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Document Preparation Profile (DPP)
Version 1 dated on 11 August 2016

1. IDENTIFICATION

Document Category: Specific Safety Guide

Working ID: DS508

Proposed Title: Application of Safety Principles and
[of General Design Requirements for Design of Nuclear Power Plants](#)[\[FR\]](#)

Proposed Action: New document

Review Committee(s) or Group: NUSSC, NSGC

Technical Officer(s): Javier Yllera (NSNI/SAS)

2. BACKGROUND

Over the last decade the safety standards publications on nuclear power plant design safety and safety assessment have experienced substantial revisions. The issuing of GSR Part 4, Safety Assessment for Activities and Facilities in 2008 in accordance with the agreed long term structure of the Safety Standards, led to a very concise treatment of the requirements for safety assessment in the design of NPPs during the revision of NS-R-1: "Safety of Nuclear Power Plants: Design", which became superseded in 2012 by SSR 2/1 with the same title. At the same time, SSR 2/1 introduced also relevant changes in the design safety principles of nuclear power plants ~~with the objective of practically eliminating plant conditions leading to large or early releases~~[\[FR\]](#).

GSR Part 4 is a generic standard and is intended to cover also the whole lifecycle of the facilities, not only the design. Nevertheless, the requirements for safety assessment mirror in general the safety requirements for NPP design.

These changes in the safety requirements have implications on the corresponding safety guides. For safety assessment, three specific safety guides for nuclear power plants were developed in support of GSR Part 4, namely:

- SSG-2: Deterministic Safety Analysis for Nuclear Power Plants
- SSG-3: Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants
- SSG-4: Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants,

The safety guide NS-G-1.2, Safety Assessment and Verification for Nuclear Power Plants (2001), which provided recommendations regarding the requirements on safety assessment included in NS-R-1, was used as a basis for the formulation of requirements in GSR Part 4 and the safety guide was eventually declared superseded.

The revision of safety guides in support of SSR 2/1, Rev. 1 is underway. These technically specific safety guides provide recommendations related to the design of plant systems or related to general design aspects applicable to all or many systems, e.g. safety classification.

3. JUSTIFICATION FOR THE PRODUCTION OF THE SAFETY GUIDE

As a result of the changes introduced in the safety requirements for nuclear power plant design and safety assessment, overarching guidance is needed on the application of some requirements.

Guidance is needed ~~in relation to~~ the implementation of some important changes introduced in SSR 2/1, such as the introduction of the so called “design extension conditions” in the plant design envelope as well as the need to demonstrate that ~~event sequences~~[plant conditions\[GE\]](#) leading to large or early releases have to be practically eliminated. Other relevant changes introduced in SSR 2/1 after the Fukushima Daiichi accident include requirements for ~~more adequate~~[\[GE\]](#) safety margins, ~~and~~ strengthening the implementation of the defence in depth [concept\[GE\] and consideration of multi unit plant designs.\[BE\]](#) - The implementation of these and other changes in the requirements need to be reflected in the safety guide. The nature of the requirements affected by the changes described is cross cutting and cannot be limited to recommendations for the design of individual plant systems. In addition, treating these new and cross cutting topics in a separate safety guide reduces the risk for inconsistent interpretation and recommendations if they are treated in several safety guides related to plant system design. Therefore, a new safety guide is necessary covering the changes in the requirements that have been indicated.

In addition, several requirements in GSR Part 4 are currently not addressed in safety guides. They are primarily related to the assessment of general design requirements [for NPPs, i.e. those in sections 3 to 5 of SSR 2/1 applicable to all plant systems.\[FR\]](#) which was previously addressed in NS-G-1.2. A gap analysis was performed in this regard and presented at the 37th NUSSC meeting. Several requirements of GSR Part 4 are currently covered by existing safety guides indicated above, SSG-2, SSG-3 and SSG-4. The assessment of human factors is also considered in the new safety guide on “Human Factors Engineering”, DS492. The assessment of the site characteristics is addressed in the safety guides on site evaluation for NPPs. Finally, a number of requirements on preparation of the safety assessment, responsibility for the safety assessment, management and use of the safety assessment, are addressed in the safety guides on management systems. The missing topics should be dealt with in the proposed new safety guide as well. [Some of them, e.g. the assessment of defence in depth, need a holistic analysis that cannot be the subject of individual safety guides \[FR\].](#)

