

# International Basic Safety Standards – Protecting people and the environment

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**ABSTRACT** An interim edition of the IAEA Safety Requirements document: “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards” (BSS) was published in November 2011. The revision of the BSS was coordinated by a BSS Secretariat consisting of representatives of the IAEA, FAO, EC, ILO, UNEP, PAHO, WHO and NEA/OECD. The BSS takes into account the Fundamental Safety Principles, the findings of the United Nations Scientific Committee on the Effects of Atomic Radiation and the 2007 recommendations of the International Commission of Radiological Protection (ICRP) and other applicable ICRP statements and publications. This paper provides an overview of the revised BSS, including requirements on preparedness for a nuclear or radiological emergency and to remediation of areas contaminated by residual radioactive material following a nuclear or radiological emergency.

**Keywords:** International BSS / radiation protection / exposure situation / emergency / remediation

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## 1. Introduction

The fifth edition of the International Basic Safety Standards (BSS) (IAEA, 2011) was approved by the IAEA Board of Governors in September 2011 and an interim edition was published in November 2011. The potential cosponsoring organizations (EC, FAO, ILO, NEA/OECD, PAHO, UNEP, WHO) are now following their processes for approving the BSS, and it is expected that the final edition will be published in 2013.

The BSS takes into account the findings of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 2009), and the latest publications of the International Commission of Radiological Protection. These

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ICRP publications include the 2007 recommendations of the ICRP (ICRP, 2007), the statement on radon (ICRP, 2010), the statement on tissue reactions (ICRP, 2012), and application of the ICRP recommendations for the protection of people in emergency exposure situations (ICRP, 2009a) and application of the ICRP recommendations to protection of people living in long-term contaminated areas following a nuclear or radiological emergency (ICRP, 2009b). The BSS is addressed in particular to regulatory bodies and other relevant national authorities, and also to licensees, employers, radiological medical practitioners, professional bodies and service providers. They can be used by Member States as a reference for their national regulations. 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 structure of the BSS follows the approach, philosophy and terminology of the 2007 recommendations of the ICRP (ICRP, 2007). There are five Sections to the BSS: an Introduction; Section 2 that contains requirements that are applicable to all exposure situations; Section 3 that contains requirements for planned exposure situations; Section 4 on emergency exposure situations; and Section 5 on existing exposure situations. Section 3 includes sub-sections on the three categories of exposure: occupational exposure, public exposure, and medical exposure. Sections 4 and 5 include sub-sections on public exposure and on occupational exposure.

## 2. General aspects of the BSS

Section 2 of the BSS contains requirements that are applicable to all exposure situations: planned, emergency and existing. The requirements relating to the three principles of radiation protection are addressed: justification, optimization of protection and safety, and dose limits. The principles of justification and optimization apply to all three exposure situations, while the principle relating to dose limits only applies to planned exposure situations.

This section also includes requirements on the responsibilities of governments in relation to the establishment of a legal and regulatory framework for protection and safety in all exposure situations and requirements on the regulatory body in relation to establishing a regulatory system for protection and safety. These requirements are consistent with the IAEA Safety Requirements publication GSR Part 1 (IAEA, 2010).

The BSS assigns specific responsibilities to particular parties for each requirement. The person or organization responsible for any facility or activity that gives rise to radiation risks has the prime responsibility for protection and safety. The principal parties with responsibilities for protection and safety include licensees and employers in relation to occupational exposures. For the first time the BSS also includes as principle parties: radiological medical practitioners in relation to medical exposures; persons and organizations designated to deal with emergency

exposure situations; and persons or organizations designated to deal with existing exposure situations.

The responsibilities of the principal parties include ensuring that all personnel engaged in activities relevant to protection and safety have appropriate education, training and qualification so that they can understand their responsibilities and can perform their duties competently, with appropriate judgement and in accordance with procedures.

### **3. Planned exposure situations**

Section 3 contains five sub-sections: scope; generic requirements; occupational exposure; public exposure, and medical exposure.

The list of practices covered in the scope includes the generation of nuclear power, including activities within the nuclear fuel cycle that involve exposure to radiation or exposure due to radioactive material; the use of radiation or radioactive material for medical, industrial, veterinary, agriculture, legal or security purposes; and the mining and processing of raw materials that involve exposure to radioactive material. While their inclusion within the scope has been implicit in the past, this is the first time that the use of radiation for legal and security purposes, and the mining and processing of raw materials, have been explicitly included in the list of practices.

