# Document Preparation Profile (DPP)
# Version 1 dated 10 February 2025

## 1. IDENTIFICATION

**Document Category:** **Safety Requirements**

**Working ID:** **DS557**

**Proposed Title:** **Site Evaluation for Nuclear Installations**

**Proposed Action:** **Revision of a publication**

**IAEA Safety Standard Series No. SSR-1, Site Evaluation for Nuclear Installations, Specific Safety Requirements, 2019**

**Review Committee(s) or Group:** **NUSSC, RASSC, WASSC, TRANSSC, NSGC, EPReSC**

**Technical Officer(s):** **Paolo Contri**

## 2. BACKGROUND

The requirements for site evaluation of nuclear installations in SSR-1 are intended to contribute to the protection of workers, the public, and the environment from the harmful effects of ionizing radiation. These requirements aim to support the application of the fundamental safety objectives established in IAEA Safety Standards Series No. SF-1, Fundamental Safety Principles.

The revision of this document has been prompted by input and feedback from Member States received on several occasions, including:

- The implementation of the last years' SEED (Site and External Events Design Review Service) safety reviews, particularly concerning site selection and site safety, as summarized in the publication "Highlights from Site and External Events Design (SEED) Missions";
- The development of several technical documents that consolidate Member States' experiences with recent events, new advancements in hazard development, and modern approaches to installation design, especially regarding extreme external scenarios. These efforts also focus on assessing safety margins beyond the design basis;
- Ongoing discussions within the Steering Committee for the Coordinated Research Program (CRP) on "Climate Change Challenges to the Safety of Nuclear Installations", which emphasized the need to gather experience and disseminate updated guidance on hazards affected by climate change;
- The annual Technical Meeting on "Protection of Nuclear Installations Against External Hazards", 17th Plenary Meeting of the External Events Safety Section Extrabudgetary Programme, which gathered the most recent Member States' experiences related to site selection, site evaluation, hazard assessment, new reactor deployment (especially SMRs), and the operational experience of coping with external event scenarios. The meetings also addressed periodic safety reviews of existing installations, highlighting the need for guidelines on hazard re-evaluation methods and projection in time;

- A series of consultancy meetings supporting the review of the ancillary Specific Safety Guides on Site Evaluation, which highlighted the need for an overarching Requirements document that reflects the latest Member States' experiences. This includes technology neutrality, new scenarios (e.g., climate change), interfaces with security-related scenarios (i.e. aircraft impact and explosions), and siting of plants with standard design when a site specific hazard analysis has to be conducted;
- A recent IAEA publication on "Applicability of IAEA Safety Standards to Non-Water Cooled Reactors and Small Modular Reactors", which identified critical review areas for the Siting Requirements, particularly concerning SMR reactor types; and the subsequent revision of safety standards that have attempted to address issues in relation to the licensing, safety demonstration, commissioning and operation of SMRs., such as SSR-2/1 (Rev. 1) and SSG-77.
- Recent consultancy meetings related to the development of a TECDOC on floating reactors, which called for improved requirements on site boundaries, emergency zones, and hazard development;
- A recent INSAG report on "Application of the principle of defence in depth in nuclear safety to small modular reactors, addendum to INSAG-10" , which highlighted the need for the 5 levels of Defence in Depth (DID) for the safety of SMR-type reactors;
- The call for actions from the recent International Conference on "A Decade of Progress After Fukushima Daiichi: Building on Lessons Learned to Further Strengthen Nuclear Safety", held in Vienna on 8-12 November 2021, with recommendations to the IAEA on developing dedicated requirements on extreme hazard characterisation;
- The approval of the Medium Term Development Plan by the NUSSC committee in November 2024, which explicitly prioritized the revision of this Requirements document.

## 3. JUSTIFICATION FOR THE PRODUCTION OF THE PUBLICATION

Recent documents, meetings, review missions, and conferences have highlighted several applicability issues with the SSR-1, particularly in relation to the siting of new reactor types. A detailed list of these issues is provided in the attached gap analysis in the Annex.

