

Document Preparation Profile (DPP)

Version 2 dated 1 June 2023

1. IDENTIFICATION

Document Category: Specific Safety Guide

Working ID: DS552

Proposed Title: Safety Evaluation of Nuclear Installations for External Events
Excluding Earthquakes

Proposed Action: New Safety Guide

Review Committee(s) or Group: NUSSC, WASSC

Technical Officer(s): Michael Salmon (NSNI/EESS), Mazhar Mahmood (NSNI/EESS)

2. BACKGROUND

IAEA Safety Standards Series No. SF-1, Fundamental Safety Principles, provides safety principles that constitute the basis for establishing safety requirements to achieve the fundamental safety objective of protecting people and the environment from harmful effects of ionizing radiation. Safety requirements for design, assessment and periodic review of safety against external hazards are established in IAEA Safety Standards Series Nos GSR Part 4 (Rev. 1), Safety Assessment for Nuclear Facilities and Activities; SSR-1, Site Evaluation of Nuclear Installations; SSR-2/1 (Rev. 1), Safety of Nuclear Power Plants: Design; SSR-2/2 (Rev. 1), Safety of Nuclear Power Plants: Commissioning and Operation; SSR-3, Safety of Research Reactors and SSR-4, Safety of Nuclear Fuel Cycles Facilities. Meeting the safety requirements established in these IAEA standards will ensure that the fundamental safety objective of SF-1 is achieved. SSR-2/1 (Rev. 1) requires that a comprehensive safety assessment be carried out for design of nuclear power plants. The safety assessment should investigate the capability of the design to withstand postulated initiating events and accidents – including those triggered by external hazards. Requirement 17 of SSR-2/1 (Rev. 1) requires that items important to safety be designed for protection against internal and external hazards. The external hazards include seismic, meteorological, hydrological and volcanic hazards, and human induced events.

Recommendations on seismic safety assessment are provided in IAEA Safety Standards Series No. SSG-89, Evaluation of Seismic Safety for Nuclear Installations, and practical guidance is provided in Safety Report No. 103, Methodologies for Seismic Safety Evaluation of Existing Nuclear Installations. A new safety guide that provides recommendations on conducting safety evaluations of nuclear installations in relation to external events other than earthquakes is therefore needed. This new publication will provide recommendations on methodologies for the safety assessment of external events excluding earthquakes, validated by the current international state of the practice and intended to meet the requirements for nuclear facilities established in SSR-1, SSR-2/1 (Rev. 1), SSR-3 and SSR-4.

The new safety guide will provide specific recommendations on the conduct of safety assessments for both new and existing nuclear installations in relation to external events other than earthquakes. This publication will incorporate lessons learned based on industry practice following the Great East Japan Earthquake and Tsunami of 2011 and the subsequent Fukushima Daichi accident. In addition, the use

of a graded approach to safety evaluation of nuclear installations other than nuclear power plants and advanced reactors with passive and inherent design safety features in relation to external hazards excluding earthquakes will be addressed.

A gap analysis is attached.

3. JUSTIFICATION FOR THE PRODUCTION OF THE PUBLICATION

The recommendations currently provided in the IAEA safety standards relating to the safety evaluation of nuclear installations apply mainly to seismic safety. A safety guide which provides recommendations for meeting the requirements promulgated in safety standards for external events other than earthquakes is therefore needed. This new safety guide will provide recommendations on the safety evaluation of nuclear installations in relation to external events such as high wind and tornadoes, flooding, extreme temperatures, volcanic activity, and human induced external events.

The need for such a safety guide has also been communicated to the External Events Safety Section (EESS) by both donor and recipient Member States at Technical Meetings and in consultancies. This safety guide will complement existing safety standards on external events. It will also present methods for the use of a graded approach which may be applicable to nuclear installations other than power plants. The use of a graded approach the safety evaluation of reactor designs with advanced safety features will also be addressed.

Additionally, the impact of climate change on meteorological and hydrological hazards has been the subject of much interest among the scientific community and the public at large. This publication will incorporate lessons learned on this evolving topic for consideration in the safety evaluation.