4. OBJECTIVE

The objective of the new specific safety guide is to provide recommendations on the application of safety principles and general requirements in SSR 2/1, Rev.1, including those related to the extension of the plant design envelope and the practical elimination of plant conditions leading to early or large releases. Such topics have been addressed in TECDOC 1791, Considerations on the Application of the IAEA Safety Requirements for the Design of Nuclear Power Plants. This TECDOC, which is not part of the safety standards series, would be useful in the development of the proposed new safety guide.

The safety guide will provide also recommendations for the application of those safety requirements

of GSR Part 4, rev. 1 relevant for nuclear power plants and associated requirements in SSR 2/1, rev. 1 that are still not covered by other safety guides [\(see details in annex\)\[FR\]](#).

The new safety guide will mainly address the following requirements in GSR Part 4:

- Requirement 7: Assessment of safety functions
- Requirement 10: Assessment of engineering aspects
- Requirement 13: Assessment of defence in depth (DiD)

5. SCOPE

The new safety guide will cover [the requirements addressing\[FR\]](#) the topics described in the previous section. A preliminary table of contents is provided in section 7.

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

The safety guide will be a specific guide for nuclear power plants directly related with the following safety standards – without listing all of them – and other relevant publications:

Safety Standard Series

1. [Fundamental Safety Principles. Safety Fundamentals No. SF-1, Vienna \(2006\)\[FR\]](#)
- ~~1-2.~~ Safety of Nuclear Power Plants: Design, Specific Safety Requirements No. SSR-2/1 (Rev.1), Vienna (2016);
- ~~2-3.~~ Safety Assessment of Facilities and Activities, General Safety Requirements No. GSR Part 4 (Rev.1), Vienna (2016);
- ~~3-4.~~ DS449: Format and Content of the Safety Analysis Report for Nuclear Installations (revision of GS-G-4.1, 2004)
- ~~4-5.~~ SSG-30 Safety Classification of Structures, Systems and Components in Nuclear Power Plants (2014)
- ~~5-6.~~ SSG-39 Design of Instrumentation and Control Systems for Nuclear Power Plants (2016)
- ~~6-7.~~ DS487: Design of Fuel Handling and Storage Systems for Nuclear Power Plants (revision of NS-G-1.4, 2003)
- ~~7-8.~~ DS498: External Events Excluding Earthquakes in the Design of Nuclear Installation (Revision of NS-G-1.5, 2003)
- ~~8-9.~~ DS490: Seismic Design and Qualification for Nuclear Power Plants (Revision of NS-G-1.6, 2003)
- ~~9-10.~~ DS494: Protection against Internal Hazards in the Design of Nuclear Power Plants, revision and combination of NS-G-1.7 and NS-G-1.11 (Revision and combination of NS-G-1.7 and NS-G-1.11, 2004)
- ~~10-11.~~ SSG-34 Design of Electrical Power Systems for Nuclear Power Plants (2016)
- ~~11-12.~~ DS481: Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants (revision of NS-G-1.9, 2004)
- ~~12-13.~~ DS482: Design of Reactor Containment Structure and Systems for Nuclear Power Plants (revision of NS-G-1.10, 2004)

- ~~13~~14. _____ DS488: Design of the Reactor Core for Nuclear Power Plants (Revision of NS-G-1.12, 2005)
- ~~14~~15. _____ NS-G-1.13 Radiation Protection Aspects of Design for Nuclear Power Plants (2005)
- ~~15~~16. _____ DS491: Deterministic Safety Analysis for Nuclear Power Plants (revision of SSG-2, 2009)
- ~~16~~17. _____ SSG-3: Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants (2010)
- ~~17~~18. _____ SSG-4: Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants (2010)

Safety Report Series

IAEA Safety Report Series No. 46, Assessment of Defence in Depth for Nuclear Power Plants (2005), provides particular insights that can be useful [help](#) for the development of this safety guide

Nuclear Security Series [FR]

1. [NSS13: Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities.](#)
2. [NSS4: Engineering Safety Aspects of the Protection of Nuclear Power Plants against Sabotage](#)

TECDOC Series

IAEA TECDOC-1791 (2016): Considerations on the Application of the IAEA Safety Requirements for the Design of Nuclear Power Plants provides some details on some of the topics that will be included in the safety guide and could be used as basis for the development of the safety guide.

