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**Document Preparation Profile (DPP)**  
**Version 3 dated 04-11-2022**

**1. IDENTIFICATION**

**Document Category:** Safety Guide – IAEA Safety Standards Series No. SSG-8 [Rev.1]

**Working ID:** DS545

**Proposed Title:** Radiation Safety of Gamma, X Ray and Electron Beam Irradiation Facilities

**Proposed Action:** Revision of the Specific Safety Guide No. SSG-8  
Radiation Safety of Gamma, Electron and X Ray Irradiation Facilities,  
SSG-8, 2010

**Review Committee(s) or Group:** RASSC (Lead), WASSC, TRANSSC, EPreSC, NSGC

**Technical Officer(s):** Haridasan PAPPINISSERI, RSM-NSRW

**2. BACKGROUND**

IAEA Safety Standards Series No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, establishes requirements for the protection of people and the environment from the harmful effects of ionizing radiation and for the safety of radiation sources. The implementation of these requirements helps to ensure that the number of people exposed to radiation and their doses are kept as low as reasonably achievable and helps to prevent emergencies or to mitigate their consequences.

IAEA Safety Standards Series No. SSG-8, Radiation Safety of Gamma, Electron and X Ray Irradiation Facilities, is intended to implement the requirements of GSR Part 3 in respect of the radiation sources used in irradiation facilities. However, the publication, issued in 2010, predates GSR Part 3 and several other relevant safety standards.

As proposed during a consultancy meeting in August 2022, the revised publication will alter the current title, for better reflecting the content and industrial practice. The meeting noted several gaps or updating certain contents to that will represent the actual industrial practice being ongoing in Member States. The table of contents will be updated by including additional sections on Duties and Responsibilities, Safety Assessment, Radiation Protection Programme, Qualification and Training, and Protection of public and the environment. This Safety Guide will have an expanded scope to include all Categories of gamma, X ray and electron beam (eBeam) irradiators.

**3. JUSTIFICATION FOR THE PRODUCTION OF THE PUBLICATION**

The revision of SSG-8 is necessary as it predates the current safety requirements established in GSR Part 1 (Rev.1), GSR Part 2, GSR Part 3, GSR Part 4, GSR Part 7 and SSR-6 (Rev. 1) and

recommendations in supporting Safety Guides. A revision is needed to ensure consistency with the current safety requirements and with the terminology of the IAEA Safety Glossary (2018 Edition).

Since the development of SSG-8, the application of ionising radiation technologies has expanded. The use of eBeam and X ray technologies are increasing in industrial and research settings. To meet this increasing demand new technologies are emerging. For example, low energy eBeam and X ray irradiation is gaining increased commercial attention. Since the publication of SSG-8 in 2010 more experience in safely handling of these technologies has been gained. The revised Safety Guide will capture this expanded knowledge.

Although SSG-8 continues to be used widely it is in need of revision. IAEA Radiation Safety Standard Committee (RASSC) eight term 2021–2023, assigned the revision of SSG-8 as high priority. The Committee considered several extant safety guides in need of revision, and this was identified as priority one.

#### **4. OBJECTIVE**

The objective of the proposed revision of SSG-8 is to provide recommendations and guidance on meeting the requirements established in GSR Part 3 concerning the design and use of ionizing technology-based irradiation facilities. This includes gamma, X ray and electron beam (eBeam) irradiation facilities.

The recommendations in this revised publication will also address SSR-6 (Rev. 1) and other relevant IAEA safety standards, Nuclear Security Series publications, and the Code of Conduct on the Safety and Security of Radioactive Sources in relation to ionizing technology based irradiation practices.

The recommendations in the proposed publication are targeted primarily at regulatory bodies and current and future operating organizations of industrial and research irradiation facilities, as well as their employees and radiation protection officers. This safety guide will also be of interest to qualified experts, equipment designers and manufacturers, and equipment service providers. The guidance will also be of interest to those who are utilizing industrial irradiation services.

