Document Preparation Profile (DPP)
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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**

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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 extracted by the Secretariat during the periodic review of all the SEED Mission reports issued in the last 10 years, carried out in 2024;
- The development of several technical documents by the IAEA (list available at the website) that consolidate Member States' experiences with recent events, new advancements in hazard development (especially in uncertainty estimation, hazard extrapolation to long return periods, etc.), and modern approaches to installation design, especially regarding extreme external hazard scenarios and those affected by climate change. These efforts specially 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 such as intensive flooding, rotational winds, heatwaves, droughts etc.;
- 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 over 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 human induced 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, new technologies and deployment forms; and the subsequent revision of safety standards that have attempted to address issues in relation to the licensing, safety demonstration, commissioning and operation correspondingly, such as SSR-2/1 (Rev. 1) and SSG-77.
- Recent consultancy meetings related to the development of a Technical Report on floating reactors, which highlights the need of interpretation of site boundaries, emergency zones, and hazards development in the context of floating NPPs
- A recent INSAG report (INSAG28) 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 to be always considered and assessed, rather than eliminated or not implemented.
- 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 external 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 possibly requiring revision, improvement or new development:

- **Technology neutrality**: requirements should be applicable to all the facilities in the scope of SSR-1, as much as feasible. Site safety assessments should explicitly consider the compatibility between the site, number and type of installation to be built. Consideration of specific conditions associated with the selected reactor technology and deployment type (e.g. SMRs, underground plants, transportable NPPs - for which the notion of "site" may need a more complex approach, etc.) should be provided. A plant parameter envelope may be applicable in the site selection phase.

- **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 Depth (DID) for external event scenarios in all types of nuclear installations (especially those other than NPPs). Additionally, events which refer to beyond-design-basis event scenarios need to 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 the corresponding risks over time.
- **Site characterization techniques**: Updated requirements on site investigation techniques (and preliminary) 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 (only for monitoring).
- **Identification of "bounding site" conditions**: Clarify how bounding site conditions (sometimes called Plant Parameter Envelope (PPE)) developed for the design of standardized plants can be compared with the site-specific conditions in the 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 starting at the stage of development of the design basis for the installation, particularly in the establishment of design basis threats (DBT) and design basis external event scenarios respectively, considering their role in the overall site assessment process.
- **Site related issues during the operating life of the installations**: Develop requirements (and preliminary guidance) on monitoring systems and reliable sources of information on site hazards, especially addressing meteorological and hydrological hazards and climate change considerations, to support proactive operator actions, hazard review on the occasion of the periodic safety review (or any other relevant occasion), 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 may also serve as a basis 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 and deployment types, including, but not exclusively, the following: small modular reactors (SMRs), transportable reactors (e.g. floating, micro-reactors, etc.), underground nuclear installations, advanced reactors (as defined at the IAEA doc NR-T-1.19), fusion facilities, and others.

The revision will continue to ensure full compatibility with the IAEA Safety Fundamentals and other related Safety Requirements documents, as well as with relevant Security Guidance 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 (note that many documents are currently under revision; therefore, consistency should be guaranteed with the revisions that will be issued in due progress).

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. SSR-6: Regulations for the safe transport of radioactive materials (2018);
10. GSR Part 5 (Rev.1): Predisposal Management of Radioactive Waste;
11. SSG-9 (Rev. 1): Seismic Hazards in Site Evaluation For Nuclear Installations (2022);
12. SSG-38: Construction for Nuclear Installations (2015)
13. SSG-54: Accident Management Programmes for Nuclear Power Plants (2019)
14. SSG-89: Evaluation of Seismic Safety for Nuclear Installations (2024);
15. SSG-79: External Human Induced Events in Site Evaluation for Nuclear Power Plants (2023);
16. DS529: Investigation of Site Characteristics and Evaluation of Radiation Risks to the Public and the Environment in Site Evaluation for Nuclear Installations (2025);
17. DS531: Geotechnical Aspects in Siting and Design of Nuclear Installations (2025);
18. DS541: Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations (2027);
19. SSG-21: Volcanic Hazard in Site Evaluation for Nuclear Installations (2012);
20. SSG-35: Site Survey and Site Selection for Nuclear Installations (2015);
21. DS552: Safety Assessment of Nuclear Installations in Relation to External Event Scenarios (2027);
22. INSAG-28: Application of the Principle of Defence in Depth in Nuclear Safety to Small Modular Reactors, addendum to INSAG-10 (2024);
23. SSG-12: Licensing Process for Nuclear Installations (2010);
24. SSG-77: Protection Against Internal and External Hazards in the Operation of Nuclear Power Plants (2022).

