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Document Preparation Profile (DPP)
Version ~~02~~ 03 dated ~~27 November 2017~~20 June 2018

1. IDENTIFICATION

Document Category or set of publications to be revised in a concomitant manner:

Safety Guides

Working ID: **DS514**

Proposed Title: **~~Equipment~~ Qualification of Items Important to Safety in Nuclear Installations**

Proposed Action: **New document**

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

Technical Officer(s): **Alexander DUCHAC**

2. BACKGROUND

The ~~equipment~~ qualification of items important to safety in nuclear installations is a vital part of the installation design basis. IAEA Safety Standards Series No. SSR-2/1 (Rev. 1), Safety of Nuclear Power Plants: Design states that "a qualification programme for items important to safety shall be implemented to verify that items important to safety at a nuclear power plant are capable of performing their intended functions when necessary, and in the prevailing environmental conditions, throughout their design life, with due account taken of plant conditions during maintenance and testing".

Equipment qualification is an important design attribute to minimize ~~common cause~~ failures of ~~equipment~~ items important to safety due to the effect of issues related to functional, seismic, and environmental capability, and potential electromagnetic interference and harsh environmental over the full range from normal operating conditions resulting from accidental to and including design-basis conditions~~due to the effect of seismic, electromagnetic interference and harsh environmental conditions resulting from accident conditions~~. Equipment qualification will also cover all items important to safety which are installed after the initial start-up of the nuclear installation in the course of modifications, aging management and obsolescence management. An incomplete design basis that results in equipment not being qualified for the intended function cannot be solved by redundancy or diversity.

Equipment qualification includes qualification of items important to safety for functional capability, seismic conditions, environmental conditions, and electromagnetic interference effects over the full range from normal operating conditions up to and including design basis accident conditions. The qualified life for a particular equipment type component is established by type testing, analysis, or a combination of testing and analysis in accordance with methods provided in industrial accepted consensus standards (e.g., IEC/IEEE 60780/323). The qualified life considers the in-service ageing of equipment as a result of environmental stressors present in equipment locations during normal operating conditions of the installation (such as temperature, humidity, radiation, and submergence), including the capability to perform their intended safety functions under design-basis accident conditions near the end of its qualified life.~~Equipment qualification includes qualification of structures, systems and components to seismic, environmental and electromagnetic interference effects. The qualified life for a particular equipment type is established by type testing in accordance with methods provided in industrial standards (e.g. IEC/IEEE 60780/323). The qualified life considers the in-service ageing of~~

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~~equipment as a result of environmental stressors present in equipment locations during normal operating conditions of the installation (temperature, humidity, radiation).~~

Equipment relied upon to perform safety functions in the event of design extension conditions with core melting should also be demonstrated to be capable of performing those functions using implementation of a qualification programme. However, given the potential uncertainties of conditions during design extension conditions with core melting, the demonstration of this capability can be done using realistic analyses, considering uncertainties and margins as appropriate regarding the definition of these conditions.

~~IAEA Safety Standards Series No. SSR-2/1 (Rev. 1), Safety of Nuclear Power Plants: Design, takes into account equipment qualification as part of the plant design basis, and requires that the equipment qualification for operational states as well as accident conditions be demonstrated.~~

IAEA Safety Standards Series No. SSR-2/2 (Rev. 1), Safety of Nuclear Power Plants: Commissioning and Operation requires the systematic assessment of equipment qualification to provide reliable confirmation that items important to safety are capable of the required performance for operational states and for accident conditions.

IAEA Safety Standards Series No. SSR-3, Safety of Research Reactors, and IAEA Safety Standards Series No. SSR-4, Safety of Nuclear Fuel Cycle Facilities require a qualification programme to be implemented for a research reactor facility to verify that items important to safety are capable of performing their intended functions when necessary, and in the prevailing environmental conditions resulting from accident conditions, throughout their design life, with due account taken of reactor conditions during maintenance and testing.

IAEA Safety Standards Series No. GSR Part 4 (Rev. 1), Safety Assessment of Facilities and Activities, requires that equipment qualification be assessed as part of the assessment of engineering aspects and the assessment of safety functions.

Equipment qualification is also an individual safety factor in the periodic safety review of nuclear power plants (IAEA Safety Standards Series No. SSG-25, Periodic Safety Review for Nuclear Power Plants), and should be considered in the classification of structures, systems and components (see IAEA Safety Standards Series No. SSG-30, Safety Classification of Structures, Systems and Components in Nuclear Power Plants).

IAEA Safety Reports Series No. 3, Equipment Qualification in Operational Nuclear Power Plants: Upgrading, Preserving and Reviewing, was published in 1998. The information provided in this Safety Report needs to be updated to be consistent with current safety requirements (e.g. to provide reliable confirmation that items important to safety are capable of the required performance for operational states and for accident conditions), and to take account of feedback from the Fukushima Daiichi accident, as well as the latest developments in qualification methods and industrial standards since the Safety Report was published.

