Document Preparation Profile (DPP)

1. IDENTIFICATION

Document Category **Safety Guide**

Working ID: **DS470**

Proposed Title: **Radiation Safety of Radiation Sources Used in Research and Education**

Proposed Action: **new document**

Review Committee(s): **RASSC, WASSC, TRANSSC, NSGC**

Technical Officer(s): **T. Boal**

2. BACKGROUND/RATIONALE

This Safety Guide was included in the "Reference Set of Safety Guides for the Long Term" (2009).

The Safety Guide will provide guidance for implementing the Safety Requirements publication GSR Part 3 (Interim edition) "Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards" (the BSS) with regard to the safety of radiation sources used in research, including commercial, industrial and radiopharmaceutical research, and education.

This Safety Guide is part of a series of Specific Safety Guides for facilities and activities such as industrial, research and educational uses of ionizing radiation e.g. for industrial irradiators, industrial radiography, nuclear gauges, well logging, isotope production facilities, and the use of radiation sources for inspection purposes and non-medical imaging that have been published or are currently under development.

3. OBJECTIVE

The objective of the proposed Safety Guide is to provide guidance on safety measures specific to meet the requirements on the use of radiation generators, radiation sources and radioactive material for purposes of research and education. The Safety Guide will provide guidance on meeting the requirements of the BSS and other relevant Safety Requirements publications in the Safety Standards Series in carrying out these practices.

4. JUSTIFICATION

The IAEA has produced several publications on the safe use of radiation generators, radiation sources and radioactive material, and the establishment of associated facilities.

However, there is currently no Safety Guide addressing protection and safety for X ray generators, radiation sources and radioactive material used for research and education. This Safety Guide will deal with practical issues and radiation protection in research and education.

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

This Specific Safety Guide belongs to the thematic area of the application of radiation sources.

The proposed Safety Guide will provide recommendations of measures that should be taken to ensure fulfilment of the safety requirements included in the following documents:

1. INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, Safety Standards Series No. GSR Part 3 (Interim), 2011.
2. INTERNATIONAL ATOMIC ENERGY AGENCY, Governmental, Legal and Regulatory Framework for Safety, Safety Standards Series No. GSR Part 1 (2010).
3. INTERNATIONAL ATOMIC ENERGY AGENCY, Predisposal Management of Radioactive Waste, Safety Standards Series No. GSR Part 5, (2009)
4. INTERNATIONAL ATOMIC ENERGY AGENCY, Decommissioning of Facilities Using Radioactive Material, Safety Standards Series No. WS-R-5, (2006)
5. FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS, PAN AMERICAN HEALTH ORGANIZATION, WORLD HEALTH ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, Safety Standards Series No. GS-R-2, (2002)
6. INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transport of Radioactive Material 2012 Edition, Safety Standards Series No. SSR-6, (2012)
7. INTERNATIONAL ATOMIC ENERGY AGENCY, The Management System for Facilities and Activities, Safety Standard Series No. GS-R-3, (2006).
8. INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Assessment for Facilities and Activities, Safety Standard Series No. GSR Part 4 (2009).

The proposed Safety Guide will take account of the guidance provided in, and will include references to, the following Safety Guides:

1. INTERNATIONAL ATOMIC ENERGY AGENCY, Building Competence in Radiation Protection and the Safe Use of Radiation Sources, Safety Standards Series No. RS-G-1.4 (2001).
2. INTERNATIONAL ATOMIC ENERGY AGENCY, Occupational Radiation Protection, Safety Standards Series No. RS-G-1.1 (1999).
3. INTERNATIONAL ATOMIC ENERGY AGENCY, Application of the Concepts of Exclusion, Exemption and Clearance, Safety Standards Series No. RS-G-1.7 **(**2004).
4. INTERNATIONAL ATOMIC ENERGY AGENCY, Environmental and Source Monitoring for Purposes of Radiation Protection, Safety Standards Series No. RS-G-1.8, (2005).
5. INTERNATIONAL ATOMIC ENERGY AGENCY, Categorization of Radioactive Sources, Safety Standards Series No. RS-G-1.9 (2005).
6. INTERNATIONAL ATOMIC ENERGY AGENCY, Safety of Radiation Generators and Sealed Radioactive Sources, Safety Standards Series No. RS-G-1.10 **(**2007).
7. INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Safety of Gamma, Electron and X Ray Irradiation Facilities, Safety Standards Series No. SSG-8, (2010).
8. INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Safety in Industrial Radiography, Safety Standards Series No. SSG-11, (2011).
9. INTERNATIONAL ATOMIC ENERGY AGENCY, Regulatory Control of Radioactive Discharges to the Environment, Safety Standards Series No. WS-G-2.3, (2000).

10. INTERNATIONAL ATOMIC ENERGY AGENCY, Management of Waste from the Use of Radioactive Materials in Medicine, Industry, Agriculture, Research and Education, Safety Standards Series No. WS-G-2.7, (2005).
11. INTERNATIONAL ATOMIC ENERGY AGENCY, Regulatory Control of Radiation Sources, Safety Standards Series No. GS-G-1.5 (2004).
12. INTERNATIONAL ATOMIC ENERGY AGENCY, Decommissioning of Medical. Industrial and Research Facilities, Safety Standard Series No. WS-G-2.2, (1999).