4. OBJECTIVE

The objective of this safety guide is to provide recommendations on how to comply with the applicable safety requirements of SSR-1 (e.g., Requirements 7), SSR 2/1 (Rev. 1), e.g., Requirements 10 & 17, SSR-3 (e.g., Requirements 5, 18, 20 & 22) and SSR-4 (16, 20 & 21), regarding the safety evaluation of nuclear installations for external events excluding earthquakes. This safety guide is intended for use by regulatory bodies, designers of nuclear installations, operating organizations, advisory bodies and technical support organizations.

5. SCOPE

This publication will cover both new and existing nuclear installations as defined in the IAEA Nuclear Safety and Security Glossary, 2022 (Interim) Edition, Terminology Used in Nuclear Safety, Nuclear Security, Radiation Protection and Emergency Preparedness and Response. The methodologies developed for the safety evaluation of nuclear power plants in relation to external events are also applicable to other nuclear installations through the use of a graded approach. This safety guide will address external events in the safety evaluation of nuclear installations for those external events outlined in IAEA Safety Standards Series No. SSG-68, Design of Nuclear Installations Against External Events Excluding Earthquakes to include natural external events (e.g. floods, extreme meteorological conditions, extreme winds, volcanism), human induced external events (e.g. aircraft crashes, external explosions, external fire) and combinations of external hazards.

The safety assessment of intentional malevolent acts is not covered in the proposed publication.

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

This publication will potentially interface with the following IAEA Safety Standards Series publications:

- International Atomic Energy Agency, Fundamental Safety Principles, IAEA Safety Fundamentals No. SF-1, IAEA, Vienna (2006).
- International Atomic Energy Agency, Safety Assessment for Facilities and Activities, IAEA Safety Standards Series No. GSR Part 4 (Rev. 1), IAEA, Vienna (2016).
- International Atomic Energy Agency, Predisposal Management of Radioactive Waste, IAEA Safety Standards Series No. GSR Part 5, IAEA, Vienna (2009).
- International Atomic Energy Agency, Site Evaluation for Nuclear Installations, IAEA Safety Standards Series No. SSR-1, IAEA, Vienna (2019).
- International Atomic Energy Agency, Safety of Nuclear Power Plants: Design, IAEA Safety Standards Series No. SSR-2/1 (Rev. 1), IAEA, Vienna (2016).
- International Atomic Energy Agency, Safety of Nuclear Power Plants: Commissioning and Operation, IAEA Safety Standards Series No. SSR-2/2, Rev. 1, IAEA, Vienna (2016).
- International Atomic Energy Agency, “Safety of Research Reactors,” IAEA Safety Standards Series No. SSR-3, IAEA, Vienna (2016).
- International Atomic Energy Agency, Safety of Nuclear Fuel Cycle Facilities, IAEA Safety Standards Series No. SSR-4, IAEA, Vienna (2017).
- International Atomic Energy Agency, Design of Nuclear Installations Against External Events Excluding Earthquakes, IAEA Safety Standards Series No. SSG-68, IAEA, Vienna (2021).
- International Atomic Energy Agency, Seismic Hazards in Site Evaluation for Nuclear Installations, IAEA Safety Standards Series No. SSG-9, Rev. 1, IAEA, Vienna (2022)
- International Atomic Energy Agency, Hazards Associated with Human Induced External Events in Site Evaluation for Nuclear Installations, IAEA Safety Standards Series No. SSG-79, IAEA, Vienna (2023).
- International Atomic Energy Agency, Investigation of Site Characteristics and Evaluation of Radiation Risks to the Public and the Environment in Site Evaluation for Nuclear Installations, IAEA Safety Standards Series No. DS529, IAEA, Vienna (in preparation).
- International Atomic Energy Agency, Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Plants, Safety Guide, IAEA Safety Standards Series No. NS-G-3.6, IAEA, Vienna (2005).
- International Atomic Energy Agency, Volcanic Hazards in Site Evaluation for Nuclear Installations, Safety Guide, IAEA Safety Standards Series No. SSG-21, IAEA, Vienna (2012).
- International Atomic Energy Agency, Meteorological and Hydrological Hazards and Site Evaluation of Nuclear Installations, IAEA Safety Standards Series No. SSG-18, IAEA, Vienna (2011).
- International Atomic Energy Agency, Site Survey and Site Selection for Nuclear Installations, IAEA Safety Standards Series No. SSG-35, IAEA, Vienna (2015).
- International Atomic Energy Agency, Deterministic Safety Analysis for Nuclear Power Plants, IAEA Safety Standards Series No. SSG-2, IAEA, Vienna (2019).
- International Atomic Energy Agency, Protection Against Internal and External Hazards in the Operation of Nuclear Power Plants, IAEA Safety Standards Series No. SSG-77, IAEA, Vienna (2022).

