste.

Safety measures and security measures¹ have in common the aim of protecting human life and health and the environment. Safety measures and security measures must be designed and implemented in an integrated manner so that security measures do not compromise safety and safety measures do not compromise security.

The IAEA safety standards reflect an international consensus on what constitutes a high level of safety for protecting people and the environment from harmful effects of ionizing radiation. They are issued in the IAEA Safety Standards Series, which has three categories (see Fig. 1).

Safety Fundamentals

Safety Fundamentals present the fundamental safety objective and principles of protection and safety, and provide the basis for the safety requirements.

Safety Requirements

An integrated and consistent set of Safety Requirements establishes the requirements that must be met to ensure the protection of people and the environment, both now and in the future. The requirements are governed by the objective and principles of the Safety Fundamentals. If the requirements are not met, measures must be taken to reach or restore the required level of safety. The format and style of the requirements facilitate their use for the establishment, in a harmonized manner, of a national regulatory framework. Requirements, including numbered ‘overarching’ requirements, are expressed as ‘shall’ statements. Many requirements are not addressed to a specific party, the implication being that the appropriate parties are responsible for fulfilling them.

Safety Guides

Safety Guides provide recommendations and guidance on how to comply with the safety requirements, indicating an international consensus that it is necessary to take the measures recommended (or equivalent alternative measures). The Safety

¹ See also publications issued in the IAEA Nuclear Security Series.

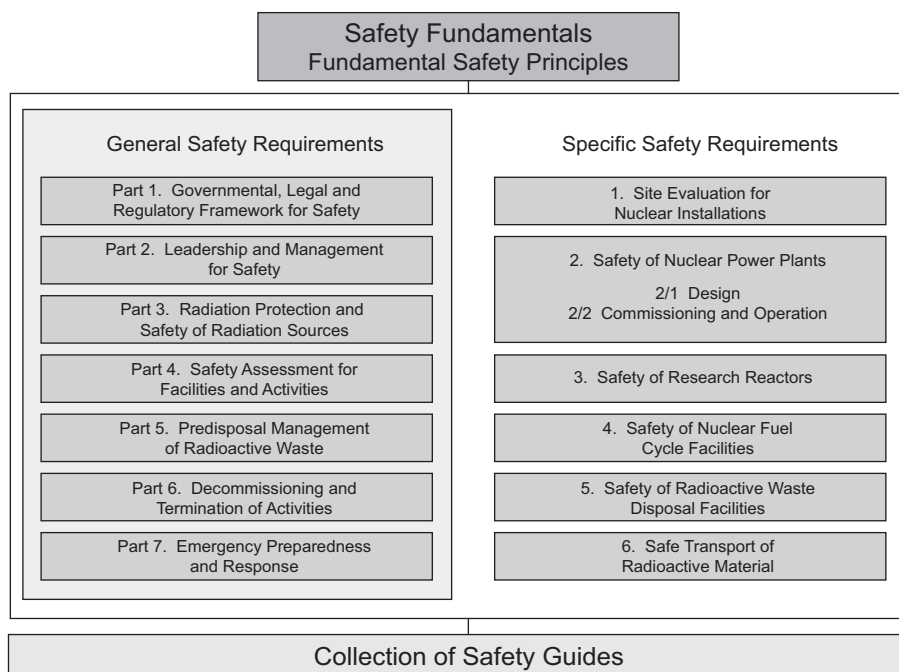


FIG. 1. The long term structure of the IAEA Safety Standards Series.

Guides present international good practices, and increasingly they reflect best practices, to help users striving to achieve high levels of safety. The recommendations provided in Safety Guides are expressed as ‘should’ statements.

APPLICATION OF THE IAEA SAFETY STANDARDS

The principal users of safety standards in IAEA Member States are regulatory bodies and other relevant national authorities. The IAEA safety standards are also used by co-sponsoring organizations and by many organizations that design, construct and operate nuclear facilities, as well as organizations involved in the use of radiation and radioactive sources.

The IAEA safety standards are applicable, as relevant, throughout the entire lifetime of all facilities and activities — existing and new — utilized for peaceful purposes and to protective actions to reduce existing radiation risks. They can be used by States as a reference for their national regulations in respect of facilities and activities.

The IAEA's Statute makes the safety standards binding on the IAEA in relation to its own operations and also on States in relation to IAEA assisted operations.

The IAEA safety standards also form the basis for the IAEA's safety review services, and they are used by the IAEA in support of competence building, including the development of educational curricula and training courses.