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7. OVERVIEW

The new safety guide will be structured in line with the current structure and content of specific safety guides and a scope as indicated above. The detailed table of contents will be defined during the development of the guide. Preliminarily, the following structure is proposed for the safety guide:

1. INTRODUCTION

2. OBJECTIVES AND SCOPE

3. STRUCTURE

4. DESIGN SAFETY PRINCIPLES

- Plant states considered in the design: [FR]
 - Normal operation
 - Abnormal operation
 - Design Basis Accidents
 - Design extension conditions without significant fuel degradation
 - Design extension conditions with core melting
- Demonstration of practical elimination of plant conditions potentially leading to large or early releases

5. ASSESSMENT OF SAFETY FUNCTIONS

- Fulfilment of fundamental and related safety functions
- Safety approach and plant safety architecture
- Radiation protection in design

6. ASSESSMENT OF ENGINEERING ASPECTS IMPORTANT TO SAFETY

- Proven engineering practices and operational experience
- Engineering design rules
- Innovative design features
- Conformity with applicable codes, standards and guides
- Load and load combination [WNA]
- Selection of materials
- Design for reliability and prevention of CCFs [GE], such as:
 - Redundancy and single failure assessment
 - Physical separation and independence
 - Diversity
 - In-service testing, maintenance, repair, inspections and monitoring
 - Equipment qualification
- Considerations for multi unit plant designs [BE, WNA]
- Safety assessment and verification of design provisions for [FR]:
 - Normal operation
 - Anticipated operational occurrences [JA, WNA]
 - Design Basis Accidents
 - Design extension conditions without significant fuel degradation
 - Design extension conditions with core melting

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7.5. ASSESSMENT OF DEFENCE IN DEPTH

- Implementation of defence in depth
- Assessment of robustness of each DiD level
- Independence of safety provisions for different defence in depth levels

6. ASSESSMENT OF SAFETY FUNCTIONS [FR]

- [Fulfilment of fundamental and related safety functions](#)
- [Safety approach, functions important to safety and plant safety architecture \[WNA\]](#)
- [Assessment of practical elimination of event sequences \[GE\] potentially leading to large or early releases \[FR\]](#)

REFERENCES

APPENDICES/ANNEXES (as appropriate)

8. PRODUCTION SCHEDULE:

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

	A*	B*	C*
STEP 1: Preparing a DPP	DONE	DONE	DONE
STEP 2: Approval of DPP by the Coordination Committee	March 2017		
STEP 3: Approval of DPP by the relevant review Committees	July 2017		
STEP 4: Approval of DPP by the CSS	November 2017		
STEP 5: Preparing the draft a TM is not expected to be organized	November 2017		
STEP 6: Approval of draft by the Coordination Committee	3Q 2018		
STEP 7: Approval by the relevant review Committees for submission to Member States for comments	4Q 2018		
STEP 8: Soliciting comments by Member States	1Q 2019		
STEP 9: Addressing comments by Member States	2Q 2019		
STEP 10: Approval of the revised draft by the Coordination Committee Review in NS-SSCS	3Q 2019		
STEP 11: Approval by the relevant review Committees	4Q 2019		
STEP 12: Endorsement by the CSS	1Q 2020		
STEP 13: Establishment by the Publications Committee and/or Board of Governors (for SF and SR only))			
STEP 14: Target publication date	4Q 2020		

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- *Column A for Safety Fundamentals, Safety Requirements and Safety Guides.*

- *Column B for Nuclear Security Series publications noting that for Technical Guides a fast track may be proposed and justified for approval by the NSGC at step 3. If approved, the draft will not be subject to the steps 4 to 10 and, be provided at step 11 to the NSGC to take note of it before its publication*
- *Column C for TECDOCs, safety reports and other publications*

