SPESS F
Document Preparation Profile (DPP)
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1. IDENTIFICATION

Document Category: **Specific Safety Guide**

Working ID: **DS528**

Proposed Title: **Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants**

Proposed Action: **Full Revision of the IAEA Safety Guide SSG-4 "Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants" (2010)**

Review Committee(s) or Group: **NUSSC**

Technical Officer: **Jorge LUIS HERNANDEZ (SAS/NSNI)**

2. BACKGROUND

The IAEA Safety Guide SSG-4 "Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants" (2010) (hereinafter referred to as the Safety Guide) was developed to provide recommendations for the development and application of Level 2 PSA for nuclear power plants (NPPs) together with SSG-3 (on Level 1 PSA) and to meet the relevant requirements established in the IAEA Safety Standards existing at that time, in particular GSR Part 4 "Safety Assessment for Facilities and Activities" (2009), NS-R-1 "Safety of Nuclear Power Plants: Design" (2000), and NS-R-2 "Safety of Nuclear Power Plants: Operation" (2000).

Since then, all these Safety Requirements publications have been revised, taking into account the latest developments and relevant practices in the Member States as well as the feedback from the Fukushima Daiichi nuclear accident in 2011.

Among the significant changes incorporated into the Safety Requirements publications GSR Part 4 (Rev. 1), SSR-2/1 (Rev. 1) and SSR-2/2 (Rev. 1) are those related to severe accidents, and the margins to both withstand extreme external events and avoid cliff edge effects.

Those changes have had an impact on safety provision incorporated, in the plant design as well as on the plant operation for all plant states, to cope with severe accidents which are modelled in Level 2 PSA.

3. JUSTIFICATION FOR THE PRODUCTION OF THE DOCUMENT

An analysis of the scope and content of the Safety Guide concluded that it is necessary to incorporate updated technical content and to address the changes incorporated in the relevant Safety Requirements publications. Additionally, the Safety Guide requires incorporation of the recent developments in Member States in specific areas related to Level 2 PSA, such as:

- Modelling of additional safety features considered for design extension conditions;

- Modelling the use of non-permanent equipment;
- Multiunit and multi-source considerations;
- Severe accident management;
- More detailed information on current practices considering low power and shutdown states as well as internal and external hazards, and their combinations, in the scope of the Level 2 PSA;
- More detailed information on the latest update on strategies for dealing with the progression of core damage and with damage of fuel in the spent fuel pool and their related phenomena, and the results of experiments conducted in support of those strategies and improvements of code simulation capabilities; as the interface between Level 1 and Level 2 PSA is based on both CDF and FDF;
- More detailed guidance on human factors for Level 2 PSA;
- Expansion of the scope of the Safety Guide by providing practical examples of Level 2 PSA practice for different reactor technologies to the extent possible.
- Development and use of dynamic and parametric models

Hence, the Safety Guide will undergo a full revision to incorporate the above-mentioned aspects in the related sections. The added value of the revised Safety Guide will be to provide Member States with comprehensive, consistent and up-to-date recommendations for the development and application of Level 2 PSA for NPPs.

4. OBJECTIVE

The objective of this Safety Guide is to provide recommendations for meeting the requirements of GSR Part 4 (Rev. 1), SSR-2/1 (Rev. 1) and SSR-2/2 (Rev. 1) regarding Level 2 PSA for NPPs. In addition, it will complement the recommendations in the Safety Guide on Level 1 PSA.

It is expected that the Safety Guide will promote technical consistency among Level 2 PSA studies and their application to risk informed decision making. In particular, it aims at providing guidance to support:

(a) Comparison of results of the Level 2 PSA with probabilistic safety goals or criteria, if these have been set, to assess the overall level of safety of the plant;

(b) Evaluation of plant design to identify potential vulnerabilities in the mitigation of severe accidents;

(c) Development of severe accident management guidelines that can be applied following fuel damage;

(d) To provide the source terms as input into emergency planning;

(e) Use of the source terms and frequencies as input data to assess off-site consequences;

(f) Prioritization of research relating to severe accident issues;

(g) Use of a range of other PSA applications in combination with the Level 1 PSA results and insights;

(h) More detailed considerations to address the combination of hazards.

In addition, this Safety Guide will provide a standard framework to facilitate a regulatory review or peer review of Level 2 PSA and its various applications.

The revised Safety Guide is intended for use by designers, operating organizations, technical support organizations and regulatory bodies in the development, application and independent review of Level 2 PSA. The revised Safety Guide is also intended for use in connection with both the review for authorization (licensing) of the construction and the operation of new NPPs and the safety re-evaluation of existing NPPs during periodic safety reviews and modifications.

5. SCOPE

This Safety Guide addresses the necessary technical features of Level 2 PSA and applications for both existing and new NPPs. The revision of the Safety Guide expands the content to integrate updated considerations for Level 2 PSA on areas mentioned in Section 3 of this DPP.