International conventions contain requirements similar to those in the IAEA safety standards and make them binding on contracting parties. The IAEA safety standards, supplemented by international conventions, industry standards and detailed national requirements, establish a consistent basis for protecting people and the environment. There will also be some special aspects of safety that need to be assessed at the national level. For example, many of the IAEA safety standards, in particular those addressing aspects of safety in planning or design, are intended to apply primarily to new facilities and activities. The requirements established in the IAEA safety standards might not be fully met at some existing facilities that were built to earlier standards. The way in which IAEA safety standards are to be applied to such facilities is a decision for individual States.

The scientific considerations underlying the IAEA safety standards provide an objective basis for decisions concerning safety; however, decision makers must also make informed judgements and must determine how best to balance the benefits of an action or an activity against the associated radiation risks and any other detrimental impacts to which it gives rise.

DEVELOPMENT PROCESS FOR THE IAEA SAFETY STANDARDS

The preparation and review of the safety standards involves the IAEA Secretariat and four safety standards committees, for nuclear safety (NUSSC), radiation safety (RASSC), the safety of radioactive waste (WASSC) and the safe transport of radioactive material (TRANSSC), and a Commission on Safety Standards (CSS) which oversees the IAEA safety standards programme (see Fig. 2).

All IAEA Member States may nominate experts for the safety standards committees and may provide comments on draft standards. The membership of the Commission on Safety Standards is appointed by the Director General and includes senior governmental officials having responsibility for establishing national standards.

A management system has been established for the processes of planning, developing, reviewing, revising and establishing the IAEA safety standards. It articulates the mandate of the IAEA, the vision for the future application of the

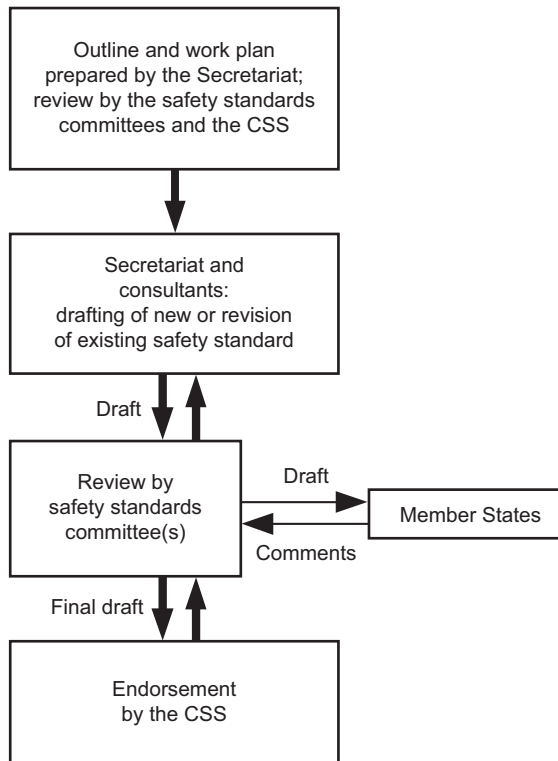


FIG. 2. The process for developing a new safety standard or revising an existing standard.

safety standards, policies and strategies, and corresponding functions and responsibilities.

INTERACTION WITH OTHER INTERNATIONAL ORGANIZATIONS

The findings of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the recommendations of international expert bodies, notably the International Commission on Radiological Protection (ICRP), are taken into account in developing the IAEA safety standards. Some safety standards are developed in cooperation with other bodies in the United Nations system or other specialized agencies, including the Food and Agriculture Organization of the United Nations, the United Nations Environment Programme, the International Labour Organization, the OECD Nuclear Energy Agency, the Pan American Health Organization and the World Health Organization.

INTERPRETATION OF THE TEXT

Safety related terms are to be understood as defined in the IAEA Safety Glossary (see <http://www-ns.iaea.org/standards/safety-glossary.htm>). Otherwise, words are used with the spellings and meanings assigned to them in the latest edition of The Concise Oxford Dictionary. For Safety Guides, the English version of the text is the authoritative version.

The background and context of each standard in the IAEA Safety Standards Series and its objective, scope and structure are explained in Section 1, Introduction, of each publication.

Material for which there is no appropriate place in the body text (e.g. material that is subsidiary to or separate from the body text, is included in support of statements in the body text, or describes methods of calculation, procedures or limits and conditions) may be presented in appendices or annexes.

An appendix, if included, is considered to form an integral part of the safety standard. Material in an appendix has the same status as the body text, and the IAEA assumes authorship of it. Annexes and footnotes to the main text, if included, are used to provide practical examples or additional information or explanation. Annexes and footnotes are not integral parts of the main text. Annex material published by the IAEA is not necessarily issued under its authorship; material under other authorship may be presented in annexes to the safety standards. Extraneous material presented in annexes is excerpted and adapted as necessary to be generally useful.

