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1. IDENTIFICATION

Document Category	Safety Guide
Working ID:	DS551
Proposed Title:	Decommissioning of Uranium Production Facilities
Proposed Action:	New publication
Review Committee:	<u>WASSC, RASSC, <u>EPR</u>SC, <u>NUSSC</u></u>
Technical Officer:	Z. Fan, V. Ljubenov (NSRW/WES)

2. BACKGROUND

As world energy needs increase, nuclear power from fission reactors continues to be a viable form of power production. This increasing demand, together with technology, such as in-situ recovery of uranium, that make lower grade deposits of uranium economically feasible, has resulted in an increased number of countries with interest in uranium production.

The term “uranium production”-as used in this proposed publication includes mining of uranium ores by conventional ~~methods~~ (underground and open pit) or by in-situ recovery (sometimes termed “in-situ leaching”) methods, ~~and the~~ milling or processing of the mined material to produce uranium concentrate, including yellowcake or uranium slurry. ~~It also includes~~ recovery of uranium as a secondary mineral or by-product or from another source, and ~~activities related to the~~ management of residues and waste arising from ~~these activities~~ uranium production.

There are numerous cases worldwide where past uranium production facilities have been abandoned due to a lack of proper arrangements for decommissioning and for management of residues without proper consideration of the environment. In some cases, this abandonment has led to a negative impact on human health, environment, and economy. The prevention of future legacies or abandoned sites requires Member States to develop comprehensive legal and regulatory frameworks for decommissioning of uranium production facilities and for safe management of radioactive residues and waste from mining and processing of uranium.

Operation of existing and new uranium production facilities should be conducted in a manner that is protective of human health and the environment, keeping in mind lessons from the past and applying best practices. In particular, residues need to be appropriately managed and decommissioning should be planned and implemented to avoid creating new legacy sites. The lessons learned from the past highlight the importance of a well-planned decommissioning programme for safe and sustainable development of uranium production.

The need for recommendations on the decommissioning of uranium production facilities was identified in the following meetings (see Annex):

- Technical Meeting on the Decommissioning of Uranium Production Facilities and Other Facilities Containing Naturally Occurring Radioactive Materials, November 2019.

- Technical Meeting on Decommissioning Planning for Uranium Production (virtual event), December 2021.
- Annual Meeting of the Regulatory Forum for Safety of Uranium Production and NORM (virtual event), June 2022.

These events concluded that many of the existing uranium production facilities have not started planning for decommissioning due to a lack of guidance for planning and regulatory oversight of the decommissioning process.

3. JUSTIFICATION FOR THE PRODUCTION OF THE PUBLICATION

IAEA Safety Standards Series No. GSR Part 6, Decommissioning of Facilities provides requirements for the effective development and implementation of a decommissioning programme. The requirements apply to nuclear power plants, research reactors, other nuclear fuel cycle facilities, including predisposal waste management facilities, facilities for processing naturally occurring radioactive material (NORM), former military sites, and relevant medical facilities, industrial facilities, and research and development facilities.

Two Safety Guides are published to support GSR Part 6: IAEA Safety Standards Series No. SSG-47, Decommissioning of Nuclear Power Plants, Research Reactors and Other Nuclear Fuel Cycle Facilities; and No. SSG-49, Decommissioning of Medical, Industrial and Research Facilities. ~~Uranium mines, thorium mines, and radioactive waste disposal facilities are outside the scope of the SSG-47, as they are subject to closure and not to decommissioning. Surface processing facilities for the mining and processing of uranium and thorium are subject to decommissioning, and all the recommendations in the SSG-47 are also applicable to facilities of this type.~~ Uranium production is outside the scope of SSG-49. The SSG-47, according to para. 1.14,

~~SSG-49 “...does not address... decommissioning of nuclear fuel cycle facilities (uranium conversion plants, uranium enrichment plants, nuclear fuel fabrication plants, research reactors including subcritical and critical assemblies, nuclear power plants, facilities for storage of spent fuel, reprocessing facilities and facilities for predisposal management of radioactive waste) and decommissioning of the surface processing facilities for mining and processing of uranium and thorium ores and other facilities used for industrial activities involving naturally occurring radioactive material”. Uranium production is covered by SSG-47 only partly. Uranium mines and thorium mines and facilities for disposal of radioactive waste are outside the scope of this Safety Guide SSG-47, as they are subject to closure and not to decommissioning.~~

At present, there are no comprehensive and specific recommendations on decommissioning of uranium production facilities. A uranium production facility is unique in terms of its geographic boundary, volume of residues and areas that requires consideration, and general need of long term management of residues and waste on the site. In addition, there are different methods used for uranium production, such as conventional methods (underground and open pit) or in-situ recovery (sometimes termed “in-situ leaching”) methods as well as recovery of uranium as a secondary mineral or by-product or from another source. Decommissioning of uranium production facilities demands special considerations for each of the methods and also proper closure of disposal facilities for waste.

