Document Preparation Profile (DPP)
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1. IDENTIFICATION

Document Category: **Safety Guide**

Working ID: **DS507**

Proposed Title: **Seismic Hazards in Site Evaluation for Nuclear Installations**

Proposed Action: **Revision of a document "Seismic Hazards in Site Evaluation for Nuclear Installations" Specific Safety Guide SSG-9 (2010)**

Review Committee(s): **NUSSC, WASSC**

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2. BACKGROUND

Since its publication in 2010, the Specific Safety Guide SSG-9 "Seismic Hazards in Site Evaluation for Nuclear Installations" has been used extensively in IAEA safety review services. SSG-9 included several major amendments, inter alia, it expanded the scope of the preceding safety guide (NS-G-3.3) from nuclear power plants to nuclear installations, introduced a graded approach in order to treat the seismic hazard assessment for nuclear installations other than nuclear power plants, incorporated concepts of simulating ground motion based on fault rupture modelling and strengthened the guidance on the use of prehistorical evidences (Palaeoseismology) and on the treatment of uncertainties.

SSG-9 (2010) emphasized recognition and reduction of uncertainties (e.g., paragraphs 2.6 ~ 2.10) based on the lessons learned from the 2007 Niigata-ken Chuetsu Oki earthquake, where the observed ground motion largely exceeded the design basis ground motion of Kashiwazaki Kariwa NPP in Niigata Prefecture, Japan. Nevertheless, the 2011 off the Pacific coast of Tohoku earthquake and tsunami occurred in Japan Trench on March 11 highlighted again issues of uncertainties in the assessment of seismic hazards in site evaluation. The 3rd International Experts Meeting on external events (2012) and the Director-General's report on Fukushima Daiichi Accident (2015) identified several issues on seismic hazard assessment, including 1) natural hazard assessment has to be sufficiently conservative, 2) periodical review of nuclear safety including design basis external events, 3) combination of natural hazards and simultaneous effects of natural hazards on multiple units in a site and a single unit site, and 4) the use of operating experiences for safety improvements. In order to address those issues, NS-R-3 was revised into NS-R-3 Rev.1 in 2016.

Assessment of seismic hazard is a multi-disciplinary field that involves knowledge and techniques of geology, geophysics, geotechnical engineering and seismology which are fast evolving disciplines in terms that new data are obtained using state-of-the-art technologies. For example, Light Detection and Ranging technology (in short LiDAR) has become common over the past decade in order to obtain a digital elevation model of ground surface (geodetic and geomorphological data) in the site vicinity of nuclear installations. Geodetic and geomorphological data by LiDAR enables more precise analysis and insights to identify capable seismogenic structures. Another example is increase of seismological information. By the accumulation of digitally recorded ground motions in many parts of the world, seismologists are now able to evaluate seismogenic structure and relevant ground motions efficiently (e.g., new ground motion prediction equations and simulated ground motions using fault rupture modelling). The technical advancement and innovations in this field can be utilized in order to reduce

uncertainties in seismic hazard assessments and they also have to be incorporated in the safety guide in order to disseminate to Member States.

There has also been significant progress in the approaches used for fault displacement hazard analysis since the publication of SSG-9 (2010). Fault displacement, which is one of the seismically induced hazards, collects attention of scientists and researchers internationally. A workshop on this subject was held in December 2016 in the United States hosted by the United States Geological Survey, Menlo Park, and research activities and accumulation of field survey data showed a progress in developing and improving fault displacement hazard assessment methodologies. In the USA and Japan, academic societies have been developing standards on fault displacement hazard assessment for nuclear facilities. Additionally, from 2012 to 2016, six Japanese existing nuclear power plant site owners have gone through intensive investigations about the capability of faults located in the sites and are assessing hazards if they are capable for displacement. The regulatory body's expert panels reviewed the results of the owners, and submitted reports to the regulator.

3. JUSTIFICATION FOR THE PRODUCTION OF THE DOCUMENT

As indicated above, the knowledge and technology of seismic hazard assessment have evolved rapidly. Although no flaws have been observed in the application of SSG-9 (2010), it is considered that in order to keep up with the pace of the scientific and technological progress, reducing uncertainty and lessons learned from past events (e.g. Fukushima Daiichi accident) a revision of this Safety Guide will be timely.