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1. INTRODUCTION

BACKGROUND

1.1. The IAEA has issued a number of safety standards establishing requirements for the regulatory control of radioactive material [1–3] and guidance on the security of radioactive sources [4]. Nevertheless, radioactive material may have been in use within a State before a system of control based on these requirements was established. Even now, the regulatory infrastructure within a State may not be sufficiently well developed, or may fail, with the consequence that radioactive sources may be lost from regulatory control and may enter the general environment. Thus, irrespective of the state of development of the regulatory infrastructure within a State, radioactive material may become mixed with scrap metal destined for recycling.

1.2. Scrap metal is an important source material for the metal production industry, contributing a large fraction of the final product (in the case of steel, about 50%). Most cities have several scrapyards, ranging from small operations involving a few individuals through medium sized facilities to, in industrialized States, large scrapyards handling between a hundred thousand and some ten million tonnes of scrap metal each year. The number of metal works and foundries worldwide that buy scrap to melt and refine or cast to shape is in the tens of thousands [5]. Furthermore, there is substantial transboundary movement of scrap metal and other products of the metal recycling and production industries¹ [6]. As a consequence, radioactive material mixed with scrap metal may inadvertently be transported across national borders. In view of this international dimension, a harmonized approach to dealing with radioactive material incorporated into scrap metal is clearly desirable.

1.3. Radioactive sources (including sealed sources, i.e. sources that are permanently sealed in a capsule or closely bonded and in a solid form) are used widely throughout the world in a variety of medical, industrial, research and military applications. A radioactive source that is not under regulatory control,

¹ The term ‘metal recycling and production industries’ is used in this Safety Guide to indicate all those physical and legal entities involved in the recycling of scrap metal, such as facilities carrying out collection, sorting and processing of scrap metal, foundries that melt scrap metal, and industry associations. The term ‘metal recycling and production facility’ is used to indicate any facility within the metal recycling and production industries.

either because it has never been under regulatory control or because it has been abandoned, lost, misplaced, stolen or otherwise transferred without proper authorization, is referred to as an orphan source [7]. Orphan sources have led to accidents with serious, even fatal, consequences as a result of the exposure of individuals to radiation (see Annex I). The melting of an orphan source with scrap metal or its rupturing when mixed with scrap metal has also resulted in contaminated recycled metal and wastes. If this happens, expensive cleanup operations may be necessary. If the contaminated material is not detected at the metal recycling and production facility, workers may be exposed to radiation and radionuclides may become incorporated into various finished products and wastes, which, in turn, may lead to the exposure of users of these products.

1.4. Concern over accidents involving orphan sources, including those that have occurred in the metal recycling and production industries, led to the establishment of an international undertaking, the Code of Conduct on the Safety and Security of Radioactive Sources (the Code of Conduct) [8] and the associated Guidance on the Import and Export of Radioactive Sources [9]. Nevertheless, the possibility of orphan sources being present in scrap metal remains [10].

1.5. Radioactive material in unsealed form may also be present in scrap metal as a consequence of inadequate control during the decommissioning of a nuclear installation or other facility. It may also arise as a consequence of the presence of radionuclides of natural origin, which occur in industries that process large amounts of raw material; examples are the mining and processing of various ores and the production of oil and gas. The hazard to human health from such low levels of contamination is generally low when compared with that from orphan sources; the main problem is likely to be a financial one.

1.6. The IAEA has assisted the United Nations Economic Commission for Europe (UNECE) in its efforts towards unifying and harmonizing both monitoring strategies for the detection of radioactive material in scrap metal and procedures to be used following the discovery of such radioactive material [11–13]. The major aim of the UNECE is to promote pan-European economic integration, and, in the context of this work, the IAEA provided guidance on radiation safety matters. This Safety Guide takes account of all the work undertaken by the UNECE and the IAEA over the past decade or more to strengthen the safety and security of radioactive sources and the control of other radioactive material, including several relevant international conferences [5, 14–18].

1.7. Application of the requirements of the safety standards and use of the supporting guidance given in this and other Safety Guides will provide confidence to the metal recycling and production industries that scrap metal and recycled metal products and any wastes produced are safe from a radiological perspective.

