

**Document Preparation Profile (DPP)  
Version 01 dated 31 July 2017**

## 1. IDENTIFICATION

**Document Category:** Specific Safety Guides

**Working ID:** DS510

**Proposed Title:**

- Safety Assessment for Research Reactors and Preparation of the Safety Analysis Report;
- Safety in the Utilization and Modification of Research Reactors;

**Proposed Action:** Revision of 2 interrelated Specific Safety Guides on Research Reactors as a set of publications:

- SSG-20: Safety Assessment for Research Reactors and Preparation of the Safety Analysis Report, 2012;
- SSG-24: Safety in the Utilization and Modification of Research Reactors, 2012.

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

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## 2. BACKGROUND

The IAEA Safety Standards related to the safety of research reactors include IAEA Safety Standards Series No. SSR-3, Safety of Research Reactors (2016), and eleven Specific Safety Guides (hereinafter referred to as Guides). These Guides were all published before SSR-3 was issued and represent the international consensus on the safety of research reactors at the respective date of publication. These Guides have been extensively used as the basis for the safety assessments conducted during the IAEA Integrated Safety Assessment of Research Reactors (INSARR) missions and were used by many Member States as reference when establishing national safety regulations and safety policies and practices of research reactor operating organizations.

The publication of SSR-3 in 2016 superseded IAEA Safety Standards Series No. NS-R-4, Safety of Research Reactors (2005), and in doing so introduced several new requirements on the safety of research reactors and significantly modified the substance of others. To assess the extent of these changes, a gap analysis was performed to compare the requirements in SSR-3 with the previous safety requirements in NS-R-4. The analysis identified new requirements in SSR-3, including Req. 22, Design Extension Conditions; Req. 39, Prevention of Unauthorized Access to, or Interference with, Items Important to Safety; Req. 40, Prevention of Disruptive or Adverse Interactions between Systems Important to Safety; Req. 55, Emergency Response Facilities on the Site; Req. 76, Material Conditions and Housekeeping; and Requirement 90, Interfaces between nuclear safety and nuclear security. Requirements related to management for safety and verification of safety, site evaluation, general design requirements, treatment of accident conditions, safety analysis and defence-in-depth were

significantly modified. The gap analysis also identified information in NS-R-4 that was not carried over to SSR-3 because it was more suitable for inclusion in Guide-level publications. Additionally, the scope of SSR-3 includes subcritical assemblies, a category of nuclear installation that was not previously grouped with research reactors and therefore not subject to the requirements of NS-R-4 nor covered by the existing Guides.

An analysis of the scope and content of the Guides and the new and significantly modified requirements in SSR-3 was performed. The analysis resulted in identification of eight Guides (Group 1) that largely remain valid in their technical content, but have outdated references and deviations from the requirements in SSR-3. Two Guides (Group 2) were found to need more in-depth technical revisions mainly due to the new requirement in SSR-3 on design extension conditions. Finally, the analysis showed that IAEA Safety Standards Series No. SSG-22 (Group 3), Use of a Graded Approach in the Application of the Safety Requirements for Research Reactors (2012), needs to be revised in its entirety due to its heavy reliance on outdated references to individual paragraphs of NS-R-4 and a lack of guidance related to new requirements in SSR-3, particularly design extension conditions and interfaces between nuclear safety and nuclear security. More detailed results of the analysis and the main revisions needed to the Guides covered by this DPP are provided in the Annex.

Based on the results of the analysis, the 11 Guides will be revised by amendment in three groups according to the estimated extent of the revisions needed and their technical interlinkages. These groups are as follows:

#### Group 1

- IAEA Safety Standards Series No. NS-G-4.1, Commissioning of Research Reactors, IAEA, Vienna (2006);
- IAEA Safety Standards Series No. NS-G-4.2, Maintenance, Periodic Testing and Inspection of Research Reactors, IAEA, Vienna (2006);
- IAEA Safety Standards Series No. NS-G-4.3, Core Management and Fuel Handling for Research Reactors, IAEA, Vienna (2008);
- IAEA Safety Standards Series No. NS-G-4.4, Operational Limits and Conditions and Operating Procedures for Research Reactors, IAEA, Vienna (2008);
- IAEA Safety Standards Series No. NS-G-4.5, The Operating Organization and the Recruitment, Training and Qualification of Personnel for Research Reactors, IAEA, Vienna (2008);
- IAEA Safety Standards Series No. NS-G-4.6, Radiation Protection and Radioactive Waste Management in the Design and Operation of Research Reactors, IAEA, Vienna (2008);
- IAEA Safety Standards Series No. SSG-10, Ageing Management for Research Reactors, IAEA, Vienna (2010);
- IAEA Safety Standards Series No. SSG-37, Instrumentation and Control Systems and Software Important to Safety for Research Reactors, IAEA, Vienna (2015).