- International Atomic Energy Agency, Safety Aspects of Nuclear Power Plants in Human Induced External Events; Assessment of Structures, IAEA Safety Reports Series No. 87, IAEA, Vienna (2018).
- International Atomic Energy Agency, Consideration of External Hazards in Probabilistic Safety Assessment for Single Unit and Multi-Unit Nuclear Power Plants, IAEA Safety Reports Series No. 92, IAEA, Vienna (2018).
- International Atomic Energy Agency, Evaluation of Seismic Safety for Nuclear Installations, IAEA Safety Standards Series No. SSG-89, IAEA, Vienna (in preparation).
- International Atomic Energy Agency, Evaluation of Seismic Safety for Nuclear Installations, IAEA Safety Reports Series No. 103, IAEA, Vienna (2020).
- International Atomic Energy Agency, Assessment of Vulnerabilities of Operating Nuclear Power Plants to Extreme External Events, IAEA-TECDOC-1834, IAEA. Vienna (2017).
- International Atomic Energy Agency, Storage of Spent Nuclear Fuel, IAEA Safety Standards Series No. SSG-15 (Rev. 1), IAEA. Vienna (2020).
- International Atomic Energy Agency, The Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste, IAEA Safety Standards Series GSG-3, IAEA, Vienna (2017).

All other sections of the Division of Nuclear Installation Safety (NSNI) — namely 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 will also be consulted as part of the drafting process.

7. OVERVIEW

The new safety guide is proposed to include the following contents:

1. Introduction
 2. General Considerations for Safety Evaluation for External Events
 3. Selection of the Safety Assessment Methodology
 4. Identification of Site-Specific External Event Hazards
 5. Screening of External Event Hazards
 6. Data Collection and Investigations
 7. Evaluation of External Events Safety for Nuclear Power Plants
 8. Evaluation of External Events Safety for Nuclear Installations other than Nuclear Power plants
 9. Use of External Events Safety Evaluation Results for Nuclear Installations
 10. Management System for Safety Evaluation for Nuclear Installations
- Appendices
- References
- Annexes

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

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

9. RESOURCES

30 staff-weeks of IAEA professional staff plus 50,000 Euro for a Technical Meeting (approximately 60 participants for 5 days) and 30,000 Euros for 3 consultancy meetings (5 participants for 5 days in each meeting).

ANNEX – Gap Analysis Report

A Tool for SEED Mission Assessment (ToSMA) was used to analyse the effectiveness of the Site and External Events Design (SEED) missions conducted by the External Events Safety Section (EESS) between the years 2000 and 2020 in relation to lessons learned, suggestions for improvement and feedback from the Member States. Based on statistical data provided in the ToSMA system, EESS conducted 220 SEED missions between 2000 and 2020 covering 188 nuclear power plants and 27 research reactors in 44 different Member States. In addition to the SEED mission reports, incident (event) reports accumulated in the International Reporting System for Operating Experience (IRS), Fuel Incident Notification and Analysis System (FINAS), and Incident Reporting System for Research Reactors (IRSRR) databases for more than 20 years are another major source of feedback regarding external hazards.

An analysis of the event databases showed that external hazards significantly affected nuclear installations, as shown in Figure A.1 below. This Figure shows that significant numbers of external events other than earthquakes were reported at nuclear installation sites in different Member States, which clearly indicates a need for safety evaluation of nuclear installations in relation to external events.

