

Document Preparation Profile (DPP) Version 1 dated 29 July 2013

1. IDENTIFICATION

Document Category	Safety Guide
Working ID:	DS481
Proposed Title:	Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants
Proposed Action:	Revision of Safety Standards Series No. NS-G-1.9, IAEA, Vienna (2004)
Review Committee(s) or Group:	NUSSC, NSGC
Technical Officer:	Javier Yllera

2. BACKGROUND

The IAEA Safety Guide NS-G-1.9, “Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants” was published in 2004 to provide recommendations on meeting the requirements included in NS-R-1, “Safety Requirements on the Safety of Nuclear Power Plants: Design” of 2001. A decade later, in 2011, NS-R-1 was superseded by SSR-2/1, “Safety of Nuclear Power Plants: Design”. Among the most significant changes introduced is the extension of the plant states to be considered in the plant design basis, which includes also multiple failures potentially leading to a severe accident. The strengthening of the independence and effectiveness of the different levels of defence in depth provisions for preventing large releases is also an essential aspect of the new requirements. The importance of addressing these aspects was strongly highlighted by the feedback of experience from the Fukushima accident. In addition to these changes, some other design aspects have been identified as important elements for post-Fukushima safety enhancements. Among those related to the Reactor Coolant System and Associated Systems (RCSASs), the reliable use of mobile sources for cooling, the diversification of ultimate heat sink, as well as the sufficient provision of safety margins ~~to avoid cliff edge effects~~ [ENISS2] can be noted.

3. JUSTIFICATION FOR THE PRODUCTION OF THE DOCUMENT

In the process of review and revision of the IAEA Safety Standards to account for the feedback of experience from the Fukushima accident, which is a key element of the IAEA Nuclear Safety Action Plan, the relevant IAEA Safety Requirements are being reviewed and a pilot exercise has been initiated aiming at assessing the impact of changes to Safety Requirements on subordinated Safety Guides. NS-G-1.9 was one of the Safety Guides selected for the exercise. The pilot review of NS-G-1.9 led to the conclusion endorsed by NUSSC in June 2013 that it is necessary to produce a new version of the guide (See Annex 1).

4. OBJECTIVE AND SCOPE

The main objective of the revised Safety Guide is to provide guidance on how to meet the current design safety requirements in relation with the Reactor Coolant System and Associated Systems (RCSAS) in Nuclear Power Plants (NPPs) recently established in SSR-2/1. The publication is intended to provide guidance mainly for new water cooled reactors and, as far as reasonably achievable, also for safety re-evaluation or assessment of existing nuclear power plants and applicable feedback of experience from the Fukushima accident [FRA1].

The main changes that the revised Safety Guide will introduce are:

- The style and format of the Safety Guide needs to be updated, eliminating some narrative parts and making appendixes or annexes consistent with the modern type of reactors being considered for design. Aspects that are covered in other Safety Guides, in particular related to safety classification should be reduced to a minimum and linked to the newly approved Safety Guide on safety classification.
- In general, the terminology of the Safety Guide needs to be revised and made consistent with the new definition of plant state categories introduced in SSR 2/1, i.e. the inclusion of design extension conditions and the consideration of severe accidents in the design basis. The section on design basis needs to be revised accordingly.
- The recommendations in the Safety Guide will be reformulated as necessary to fulfil the current design requirements in SSR-2/1. This includes the recommendations regarding design extension conditions that relate to RCSAS systems. SBO, ATWS and failure of ECCS functions after a loss of coolant accident are planned to be considered. [USA3]
- The revised Safety Guide will provide safety recommendations on the features for design extension conditions that ~~are~~ may be [ENISS3] needed to prevent core damage at high pressure conditions and to cool the fuel after a severe accident.
- The Safety Guide will cover the gap existing ~~on~~ between [CAN1] safety recommendations on structures, systems and components connecting the ultimate heat sink (final water body or the atmosphere absorbing to residual heat) and the current set of systems covered by the Safety Guide.
- The safety recommendations for RCSASs will be analysed and amended as appropriate taking into consideration the possible introduction of passive safety features ~~that are being introduced~~ in the ~~newest~~ designs for RCSAS systems of some reactors [ENISS5, WNA1].
- The Safety Guide will include changes deriving from the revisions to be introduced in an addendum to SSR-2/1 on the basis of feedback of experience from the Fukushima accident.

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

The new version of the Safety Guide will be directly related to SSR-2/1, and, as with the current version of the Safety Guide, it will have interfaces with a number of Safety Guides on NPP Design, among them:

- Design of the Reactor Core for Nuclear Power Plants, NS-G-1.12,
- Design of Reactor Containment Systems for Nuclear Power Plants, NS-G-1.10
- Design of Emergency Power Systems for Nuclear Power Plants, NS-G-1.8 (under revision),
- Instrumentation and Control Systems Important to Safety in Nuclear Power Plants, NS-G-1.3, (under revision).
- Draft Safety Guide on Safety Classification of Structures, Systems and Components in Nuclear Power Plants, DS 367. [JAP2]

There will be also relations with several of the existing Standards on internal and external hazards, nuclear power plant operation and safety assessment.