#### Group 2

- IAEA Safety Standards Series No. SSG-20, Safety Assessment for Research Reactors and Preparation of the Safety Analysis Report, IAEA, Vienna (2012);
- IAEA Safety Standards Series No. SSG-24, Safety in the Utilization and Modification of Research Reactors, IAEA, Vienna (2012).

#### Group 3

- IAEA Safety Standards Series No. SSG-22, Use of a Graded Approach in the Application of the Safety Requirements for Research Reactors, IAEA, Vienna (2012).

Two Guides (Group 2) will be revised under this DPP. Group 1 and Group 3 will be revised under separate DPPs.

### 3. JUSTIFICATION FOR THE PRODUCTION OF THE DOCUMENTS

The revision of the Guides (Group 2) proposed in this DPP is timely because they predate SSR-3 and most of the General Safety Requirements publications, and as such, the Guides contain many references to superseded requirements, do not fully address all of the current requirements and do not cover the safety of subcritical assemblies. In addition, guidance in similar NPP safety standards will be considered to ensure overall consistency. The added value of the revised Guides will be to provide target users with comprehensive, consistent and up-to-date guidance for implementing the safety requirements in SSR-3 and the General Safety Requirements as they apply to research reactors.

The revision of the two Guides covered by this DPP will benefit from amendments to take into consideration the following:

- Revisions implemented in the General Safety Requirements, other IAEA Safety Standards and, in particular, the new and modified requirements in SSR-3 since publication of the Guides;
- Long Term Structure of the IAEA Safety Standards;
- Feedback from the users of the IAEA Safety Standards related to research reactors;
- Use of these Guides for subcritical assemblies, which are now in the scope of SSR-3;
- Lessons from the accident at the Fukushima Daiichi nuclear power plant and other events in the nuclear industry, including those occurring at research reactors that were reported to the Incident Reporting System for Research Reactors;
- Experience gained with INSARR missions.

More specifically, amendments of the Guides are needed to address the following:

1. As mentioned above in Section 2, there are several new requirements in SSR-3 and others have been substantively modified from their original form in NS-R-4. These requirements are not fully addressed in the Guides, particularly Req. 22, Design Extension Conditions; Req. 55, Emergency Response Facilities on the Site; Req. 76, Material Conditions and Housekeeping; and Req. 90, Interfaces between nuclear safety and nuclear security.
2. Some statements in the Guides that are expressed as “should” statements do, in fact, duplicate some requirements of SSR-3 and GSR Parts 1-7. As such they do not add any value in the Guides and could confuse users about whether something is a requirement or a recommendation. Such statements should be carefully rechecked and either removed from the Guides (as no value added) or modified to make them useful recommendations, supporting the appropriate requirements.
3. IAEA Safety Standards Series No. SSG-22, Use of a Graded Approach in the Application of the Safety Requirements for Research Reactors, was published in 2012. The Guides proposed for revision in this DPP were published at the same time as SSG-22 and contain information about applying a graded approach in their respective areas. This information needs to be removed from the Guides where necessary and consolidated in a harmonized manner in a revision to SSG-22 that will be proposed under a separate DPP.
4. The publication of SSR-3 expanded the scope of the safety requirements for research reactors to include subcritical assemblies. As they were both published prior to SSR-3, the Guides do not provide explicit guidance about how subcritical assemblies should implement the safety requirements. Although most requirements in SSR-3 are universally-applicable to research reactors and subcritical assemblies, SSR-3 makes several explicit references to the safety of

subcritical assemblies (for example, SSR-3, Paras. 6.62 and 6.66). The Guides need to be updated to address subcritical assemblies in general and the specific references in SSR-3.