OBJECTIVE

1.8. The objective of this Safety Guide is primarily to provide recommendations to governments and national authorities, including regulatory bodies, on applying the Fundamental Safety Principles [19] by meeting the Safety Requirements [1–3, 20] in relation to the control of radioactive material in scrap metal and metal products. The recommendations in this Safety Guide take account of the basic principles in the Code of Conduct [8] and the obligations that States Parties may have under international conventions [21, 22]. However, it also provides recommendations that may be used by the metal recycling and production industries in general on the arrangements that should be made to protect workers, members of the public and the environment. Its primary focus is on the control of orphan sources that might be found within the metal recycling and production industries. It also provides recommendations on the control of other radioactive material that might enter the metal recycling and production industries.

SCOPE

1.9. This Safety Guide is concerned with orphan sources and other radioactive material² that may enter the metal recycling supply chain. It applies to all operations in the handling of scrap metal for recycling and the subsequent processing of this material. However, in view of the wide range in size of these operations, this Safety Guide provides recommendations on how to apply a graded approach to the control of orphan sources and other radioactive material, on the basis of the size of the individual metal recycling and production facility and on the radioactive material that it might reasonably be expected to encounter.

² In this Safety Guide, when there is no need for a distinction to be made between orphan sources and other radioactive material, the generic term ‘radioactive material’ is used, with the meaning of “material designated in national law or by a regulatory body as being subject to regulatory control because of its radioactivity” [7].

1.10. This Safety Guide does not provide detailed recommendations on the following:

- (a) Meeting the requirements for authorized uses of radioactive material that are aimed at preventing a loss of control over radioactive material and which include the monitoring of material for the purposes of clearance³ from regulatory control.
- (b) National, regional or local emergency response plans that may be called into play as a consequence of the discovery of radioactive material in scrap metal, metal products or wastes from metal processing facilities.
- (c) The decontamination of premises that might be contaminated as a consequence of the processing or melting of radioactive material in a scrap metal stream.
- (d) The subsequent management of any recovered orphan sources or of any radioactive waste following the discovery of radioactive material in scrap metal.
- (e) The monitoring of commodities, including scrap metal, as they are transported across national borders, since such monitoring is normally undertaken for the purposes of national security. Nevertheless, it is noted that such border monitoring will contribute to preventing radioactive material from being inadvertently processed within the metal recycling and production industries and should be regarded as an important component part of the overall system of control of radioactive material within a State [5].

References [1–3, 23–28] establish requirements and provide recommendations and guidance on these matters.

³ The term ‘clearance’ is defined in the IAEA Safety Glossary [7] as removal of radioactive material or radioactive objects within authorized practices from any further regulatory control by the regulatory body. This is a specific use of the normal dictionary meaning of the word, which is ‘removal of obstructions’ or ‘permission to proceed’. In radiation safety, it relates to a process of checking material to determine whether it can be considered as non-radioactive within the context of radiation protection regulations and therefore be released from further regulatory control. Clearance levels therefore specify upper limits on any residual contamination by radionuclides, in much the same way as upper limits are given for a whole range of other possible environmental contaminants in different commodities. Thus, any scrap metal that has been cleared in this way need not be subject to regulatory control and may be regarded as safe for recycling.

STRUCTURE

1.11. Section 2 provides a general overview of the principles of radiation protection in relation to the presence of radioactive material in scrap metal. Section 3 provides recommendations on the responsibilities of the various parties involved — national authorities and the metal recycling and production industries — on the basis of the safety standards [1–3, 20] and international agreements, particularly the Code of Conduct [8]. Section 4 provides recommendations on monitoring for radioactive material. Section 5 provides recommendations on the initial response to the discovery of radioactive material. Section 6 provides recommendations on the remediation of contaminated areas, and Section 7 provides recommendations on the management of recovered radioactive material.

1.12. The Safety Guide also contains three annexes. Annex I provides a review of some events involving radioactive material that have occurred in the metal recycling and production industries. Annex II provides a description of the categorization of radioactive sources [29]. Annex III provides some examples of national and international initiatives to deal with radioactive material in scrap metal. The terms used in this Safety Guide are defined in the IAEA Safety Glossary [7], unless otherwise indicated.

2. PROTECTION OF PEOPLE AND THE ENVIRONMENT

GENERAL

2.1. The Fundamental Safety Principles [19] establish the fundamental safety objective and ten fundamental safety principles. This objective, “to protect people and the environment from harmful effects of ionizing radiation”, applies to all

facilities and activities⁴ that give rise to radiation risks⁵, including the presence of radioactive material in scrap metal within the metal recycling and production industries. Principle 7 states that: “People and the environment, present and future, must be protected against radiation risks.” Principle 8 states that: “All practical efforts must be made to prevent and mitigate nuclear or radiation accidents.”