#### **5. SCOPE**

This Safety Guide provides recommendations on how to meet the requirements of GSR Part 3 with regard to the safe design and operation of irradiation facilities [gamma irradiators (Categories I to IV), [X ray irradiators \(Categories I and II\)](#) and electron beams irradiators ([Categories I and II](#)) and [X ray irradiators \(Categories I and II\)](#)] that are used for the [blood and blood component irradiation](#), industrial radiation processing and research and development.

This Safety Guide will not include the X ray generators and other radiation sources used for security inspection purpose and for non-medical human imaging ([addressed in SSG-55](#)). It will not include the use of ionizing radiation for medical diagnosis and therapeutic applications, industrial radiography, heavy ions and cyclotrons, as these may be found in other IAEA safety guides. This Safety Guide will not duplicate the guidance in GSG-7 and GSG-8.

#### **6. PLACE IN THE OVERALL STRUCTURE OF THE RELEVANT SERIES AND INTERFACES WITH EXISTING AND/OR PLANNED PUBLICATIONS**

This Safety Guide will interface with at least the following IAEA Safety Standards Series and other publications (the list is not intended to be final or exhaustive):

- GSR [Part 1 (Rev.1) Governmental, Legal and Regulatory Framework for Safety, 2016.
- GSR Part 2, Leadership and Management for Safety, 2016
- GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, 2014
- GSR Part 4 (Rev. 1), Safety Assessment for Facilities and Activities, 2016
- GSR Part 5, Predisposal Management of Radioactive Waste, 2009
- GSR Part 6, Decommissioning of Facilities, 2014
- GSR Part 7, Preparedness and Response for a Nuclear or Radiological Emergency, 2015
- SSR-6 (Rev. 1), Regulations for the Safe Transport of Radioactive Material, 2018
- NSS No. 11-G (Rev. 1), Security of Radioactive Material in Use and Storage and of Associated Facilities, 2019
- NSS No. 9-G (Rev. 1), Security of Radioactive Material in Transport, 2020
- NSS No. 14 Nuclear Security Recommendations on Radioactive Material and Associated Facilities, 2011
- RS-G-1.9, Categorization of Radioactive Sources, [2005](#) |
- Code of Conduct on the Safety and Security of Radioactive Sources and supplementary guidance, [2004](#) |
- GSG-7 Occupational Radiation Protection, 2018
- GSG-8 Radiation Protection of the Public and the Environment, 2018
- SSG-45 Pre-disposal Management of Radioactive Waste from the Use of Radioactive Material in Medicine, Industry, Agriculture, Research and Education, 2019
- SSG-46 Radiation Protection and Safety in Medical Uses of Ionizing Radiation, 2018
- SSG-49 Decommissioning of Medical, Industrial and Research Facilities, 2019

All relevant sections in the IAEA's Department of Nuclear Safety and Security will be consulted, as appropriate, throughout the drafting and review process.

## 7. OVERVIEW

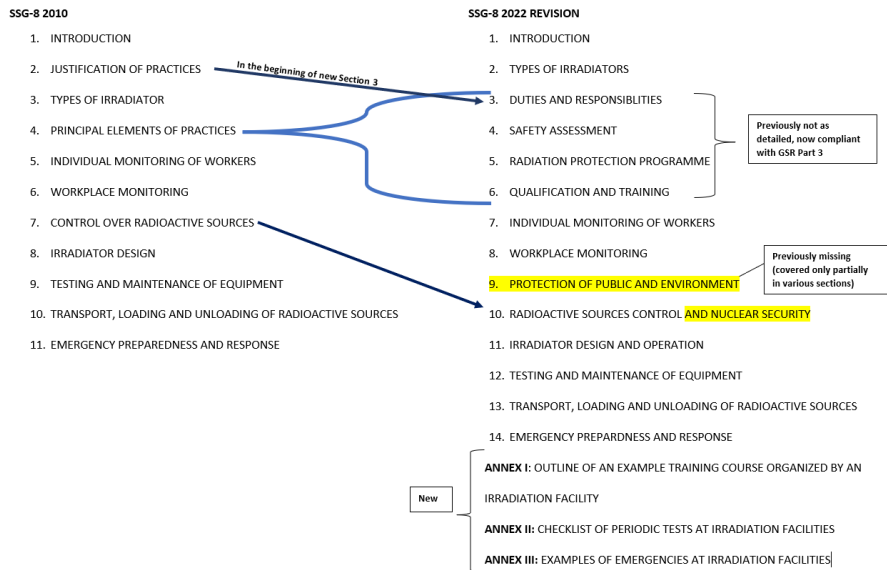
A consultancy meeting in August 2022 reviewed the current structure and content of SSG-8 and concluded that some changes in a revised version is needed, though the majority of the current structure has to be retained. The outline of the publication will be similar to that of the publication that is being revised. For the comparison of previous and proposed table of content please see the table below.

