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Document Preparation Profile (DPP)
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1. IDENTIFICATION

Document Category: Specific Safety Guide

Working ID: DS523

Proposed Title: Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants

Proposed Action: Revision of IAEA Safety Guide SSG-3 “Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants” (2010) by Amendment

Review Committee: NUSSC, NSGC

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2. BACKGROUND

The IAEA Safety Guide SSG-3 “Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants” (2010) (hereinafter referred to as the Guide) was published to meet requirements from GSR Part 4 “Safety Assessment for Facilities and Activities” (2009) on probabilistic safety assessment, taking into account specific aspects of nuclear power plants addressed in NS-R-1 “Safety of Nuclear Power Plants: Design” (2000).

Over the last decade, all relevant Safety Requirements publications have been revised. GSR Part 4 was superseded by GSR Part 4 (Rev. 1) “Safety Assessment for Facilities and Activities” (2016). Additionally, NS-R-1 was superseded by SSR-2/1 “Safety of Nuclear Power Plants: Design” (2012), which was revised later and replaced by SSR-2/1 (Rev. 1) in 2016. Similarly, NS-R-2 was superseded by SSR-2/2 “Safety of Nuclear Power Plants: Commissioning and Operation” (2012), which was revised later and replaced by SSR-2/2 (Rev. 1) in 2016. The aforementioned revisions were mainly driven by the feedback of experience and lessons learned from the Fukushima Daiichi nuclear power plant accident, as well as by the recent developments of the relevant practices in Member States.

Among the significant changes in the IAEA Safety Requirements are those incorporated in GSR Part 4 (Rev. 1), where it is stated that:

“The revisions to GSR Part 4 relate to the following main areas:

- Margins for withstanding external events;*
- Margins for avoiding cliff edge effects;*
- Safety assessment for multiple facilities or activities at a single site;*
- Safety assessment in cases where resources at a facility are shared;*
- Human factors in accident conditions.”*

In addition, relevant changes have been introduced to NS-R-1 and NS-R-2 publications that were revised twice (in 2012 and 2016), meanwhile the superseded versions of these documents are

still referenced in the Guide. The changes in the Safety Requirements SSR-2/1 (Rev. 1) and SSR-2/2 (Rev. 1) in relation to PSA are associated with the establishment of more detailed requirements on the application of PSA for NPP design and use of probabilistic considerations in decision making during plant operation.

Thus, there is a need to revise the Guide by amendment in order to reflect above mentioned developments and changes.

3. JUSTIFICATION FOR THE PRODUCTION OF THE DOCUMENT

An analysis of the scope and content of the Guide concluded that it largely remains valid in its technical content but has outdated references and requires revision in order to address changes incorporated in the relevant Safety Requirements. In addition, the above-mentioned analysis has shown that the Guide requires incorporation of the recent developments in Member States in specific areas related to PSA, such as multiunit PSA, spent fuel pool PSA, passive systems reliability and computer based systems reliability.

Hence, the Guide will be revised by amendment, taking into account the above-mentioned conclusions. The added value of the revised Guide will be to provide Member States with comprehensive, consistent and up-to-date recommendations for the development and application of Level 1 PSA for NPPs covering a wider scope.

The revision of the Guide proposed in this DPP is timely considering that there is a need to reflect the changes introduced by revisions in Safety Requirements and recent developments in Member States in specific areas related to PSA. In addition, the Guide was published almost ten years ago and contains references to superseded IAEA Safety Standards and other obsolete publications.

Thus, the revision of the Guide will cover the following considerations:

- Revisions implemented in IAEA Safety Standards;
- Lessons from the accident at the Fukushima Daiichi nuclear power plant ;
- Expanding the scope of PSA;
- Recent developments in Member States related to PSA;
- Experience gained with IAEA PSA review services (i.e. TSR-PSA).

More specifically, amendments of the Guide are needed to address the following aspects:

1. Development of multiunit Level 1 PSA models, to reflect the changes introduced in GSR Part 4 (Rev. 1) and experience cumulated within the IAEA activities in the area of Multiunit PSA;
2. Expanding the scope of the Guide to cover also the spent fuel pools as a source of radioactive material¹;
3. Considerations of hazard combinations, to supplement corresponding discussion in Sections 6 and 8 of the current Guide);

¹ Currently the Guide is focused on the reactor core and does not cover spent fuel pools on the site. However, while considering Level 1 PSA for low power and shutdown modes, the risk from the fuel assemblies transferred from the reactor core is also addressed.

4. Recent developments in the area of human factors in accident conditions to supplement the paragraphs 5.96 – 5.113.
5. Recent developments in the area of reliability analysis of passive systems and software-based systems, to supplement the paragraphs 5.114-5.120 of the current Guide;
6. Recent developments in the area of use and applications of PSA, to supplement Section 10 of the current Guide;
7. Experience gained from IAEA PSA review services in various Member States (i.e. TSR-PSA) in terms of applicability of certain paragraphs of the Guide for review purposes.

In addition, taking into account that PSA can reveal vulnerabilities some Member States consider PSA report as a classified document and therefore, this Safety Guide is considered as a generic safety-security interface document. At the same time, it needs to be noted that the consideration of hazards arising from malicious acts is out of the scope of this Safety Guide and therefore, there are no specific safety-security interfaces.

4. OBJECTIVE

The objective of this Safety Guide is to provide recommendations for meeting the requirements of GSR Part 4 (Rev. 1) in development and application of Level 1 Probabilistic Safety Assessment for NPPs.