2.2. Requirements designed to protect people and the environment from harmful effects of ionizing radiation and relevant to establishing control over radioactive material that may be present in scrap metal were established in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (the BSS) [1] (since revised), the Safety Requirements publication on the Governmental, Legal and Regulatory Framework for Safety [2], and the Safety Requirements publication on Preparedness and Response for a Nuclear or Radiological Emergency [20].

INCIDENTS AND EMERGENCY EXPOSURE SITUATIONS

2.3. Paragraph 3.2 of Ref. [19] states that:

“Safety is concerned with both radiation risks under normal circumstances and radiation risks as a consequence of incidents ... as well as with other possible direct consequences of a loss of control over a ... radioactive source or any other source of radiation. Safety measures include actions to prevent incidents and arrangements put in place to mitigate their consequences if they were to occur.”

⁴ The term ‘facilities and activities’ as used in the Fundamental Safety Principles [19] is a general one encompassing any human activity that may cause people to be exposed to radiation risks arising from naturally occurring or artificial sources. Facilities within the metal recycling and production industries would therefore be included, even though the presence of radioactive material is unwanted.

⁵ The term ‘radiation risks’ is used in a general sense to refer to:

- Detrimental health effects of radiation exposure (including the likelihood of such effects occurring).
- Any other safety related risks (including those to ecosystems in the environment) that might arise as a direct consequence of:
 - Exposure to radiation;
 - The presence of radioactive material (including radioactive waste) or its release to the environment;
 - A loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation [7].

2.4. An emergency is defined as “a non-routine situation that necessitates prompt action, primarily to mitigate a hazard or adverse consequences for human health and safety, quality of life, property or the environment” [7, 20]. It includes situations for which prompt action is warranted to mitigate the effects of a potential hazard. Whether a situation meets the definition of an emergency, therefore, does not depend on the size of the hazard, the severity of the adverse consequences or the nature of the response to mitigate the situation. The discovery of radioactive material in scrap metal or metal products therefore falls within the definition of an emergency. However, the extent of the actions that are taken in response to the discovery of radioactive material in the metal recycling and production industries will vary substantially, from isolation of the suspected radioactive material to shutdown of the facility and restriction of access to certain areas pending further radiological investigation. In some cases, for example, where there has been a release of radioactive material to the atmosphere or a dispatch of contaminated products for general use, action off the site of the facility may be necessary.

2.5. An intervention is an action intended to reduce or avert exposure or the likelihood of exposure to sources of radiation that are not part of a controlled (or authorized) use of radioactive material or that are out of control as a consequence of an accident [7]. Actions taken to control and remove radioactive material from scrap metal following its discovery at a metal recycling and production facility fall within this definition. It is therefore appropriate to apply the radiation protection requirements for intervention established in the BSS to such situations [1].

2.6. Reference [20] defines five threat categories for the purpose of grading the application of the requirements for emergency preparedness and response⁶.

⁶ The word ‘threat’ is used in Ref. [20] for the purposes of establishing safety requirements relating to emergency preparedness for and response to a nuclear or radiological emergency. It is not to be confused with the use of the word in the context of nuclear security, where it relates to criminal acts involving nuclear and other radioactive material (see also footnote 9).

Paragraph 3.6 of Ref. [20] states that: “Threat category IV applies to activities that can lead to emergencies occurring virtually anywhere; it is also the minimum level of threat, which is assumed to apply for all States and jurisdictions.”⁷ Paragraph 3.19 of Ref. [20] furthermore states that: “Locations at which there is a significant probability of encountering a dangerous source that has been lost, abandoned, illicitly removed or illicitly transported shall also be identified in the threat assessment.”⁸ Paragraph 3.20 of Ref. [20] states that: “Large scrap metal processing facilities ... should be considered in the threat assessment.” The requirements relating to threat category IV established in Ref. [20] therefore apply to the metal recycling and production industries. Recommendations on how to meet the requirements established in Ref. [20] are provided in the supporting Safety Guide [28].

2.7. The radiation protection requirements for intervention are as follows:

- (a) “[P]rotective actions or remedial actions shall be undertaken whenever they are justified” (para. 3.3 of Ref. [1]);
- (b) “The form, scale, and duration of any such protective action or remedial action shall be optimized so as to produce the maximum net benefit, understood in a broad sense, under the prevailing social and economic circumstances” (para 3.4 of Ref. [1]).

⁷ Reference [20] describes threat category IV as follows:

“Activities that could give rise to a nuclear or radiological emergency that could warrant urgent protective action in an unforeseeable location. These include non-authorized activities such as activities relating to dangerous sources [see Annex II of this Safety Guide for an explanation of this term] obtained illicitly. They also include transport and authorized activities involving dangerous mobile sources such as industrial radiography sources, nuclear powered satellites or radiothermal generators. Threat category IV represents the minimum level of threat, which is assumed to apply for all States and jurisdictions.”