There is an evident gap in IAEA safety standards for decommissioning of uranium production facilities. The IAEA Technical Meeting on the Decommissioning of Uranium Production Facilities and Other Facilities Containing Naturally Occurring Radioactive Materials, held in November 2019, recommended “the IAEA should develop a safety document on the decommissioning of uranium production facilities as it is an evident gap in existing IAEA safety standards and Member States have needs”. It will help Member States with planning, implementation, and regulatory oversight of decommissioning of uranium production facilities of different methods.

Need of an IAEA Safety Guide on decommissioning of uranium production facilities has been also identified by Waste Safety Standards Committee (WASSC) among priority issues for its ninth term (2021–2023). The **52nd WASSC meeting held in October 2021 requested the Secretariat to develop a DPP for a new Safety Guide on Decommissioning of Uranium Production Facilities (action under agenda item W2.1).**

4. OBJECTIVE

The objective of the proposed publication is to provide recommendations and guidance for governments, regulatory bodies, operating organizations, technical support organizations, and other interested parties on planning for decommissioning of uranium production facilities throughout their lifetime; from siting, design, and construction of facilities, through to implementation and completion of their decommissioning and terminating the authorization, as well as post-decommissioning control where a restricted release situation may be relevant. It aims at ensuring that decommissioning of facilities is conducted in a safe, economical, and environmentally acceptable manner, in accordance with best international practices. The proposed publication will support the application of IAEA Safety Standards Series No. GSR Part 6, Decommissioning of Facilities.

The proposed publication is intended to support development and review of decommissioning plans for uranium production facilities, and to provide information on conduct, completion, and regulatory oversight of decommissioning of uranium production facilities.

5. SCOPE

The proposed publication will provide recommendations on meeting the safety requirements applicable to decommissioning of uranium production facilities, primarily those provided in GSR Part 6 and GSR Part 3.

It will address decommissioning considerations and actions for the safe decommissioning of uranium production facilities, including conventional uranium production facilities, heap leaching facilities, in-situ recovery facilities, and other facilities producing uranium concentrate. These recommendations will be relevant for the decommissioning of supporting infrastructure (i.e. those parts of the facility other than the disposal area itself, which is subject to closure). The proposed publication will address topics such as development of legal and regulatory frameworks, financial considerations and guarantees, planning, conduct and completion of decommissioning.

For long term management of residues and waste from uranium production facilities, IAEA Safety Standards Series No. SSG-60, Management of Residues Containing Naturally Occurring Radioactive Material from Uranium Production and Other Activities, applies.

This proposed publication will address radiological hazards resulting from decommissioning. Non-radiological hazards, such as industrial hazards or hazards due to chemical waste, can be significant during decommissioning. Such hazards require due consideration in the planning and implementation process, in the safety assessments and environmental impact assessments, and in the estimation of costs and the provision of financial resources for the decommissioning project. The publication will acknowledge major hazards the need to consider ed ~~the full range of hazards~~ but how to address non-radiological hazards is outside the scope of this publication.

The guidance in the proposed publication will be applicable to planned uranium production facilities, operating facilities, facilities awaiting decommissioning after permanent shutdown, and to facilities that are already in the process of decommissioning.

This publication will not apply to situations where uranium production facilities are considered in the context of an existing exposure situation, where IAEA Safety Standards Series No. GSG-15, Remediation Strategy and Process for Areas Affected by Past Activities or Events, applies.

Security aspects during decommissioning are outside the scope of this publication.

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

The proposed new Safety Guide will provide comprehensive and specific guidance on decommissioning of uranium production facilities, filling an existing information gap, providing new information, and consolidating existing relevant and up to date information that is scattered throughout numerous IAEA publications.