9. RESOURCES

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


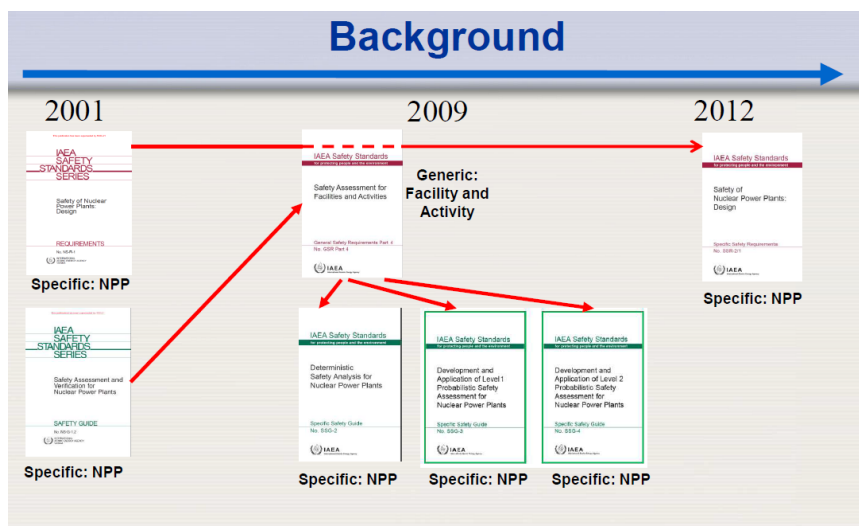
ANNEX: Gap Analysis in relation to guidance for the safety assessment of NPPs presented at the 37th NUSSC Meeting

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Background

- Pilot Exercise on SG review /revision process conducted in 2013 identified gaps in safety assessment guidance as a result of:
 - Fukushima lessons learned,
 - publication of SSR 2/1
 - Superseding of N-SG-1.2 Safety Assessment and Verification
- **SSG-2 is a main document affected**

Current Situation

- Main issues found so far:
- Not all the contents of NS-G-1.2 have been carried forward into GSR Part 4 as the basis for requirements for “NPP” safety assessment.
- Not all the requirements of GSR Part 4 are covered by the supporting safety assessment safety guides (for NPPs).

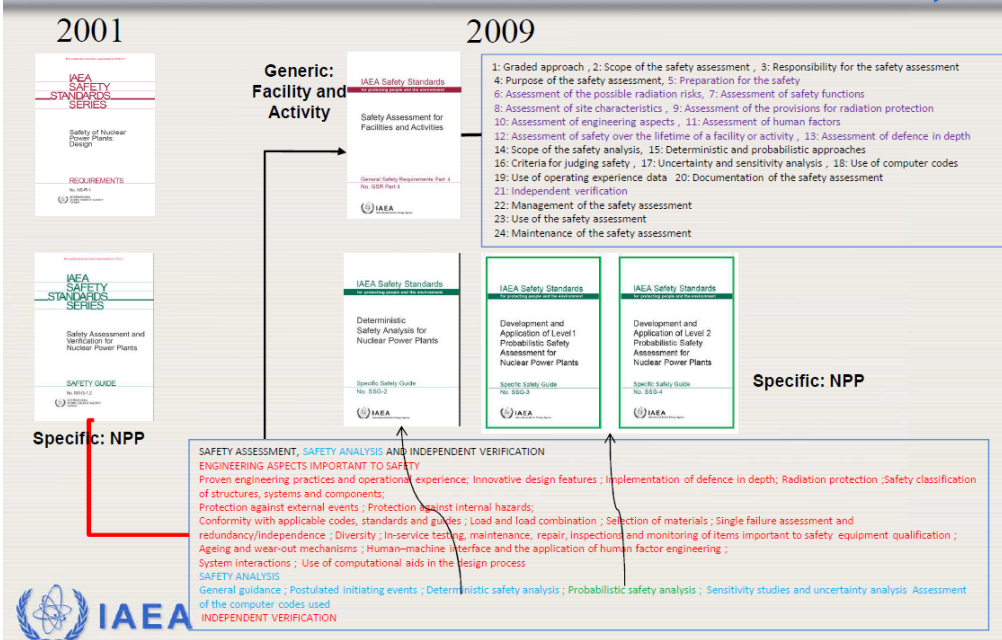
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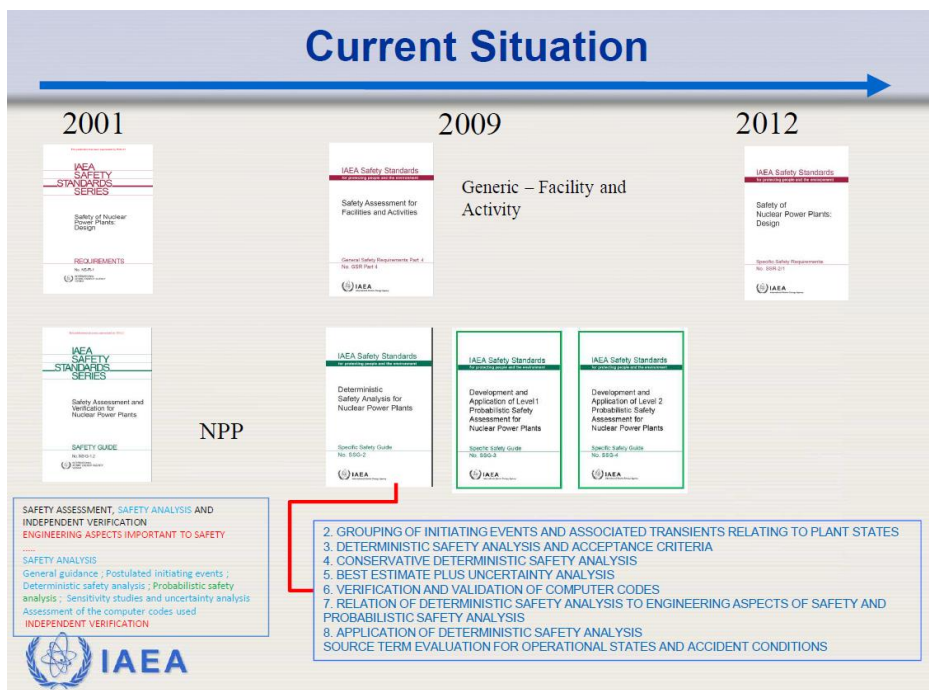
Current Situation