⁸ In the definition of threat assessment given in the IAEA Safety Glossary [7] it is noted that use of the term does not imply that any threat, in the sense of an intention and capability to cause harm, has been made in relation to facilities, activities or sources.

2.8. In order to apply the second of these requirements, the operator⁹ of a facility in which radioactive material might be discovered should ensure that appropriate arrangements are put in place to identify such material and to respond in such a way as to keep the radiation doses to workers and members of the public to levels that are as low as reasonably achievable, taking account of economic and social factors. The arrangements should be graded according to the size of the facility and the radioactive material that is likely to be encountered at the facility. In practice, this means that small and medium sized facilities should have some awareness of the problem and be able to visually recognize suspect material (i.e. a package or device that may contain a radioactive source), and awareness of the person or organization to contact in the event that such material is discovered. On the other hand, large facilities should be equipped with radiation detectors and should have sufficient radiation protection expertise available to undertake an initial response to isolate suspect material.

2.9. Detailed information on the protection of workers involved in the response to emergencies and in cleanup operations is provided in Ref. [30].

CONTAMINATION BY RADIONUCLIDES OF ARTIFICIAL ORIGIN

2.10. The concept and the radiological criteria to be used as a basis for determining exemption and clearance levels are defined in Ref. [1]. Reference [31] provides values of activity concentration for bulk amounts of material containing radionuclides of artificial origin based on the criteria of Ref. [1] and on very conservative (i.e. cautious) models of exposure pathways that are more than sufficient to take account of the exposure pathways that might ensue from the recycling of scrap metal [32]. The values of activity concentration

⁹ The term ‘operator’ means “Any organization or person ... responsible for ... radiation ... safety ... when undertaking *activities* or in relation to any ... *sources of ionizing radiation*” [7]. Principle 1 of Ref. [19] places the prime responsibility for safety on the person or organization responsible for facilities and activities that give rise to radiation risks (see footnote 4 for an explanation of the term ‘facilities and activities’). Footnote 5 of Ref. [19] states that: “Not having an authorization would not exonerate the person or organization responsible for the facility or activity from the responsibility for safety.” Paragraphs 4.19 and 4.24 of Ref. [20] also refer to the operator(s) of a facility in threat category IV. The fundamental point is that the term ‘operator’ as used in the IAEA safety standards does not apply only to planned exposure situations that are subject to authorization, but also to industries, such as the metal recycling and production industries, in which radioactive material may be present but which may not be subject to authorization by the regulatory body.

for bulk material containing some commonly encountered radionuclides of artificial origin are given in Table 1.

2.11. Paragraph 5.8 of Ref. [31] states that:

“there should be no need for any further action (e.g. to reduce exposures) for materials containing radionuclides at activity concentrations below [the values given in Table 1]. In particular, national and international trade in commodities containing radionuclides with activity concentrations below the values of activity concentration provided in [Table 1] should not be subject to regulatory control for the purposes of radiation protection.”

As such, the values of activity concentration provided in Table 1 are appropriate for use by the metal recycling and production industries as a basis for determining whether the scrap metal is safe for recycling (see footnote 3). A graded approach consistent with paras 5.11–5.13 of Ref. [31] may be applied to activity concentrations that exceed the values given in Table 1.

CONTAMINATION BY RADIONUCLIDES OF NATURAL ORIGIN

2.12. Reference [31] specifies values of activity concentration below which it is usually unnecessary to regulate material containing radionuclides of natural

TABLE 1. VALUES OF ACTIVITY CONCENTRATION FOR SOME RADIONUCLIDES OF ARTIFICIAL ORIGIN COMMONLY ENCOUNTERED IN BULK MATERIAL [31]

Radionuclide	Activity concentration (Bq/g)
Am-241, Ag-110m, Co-60, Cs-137, Pu-239, Zn-65	0.1
Cm-244, Ir-192, Nb-95, Sr-90, Tc-99, Tl-204, Zr-95	1
Au-198	10
Ni-63	100
Pm-147	1000

origin.¹⁰ These levels, given in Table 2, may also be used to determine whether scrap metal containing radionuclides of natural origin is acceptable for recycling, irrespective of the origin of the material. The values were derived by taking into account the amenability to control of radionuclides of natural origin. Doses to individuals as a consequence of these values of activity concentration were considered to be unlikely to exceed about 1 mSv in a year [31].