In general, the following areas have been identified as requiring revision, improvement or even new development:

- **Technology neutrality**: Site safety assessments should explicitly consider the compatibility between the site, number and type of installation to be built, and account for specific conditions associated with the selected reactor technology (e.g. SMRs, transportable NPPs, underground, etc.) must be explicitly addressed.
- **Development of extreme hazard scenarios for the safety assessment of design**: There is a need to clarify the hazard characteristics to be used in the safety assessment of all levels of defence in depthDepth (DID) for external event scenarios in all types of nuclear installations (especially. those other than NPPs). Additionally, events which refer to beyond-design-basis scenarios must be characterized to ensure a comprehensive safety assessment during the design phase, focusing on evaluating robustness and resilience.
- **Characterization of low-probability scenarios**: There is a need to improve the management of large uncertainties associated with low-probability scenarios and the development of models to project these risks over time.

- **Site characterization techniques**: Updated techniques and guidance on the application of the graded approach are required for all phases of a plant's life, including site selection, site evaluation, construction, operation (incl. periodic safety review) and decommissioning.
- **Identification of "bounding site" conditions**: clarify how bounding site conditions for the design of standardized plants should be considered in the site-specific licensing process in view of the design safety assessment of the standardized plant for any specific site.
- **Safety–security interfaces**: It is crucial to address safety and security interfaces since the stage of development of design basis for the installation, particularly in the establishment of design basis threats (DBT) and design basis external scenarios respectively, considering their role in the overall site assessment process.
- **Site related issues during the operating life of the installations**: Develop guidance on monitoring systems and reliable sources of information on site hazards, especially addressing meteorological and hydrological hazards, to support proactive operator actions, hazard review on the occasion of the periodic safety review, management of emergency actions at the site and in the site vicinity when affected by extreme external event scenarios.

The proposed modifications will be reviewed by expert teams tasked with revising the requirements document. These revisions aim to provide Member States with comprehensive and up-to-date safety requirements that reflect the general consensus among States.

## 4. OBJECTIVE

The objective of this revision is to integrate the input, feedback and proposals from Member States, collected on multiple occasions, into an updated safety requirements publication. This revised publication will align with the IAEA Safety Fundamentals and the requirements related to design, operation, and safety assessment.

The updated publication is intended to support States in the site evaluation of both existing and new nuclear installations. It will also serve as a guide for developing and updating national safety requirements and regulations.

## 5. SCOPE

The revision of the existing document will impact all current chapters, with particular focus on ensuring its applicability to a wide range of emerging technologies, including, but not exclusively, the following: small modular reactors (SMRs), transportable reactors (e.g. micro-reactors) underground installations, advanced reactors, fusion reactors, and others.

The revision will also ensure full compatibility with the IAEA Safety Fundamentals and other related Safety Requirements documents.

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

The revised publication will be part of the Specific Safety Requirements series, as outlined in the long-term structure of the IAEA Standards Series. This document will interface with the following related documents:

1. Fundamental Safety Principles, IAEA Safety Standards Series No. SF-1 (2006);
2. GSR Part 1 (Rev.1): Governmental, Legal and Regulatory Framework for Safety (2016);
3. GSR Part 7: Preparedness and Response for a Nuclear or Radiological Emergency (2015); ).
4. SSR-2/1 (Rev. 1): Safety of Nuclear Power Plants: Design (2016);
5. SSR-2/2 (Rev. 1): Safety of Nuclear Power Plants: Commissioning and Operation (2016);
6. GSR Part 4 (Rev. 1): Safety Assessment for Facilities and Activities (2016);
7. SSR-3: Safety of Research Reactors (2016);
8. SSR-4: Safety of Nuclear Fuel Cycle Facilities (2017);
9. GSR Part 5 (Rev.1): Predisposal Management of Radioactive Waste;
10. SSG-9 (Rev. 1): Seismic Hazards in Site Evaluation For Nuclear Installations (2022);
11. SSG-89: Evaluation of Seismic Safety for Nuclear Installations (2024);
12. SSG-79: External Human Induced Events in Site Evaluation for Nuclear Power Plants (2023);
13. DS529: Investigation of Site Characteristics and Evaluation of Radiation Risks to the Public and the Environment in Site Evaluation for Nuclear Installations (2025);
14. DS531: Geotechnical Aspects in Siting and Design of Nuclear Installations (2025);
15. DS541: Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations (2027);
16. SSG-21: Volcanic Hazard in Site Evaluation for Nuclear Installations (2012);
17. SSG-35: Site Survey and Site Selection for Nuclear Installations (2015);
18. DS552: Safety Assessment of Nuclear Installations in Relation to External Event Scenarios (2027);
19. INSAG-28: Application of the Principle of Defence in Depth in Nuclear Safety to Small Modular Reactors, addendum to INSAG-10 (2024);
20. SSG-12: Licensing Process for Nuclear Installations (2010);
21. SSG-77: Protection Against Internal and External Hazards in the Operation of Nuclear Power Plants (2022).