The requirement on the graded approach requires that the application of the requirements in the BSS in planned exposure situations is to be commensurate with the characteristics of the practice, or the source within the practice, and the magnitude and likelihood of exposures. Implicit in the use of a graded approach is that not all requirements of the BSS are relevant for every type of practice or source.

Section 3 includes a requirement that all persons or organizations that intend to operate a facility or conduct an activity are required to submit to the regulatory body a notification or an application for authorization. When specified, an application for authorization is to include a safety assessment, which is to be reviewed and assessed by the regulatory body.

Licensees are required to apply good engineering practice and to take all practicable measures to prevent accidents and to mitigate the consequences of accidents that do occur. Such measures need to be carried out in cooperation with other parties such as designers and manufacturers of facilities and sources, taking into account national and international standards, and include defence in depth.

If the safety assessment indicates that there is a reasonable likelihood for an emergency affecting workers or members of the public, the licensee is required to prepare an emergency plan for the protection of people and the environment. The emergency plan is to include arrangements for the prompt identification of an emergency, and for determining the appropriate level of emergency response. It

should also include provision for individual monitoring and area monitoring, arrangements for medical treatment, and arrangements for assessing and mitigating any consequences of an emergency.

Licensees are responsible for the implementation of their emergency plans and are required to be prepared to take any necessary action for effective response.

The requirements for occupational exposure in planned exposure situations address optimization of protection and safety; the responsibilities of employers and licensees; monitoring and recording of occupational exposure; compliance by workers; arrangements under a radiation protection programme; local rules and procedures; personal protective equipment; assessment of occupational exposure; workers health surveillance; records of occupational exposure; training of workers; conditions of service; and special arrangements for female workers.

Schedule III of the BSS sets out the dose limits for workers in planned exposure situations. For occupational exposure of workers over the age of 18 years, the dose limit is an effective dose of 20 mSv per year averaged over 5 consecutive years and of 50 mSv in any single year. The limit for occupational exposure of workers for the equivalent dose to the lens of the eye has been reduced to 20 mSv per year averaged over 5 consecutive years and to 50 mSv in a single year.

Relevant requirements for occupational exposure in planned exposure situations also apply to occupational exposure for emergency exposure situations, and for existing exposure situations.

#### **4. Emergency exposure situations**

There are four requirements in Section 4 of the BSS dealing with Emergency Exposure Situations, covering the following topics:

- Establishment of an emergency management system;
- Development and implementation of protection strategies;
- Arrangements for controlling the exposure of emergency workers;
- And arrangements for the transition from an emergency exposure situation to an existing exposure situation.

Governments are responsible for ensuring that protection strategies for the public are developed, justified and optimized at the planning stage. The protection strategies are required to include a reference level for the public, expressed in terms of residual dose, in the range of 20–100 mSv that includes dose contributions *via* all exposure pathways.

In responding to an emergency, the dose to an emergency worker can only exceed 50 mSv in very specific circumstances, namely:

- a) for the purposes of saving life or preventing serious injury;

- b) when undertaking actions to prevent severe deterministic effects and actions to prevent the development of catastrophic conditions that could significantly affect people and the environment; or
- c) when undertaking actions to avert a large collective dose.

There is a further requirement that emergency workers who undertake actions in which the doses received might exceed 50 mSv do so voluntarily.

## 5. Existing exposure situations

Two of the six requirements in Section 5 address the generic responsibilities of the government and the application of the principles of justification and optimization. The remaining four requirements are focused on public exposure (three requirements) and occupational exposure (one requirement).

The general philosophy for managing all existing exposure situations is that the government ensures that the necessary infrastructure is in place to evaluate any existing exposures that arise, to determine which occupational exposures and public exposures are of concern from the point of view of radiation protection and to implement any actions that are deemed necessary. In many Member States the responsibility for managing existing exposure situations is devolved to the regulatory body. The BSS does not require that the regulatory body is constantly looking for new and novel existing exposure situations, but when such a situation is identified, the regulatory body must be able to deal with it and to be appropriately prepared.