In addition to the reasons provided above, other considerations that would justify its revision would be based on:

- To reinforce recommendations pursuant to meet the objectives of the Vienna Declaration on Nuclear Safety;
- To make the guide consistent with Safety Requirements for Site Evaluation of Nuclear Installations (NS-R-3 Full-revision in progress, as DS484)
- To take into account relevant aspects of the Director General's Report on the Fukushima Daiichi Accident, IAEA, 2015

4. OBJECTIVE

The objective to revise Safety Guide SSG-9 (2010) is to reflect the feedback received by the Member States following its application. It is intended to review and if necessary revise the following topics with high priority:

- Including newly developed methods of data collection (such as LiDAR, GPS, geophysical and palaeoseismological methods, instrumental seismological records). Providing more detailed guidance on the database requirements for new and existing nuclear installations.
- Addressing issues related to multi-unit sites.
- Including and providing more details on recently developing subjects in the Safety Guide, such as ground motion simulation based on fault rupture modelling, kappa correction, cumulative absolute velocity filtering, sigma truncation, etc.

- Providing clearer and detailed guidance on capable faults and fault displacement hazard analysis for new and existing nuclear installations
- Providing a more consistent approach for treating all geotechnical hazards generated by earthquakes which are treated or discussed in different safety guides (e.g. the earthquake relevant hazards are treated insufficiently in NS-G-3.6)
- Providing clearer and detailed guidance on combination of seismic hazards (including both surface faulting and ground motion) and relevant geological, hydrological and geotechnical hazards.
- Providing clearer and detailed guidance on hazard/design interface with site response.

5. SCOPE

It is not intended to significantly change the scope of the Safety Guide, that is primary seismic hazard evaluation for any nuclear installations.

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

This Safety Guide falls within the thematic area of Site Evaluation and will interface with the following IAEA Safety Standards and other publications (this is not, and cannot be, regarded as an exclusive or exhaustive list):

- Site Evaluation for Nuclear Installations - Safety Requirements, NS-R-3 Rev. 1 (2016)
- Site Evaluation for Nuclear Installations – Specific Safety Requirements (DS484)
- Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Plants, Safety Guide, NS-G-3.6 (2005).
- Evaluation of Seismic Safety for Existing Nuclear Installations Safety Guide NS-G-2.13 (2009)
- Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations, Safety Guide SSG-18 (2011)
- Volcanic Hazards in Site Evaluation for Nuclear Installations, Safety Guide, SSG-21 (2012)
- Seismic Design and Qualification for Nuclear Power Plants, Safety Guide, NS-G-1.6 (2003) (DS490)

7. OVERVIEW

It is planned to keep the structure and the Table of Contents of the revised Safety Guide similar to the present SSG-9 (2010):

1. INTRODUCTION
2. GENERAL RECOMMENDATIONS
3. NECESSARY INFORMATION AND INVESTIGATIONS (DATABASE)
4. CONSTRUCTION OF A REGIONAL SEISMOTECTONIC MODEL
5. EVALUATION OF THE GROUND MOTION HAZARD
6. SEISMIC HAZARD ANALYSIS

7. POTENTIAL FOR SEISMICALLY INDUCED FAULT DISPLACEMENT AT THE SITE AND GEOLOGICAL HAZARDS
8. DESIGN BASIS GROUND MOTION, FAULT DISPLACEMENT AND OTHER HAZARDS
9. EVALUATION OF SEISMIC HAZARDS FOR NUCLEAR INSTALLATIONS OTHER THAN NUCLEAR POWER PLANTS
10. PROJECT MANAGEMENT SYSTEM

REFERENCES

ANNEXES

DEFINITIONS

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	Q1 2017
STEP 3: Approval of DPP by the relevant review Committees	Q1 2017
STEP 4: Approval of DPP by the CSS	Q2 2017
STEP 5: Preparing the draft (TM to be organized)	Q2-Q3 2017
STEP 6: Approval of draft by the Coordination Committee	Q4 2017
STEP 7: Approval by the relevant review Committees for submission to Member States for comments Consultation with all SSC on possible restructuring of the safety guides and preparing of one guide	Q1 2018
STEP 8: Soliciting comments by Member States	Q2 2018
STEP 9: Addressing comments by Member States	Q4 2018
STEP 10: Approval of the revised draft by the Coordination Committee Review in NS-SSCS	Q1 2019
STEP 11: Approval by the relevant review Committees	Q2 1019
STEP 12: Endorsement by the CSS	Q4 2019
STEP 13: Establishment by the Publications Committee	Q1 2020
STEP 14: Target publication date	Q4 2020

9. RESOURCES

Staff: 20 staff weeks
Consultants: 10 consultant weeks