The proposed publication will interface at least with the following IAEA safety standards (this is not, and cannot be, regarded as an exhaustive list):

- [1] EUROPEAN ATOMIC ENERGY COMMUNITY, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Fundamental Safety Principles, IAEA Safety Standards Series No. SF-1, IAEA, Vienna (2006).
- [2] INTERNATIONAL ATOMIC ENERGY AGENCY, Governmental, Legal and Regulatory Framework for Safety, IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), IAEA, Vienna (2016).
- [3] INTERNATIONAL ATOMIC ENERGY AGENCY, Leadership and Management for Safety, IAEA Safety Standards Series No. GSR Part 2, IAEA, Vienna (2016).
- [4] EUROPEAN COMMISSION, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014).
- [5] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Assessment for Facilities and Activities, IAEA Safety Standards Series No. GSR Part 4 (Rev. 1), IAEA, Vienna (2016).
- [6] INTERNATIONAL ATOMIC ENERGY AGENCY, Predisposal Management of Radioactive Waste, IAEA Safety Standards Series No. GSR Part 5, IAEA, Vienna (2009).
- [7] INTERNATIONAL ATOMIC ENERGY AGENCY, Disposal of Radioactive Waste, IAEA Safety Standards Series No. SSR-5, IAEA, Vienna (2011).
- [8] INTERNATIONAL ATOMIC ENERGY AGENCY, Decommissioning of Facilities, IAEA Safety Standards Series No. GSR Part 6, IAEA, Vienna (2014).
- [9] INTERNATIONAL ATOMIC ENERGY AGENCY, Management of Residues Containing Naturally Occurring Radioactive Material from Uranium Production and Other Activities, IAEA Safety Standards Series No. SSG-60, IAEA, Vienna (2021).

[9][10] INTERNATIONAL ATOMIC ENERGY AGENCY, Decommissioning of Nuclear Power Plants, Research Reactors and Other Nuclear Fuel Cycle Facilities, IAEA Safety Standards Series No. SSG-47, IAEA, Vienna (2018).

The proposed publication may also have interface with the following IAEA publications:

[40][11] FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL

MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

~~[11]~~[12] INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transport of Radioactive Material 2018 Edition, IAEA Safety Standards Series No. SSR-6 (Rev. 1), IAEA, Vienna (2018).

~~[12]~~[13] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Assessment for the Decommissioning of Facilities Using Radioactive Material, IAEA Safety Standards Series No. WS-G-5.2, IAEA, Vienna (2008)

~~[13]~~[14] INTERNATIONAL ATOMIC ENERGY AGENCY, UNITED NATIONS ENVIRONMENT PROGRAMME, Radiation Protection of the Public and the Environment, IAEA Safety Standards Series No. GSG-8, IAEA, Vienna (2018).

~~[14]~~[15] INTERNATIONAL ATOMIC ENERGY AGENCY, UNITED NATIONS ENVIRONMENT PROGRAMME, Regulatory Control of Radioactive Discharges to the Environment, IAEA Safety Standards Series No. GSG-9, IAEA, Vienna (2018).

~~[15]~~[16] INTERNATIONAL ATOMIC ENERGY AGENCY, UNITED NATIONS ENVIRONMENT PROGRAMME, Prospective Radiological Environmental Impact Analysis for Facilities and Activities, IAEA Safety Standards Series No. GSG-10, IAEA, Vienna (2018).

~~[16]~~[17] FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, UNITED NATIONS DEVELOPMENT PROGRAMME, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS, Remediation Strategy and Process for Areas Affected by Past Activities or Events, IAEA Safety Standards Series No. GSG-15, IAEA, Vienna (2022).

~~[17]~~[18] INTERNATIONAL ATOMIC ENERGY AGENCY, Release of Sites from Regulatory Control on Termination of Practices, IAEA Safety Standards Series No. WS-G-5.1, IAEA, Vienna (2006). (under revision as DS542)

~~[18]~~[19] INTERNATIONAL ATOMIC ENERGY AGENCY, Monitoring and Surveillance of Radioactive Waste Disposal Facilities, IAEA Safety Standards Series No. SSG-31, IAEA, Vienna (2014).

~~[19]~~[20] INTERNATIONAL ATOMIC ENERGY AGENCY, Application of the Concepts of Clearance, IAEA Safety Standards Series No. GSG-18 (in publication).

~~[20]~~[21] DS526, National Policies and Strategies for the Safety of Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (new Safety Guide under development).

~~[21]~~[22] DS538, Long Term Post-Remediation Management of Areas Affected by Past Activities or Events (new Safety Guide under development)

~~[22]~~[23] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security in the Uranium Extraction Industry, IAEA-TDL-003, IAEA, Vienna (2016).