In line with the philosophy of the ICRP (ICRP, 2007), public exposure in existing exposure situations is addressed through the use of reference levels that are typically expressed as an annual effective dose to the representative person in the range 1–20 mSv. In the case of exposure to indoor radon, for practical reasons the decision has been taken to express the reference level in terms of average radon concentration (expressed in terms of becquerels per cubic metre). Specific reference levels for different exposure scenarios are given in Table I.

**Table I**  
Reference levels for various exposure pathways.

Exposure Pathway	Reference Level <sup>1</sup>
Residing in a Contaminated Area	1–20 mSv
Foodstuffs	1 mSv
Drinking Water	1 mSv
Construction Materials	1 mSv
<sup>222</sup> Rn in Dwellings	Not exceeding 300 Bq/m <sup>3</sup>
<sup>222</sup> Rn in Workplaces	Not exceeding 1000 Bq/m <sup>3</sup>

<sup>1</sup> Annual effective dose to the representative person or annual average radon concentration.

The remediation of areas with residual radioactive material is a topic of particular interest. For those areas with long lasting residual radioactive material in which the government has decided to allow habitation and the resumption of social and economic activities, the established reference levels (in the range 1–20 mSv) need to be consistent with day to day life.

Remedial actions need to be both justified and optimized and must be approved by the relevant authorities. Remediation is managed as a planned exposure situation: workers are subject to dose limits and the additional dose received by those living in the area as a direct result of the remedial work being undertaken must not exceed 1 mSv.

The BSS also includes a requirement on regulatory bodies to establish reference levels for radionuclides in commodities, such as construction material, food, feed and drinking water. Such commodities may be contaminated as a result of an emergency. The BSS states that the reference levels for exposure due to radionuclides in commodities shall typically not exceed a value of about 1 mSv. The BSS requires that the regulatory body consider the guideline levels for radionuclides contained in food traded internationally, that could contain radioactive substances as a result of a nuclear or radiological emergency, as published by the joint FAO/WHO Codex Alimentarius Commission (WHO, 2006). These levels were derived using a radiological criterion of 1 mSv for individual annual dose, and assume that ten per cent of the foodstuffs are imported from areas contaminated with radionuclides.

## 6. Conclusions

Based on the Fundamental Safety Principles (IAEA, 2006), the BSS establishes requirements for the protection of people and the environment from harmful effects of ionizing radiation and for the safety of radiation sources. They are intended to be used by governmental authorities, including regulatory bodies, and by organizations operating nuclear facilities and facilities producing or using radiation sources. The requirements take into account the most recent recommendations of the ICRP, and are supported by a set of safety guides that assist with implementation.

## REFERENCES

- IAEA (2006) Fundamental Safety Principles, IAEA Safety Standard Series No. SF-1.
- IAEA (2010) Governmental, Legal and Regulatory Framework for Safety, IAEA Safety Standard Series, GSR Part 1.
- IAEA (2011) Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series GSR Part 3 (Interim).

- ICRP Publication 103 (2007) The 2007 Recommendations of the International Commission on Radiological Protection, *Ann. ICRP* **37** (2-4).
- ICRP Publication 109 (2009a) Application of the Commission's Recommendations for the Protection of People in Emergency Exposure Situations, *Ann. ICRP* **39** (1).
- ICRP Publication 111 (2009b) Application of the Commission's Recommendations to the Protection of People Living in Long-term Contaminated Areas After a Nuclear Accident or a Radiation Emergency, *Ann. ICRP* **39** (3).
- ICRP Publication 115 (2010) Lung Cancer Risk from Radon and Progeny and Statement on Radon, *Ann. ICRP* **40** (1).
- ICRP Publication 118 (2012) ICRP Statement on Tissue Reactions/Early and Late Effects of Radiation in Normal Tissues and Organs – Threshold Doses for Tissue Reactions in a Radiation Protection Context, *Ann. ICRP* **41** (1-2).
- UNSCEAR (2009) United Nations, Effects of Ionizing Radiation. Volume I: Report to the General Assembly, Scientific Annexes A and B; Volume II: Scientific Annexes C, D and E. United Nations Scientific Committee on the Effects of Atomic Radiation, UNSCEAR 2006 Report.
- WHO (2006) Joint FAO/WHO Codex Alimentarius Commission (2006), Codex General Standard for Contaminants and Toxins in Foods, Schedule I – Radionuclides, CODEX STAN 193-1995.