3. JUSTIFICATION FOR THE PRODUCTION OF THE DOCUMENT

Several Operational Safety Review Teams (OSART) and Safety Aspects of Long Term Operation (SALTO) missions have identified that equipment qualification programmes, intended to provide assurance that equipment is qualified for its intended use in normal operational states and accident conditions, were either inadequate or not in place. These non-compliances have been observed at many nuclear power plants and represent a failure to meet specific requirements established in SSR-2/1 (Rev. 1) and SSR-2/2 (Rev. 1).

The IAEA does not have a Safety Guide that provides recommendations on equipment qualification to meet Requirement 30 of SSR-2/1 (Rev. 1), Requirement 13 of SSR-2/2 (Rev. 1), Requirement 29 of SSR-3, ~~and~~ Requirement 30 of SSR-4 and Requirement 10 of GSR-Part 4 (Rev. 1). Justification for the production of this publication can be summarized as follows:

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- Safety Reports Series No. 3 is outdated and does not reflect the latest developments in the IAEA safety standards or the lessons from the Fukushima Daiichi accident;
- Recommendations on equipment qualification other than seismic qualification (i.e. environmental qualification, qualification for electromagnetic interference) are provided in several Safety Guides (e.g. SSG-34, SSG-39, SSG-48); this may lead to inconsistencies in the development of equipment qualification programmes;
- Assessment of the performance of accident monitoring and mitigation equipment under severe accident conditions is currently not sufficiently addressed.

The current status leads to inconsistencies in the depth of guidance provided in different IAEA publications. Collecting the existing guidance together with additional new recommendations into one, up to date IAEA publication will help users to develop and implement their equipment qualification processes which need to be managed programmatically ensuring that all combined qualification activities (e.g. seismic, environmental, EMI/RFI[1]), ageing management are addressed. ~~programmes consistently with the IAEA recommendations.~~

Furthermore, a single Safety Guide with recommendations on equipment qualification will more effectively support the IAEA's technical safety review services (e.g. periodic safety reviews in accordance with SSG-25, Safety Factor 3: Equipment Qualification), as well as OSART and SALTO review missions.

4. OBJECTIVE

This new Safety Guide will provide recommendations on the development and implementation of equipment qualification programmes at nuclear installations to meet specific requirements established in the IAEA Safety Standards. In particular, this Safety Guide will provide recommendations on meeting Requirement 30 of SSR-2/1 (Rev. 1), Requirement 13 of SSR-2/2 (Rev. 1), Requirement 29 of SSR-3, Requirement 30 of SSR-4 and Requirement 10 of GSR-Part 4 (Rev. 1).

The target audience of this publication are engineers, operators, researchers, managers, and personnel responsible for all aspects of ~~equipment~~ qualification of items important to safety for nuclear ~~power plants~~installations. This publication will also provide useful guidance for regulatory authorities to support their licensing activities related to equipment qualification.

5. SCOPE

This new Safety Guide will primarily address the process for establishing and maintaining equipment qualification programmes in nuclear ~~power plants~~installations related to functional capability, seismic conditions, environmental conditions, and electromagnetic interference effects over the full range from normal operating conditions up to and including design-basis conditions to provide reliable confirmation that items important to safety are capable of the required performance for operational states and accident conditions. The new Safety Guide will also provide guidance for the demonstration of the capability of equipment relied upon to reliably perform safety functions in the event of a severe accident at the nuclear power plant ~~to provide reliable confirmation that items important to safety are capable of the required performance for operational states and~~

[1] EMI/RFI - Electromagnetic interference / radiofrequency interference

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~~accident conditions~~. Recommendations provided in this new Safety Guide can also be considered for other nuclear installations (e.g. small modular reactors, research reactors).

The equipment in the scope includes electrical, instrumentation and controls, electromechanical, active mechanical equipment and installation features associated with this equipment (e.g. connectors, penetrations, seals, mounting equipment), as well as materials of construction which could affect the performance of this equipment including containment wall paint and piping insulation. Piping, structures and other passive components are not within the scope of this safety guide because their qualification (safety status) is achieved directly by design, construction, inspection and testing according to applicable codes.

Seismic qualification is out of scope; however this publication will reference IAEA Safety Standards Series No. NS-G-1.6, Seismic Design and Qualification for Nuclear Power Plants, as it is the only existing Safety Guide that provides recommendations on equipment qualification specific to seismic design and qualification ~~for nuclear power plants~~(DS490 under revision).