5. An analysis of the guidance and information in NS-G-4.4 and SSG-20 was made to assess whether the two publications should be combined. The analysis showed there are benefits in retaining two separate publications to support member states to enhance safety in these two separate and distinct areas. These benefits are mainly to make the documents user friendly and not to impose difficulties in the structure. It is also not appropriate to combine guidance on operating procedures and on safety assessment, licensing and safety documentation, which are two distinct areas.
6. In some cases, parts of the Guides have to be updated to better reflect the current operational practices at research reactors and the state-of-the-art in relevant technologies.

#### **4. OBJECTIVE**

The objective of the revised Guides is to provide research reactor operating organizations, regulatory bodies and other organizations involved in the safety of research reactors with guidance on meeting the applicable requirements of SSR-3 and the General Safety Requirements as they apply to research reactors.

#### **5. SCOPE**

The revised Guides (in conjunction with those being revised under separate DPPs, as described in Section 2, above) will cover all areas important to the safety of research reactors, including the safety of subcritical assemblies. The Guides are applicable during all stages in the lifetime of a research reactor facility, including design, construction, commissioning, operation, utilization and modification, extended shutdown and planning for decommissioning.

The scope of both Guides will not change during the revision process, with the exception that they will be applicable to subcritical assemblies.

In addition, the analysis described in Section 2 resulted in identification of the main revisions to both Guides (see the Annex) that are needed to fully address the requirements in SSR-3 and the General Safety Requirements.

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

The Guides covered by this DPP are facility-specific (i.e. research reactors and subcritical assemblies), support the application of SSR-3 and interface with all General Safety Requirements and General Safety Guides. The Guides interface with the following IAEA Safety Standards and other publications (this is not, and cannot be, regarded as an exclusive or exhaustive list):

- IAEA Safety Standards Series No. SF-1, Fundamental Safety Principles, IAEA, Vienna (2006);
- IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), Governmental, Legal and Regulatory Framework for Safety, IAEA, Vienna (2016);
- IAEA Safety Standards Series No. GSR Part 2, Leadership and Management for Safety, IAEA, Vienna (2016);
- IAEA Safety Standards Series No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA, Vienna (2014);
- IAEA Safety Standards Series No. GSR Part 4, (Rev.1) Safety Assessment for Facilities and Activities, IAEA, Vienna (2016);

- IAEA Safety Standards Series No. GSR Part 5, Predisposal Management of Radioactive Waste, IAEA, Vienna (2009);
- IAEA Safety Standards Series No. GSR Part 6, Decommissioning of Facilities, IAEA, Vienna (2014);
- IAEA Safety Standards Series No. GSR Part 7, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA, Vienna (2015);
- IAEA Safety Standards Series No. SSR-3, Safety of Research Reactors, IAEA, Vienna (2016);
- IAEA Safety Standards Series No. NS-R-3 (Rev. 1), Site Evaluation for Nuclear Installations, IAEA, Vienna (2016);
- IAEA Safety Standards Series No. GS-G-3.1, Application of the Management System for Facilities and Activities, IAEA, Vienna (2006);
- IAEA Safety Standards Series No. GS-G-3.5, The Management System for Nuclear Installations, IAEA, Vienna (2009);
- IAEA Safety Standards Series No. NS-G-4.1, Commissioning of Research Reactors, IAEA, Vienna (2006);
- IAEA Safety Standards Series No. NS-G-4.2, Maintenance, Periodic Testing and Inspection of Research Reactors, IAEA, Vienna (2006);
- IAEA Safety Standards Series No. NS-G-4.3, Core Management and Fuel Handling for Research Reactors, IAEA, Vienna (2008);
- IAEA Safety Standards Series No. NS-G-4.4, Operational Limits and Conditions and Operating Procedures for Research Reactors, IAEA, Vienna (2008);
- IAEA Safety Standards Series No. NS-G-4.5, The Operating Organization and the Recruitment, Training and Qualification of Personnel for Research Reactors, IAEA, Vienna (2008);
- IAEA Safety Standards Series No. NS-G-4.6, Radiation Protection and Radioactive Waste Management in the Design and Operation of Research Reactors, IAEA, Vienna (2008);
- IAEA Safety Standards Series No. SSG-10, Ageing Management for Research Reactors, IAEA, Vienna (2010);
- IAEA Safety Standards Series No. SSG-22, Use of a Graded Approach in the Application of the Safety Requirements for Research Reactors, IAEA, Vienna (2012);
- IAEA Safety Standards Series No. SSG-37, Instrumentation and Control Systems and Software Important to Safety for Research Reactors, IAEA, Vienna (2015);
- IAEA Services Series No. 25, Guidelines for the Review of Research Reactor Safety, IAEA, Vienna (2013).
- DS492 Human Factors Engineering in Nuclear Power Plants