The development of the new Safety Guide will need to be coordinated with the development and revision of other relevant guidance provided in the IAEA safety standards and the IAEA Nuclear Security Series publications.

The three Sections in the Division of Radiation, Transport and Waste Safety (NSRW) will be consulted in the drafting process. Additional input will be sought from the Division of Nuclear Fuel Cycle and Waste Technology (NEFW) of the Department of Nuclear Energy (NE).

7. OVERVIEW

The tentative table of contents for the proposed publication is as follows:

1. INTRODUCTION
 - 1.1. Background
 - 1.2. Objective
 - 1.3. Scope
 - 1.4. Structure
2. PROTECTION OF PEOPLE AND PROTECTION OF THE ENVIRONMENT IN THE DECOMMISSIONING OF URANIUM PRODUCTION FACILITIES
 - 2.1 Optimization of protection and safety in decommissioning
 - 2.2 Graded approach in decommissioning
 - 2.3 Assessment of safety for decommissioning
3. RESPONSIBILITIES ASSOCIATED WITH DECOMMISSIONING OF URANIUM PRODUCTION FACILITIES
 - 3.1 Responsibilities of the government
 - 3.2 Responsibilities of the regulatory body
 - 3.3 Responsibilities of licensee for decommissioning
4. MANAGEMENT OF DECOMMISSIONING OF URANIUM PRODUCTION FACILITIES
 - 4.1 Integrated management system for decommissioning
 - 4.2 Organizational structure
 - 4.3 Development of a safety policy in cooperation with all personnel
 - 4.3.4 Development of a safety culture in cooperation with all personnel
5. DECOMMISSIONING STRATEGY FOR URANIUM PRODUCTION FACILITIES
 - 5.1 Decommissioning strategy (options of strategic approach)
 - 5.2 Key factors influencing the selection of a decommissioning strategy and planning decommissioning:
 - The national policy and the regulatory framework
 - The type of facility and interdependences with other facilities or infrastructure located at the same site
 - Proposed reuse of the facility or site and the desired end state
 - The physical status and the radiological status of the facility
 - Safety aspects
 - Availability of expertise, technologies and infrastructure
 - Environmental impact
 - ~~and~~ Socioeconomic impact
 - Characteristics of residues/waste and residue/waste management plan
 - Availability of infrastructure for management of residues and wastes
 - Interested parties
6. FINANCING OF DECOMMISSIONING OF URANIUM PRODUCTION FACILITIES
 - 6.1 Responsibilities for financing of decommissioning and a mechanism
 - 6.2 Financial resources
 - 6.3 Typical costs
 - 6.4 Cost estimate financial provisions

6.5 Mechanisms to provide financial assurance

7. PLANNING FOR DECOMMISSIONING DURING THE LIFETIME OF URANIUM PRODUCTION FACILITIES

- 7.1 Regulatory oversight on the decommissioning plan
- 7.2 Considerations during planning and siting
- 7.3 Considerations during design and construction
- 7.4 Initial decommissioning plan
- 7.5 Updating of the decommissioning plan
- 7.6 Final decommissioning plan
- 7.7 Involvement of interested parties
- 7.8 Unanticipated permanent shutdown
- 7.9 ~~Interface with S~~safety assessment supporting decommissioning plan

8. CONDUCT OF DECOMMISSIONING ACTIONS FOR URANIUM PRODUCTION FACILITIES

- 8.1 Regulatory oversight during conduct of decommissioning actions
- 8.2 Emergency arrangements
- 8.3 Management of residues and waste

9. COMPLETION OF DECOMMISSIONING ACTIONS AND TERMINATION OF AUTHORIZATION FOR DECOMMISSIONING OF URANIUM PRODUCTION FACILITIES

- Final decommissioning report
- 9.2 Final radiological survey
- 9.3 Termination of authorization of decommissioning
- 9.4 Post decommissioning management and control
- Institutional controls with Long term surveillance and maintenance plan (including environmental monitoring, monitoring of groundwater and surface water, institutional control of tailings facilities)

APPENDIX I: SAFETY ASSESSMENT FOR DECOMMISSIONING OF URANIUM PRODUCTION FACILITIES

APPENDIX II: CLOSURE OF TAILINGS MANAGEMENT FACILITIES

APPENDIX III: RESTORATION OF GROUNDWATER RELATED TO IN-SITU RECOVERY

REFERENCES

ANNEX I. SUGGESTED STRUCTURE AND CONTENT OF THE INITIAL DECOMMISSIONING PLAN

ANNEX II: SUGGESTED STRUCTURE AND CONTENT OF THE FINAL DECOMMISSIONING PLAN AND SUPPORTING DOCUMENTS

ANNEX III: SUGGESTED STRUCTURE AND CONTENT OF THE FINAL DECOMMISSIONING REPORT (CLOSURE REPORT)