Draft Standards

The proposed Safety Guide will interface with the following draft standards:

1. Occupational Radiation Protection, revision of RS-G-1.1, RS-G-1.2, RS-G-1.3, RS-G-1.6, and GS-G-3.2, DS453.
2. Radiation Protection of the Public and the Environment, DS432.
3. Radiation Safety in Well Logging, DS419.
4. Radiation Safety for Nuclear Gauges, DS420.
5. Radiation Safety of Radioisotope Production Facilities, DS434.
6. Radiation Safety and Regulatory Control for Consumer Products, DS458.
7. Decommissioning of Medical, Industrial and Research Facilities, revision of WS-G-2.2, DS403.
8. Radiation Safety of X-ray Generators and Radiation Sources Used for Inspection Purposes and for Non-Medical Imaging, DS471.
9. Regulatory Control of Radioactive Discharges to the Environment, DS442.
10. Decommissioning of Facilities, revision of WS-R-5, DS450.
11. Preparedness and Response for a Nuclear or Radiological Emergency, revision of GS-R-2, DS457.
12. Predisposal Management of Waste from the Use of Radioactive Materials in Medicine, Industry, Research, Agriculture and Education, revision of WS-G-2.7, DS454.

Security publications

The proposed Safety Guide will interface with the following documents in the Nuclear Security Series:

1. INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Recommendations on Radioactive Material and Associated Facilities, Nuclear Security Series No. 14, (2011).
2. INTERNATIONAL ATOMIC ENERGY AGENCY, Security in the Transport of Radioactive Material, Nuclear Security Series No. 9, (2008).
3. INTERNATIONAL ATOMIC ENERGY AGENCY, Security of Radioactive Sources, Nuclear Security Series No. 11, (2009).

6. SCOPE AND OVERVIEW

The Safety Guide will address the radiation protection and safety aspects of the use of radioactive sources and radiation generators in research and education, including, for example, universities and research laboratories. The use of radioactive sources in research and education are planned exposure situations. The Safety Guide will cover occupational exposure and public exposure. The Safety Guide does not cover medical exposures. The exposure of students is *regarded as* a category of occupational

exposure — as for exposure of apprentices — for the purposes of application of the BSS. A discussion of the different dose limits for students under the age of 18 will be included in Safety Guide.

The radioactive sources will include sealed sources such as those used in education, sample irradiation, calibration of equipment and sources used in scientific equipment; and unsealed sources which may be used for tracer studies in biomedical and environmental research, environmental pollutants and physical sciences. The radiation generators include X ray diffraction, X ray spectroscopy, X ray machines for imaging (including electron microscopes) and linear accelerators.

The Safety Guide will provide guidance on applying the recommendations of the Safety Requirements listed in Section 5 of this DPP. The graded approach is to be applied to the implementation of these requirements.

The Safety Guide will not cover research reactors or critical assemblies (covered in other Safety Guides).

The principal issues covered in the Safety Guide will be:

— Types of radiation sources used in research and education;

— Responsibilities of the regulatory body

— Responsibilities of licensees;

— Protection of workers and students using radiation sources;

— Personal protective equipment;

— Control and storage of radioactive sources;

— Radiation detection and monitoring devices;

— Personnel dosimetry;

— Site selection;

— Facility and equipment design;

— Testing and maintenance of equipment;

— Discharges and radioactive waste management;

— Effluent and environmental monitoring;

— Transport of radioactive material;

— Emergency preparedness and response.

— Decommissioning

The interface between safety and security for radioactive sources will also be addressed.

Please see the attached proposed table of contents for further details.

7. PRODUCTION SCHEDULE: Provisional schedule for preparation of the document, outlining realistic expected dates for:

STEP 1: Preparing a DPP	DONE
STEP 2: Approval of DPP by the Coordination Committee	September 2012
STEP 3: Approval of DPP by the Safety Standards Committees or the relevant group where appropriate	November 2012
STEP 4: Approval of DPP by the CSS	March 2013
STEP 5: Preparing the draft	2013-2014
STEP 6: Approval of draft by the Coordination Committee	March 2014
STEP 7: Approval by the Safety Standards Committees for submission to Member States for comments	June 2014
STEP 8: Soliciting comments by Member States	July-October 2014
STEP 9: Addressing comments by Member States	November 2014
STEP 10: Approval of the revised draft by the Coordination Committee Review in NS-SSCS	March 2015
STEP 11: Approval by the Safety Standards Committees for submission to the CSS or the relevant group where appropriate	June 2015
STEP 12: Endorsement by the CSS	October 2015
STEP 13: Establishment by the Publications Committee and/or Board of Governors (for SF and SR only))	October 2015
STEP 14: Target publication date	2016

8. RESOURCES

Estimated resources involved by the Secretariat (person-weeks) and the Member States (number and type of meetings)