As applicable, it will be necessary to coordinate with the development and revision of other relevant IAEA Safety Standards in cooperation with the IAEA Regulatory Activities Section, Incident and Emergency Centre, Division of Nuclear Security and Division of Radiation, Transport and Waste Safety.

## **7. OVERVIEW**

This Section presents the proposed structure of each Guide, which in most cases is identical to the structure of the current Guide. It is possible that during the revision process, changes in the structure of individual Guides will be identified to improve their user-friendliness and better align with the structure and content of SSR-3.

The Guides also have another structural level below the Sub-Section level, which is not represented below. In many cases, these will remain unchanged, however some will need to be modified/deleted/included to ensure comprehensive coverage of the requirements in SSR-3.

### **Revision of SSG-20**

This Guide will cover safety assessment for research reactors and preparation of the safety analysis report and provide recommendations and guidance mainly related to implementing Requirements 1, 5, 7-66, 71, 75 and 79 of SSR-3. The proposed structure is as follows:

1. Introduction
    - Background
    - Objective
    - Scope
    - Structure
  2. Safety Assessment in the Licensing Process
    - Responsibilities
    - Acceptance Criteria
    - Information Requirements during Various Stages of the Licensing Process
    - Submission of Information to the Regulatory Body
  3. Preparation of the Safety Analysis Report
    - Purpose and Scope
    - Specific Guidance
    - Selected Postulated Initiating Events
    - Development of the Safety Analysis
  4. Information to be Submitted for the Review and Assessment Process
    - Purpose and Scope
    - Programme for Review and Assessment
- Appendix: Content of a Safety Analysis Report
- References
- Annex I: Approach to and Methods of Safety Analysis
- Annex II: Examples of Input Parameters and Initial Conditions
- Annex III: Items to be considered in the Description of the Research Reactor
- Annex IV: Typical Radiation Sources and Radiation Fields in Research Reactors
- Contributors to Drafting and Review

### **Revision of SSG-24**

This Guide will cover safety in the utilization and modification of research reactors and provide recommendations and guidance mainly related to implementing Requirements 1, 5, 6, 16 - 29, 36, 41, 55, 66, 71, 77, 83, 88 and 89 of SSR-3. The proposed structure is as follows:

1. Introduction
  - Background
  - Objective
  - Scope
  - Structure
2. Management System for the Utilization and Modification of a Research Reactor
  - General
  - Management Responsibility
  - Implementation of a Utilization or Modification Project
  - Resource Management
  - Measurement, Assessment and Improvement
  - Responsibilities of the Project Manager
  - Responsibilities of the Reactor Manager
3. Categorization, Safety Assessment and Approval of an Experiment or Modification
  - Categorization Process
  - Interfaces between Safety and Security

4. Safety Considerations for the Design of an Experiment or Modification
    - General Considerations
    - Specific Considerations
  5. Pre-Implementation Phase of a Utilization or Modification Project
    - General
    - Project Initiation
    - Project Definition
    - Design
  6. Implementation Phase of a Utilization or Modification Project
    - General
    - Fabrication
    - Installation
    - Commissioning
  7. Post-Implementation Phase of a Utilization or Modification Project
    - Post-Implementation Safety Evaluation and Approval for Routine Operation
    - Updating of Safety Documents
    - Special Surveillance
  8. Operational Safety of Experiments at a Research Reactor
    - Radiation Protection
    - Information Necessary for Safe Performance of Experiments
    - Cooperation between Experimenters and Operating Personnel
    - Operational Changes in Experiments
    - Responsibility for Safe Operation of Experiments
  9. Safety Considerations in the Handling, Dismantling, Post-Irradiation Examination and Disposal of Experimental Devices
    - General Recommendations
    - Specific Recommendations
  10. Safety Aspects of Out-of-Reactor-Core Installations
- References
- Annex I: Example of a Checklist for Categorization of an Experiment or Modification at a Research Reactor
- Annex II: Examples of the Content of the Safety Analysis Report for an Experiment at a Research Reactor
- Annex III: Examples of Reasons for a Modification at a Research Reactor
- Contributors to Drafting and Review