6. OVERVIEW

The revised Safety Guide should have a structure in line with the current format and content of Specific Safety Guides and a scope consistent with the relevant safety requirements of SSR 2/1 and applicable feedback of experience from the Fukushima Daiichi nuclear power plant accident [JAP3], accounting for the aspects described in section 4. It is planned that it will include the following main contents:

1. INTRODUCTION
2. SCOPE AND FUNCTIONS OF THE RCS AND ASSOCIATED SYSTEMS
3. GENERAL CONSIDERATIONS IN DESIGN
 - Objectives of the design
 - Design basis
 - Postulated initiating events
 - Design Extension Conditions [Several MSs]
 - Safety classification
 - Consideration for internal and external hazards
 - Reliability
 - Selection of materials
 - Layout considerations
 - Interface considerations
 - Considerations of isolation and system protection
 - Instrumentation and control system
 - Design provisions for in-service inspection, testing and maintenance, and decommissioning [WNA3]
 - Considerations for multi-unit nuclear power plants
4. SPECIFIC CONSIDERATIONS IN DESIGN
 - Reactor coolant system
 - Chemical and inventory control systems
 - Emergency boration system
 - Emergency core cooling system
 - Residual heat removal system
 - Steam and main feedwater system
 - Auxiliary and emergency feedwater system
 - Intermediate cooling circuits
 - The ultimate heat sink and its heat transport systems
 - Systems and safety features for design extension conditions

APPENDIX: CONSIDERATIONS OF THE FEEDBACK OF EXPERIENCE FROM THE FUKUSHIMA ACCIDENT IN THE DESIGN OF EXISTING NUCLEAR POWER PLANTS
REFERENCES

ANNEX I: MAIN COMPONENTS OF THE RCS

ANNEX II: DIAGRAMS OF THE RCS AND ASSOCIATED SYSTEMS

1. **PRODUCTION SCHEDULE:** Provisional schedule for preparation of the document, outlining realistic expected dates for *(fill the column corresponding to your proposed document and delete the other columns)*:

STEP 1: Preparing a DPP	DONE
STEP 2: Approval of DPP by the Coordination Committee	August 2013
STEP 3: Approval of DPP by the relevant review Committees	October 2013
STEP 4: Approval of DPP by the CSS	March 2014
STEP 5: Preparing the draft	March 2015
STEP 6: Approval of draft by the Coordination Committee	April 2015
STEP 7: Approval by the relevant review Committees for submission to Member States for comments	2Q 2015
STEP 8: Soliciting comments by Member States	4Q 2015
STEP 9: Addressing comments by Member States	1Q 2016
STEP 10: Approval of the revised draft by the Coordination Committee Review in NS-SSCS	2Q 2016
STEP 11: Approval by the relevant review Committees	2Q 2016
STEP 12: Endorsement by the CSS	3-4Q 2016
STEP 13: Establishment by the Publications Committee and/or Board of Governors (for SF and SR only)	1Q 2017
STEP 14: Target publication date	3Q 2017

8. RESOURCES

It is envisaged that the development of the document will entail the organization of three consultancy meetings and one Technical Meeting for the production of the draft and two further consultancy meetings for addressing comments from MSs, NUSSC and CSS

ANNEX 1

FEEDBACK ANALYSIS REPORT

As part of the IAEA Nuclear Safety Action Plan approved after the accident at TEPCO's Fukushima Daiichi nuclear power plant [JAP4] in March 2011, an action for reviewing and revising as necessary the relevant IAEA safety standards in a prioritized sequence was requested to the Commission on Safety Standards (CSS) and the IAEA Secretariat. A few months later, the new Safety Requirements document for NPP Design, SSR-2/1, that had been already reviewed by the Committees and the Member States, was endorsed by the CSS and approved by the IAEA Board of Governors including a note indicating that "Lessons that may be learned from studying the accident at the Fukushima Daiichi nuclear power plant in Japan following the disastrous earthquake and tsunami of 11 March 2011 will be reflected in this IAEA safety standard as revised and issued in the future"

SSR-2/1 was developed in accordance with the “Long-Term Structure of the Safety Standards” approved in May 2008, which calls also for a strategy to update the structure and style and scope of Safety Guides as described in “Strategies and Processes for the Establishment of IAEA Safety Standards” (SPESS). Due to these changes in structure and to the differences in technical aspects from SSR-2/1 versus the previous version (NS-R-1), NS-G-1.9 was already one of the Safety Guides flagged as a priority for the subsequent revision of Safety Guides related to NS-R-1.

Within the process of review and revision of the IAEA Safety Standards to account for the feedback of experience from the Fukushima accident, NS-G-1.9 was also selected for a pilot exercise aiming at assessing the impact of changes to Safety Requirements on subordinated Safety Guides. The outcome of the exercise for this guide was presented at the 35th NUSSC meeting with the conclusion that:

- Most of the amendments proposed for SSR 2/1 have no direct implications for NS-G-1.9.
- NS-G-1.9 (2004) is linked to NS-R-1 (2000) and needs a thorough revision for being consistent with SSR 2/1 and the style of the new Safety Standard series.
- NS-G-1.9 needs to reflect i.a. current terminology and requirements on plant conditions, e.g. design extension conditions, defence in depth and design basis.
- NS-G-1.9 Appendix/Annexes need to be updated (new plant design aspects, removal of safety classification in text and Annex)
- There is no value in conducting only a limited revision based upon feedback of experience from the Fukushima accident

NUSSC agreed in the 35th meeting that it is necessary to revise the Safety Guide and requested the Secretariat to initiate a DPP for this purpose