Moreover:

- All figures need update.
- The main title and some section titles have been modified.
- Some new sections and subsections have been added.
- The current table of contents has been extended to cover Category I gamma irradiators, self-shielded low energy eBeam and X Ray irradiators

- Three new Annexes are proposed.

Overall comparison of SSG-8 (2010) ToC vs. Rev. SSG-8 (2022) ToC Proposal



Proposed table of contents:

1. INTRODUCTION
  - Background
  - Objective
  - Scope
  - Structure
2. TYPES OF IRRADIATORS
  - Introduction of the categories of irradiators
  - Gamma irradiators – Category I to IV
  - Low energy electron beam and x-ray irradiators – Category I
  - High energy electron beam and x-ray irradiators – Category II
3. DUTIES AND RESPONSIBILITIES
  - Radiation protection principles
  - The government and the regulatory body
  - The operating organization
  - Radiation protection officers
  - Qualified experts
  - Workers

Clients  
Suppliers and service providers  
Safety culture  
Management of disused radioactive sources

4. SAFETY ASSESSMENT

General

Methodology for the safety assessment – *by the category of an irradiator*

Outcomes of the safety assessment

Reviews of the safety assessment

Record of the safety assessment

5. RADIATION PROTECTION PROGRAMME

Objectives and scope

Structure and content

Management structure and policies

Education and training

Local rules and supervision

Designation of controlled/supervised areas

Workplace monitoring

Personal Protective Equipment

Individual monitoring

Health surveillance programme

Radiation protection officer

Periodic reviews and audits - management system and process improvement

6. QUALIFICATION AND TRAINING

General

Design of a training programme

Structure and content

Refresher training

Training assessments and certification

7. INDIVIDUAL MONITORING OF WORKERS

General

Dosimetry (equipment, measurement, testing, calibration and maintenance)

Dose limits/constraints for occupational radiation protection

Individual dose assessment

Investigation of doses

Record keeping

8. WORKPLACE MONITORING

Workplace monitoring equipment (radiation survey meters and radiation monitors)

Maintenance and calibration

Radiation monitoring and contamination measurement

Record keeping

9. PROTECTION OF PUBLIC AND ENVIRONMENT

- General
- Dose limits/constraints for protection of the public
- Dose assessment
- Visitors
- Public engagement

10. RADIOACTIVE SOURCES CONTROL AND INTERFACE WITH NUCLEAR SECURITY

- General
- Source control
- Nuclear security considerations
- [Decommissioning of equipment](#)

11. IRRADIATOR DESIGN AND OPERATION

GENERAL

- Siting requirements for [high powered](#) irradiators including to buildings and their load-bearing structures
- Source assembly moving system
- Shielding
  - Gamma (all categories)
    - [X-ray – high and low energy](#)
    - eBeam – high and low energy
    - ~~X-ray – high and low energy~~
- Access to the radiation source and safety interlock systems
  - Safety interlock for the personnel access door
  - Backup access control – Personnel entry
  - Safety interlocks for product entry and exit ports
  - Backup access control – Product entry and exit ports
  - Removable radiation room shield plugs
  - Fixed radiation monitor with alarms
- Control console
  - Access key
  - Emergency stop device at the control console
  - Disabling the radiation source
- Internal design
  - Radiation resistant components
  - Product positioning systems
    - Gamma (all categories)
      - [X-ray – high and low energy](#)
      - eBeam – high and low energy
      - ~~X-ray – high and low energy~~
    - Product movement timer
- Irradiation chamber