- NS-G-1.2 covered the topics of deterministic and probabilistic safety assessment, and all the issues of the engineering aspects important to safety assessment and **safety verification** that are necessary for assessing an NPP design.
- These design assessment topics are not covered in SSG-2, which concentrates on the accident analysis methodological approaches.
- NS-G-1.2 was also more practical and specific for the safety assessment and verification of an NPP design.
- The development of concepts in SSR-2/1 (DEC etc.) need to be reflected in the safety assessment guidance.

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Current Situation





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Current Situation

- In particular, guidance is not provided (at least clearly) for meeting GSR part 4 requirements # 5 to 13, 21 in SSG-2 (and perhaps some others):
 - Preparation for the safety assessment
 - Assessment of the possible radiation risks
 - Assessment of safety functions
 - Assessment of site characteristics
 - Assessment for the provisions for Radiation Protection
 - Assessment of engineering aspects
 - Assessment of human factors (*No SG on Human Factors for NPP Design either*)
 - Assessment of safety of the lifetime of a facility
 - Assessment of defence in depth
 - Independent verification

We recognise that some of these aspects may be already addressed in other documents

Conclusions from NUSSC WG Meeting Feb. 2014

- The extent of the gaps in coverage was requested to be mapped out at the last NUSSC meeting. A gap analysis was presented by Japan at the NUSSC WG meeting.
- The Secretariat took this gap analysis from Japan as a kind and valuable input and complemented it. The analysis revealed sizable gaps in the coverage of the safety assessment safety guidance
- The main gap relates to safety assessment and verification associated with the engineering aspects of the safety assessment of an NPP design.
- SSG-2 should be updated to cover the applicable gaps. The opportunity should be used to align it with new or revised issues in SR 2/1, e.g. DEC, best estimate analysis, margins, etc.
- New engineering design safety assessment guidance would be needed to address the other issues identified in the gap analysis. It could also include new topics such as:
 - The assessment of independence/effectiveness of the defence in depth levels
 - The demonstration of practical elimination of large releases.
- No DPPs have been elaborated so far

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Way forward