2.13. If radionuclides of natural origin are present in an authorized facility, it is the responsibility of the operator of that authorized facility to subject scrap metal to a clearance procedure in accordance with regulatory requirements before it is released for recycling. However, there may be facilities in which radionuclides of natural origin are present that are not subject to regulatory control, and consequently scrap metal from such facilities is unlikely to have been monitored for contamination before its release for recycling. Thus, by default, the main means of controlling this type of material is by monitoring scrap metal entering the metal recycling and production industries.

2.14. Through processing, radionuclides of natural origin may become concentrated in waste products even though the levels of activity concentration in the scrap metal were initially below those given in Table 2. If this is the case, the levels in Table 2 may again be used to determine whether the waste products should be subject to regulatory control.

TABLE 2. VALUES OF ACTIVITY CONCENTRATION FOR RADIONUCLIDES OF NATURAL ORIGIN [31]

Radionuclide	Activity concentration (Bq/g)
K-40	10
All other radionuclides of natural origin	1

¹⁰ There are some situations (such as the use of some building materials containing natural radionuclides) in which exposures from materials due to radionuclides with activity concentrations below those given in Table 2 would necessitate consideration by the regulatory body for some types of regulatory control [31].

3. RESPONSIBILITIES

GOVERNMENTAL, LEGAL AND REGULATORY FRAMEWORK

3.1. Principle 2 of the Fundamental Safety Principles, which refers to the role of government, states that: “An effective legal and governmental framework for safety, including an independent regulatory body must be established and sustained” [19]. This should be achieved “without unduly limiting the operation of facilities or the conduct of activities that give rise to radiation risks” (para. 2.1, Ref. [19]).

3.2. The objective of Ref. [2] is the establishment of requirements in respect of the governmental, legal and regulatory framework for safety for the entire range of facilities and activities involving the use of radiation sources. Reference [2] establishes the requirements for a national framework enabling the government to discharge its responsibilities for radiation protection and safety. Essential parts of a national framework are: legislation and regulations; a regulatory body empowered to authorize and inspect regulated activities and to enforce the legislation and regulations; sufficient resources; and adequate numbers of trained personnel. References [2] and [20] establish requirements, including those relating to the regulatory framework, for an adequate level of preparedness for and response to a nuclear or radiological emergency in any State. Reference [3] establishes requirements for the disposal of radioactive waste, such as might be required following the discovery of radioactive material that has inadvertently been incorporated into scrap metal.

3.3. In addition, there are international agreements and conventions that may be required to be taken into account in establishing an appropriate national framework for radiation protection and safety. These include:

- (a) The Code of Conduct on the Safety and Security of Radioactive Sources [8], which is a voluntary undertaking intended to help national authorities to ensure that radioactive sources are used within an appropriate framework of radiation safety and security, and the associated Guidance on the Import and Export of Radioactive Sources [9];
- (b) The Convention on Early Notification of a Nuclear Accident [21];
- (c) The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency [21];

- (d) The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management [22].

3.4. Requirement 8 of Ref. [2] relates to emergency preparedness and response and states that: “The government shall make provision for emergency preparedness to enable a timely and effective response in a nuclear or radiological emergency.” Furthermore, it states that: “Emergency response arrangements shall include a clear assignment of responsibility for immediate notification of an emergency to the competent authorities” (para. 2.20, Ref. [2]). It goes on to state that: “The government shall specify and shall assign clear responsibilities for decision making in an emergency” (para. 2.23, Ref. [2]).

3.5. Requirement 9 of Ref. [2] relates to the system for protective actions to reduce existing or unregulated radiation risks and states:

“The government shall establish an effective system for protective actions to reduce undue radiation risks associated with unregulated sources (of natural and artificial origin) and contamination from past activities or events, consistent with the principles of justification and optimization.”

Furthermore:

“the government shall designate the organizations to be responsible for making the necessary arrangements for the protection of workers, the public and the environment The organization taking the protective action shall have access to the resources necessary to fulfil its function” (para. 2.25, Ref. [2]).

It goes on to state:

“The regulatory body shall provide any necessary inputs for the protective action, including advising the government or exercising regulatory control over protection actions. It shall establish the regulatory requirements and criteria for protective actions in cooperation with the other authorities involved, and in consultation with interested parties, as appropriate” (para. 2.26, Ref. [2]).

3.6. The salient guidance of the Code of Conduct [8], which applies to all radioactive sources that may pose a significant risk to individuals, society and the environment (i.e. dangerous sources), includes the following:

- (1) “Every State should have in place an effective national legislative and regulatory system of control over the management and protection of radioactive sources. Such a system should:

.....

“(c) include national strategies for gaining or regaining control over orphan sources;

“(d) provide for rapid response for the purpose of regaining control over orphan sources;

.....