Formatiert: Einzug: Links: 2,75 cm, Erste Zeile: 0,25 cm

Formatiert: Einzug: Erste Zeile: 1 cm

Safety delay timer with alarms

Emergency stop device

Emergency exit

Ventilation

Notices and symbols

Audible and visual signals

Signage and posting

Irradiation source status indicators

Irradiation status indicator colors

Considerations with regard to external events

#### GAMMA IRRADIATORS

Design of sealed sources

Specific requirements for wet storage conditions

Certification and documentation

Internal design

Source holder and source rack

Source guard

Emergency source cooling system

Source travel timer

Emergency access ports

Source rack position indicators

Access to radioactive sources and safety interlock systems

Access to storage pools in Category III

Backup access control – product entry and exit ports

Removable radiation room shield plugs at gamma irradiators

Fixed radiation monitor with alarms

Backup system for bringing source back to the safe position

Product exit radiation monitor

Wet source storage irradiators

Radiation monitor of the water treatment system

Storage pool integrity

Materials of pool components

Water level monitoring and control

Water conditioning

Cooling of storage pool water

In-pool piping

Storage pool guard cover

Fire protection

Power failure

Electrical power

Non-electrical power

#### X-RAY IRRADIATORS AND ELECTRON BEAM IRRADIATORS AND X-RAY IRRADIATORS

Safety considerations in the use of high energy X rays and electron and x ray accelerators

Shielding

- Disabling mechanism for the main acceleration system
  - Built-in monitoring of machine parameters
  - Built-in remote machine diagnostics
  - Safety consideration in the use of low energy X-ray and electron beam ~~and X-ray~~ systems
- FACILITY MODIFICATIONS

12. TESTING AND MAINTENANCE OF EQUIPMENT

- Periodic tests
- Leak testing of radioactive sources
- Records
- Facility maintenance programme
- Ageing management

13. TRANSPORT, LOADING AND UNLOADING OF RADIOACTIVE SOURCES

- Transport
- Loading and unloading of sources

14. EMERGENCY PREPAREDNESS AND RESPONSE

- General
- Functions for Emergency Preparedness and Response
- Infrastructure for Emergency Preparedness and Response

REFERENCES

ANNEX I: Outline of an Example Training Course Organized by an Irradiation Facility

ANNEX II: Checklist of Periodic Tests at Irradiation Facilities

ANNEX III: Summary of Selected Past Emergencies at Irradiation Facilities

**8. PRODUCTION SCHEDULE:**

	A*
STEP 1: Preparing a DPP	DONE
STEP 2: Internal review of the DPP (Approval by the Coordination Committee)	September 2022
STEP 3: Review of the DPP by the review Committee(s) (Approval by review Committee(s))	November 2022
STEP 4: Review of the DPP by the CSS (approval by CSS) or information of the CSS on the DPP	April 2023
STEP 5: Preparing the draft publication	2023, 2024
STEP 6: First internal review of the draft publication (Approval by the Coordination Committee)	August 2024
STEP 7: First review of the draft publication by the review Committee(s) (Approval for submission to Member States for comments)	November 2024
STEP 8: Soliciting comments by Member States	May 2025
STEP 9: Addressing comments by Member States	July 2025



STEP 10: Second internal review of the draft publication (Approval by the Coordination Committee)	August 2025
STEP 11: Second review of the draft publication by the review Committee(s) (Approval of the draft)	November 2025
STEP 12: (For Safety Standards) Editing of the draft publication in MTCD and endorsement of the draft publication by the CSS (For nuclear security guidance) DDG's decision on whether additional consultation is needed, establishment by the Publications Committee and editing	April 2026
STEP 13: Approval by the Board of Governors (for SF and SR only)	n/a
STEP 14: Target publication date	2026

## 9. RESOURCES

Estimated resources involved:

Secretariat (person-weeks): 40 weeks

Member States (number and type of meetings): 4-5 CSs, HBAs as needed.



**ANNEX - 1**

Chairperson report RASSC 50.

[Microsoft Word - RASSC 50 - draft report-Final With comments.docx \(iaea.org\)](#)