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 (the list is not intended to be final or exhaustive):

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-3 – Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants (under revision, DS523)
5) GS-G-4.1 – Format and Content of the Safety Analysis Report for Nuclear Power Plants (under revision, DS449)
6) SSG-2 (Rev.1) – Deterministic Safety Analysis for Nuclear Power Plants (2019)
7) SSG-25 – Periodic Safety Review for Nuclear Power Plants (2013)
8) SSG-30 – Safety Classification of Structures, Systems and Components in Nuclear Power Plants (2014)
9) SSG-51 – Human Factors Engineering in Nuclear Power Plants (2019)
10) SSG-52 – Design of the Reactor Core for Nuclear Power Plants (2019)
11) SSG-53 – Design of the Reactor Containment and Associated Systems for Nuclear Power Plants (2019)
12) SSG-54 – Accident Management Programmes for Nuclear Power Plants (2019)
13) SSG-56 – Design of the Reactor Coolant System and Associated Systems for Nuclear Power Plants (2020)
14) DS440 – Design of Auxiliary and Supporting Systems for Nuclear Power Plants
15) DS490 – Seismic Design of Nuclear Installations (revision of NS-G-1.6)

16) 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)
17) DS514 – Equipment Qualification for Nuclear Installations
18) DS498 – Design of Nuclear Installations Against External Events Excluding Earthquakes (revision of NS-G-1.5)
19) DS503 – Protection against Internal and External Hazards in the Operation of Nuclear Power Plants (revision of NS-G-2.1)
20) INSAG-25 – A Framework for an Integrated Risk Informed Decision Making Process (2011)
21) NEA/CSNI/R(2018)1 - Status of Practice for Level 3 Probabilistic Safety Assessments. Nuclear Energy Agency / Committee on the Safety of Nuclear Installations. (2018).

7. OVERVIEW

It is planned to keep the structure and the table of contents of the revised Safety Guide similar to the current Safety Guide SSG-4. The Safety Guide will retain its overall structure at section level. The planned table of contents incorporating the new subjects is as follows:

1. INTRODUCTION
2. GENERAL CONSIDERATIONS RELATING TO THE PERFORMANCE AND USE OF LEVEL 2 PSA
3. PROJECT MANAGEMENT AND ORGANIZATION FOR PSA
4. FAMILIARIZATION WITH THE PLANT DESIGN AND SEVERE ACCIDENT MANAGEMENT.
5. INTERFACE WITH LEVEL 1 PSA
6. SEVERE ACCIDENT PROGRESSION ANALYSIS
7. CONTAINMENT PERFORMANCE ANALYSIS
8. ACCIDENT PROGRESSION EVENT TREE OR CONTAINMENT EVENT TREE
9. SOURCE TERM FOR SEVERE ACCIDENTS
10. QUANTIFICATION AND ANALYSIS OF RESULTS
11. DOCUMENTATION OF THE ANALYSIS: PRESENTATION AND INTERPRETATION OF RESULTS
12. SPENT FUEL POOL
13. MULTI UNIT LEVEL 2 PSA
14. USE AND APPLICATION OF LEVEL 2 PSA
15. REFERENCES
16. ANNEX I: EXAMPLES OF HUMAN RELIABILITY ASSESSMENT MODELS FOR A LEVEL 2 PSA STUDY
17. ANNEX II: COMPUTER CODES FOR SIMULATION OF SEVERE ACCIDENTS
18. ANNEX III: SAMPLE OUTLINE OF DOCUMENTATION FOR A LEVEL 2 PSA STUDY
19. ANNEX IV – PHENOMENA STUDIES – EXPERIMENTAL BASIS

20. 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 2020
STEP 3: Approval of DPP by the relevant review Committees	June 2020
STEP 4: Approval of DPP by the CSS	November 2020
STEP 5: Preparing the draft	2Q 2021
STEP 6: Approval of draft by the Coordination Committee	3Q 2021
STEP 7: Approval by the relevant review Committees for submission to Member States for comments	4Q 2021
STEP 8: Soliciting comments by Member States	1Q 2022
STEP 9: Addressing comments by Member States	2Q 2022
STEP 10: Approval of the revised draft by the Coordination Committee Review in NSOC-SGDS (Technical Editorial review)	4Q 2022
STEP 11: Approval by the relevant review Committees	2Q 2023
STEP 12: - Submission to the CSS - Submission in parallel and approval by the Publications Committee - MTCD Editing - Endorsement of the edited version by the CSS	4Q 2023
STEP 13: Establishment by the Publications Committee and/or Board of Governors (for SF and SR only))	1Q 2024
STEP 14: Target publication date	3Q 2024

9. RESOURCES

It is estimated that the revision of the Safety Guide by a full revision would involve approximately 30 weeks of effort by experts. This is based upon assuming 4 one-week consultant's 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 10 weeks of effort by the Technical Officer.