## 8. PRODUCTION SCHEDULE:

Provisional schedule for preparation of the document, outlining realistic expected dates for each step:

STEP 1: Preparing a DPP	DONE
STEP 2: Approval of DPP by the Coordination Committee	Q3 2017
STEP 3: Approval of DPP by the relevant review Committees	Q4 2017
STEP 4: Approval of DPP by the CSS	Q2 2018
STEP 5: Preparing the draft 2 consultancy meetings are expected to be organized for the preparation of the draft	Q4 2017-Q2 2018
STEP 6: Approval of draft by the Coordination Committee	Q2 2018
STEP 7: Approval by the relevant review Committees for submission to Member States for	Q4 2018

comments	
STEP 8: Soliciting comments by Member States	Q4 2018
STEP 9: Addressing comments by Member States	Q2 2019
STEP 10: Approval of the revised draft by the Coordination Committee Review in NS-SSCS	Q3 2019
STEP 11: Approval by the relevant review Committees	Q4 2019
STEP 12: Endorsement by the CSS	Q2 2020
STEP 13: Establishment by the Publications Committee	Q3 2020
STEP 14: Target publication date	Q4 2020

## 9. RESOURCES

Staff: 16 staff weeks

Consultants: 6 consultant weeks



## 10. ANNEX: MAIN REVISIONS TO THE GUIDES

The following tables present the main revisions to the Guides at the Section level. These revisions were identified by detailed comparison of SSR-3 with NS-R-4 and the analysis described in Section 2 of this DPP.

<b>SSG-20, Safety Assessment for Research Reactors and Preparation of the Safety Analysis Report</b>	
<b>Section</b>	<b>Main Revisions</b>
1	Standardize background, objective and scope. Align discussion of graded approach with the new text in SSR-3 referencing subcritical assemblies.
2	Revise guidance on siting and site evaluation according to Section 5 of SSR-3 and other related publications since 2012.
3	Elaborate guidance related to postulated initiating events (SSR-3 Req. 18), design extension conditions (SSR-3 Req. 22), design for optimal operator performance (SSR-3, Req. 35), prevention of disruptive or inadvertent interactions between items important to safety (SSR-3, Req. 40) and subcritical assemblies. Update guidance on probabilistic safety assessment and periodic safety review.
4	Revise for consistency with GSR Part 1, Section 3 of SSR-3 and (draft) revised safety guides on regulatory supervision (DS472 and DS473).
Appendix	Appendix needs to be made consistent with SSR-3 requirements, especially those mentioned above. Add information related to subcritical assemblies.
Annex I	Add information related to design extension conditions.
Annex II	Editorial.
Annex III	Editorial.
Annex IV	Editorial.

<b>SSG-24, Safety in the Utilization and Modification of Research Reactors</b>	
<b>Section</b>	<b>Main Revisions</b>
1	Standardize background, objective and scope. Align discussion of graded approach with the new text in SSR-3 referencing subcritical assemblies.
2	Revise to focus guidance on the specific topic of the safety guide following the structure of GSR Part 2, GS-G-3.1 and GS-G-3.5: Responsibility of Management, Management of Resources, Process Implementation and Measurement, Assessment and Improvement. Eliminate repetition with GS-G-3.1 and GS-G-3.5.
3	Address design extension conditions and subcritical assemblies in the categorization of modifications. Elaborate guidance on management of the interface between safety and security for modifications and experiments.
4	Address design extension conditions, qualification of equipment, ease of replacement and other general design requirements in Section 6 of SSR-3. Elaborate guidance on subcritical assemblies. Elaborate guidance on management of the interface between safety and security.
5	Address design extension conditions in the design of modifications or utilization-related equipment or facilities.
6	Elaborate guidance on interfaces with nuclear security during the installation of modifications or utilization-related equipment or facilities.
7	Editorial.
8	Elaborate guidance on subcritical assemblies.
9	Editorial.
10	Editorial.
Annex I	Editorial.
Annex II	Update to be fully consistent with Req. 66 of SSR-3.
Annex III	Update to include facility modifications made in response to operating experience or events at other facilities.