## 7. OVERVIEW

The revision is not expected to substantially alter the current table of contents of SSR-1.

The content of any new or modified paragraphs will be based on reviews conducted by the Safety Standards Committee, Member States, and the Commission on Safety Standards, considering their implications for the Safety Requirements.

The terminology used in the revision will be consistent with the IAEA Nuclear Safety and Security Glossary (2022).

The proposed structure of the revised publication is as follows:

# CONTENTS

1. INTRODUCTION

1.1 Background
1.2 Objective
1.3 Scope
1.4 Structure

2. GENERIC REQUIREMENTS FOR SITE EVALUATION FOR NUCLEAR INSTALLATIONS

2.1 Objective
2.2 Uses for site evaluation
2.3 General criteria
2.4 Criteria for selecting hazards associated with external natural and human induced events
2.5 Criteria for determining the potential effects of the nuclear installation in the region
2.6 Criteria derived from considerations of surrounding population and emergency planning

3. EVALUATION OF EXTERNAL EVENTS IN SITE EVALUATION FOR NUCLEAR INSTALLATIONS

3.1 Earthquakes and surface faulting
3.2 Meteorological events
3.3 Flooding
3.4 Geotechnical hazards
3.5 External human induced events
3.6 Other important considerations

4. SITE CHARACTERISTICS AND THE POTENTIAL EFFECTS OF THE NUCLEAR INSTALLATION IN THE REGION

4.1 Atmospheric dispersion of radioactive material
4.2 Dispersion of radioactive material through surface water
4.3 Dispersion of radioactive material through groundwater
4.4 Population distribution
4.5 Uses of land and water in the region
4.6 Ambient radioactivity

5. MONITORING OF HAZARDS IN SITE EVALUATION FOR NUCLEAR INSTALLATIONS

6. MANAGEMENT SYSTEM FOR SITE EVALUATION FOR NUCLEAR INSTALLATIONS

REFERENCES
CONTRIBUTORS TO DRAFTING AND REVIEW

## 8. PRODUCTION SCHEDULE:

| Reference STEP | Completion date |
|---|---|
| STEP 1: Preparing a DPP | December 2024 |
| STEP 2: Internal review of the DPP (Approval by the Coordination Committee) | Q1 2025 |
| STEP 3: Review of the DPP by the review Committee(s) (Approval by review Committee(s)) | Q2 2025 |
| STEP 4: Review of the DPP by the CSS (approval by CSS) or information of the CSS on the DPP | Q4 2025 |
| STEP 5: Preparing the draft publication | Q3 2026 |
| STEP 6: First internal review of the draft publication (Approval by the Coordination Committee) | Q4 2026 |
| STEP 7: First review of the draft publication by the review Committee(s) (Approval for submission to Member States for comments) | Q2 2027 |
| STEP 8: Soliciting comments by Member States | Q2 2028 |
| STEP 9: Addressing comments by Member States | Q3 2028 |
| STEP 10: Second internal review of the draft publication (Approval by the Coordination Committee) | Q3 2028 |
| STEP 11: Second review of the draft publication by the review Committee(s) (Approval of the draft) | Q4 2028 |
| STEP 12: (For Safety Standards) Editing of the draft publication in MTCD and endorsement of the draft publication by the CSS<br>(For nuclear security guidance) DDG's decision on whether additional consultation is needed, establishment by the Publications Committee and editing | Q2 2029 |
| STEP 13: Approval by the Board of Governors (for SF and SR only) | Q3 2029 |
| STEP 14: Target publication date | Q4 2029 |

## 9. RESOURCES

The following resources will be involved by the Secretariat (person-weeks) and the Member States experts (weeks and type of meetings):

- Secretariat: 2 P-staff (0.30 Man-year) and 1 G-staff (0.2 Man-year) for the a.m. duration of the revision;
- TM Meeting (2 weeks of external participation) + 3 CS Meetings (6 Man-weeks of external experts) + 3 SSA contracts to external experts.