ANNEX IV: SUGGESTED STRUCTURE AND CONTENT OF THE FINAL RADIOLOGICAL SURVEY REPORT

ANNEX V: EXAMPLES OF DECOMMISSIONING RELATED DOCUMENTS OF URANIUM PRODUCTION BY CONVENTIONAL METHOD

**ANNEX VI: EXAMPLES OF DECOMMISSIONING RELATED DOCUMENTS OF URANIUM
PRODUCTION BY IN-SITU RECOVERY**

8. PRODUCTION SCHEDULE: Provisional schedule for preparation of the publication, outlining realistic expected dates for each step:

STEP 1: Preparing a DPP	DONE
STEP 2: Internal review of the DPP (Approval by the Coordination Committee)	Q1 2023
STEP 3: Review of the DPP by the review Committee(s) (Approval by review Committee(s))	Q2 2023
STEP 4: Review of the DPP by the CSS (approval by CSS) or information of the CSS on the DPP	Q4 2023
STEP 5: Preparing the draft publication	Q1 2024/Q1 2025
STEP 6: First internal review of the draft publication (Approval by the Coordination Committee)	Q2 2025
STEP 7: First review of the draft publication by the review Committee(s) (Approval for submission to Member States for comments)	Q4 2025
STEP 8: Soliciting comments by Member States	Q3 2026
STEP 9: Addressing comments by Member States	Q1/2027
STEP 10: Second internal review of the draft publication (Approval by the Coordination Committee)	Q2/2027
STEP 11: Second review of the draft publication by the review Committee(s) (Approval of the draft)	Q4/2027
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	Q2/2027
STEP 13: Approval by the Board of Governors (for SF and SR only)	N/A
STEP 14: Target publication date	Q4/2028

9. RESOURCES

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

Secretariat:

- One Technical Officer – 36 person-weeks
- One administrative assistant – 6 person-weeks

Member States:

- 25 consultant week (assuming 5 one-week Consultancy Meetings, each with 5 experts)
- Five person-week home based assignments
- One Technical Meeting (25 participants x 5 days)

ANNEX: GAP ANALYSIS

The lifecycle of a uranium production facility generally includes prospecting and exploration, feasibility studies and field tests, planning, assessment and licensing, construction and commissioning, operation, decommissioning, and surveillance and monitoring (institutional control). Decommissioning is critical to avoid uranium legacy sites. IAEA Safety Standards Series No. GSR Part 6, Decommissioning of Facilities, provides safety requirements to be met during the planning, implementation, and completion of decommissioning, including termination of the authorization for decommissioning.

The feedback from numerous international events indicated the need for additional systematic and more detailed guidance specific to decommissioning of uranium production facilities. For example, the IAEA Technical Meeting on the Decommissioning of Uranium Production Facilities and Other Facilities Containing Naturally Occurring Radioactive Materials, held in November 2019 with 22 participants representing 15 Member States, concluded that additional IAEA guidance related to the decommissioning of uranium production facilities is needed, and recommended the IAEA to develop a new safety related document to fill an evident gaps in existing IAEA safety standards and address the Member States' needs.

The IAEA Technical Meeting on Decommissioning Planning for Uranium Production, held virtually in December 2021 with over 80 participants representing 34 Member States, further discussed issues relating to decommissioning of uranium production facilities, addressed the following topics:

- Needs and Challenges in Decommissioning of Facilities Involving Naturally Occurring Radioactive Material
- Safety Assessment and Environmental Impact Assessment Supporting Decommissioning Planning
- Format and Content of Decommissioning Plans for Facilities Involving NORM
- Financial Aspects of Decommissioning of Facilities for Uranium Production and for Facilities Involving NORM

The above-mentioned meetings suggested that many of the existing uranium production facilities have not started planning for decommissioning due to lack of dedicated guidance for development and regulatory review of decommissioning plans. A Safety Guide specific to the decommissioning of uranium production facilities is needed to support the application of GSR Part 6 to uranium production facilities, and to provide general recommendations on topics such as development of legal and regulatory frameworks, financial considerations and guarantees, planning, safety assessment, conduct and completion of decommissioning projects.