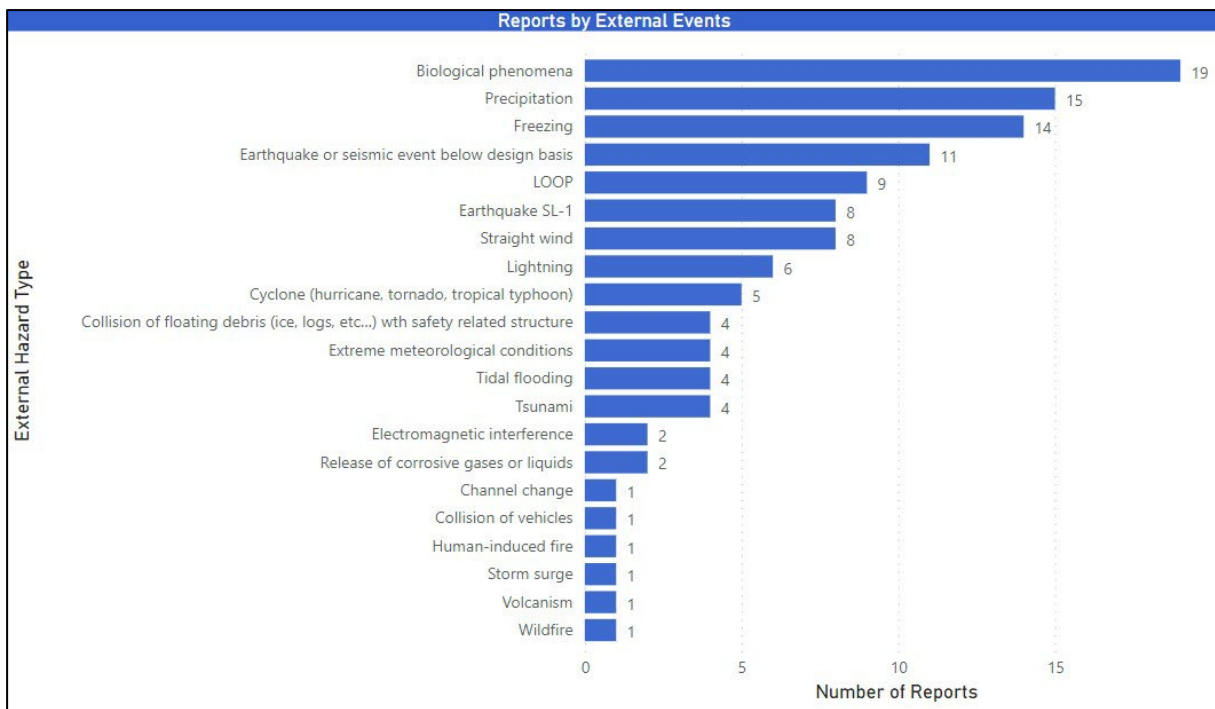


Figure A.1. Number of Events in the TOSMA Databases related to External Events

Moreover, the ToSMA analysis of SEED mission reports highlighted a significant gap between the number of recommendations issued by experts during the SEED missions in relation to safety assessment, and the number of available Safety Guides which are expected to support those recommendations.

There is also a gap in guidance on the assessment of the safety margin for beyond design basis events other than earthquakes, which was extensively carried out by almost all Member States in the aftermath of the Fukushima Daiichi accident. The so-called “stress test” programmes revealed many hazards related to computational and engineering issues that are not currently covered in any Safety Guide with enough detail to support the follow-up of those programmes.

In conclusion, there is a significant gap in IAEA publications in guidance on the safety evaluation of nuclear installations for external events, in particular in relation to beyond design basis scenarios. Currently, two publications are available related to the seismic safety evaluation of nuclear installations (SSG-89, Safety Reports Series No. 103) whose scope is limited to earthquake related hazards. A publication providing recommendations to Member States on safety evaluation for of nuclear installations in relation to external events other than earthquakes is clearly needed.

Some Member States provided encouraging feedback on the development of a publication related to this topic during the Annual Meeting of the Extrabudgetary Programme of the External Events Safety Section held on 4-7 October 2022, and during the Technical Meeting on Optimization of Protection of Advanced Reactors against External Hazards held on 28 November to 2 December 2022.