All sections of NSNI including the Operational Safety Section (OSS), Regulatory Activities Section (RAS), Research Reactor Safety Section (RRSS) and Safety Assessment Section (SAS) were consulted for the development of this DPP. These sections and the Nuclear Security of Materials & Facilities Section (NSNS/MAFA) will also be consulted as part of the drafting process.

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 Safety objectives
2.2 Uses for site evaluation
2.3 General criteria
2.4 Criteria for selecting hazards associated with external natural and human induced events and their combinations
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 EVENT HAZARD IN SITE EVALUATION FOR NUCLEAR INSTALLATIONS

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

4. SITE CHARACTERISTICS AND THE POTENTIAL EFFECTS OF THE NUCLEAR INSTALLATION ON 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 AND SITE PROPERTIES IN SITE EVALUATION FOR NUCLEAR INSTALLATIONS DURING THE PLANT LIFETIME

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 (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 person-year) and 1 G-staff (0.2 person-year) for the above mentioned. duration of the revision;
- Technical Meeting (2 weeks of external participation) + 3 Consultancy Meetings (6 person-weeks of external experts) + 3 short term 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. It is important to note that this list is not final and may change during development of the document.

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

1) Technology neutrality of the Requirements – Scope of the Requirements
    - Clarification of the document applicability to "nuclear installations" in the scope
    - Clarification on the document applicability to facilities and activities in its scope used or undertaken for peaceful purposes
    - Applicability to transportable reactors during their lifetime, recognizing that other IAEA initiatives are yet to report and details of this applicability to marine transportable reactors would like to be refined in the draft
    - 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 facilities;
    - Application of graded approach: Risk Informed Performance Based (RIPB) and alternatives.
2) Safety objectives for external event scenarios
    - Application of safety objectives (usually expressed in terms of CDF and LERF) to all safety related structures, systems and components (i.e. in the reactor island, access to the UHS, etc.) at the siting phase, supporting a site license application. Review current text with special reference to advanced reactors.
    - Reference to Safety Fundamentals for the environment-related safety objectives;
    - Site related aspects affecting the evaluation of robustness and resilience of the nuclear plant itself to feed the whole power distribution infrastructure in case of extreme external event scenarios;
    - Application of DID to the protection strategy against external events 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
    - Combinations of hazards;
    - Hazards for floating reactors (waves, capsizing, etc.);
    - Hazards from accidental impact of floating ships/barges/objects/debris against the site
    - Projection in time for time-dependent scenarios (e.g. those affected by climate change);
    - Consideration of climate change impacts during the lifetime of a nuclear facility;
    - "New entries" as other external or human induced hazards not included in SSR-1 (2019), such as: space weather, drought as hazard, permafrost (repeated freezing and thawing), pandemics, loss-of-offsite-power and human activities in the site vicinity beyond the control of the operator, etc.;

- Events induced by co-located facilities for H_2 production, district heating, water desalination, etc.;
- Updated guidelines for hazard development for extreme and rare scenarios, especially for meteorological ones
- Identification of beyond-design-basis-external-event scenarios (BDBEE) to be used for the plant safety 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) Identification of site conditions (hazards, data, etc.) in all phases of project/plant lifetime: site selection, site evaluation, design and safety assessment, construction, operation and decommissioning (only for monitoring).
    - Hazard characteristics, uncertainty levels, review, data sources as function of the project development phase;
    - Methods for quantification of uncertainties, including the epistemic component;
    - Site exclusion criteria in the site selection phase;
    - Different site investigation campaigns and hazard evaluation in all phases of plant life: site selection, site evaluation, construction, and operation. Different data sources and data validation methods;
      Impact of plant technology/design on needs for hazard development (screening, hazard recurrence period, variables, combinations, etc.)
    - 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 (also called Plant Parameter Envelope - PPE) 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;
    - Interfaces with security related issues in hazard identification (i.e. design basis threat-DBT interfaces with design basis events-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 (mitigated vs. unmitigated, 100% core melt, etc.)
    - Feasibility of emergency planning for reactors that may be transported to the site;
    - Identification of external hazards to inform the management of on-site and off-site emergencies, with special emphasis to site access and vehicle circulation, evacuation in case of major destruction, circulation impediments (e.g. pandemics) and infrastructure damage;
    - Emergency planning zone EPZ definition, also in transboundary conditions
    - Identification of factors important to assessing the 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 in the case of floating reactors.