The recommendations provided in this Safety Guide aim at promoting technical consistency among Level 1 PSA studies, in order to provide reliable support for applications of PSA and risk informed decision making, particularly to support the design of NPPs and the decision making during plant commissioning and operation.

A further aim of this Safety Guide is to recommend a standard framework that can facilitate a regulatory review or peer review of a Level 1 PSA and its various applications.

The revised Safety Guide is intended for use by designers, operators, technical support organizations and regulators in development and application of Level 1 PSA. The revised Safety Guide is intended for use in connection with authorization (licensing) of the construction of new nuclear power plants and also for the safety re-evaluation of existing nuclear power plants.

5. SCOPE

This Safety Guide addresses the necessary technical features of a Level 1 PSA and applications for nuclear power plants (both operating and new NPPs). The revision of the Guide expands the scope to cover multiunit PSA aspects and spent fuel pools as a source of radioactive material. The consideration of hazards arising from malicious acts is out of the scope of this Safety Guide.

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

This Guide will interface with at least the following IAEA Safety Standards Series and other publications:

- 1) GSR Part 4 (Rev. 1) - Safety Assessment for Facilities and Activities (2016)
- 2) SSR-2/1 (Rev. 1) - Safety of Nuclear Power Plants: Design (2016)
- 3) SSR-2/2 (Rev. 1) - Safety of Nuclear Power Plants: Commissioning and Operation (2016)
- 4) SSG-4 - Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants (2010)
- 5) GS-G-4.1 - Format and Content of the Safety Analysis Report for Nuclear Power Plants (revision of the Safety Guide is in STEP 12, DS449)
- 6) SSG-2 - Deterministic Safety Analysis for Nuclear Power Plants (revision of the Safety Guide is in STEP 12, DS491)
- 7) SSG-25 - Periodic Safety Review for Nuclear Power Plants (2013)
- 8) SSG-51 - Human Factors Engineering in Nuclear Power Plants (2019)
- 9) DS494 - Protection against Internal Hazards in the Design of Nuclear Power Plants (revision and merge of NS-G-1.7 and NS-G-1.11 Safety Guides is in STEP 11, DS494)
- 10) INSAG-25 - A Framework for an Integrated Risk Informed Decision Making Process (2011)
- 11) NSS 23-G - Security of nuclear information (2015)

7. OVERVIEW

It is planned to keep the structure and the table of contents of the revised Safety Guide similar to the present Safety Guide SSG-3. The Guide will retain its overall structure at section level (except the new Section on Multiunit PSA). The contents of the Guide will be similar to the present Safety Guide SSG-3, with certain amendments mentioned above. The planned table of contents is as follows:

1. INTRODUCTION
2. GENERAL CONSIDERATIONS RELATING TO THE PERFORMANCE AND USE OF PSA
3. PROJECT MANAGEMENT AND ORGANIZATION FOR PSA
4. FAMILIARIZATION WITH THE PLANT AND COLLECTION OF INFORMATION
5. LEVEL 1 PSA FOR INTERNAL INITIATING EVENTS FOR FULL POWER OPERATING CONDITIONS
6. GENERAL METHODOLOGY FOR LEVEL 1 PSA FOR INTERNAL AND EXTERNAL HAZARDS
7. SPECIFICS OF LEVEL 1 PSA FOR INTERNAL HAZARDS
8. SPECIFICS OF LEVEL 1 PSA FOR EXTERNAL HAZARDS
9. LEVEL 1 PSA FOR LOW POWER AND SHUTDOWN MODES

10. LEVEL 1 PSA FOR SPENT FUEL POOLS

11. LEVEL 1 PSA IN MULTIUNIT CONTEXT

12. USE AND APPLICATIONS OF PSA

REFERENCES

ANNEX I: EXAMPLE OF A GENERIC LIST OF INTERNAL AND EXTERNAL HAZARDS

ANNEX II: EXAMPLES OF FIRE PROPAGATION EVENT TREES AND SEISMIC EVENT TREES

ANNEX III: SUPPORTING INFORMATION ON PSA FOR LOW POWER AND SHUTDOWN MODES

CONTRIBUTORS TO DRAFTING AND REVIEW

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

STEP 1: Preparing a DPP	DONE
STEP 2: Approval of DPP by the Coordination Committee	April 2019
STEP 3: Approval of DPP by the relevant review Committees	June 2019
STEP 4: Approval of DPP by the CSS	December 2019
STEP 5: Preparing the draft	2Q 2020
STEP 6: Approval of draft by the Coordination Committee	3Q 2020
STEP 7: Approval by the relevant review Committees for submission to Member States for comments	4Q 2020
STEP 8: Soliciting comments by Member States	2Q 2021
STEP 9: Addressing comments by Member States	3Q 2021
STEP 10: Approval of the revised draft by the Coordination Committee Review in NSOC-SGDS (Technical Editorial review)	1Q 2022
STEP 11: Approval by the relevant review Committees	2Q 2022
STEP 12: - Submission to the CSS - Submission in parallel and approval by the Publications Committee - MTC D Editing - Endorsement of the edited version by the CSS	4Q 2022
STEP 13: Establishment by the Publications Committee and/or Board of Governors (for SF and SR only)	1Q 2023
STEP 14: Target publication date	2Q 2023

9. RESOURCES

It is estimated that revision of the Guide by amendment would involve approximately 25 weeks of effort by experts. This is based upon assuming 3 one-week consultant meetings involving no more than 5 experts and an average of one week of work per expert between meetings.

Agency resources involved are estimated at 8 weeks of effort by the Technical Officer.