**ANNEX – GAP Analysis**

A detailed gap analysis of the current version of SSR-1 has been conducted based on the feedback collected during the events outlined in Section 1.

The following sections highlight the areas of SSR-1 where significant revisions are needed, as identified in many discussions/events with the stakeholders. For each area, specific issues are identified, either due to outdated content or missing information, that require attention. All changes will consider compatibility with all recently reviewed SGs and in particular with SSR-2/1 (rev.1).

1) Technology neutrality of the Requirements – Scope of the Requirements
    - Clarification of the ”nuclear installations” in the scope of the document;
    - Applicability to transportable reactors (micro reactors, propelled ships/submarines, floating, etc.)
    - Applicability to SMRs;
    - Applicability to advanced reactors;
    - Applicability to non-water cooled reactors;
    - Applicability to research reactors;
    - Applicability to fuel fabrication facilities;
    - Applicability to fusion reactor facilities;
    - Application of graded approach: RIPB and alternatives.
2) Safety objectives for external event scenarios
    - Application of safety goals (generically expressed in terms of CDF, LERF or others) for all safety related facilities (i.e. reactor island, UHS, etc.) at the siting phase, supporting a site license application;
    - Reference to Safety Fundamentals for the environment-related safety objectives;
    - Site related aspects affecting the evaluation of robustness and resilience of the whole power distribution infrastructure in case of extreme external event scenarios;
    - With reference to SSR-1, application of DID to the EE protection and safety assessment for all plant technologies, in particular level 4 and 5 and for transportable nuclear power plants, especially for the assessment of the feasibility of emergency planning measures. .
3) Event scenarios
    - Scenario combinations;
    - Hazard for floating reactors (waves, capsizing, etc.);
    - Projection in time for time-dependent scenarios (i.e. those affected by climate change);
    - “New entries”: space weather, drought as hazard, permafrost (repeated freezing and thawing), pandemics, loss-of-offsite-power, etc.;
    - Events induced by co-located facilities for $H_2$ production, district heating, water desalination, etc.;
    - Extreme and rare scenarios categorization for hazard development
    - BDBEE scenarios identification to be used for the assessment;
    - Investigation of the low probability scenarios to be considered in the BDBEE assessment;
    - Monitoring needs and interfaces with operator decision, prevention, mitigation and restart.
4) Use of site conditions (hazards, etc.) in all phases of plant lifetime: site selection, site licensing, design, safety assessment, operation, decommissioning
    - Hazard characteristics, uncertainty levels, review, data sources as function of the project development phase;
    - Site exclusion criteria in site selection phase;
    - Different site investigation campaigns in all phases of hazard evaluation, data sources and validation;

- Impact of plant technology/design on needs for hazard development (screening, hazard recurrence period, variables, combinations, etc.);
- Control of uncertainties, exp. the epistemic component;
- Impact of operation practice on need for monitoring and pre-post event actions
- Periodic Safety Review, plant life extension, new co-located facilities, etc. hazard updating on the basis of recent evidences.

5) Siting of standard design plants
   - Selection of bounding site conditions (and later assessment of the site specific conditions);
   - The case of transportable reactors (micro reactors, floating, etc.);
   - The case of underground siting;
   - Definition of site boundary, site vicinity and region;
   - Security related issues in hazard identification (i.e. DBT interfaces with DBE), definition of site boundary (e.g. fence in a marine environment), design of protection (i.e. malevolent and accidental scenarios may require similar engineering provisions) and emergency planning.
6) Emergency planning issues
   - Realistic identification of source terms for population evacuation, to be used at the siting phase for site safety assessment;
   - Emergency planning for transportable reactors;
   - Management of on-site emergencies induced by external scenarios (circulation at site, etc.);
   - Management of on-site and off-site emergencies and evacuation in case of major destructions, circulation impediment (e.g. pandemics) and infrastructure damage;
   - EPZ in transboundary conditions
   - Assess the appropriateness of the term “feasibility” of emergency planning measures.
7) Radiation dispersion issues
   - Radiological environmental impact evaluation as part of the site evaluation process (i.e. when a final plant design has not been selected yet)
   - Source term for radiation dispersion evaluations (for non water cooled reactors, mitigated and un-mitigated, etc.);
   - Transportable reactors;
   - Dispersion in water in the deep sea (important for floating reactors).