2 Consultant meetings in 2013

1 Consultant meeting in 2014.

ANNEX

CONTENTS

        - Responsibilities for radiation safety within each laboratory/department under the Organization's radiation safety officer
        - Classes of radiation source users – students, minors, faculty, researchers, principal investigators
    - Management system
        - Responsibilities
        - Oversight and funding
        - Documentation
        - Safety Culture
        - Response to incidents/events in a timely manner
        - Investigations and feedback of operating experience
        - Incident follow-up
    - Training and education
        - Identification of individuals to receive training e.g. researchers, students, staff of radiation safety office, staff of organizations security office
    - Interface between safety and security of radioactive sources

5. INDIVIDUAL MONITORING OF USERS
    - Policy of optimization of exposure
    - Individual dose assessment and record keeping
    - External Dosimetry
        - Types of individual monitoring
            - Criteria for monitoring of users
    - Internal Dosimetry
        - Types of individual monitoring
            - Criteria for monitoring of users
    - Investigation of doses
        - Emergency/accidental exposures
    - Health surveillance

6. WORKPLACE MONITORING
    - Radiation level measurements
        - In controlled areas and unrestricted areas
    - Radioactive contamination measurements
        - Fixed contamination
        - removable contamination
    - Airborne radioactivity measurements
    - Radiation survey meters and radiation monitors
        - Active and passive monitors
        - Dosimeters
        - Survey meters
    - Maintenance and calibration
    - Use of radiation survey meters
        - Types of surveys
    - Records of radiation surveys

7. PERSONAL PROTECTIVE EQUIPMENT
    - Selection of personal protective equipment, in accordance with the safety assessment
    - Types of personal protective equipment

8. CONTROL OF RADIOACTIVE SOURCES

- Control of purchase, receipt and distribution of radioactive sources within institution from one centralized location i.e. receiving department or radiation safety office
- Access control to radioactive material within laboratories; within radiation safety office and or within radioactive waste area
- Control of inventory
    - records management, computer database, researchers, and radiation safety

9. SITE SELECTION
    - Selection of site, as per para 3.52 of the BSS
        - Location of inventory store and waste site within the campus/site
        - Security considerations, accessibility and staffing

10. FACILITY (AND EQUIPMENT) DESIGN
    - General facility requirements – applicable to all types of sources
        - Work flow
        - Other safety considerations e.g. biological, chemical, animal care, fire
        - Laboratory set-up and use considerations
            - Open lab concept
            - access control points
            - dosimeter and protective clothing storage areas
        - Laboratory equipment e.g. hot cells, fume hood, biosafety, decontamination facility/stations, eye wash, sinks, safety showers
        - Considerations for future decommissioning
        - Work surfaces and floors
        - Ventilation
        - Shielding
        - Interlocked systems on irradiators, x ray machines, accelerators, high activity hot cells, transfer systems
        - Control of radioactive materials, general restricted access to facilities containing radioactive materials or animals
        - Radioactive material and waste storage area
        - Modifications to facility infrastructure e.g. ventilation, cooling
        - Warning signs and symbols and labeling
        - Posting of information
        - Life safety – human elements in building design, ingress/egress

11. TESTING AND MAINTENANCE OF EQUIPMENT
    - Periodic tests and maintenance of safety equipment, monitors, alarms, and interlock systems
    - Records
    - Facility maintenance and modification

12. DISCHARGES AND RADIOACTIVE WASTE MANAGEMENT
    - Discharges: liquid, air
    - Waste management
        - Minimization of activity and volume
        - Unsealed sources
            - Management of liquid radioactive waste
            - Waste characterization procedures
            - Preparation of waste shipments
        - Clearance of material after decay
        - Disused sealed sources (sealed sources no longer used - para 3.60 of the BSS)
            - Return to manufacturer or clearance after decay
        - Preparation of radioactive waste packages

- Location of waste storage areas
- Inventory of all waste generated, stored, transferred or disposed of
- Disposal of machines that produce radiation
- Disposal of contaminated equipment and clothing
- Documentation

13. EFFLUENT AND ENVIRONMENTAL MONITORING
    - Air effluent monitoring
        - Stack monitoring systems
    - Liquid effluent monitoring
    - Environmental monitoring
        - Agreement with regulatory body for dosemeters and environmental air sampling on site

14. TRANSPORT OF RADIOACTIVE MATERIAL
    - Receiving of shipments of radioactive material
    - Transport requirements
    - Preparation of packages for shipment
    - Documentation and records for transport
    - Package labeling
    - Placarding
    - Shipping papers
    - Types of containers
    - Transport of radioactive waste

15. EMERGENCY PREPAREDNESS AND RESPONSE
    - Development of emergency plans
    - Emergency equipment
        - Spill kits, decontamination materials, shielding materials
    - Communication
        - Management, principal investigator, RSO staff, public information personnel
    - Training
        - Management, principal investigator and staff, RSO staff, incident responders (fire, police)
    - Periodic review and testing of emergency plans
        - Lessons learned and improvements