“(g) mitigate or minimize the radiological consequences of accidents or malicious acts involving radioactive sources” (para. 8 of Ref. [8]).

- (2) “Every State should ensure that appropriate facilities and services for radiation protection, safety and security are available to, and used by, the persons who are authorized to manage radioactive sources. Such facilities and services should include ... those needed for:

.....

“(b) intervention in the event of an accident or malicious act involving a radioactive source” (para. 9 of Ref. [8]).

- (3) “Every State should ensure that adequate arrangements are in place for the appropriate training of the staff of its regulatory body, its law enforcement agencies and its emergency services organizations” (para. 10 of Ref. [8]).

- (4) “Every State should ensure that information concerning any loss of control over radioactive sources, or any incidents, with potential transboundary effects involving radioactive sources, is provided promptly to potentially affected States through established IAEA or other mechanisms” (para. 12 of Ref. [8]). This has implications not only relating to the loss of control over a particular source that may find its way into scrap metal, but also relating to such events as the discovery that a radioactive source has been melted with scrap metal and the recycled metal subsequently exported.

- (5) “Every State should (b) encourage bodies and persons likely to encounter orphan sources during the course of their operations (such as scrap metal recyclers and customs posts) to implement appropriate monitoring programmes to detect such sources” (para. 13 of Ref. [8]).

3.7. Under the Early Notification Convention [21], States Parties commit that, in the event of an accident that may result in a significant transboundary release of radioactive material, they will notify directly or through the IAEA those States that may be affected and the IAEA. Reference [20] further requires

States to notify directly or through the IAEA those States that may be affected and the IAEA in the event of a transnational emergency [7]. The loss of a radioactive source that might become mixed with scrap metal, which may subsequently be transported across national boundaries, or the accidental melting of a radioactive source with the possibility of a release of radioactive material to the atmosphere during recycling of scrap metal, could constitute such a transnational emergency.

3.8. States Parties to the Assistance Convention [21] are required to cooperate among themselves and with the IAEA “to facilitate prompt assistance in the event of a nuclear accident or radiological emergency to minimize its consequences and to protect life, property and the environment from the effects of radioactive releases” (Article 1).

3.9. In Article 28 of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the Joint Convention) [22] each Contracting Party is required, “in the framework of its national law, [to] take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner.” Each Contracting Party is also required to “allow for reentry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources.”

THE GOVERNMENT

3.10. The government should consider how the requirements established in Refs [1–3, 20], the basic principles provided in the Code of Conduct [8] and, as appropriate, the obligations of various international conventions [21, 22] should be applied in the context of the metal recycling and production industries within its State.

3.11. The degree to which the metal recycling and production industries will be regulated from the point of view of radiation protection is a matter for each government; it depends very much on the system of regulatory control of the State. However, in the absence of any relevant regulations, the government should first consider implementing a voluntary approach that encourages all entities involved in the radiation protection aspects of the recycling of scrap metal

to cooperate in bringing radioactive material under regulatory control.¹¹ Subsequently, particularly where such voluntary arrangements prove to be insufficient, the government should consider whether additional legislation or regulations need to be established in order to protect people and the environment from hazards associated with the inadvertent processing of radioactive material together with scrap metal and whether the functions of the regulatory body need to be extended.

3.12. In view of the wide range in the size of individual operations, from very small facilities to large facilities handling hundreds of thousands of tonnes or more of scrap metal each year, the government should adopt an approach that is graded according to the size of the facility, the radiation risks and the capabilities of the operator to address the problem of scrap metal containing radioactive material. Although, in principle, this Safety Guide is relevant to all facilities in the metal recycling and production industries, the recommendations relate primarily to large facilities that handle over one hundred thousand tonnes of scrap metal annually and operate shredders and melt scrap metal. Governments and national authorities should determine the degree to which the recommendations should be applied to small and medium sized facilities.

3.13. In establishing national arrangements — whether regulatory or voluntary — the government should consider the following specific issues, taking into account the graded approach, as indicated in para. 3.12:

- (a) The degree to which operators of metal recycling and production facilities are encouraged to inform the regulatory body of their operations.
- (b) The need for operators of metal recycling and production facilities to establish arrangements for responding to the suspected or actual presence of radioactive material in scrap metal, metal products or wastes. These arrangements should cover the notification of the regulatory body and, as necessary, the competent authority in the area of emergency response, if radioactive material is determined to be present in scrap metal, metal products or wastes.
- (c) The need for operators of metal recycling and production facilities to ensure the level of protection of people and the environment as required in the BSS [1].

¹¹ An example of such a voluntary arrangement is the ‘Spanish Protocol’, which is described in Annex III.