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

This new specific Safety Guide will interface with the following IAEA Safety Standards and other publications:

- SSR-2/1 (Rev. 1): Safety of Nuclear Power Plants: Design
- SSR-2/2 (Rev. 1): Safety of Nuclear Power Plants: Commissioning and Operation
- DS508: Application of Safety Principles and General Design Requirements for NPPs
- SSR-3: Safety of Research Reactors
- SSR-4, Safety of Nuclear Fuel Cycle Facilities
- GSR Part 2: Leadership and Management for Safety
- DS513: Leadership, Management and Culture for Safety
- GSR Part 4 (Rev. 1): Safety Assessment for Facilities and Activities
- SSG-25: Periodic Safety Review for Nuclear Power Plants
- SSG-30: Safety Classification of Structures, Systems and Components in Nuclear Power Plants
- SSG-34: Design of Electrical Power Systems for Nuclear Power Plants
- SSG-39: Design of Instrumentation and Control Systems for Nuclear Power Plants
- DS449: Format and Content of the Safety Analysis Report
- DS485 (SSG-48): Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants

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- DS483: Severe Accident Management Programmes for Nuclear Power Plants

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- Safety Report No.3: Equipment Qualification in Operational Nuclear Power Plants: Upgrading, Preserving and Reviewing
- DS498 (NS-G-1.5): External Events Excluding Earthquakes in the Design of Nuclear Power Plants

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- DS490 (NS-G-1.6): Seismic Design and Qualification for Nuclear Power Plants
- TECDOC-1787: Application of the Safety Classification of Structures, Systems and Components in Nuclear Power Plants" as interface documents.
- NP-T-3.6: Cable ageing management
- NP-T-3.16: Accident Monitoring Systems For Nuclear Power Plants

The Annex to the Safety Guide will provide a list of relevant international standards that have strong relation with this Safety Guide, in particular:

- IEC/IEEE 60780-323: 2016, Nuclear Facilities - electrical equipment important to safety: Qualification
- IEEE 497 Rev. 2016 IEEE Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations
- IEC 61000-4 (all parts), Electromagnetic Compatibility (EMC) – Part 4: Testing and measurement techniques
- IEC 62003 -– Nuclear Power Plants – Instrumentation and control important to safety – Requirements for electromagnetic compatibility testing
- IEC 62342 NPP - I&C important to safety - Management of ageing
- ASME QME-1-2017 Qualification of active mechanical equipment used in nuclear facilities.

7. OVERVIEW

The proposed Safety Guide will include the following contents:

~~1. INTRODUCTION~~
~~2. CONCEPT AND PROCESS OF EQUIPMENT QUALIFICATION~~
~~3. ESTABLISHING AN EQUIPMENT QUALIFICATION PROGRAMME~~
~~4. METHODS FOR EQUIPMENT QUALIFICATION~~
~~5. PRESERVING EQUIPMENT QUALIFICATION~~
~~6. UPGRADING EQUIPMENT QUALIFICATION~~
~~7. ASSESSMENT OF EQUIPMENT CAPABILITY FOR SEVERE ACCIDENTS~~
~~8. EVALUATION OF THE EFFECTIVENESS OF EQUIPMENT QUALIFICATION~~
~~REFERENCES~~
~~DEFINITIONS~~
~~ANNEX~~

1. INTRODUCTION
   - Background
   - Objectives
   - Scope
   - Structure
2. EQUIPMENT QUALIFICATION CONCEPTS
   - Basic concept
   - Primary activities
   - Documentation

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ANNEX

DEFINITIONS

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

	A*
STEP 1: Preparing a DPP	DONE
STEP 2: Approval of DPP by the Coordination Committee	~~4Q~~ November 2017
STEP 3: Approval of DPP by the relevant review Committees	~~2Q~~ June 2018
STEP 4: Approval of DPP by the CSS	~~4Q~~ November 2018
STEP 5: Preparing the draft	June 2018 ~~-~~ – February 2019
STEP 6: Approval of draft by the Coordination Committee	~~3Q~~ March 2019
STEP 7: Approval by the relevant review Committees for submission to Member States for comments	~~4Q~~ June 2019
STEP 8: Soliciting comments by Member States	July – December 2019~~1Q 2020~~
STEP 9: Addressing comments by Member States	February ~~2Q~~ 2020
STEP 10: Approval of the revised draft by the Coordination Committee Review in NS-SSCS	~~3Q~~ March 2020
STEP 11: Approval by the relevant review Committees for submission to the CSS	~~4Q~~ June 2020
STEP 12: Endorsement by the CSS	~~2Q~~ April 2021
STEP 13: Establishment by the Publications Committee and/or Board of Governors (for SF and SR only))	2Q 2021
STEP 14: Target publication date	3Q 2021

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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 estimated that development of the new guide would involve approximately 50 weeks of effort by member states experts. This is based upon assuming 3 one-week consultant meetings involving no more than 7 experts and an average of one week of work per expert between meetings, and one-week technical meeting to provide for a review of the draft publication by a wide cohort of experts in this field.

Secretariat resources involved are estimated at 10 weeks of effort by agency staff plus support for expert travel and honoraria for experts whose effort is not otherwise funded.