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Content

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1. Introduction

This standard is based on the requirements set out in RG-0027, 'Ageing Management and Long Term Operations of Nuclear Power Plants' and covers the requirements for the Equipment Qualification Programme at Nuclear Operating Unit (NOU). These requirements are cascaded into the ageing management standard 240-149139512, 'Ageing management requirements for Koeberg Nuclear Power Station'.

An equipment qualification (EQ) programme is established to provide assurance that equipment important to safety can perform its safety function(s) before, during and after a design basis event (DBE), such as a loss of coolant accident (LOCA), high energy line break (HELB), main steam line break (MSLB), design extension conditions (DEC), seismic events and/or other environments as defined in accordance with the Interim Regulatory Guide RG-0027 for equipment qualification. The effects of significant ageing mechanisms are addressed as part of the equipment qualification programme.

The requirements in this document apply to qualified equipment located in harsh and mild plant environments.

2. Supporting Clauses

2.1 Scope

This standard provides the requirements for the development, implementation, and review of the EQ Programme. These requirements provide confirmation of the reliable performance of safety functions by such equipment during operational states and accident conditions, to avoid vulnerability due to common cause failure of the equipment.

2.1.1 Purpose

The purpose of this document is to define the requirements for the development, implementation, and the management of the EQ Programme at NOU.

2.1.2 Applicability

This document shall apply to all departments, groups, and sections, who conduct, support, or verify equipment qualification related activities at NOU.

2.1.3 Effective date

This procedure is effective from the date of authorisation.

2.2 Normative/Informative References

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

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2.2.1 Normative

[1] ISO 9001 Quality Management Systems

[2] 238-6: Nuclear document and records management requirements

[3] 240-130611911: Ageing Management and Qualification Requirements for Equipment Located in Mild Environments

[4] 240-149139512: Ageing Management Requirements for Koeberg Nuclear Power Station

[5] 240-155832775: Equipment Qualification Master List (EQML)

[6] 331-187: Equipment Qualification Programme Process and Responsibilities

[7] 331-219: Equipment Qualification Maintenance Manual for Qualified Equipment Located in Harsh Environments

[8] 331-3: Nuclear Engineering Documentation and Records Management Work Instructions

[9] RG-0027: Ageing Management and Long Term Operations of Nuclear Power Plants

[10] Safety Analysis Report (SAR) II-1.11: Environmental Qualification for Accident Conditions Inside Containment

2.2.2 Informative

[11] 240-899294359: Nuclear Safety, Seismic, Environmental, Quality, Importance and Management System Level Classification Standard

[12] 240-165386950: Environmental Condition Monitoring Programme (ECMP)

[13] 240-129883544 (KSA-089): Procurement Quality Engineering Requirements

[14] 331-144: Standard for the preparation of an Equivalency Study

[15] 331-143: The Equivalency Process to Change Plant

[16] 331-146: Obsolescence Management Programme

[17] 331-148: Programme Engineers' Guide

[18] 331-23: Processing of Industry Operating Experience in Nuclear Engineering

[19] 331-83: Standard for Plant Changes affecting the Design of Koeberg Nuclear Power Station

[20] 331-86: Design Changes to Plant, Plant Structures or Operating Parameters

[21] 331-496: Equipment Qualification (EQ) Template

[22] IAEA AMP 221: Equipment qualification (EQ) of Electric and Instrumentation & Control Components

[23] IEC/IEEE 60780-323: Nuclear facilities – Electrical equipment important to safety – Qualification

[24] IEEE Std 1050-1996: IEEE Guide for Instrumentation and Control Equipment Grounding in Generating Stations

[25] IEC 62003: Nuclear power plants – Instrumentation, control, and electrical power systems – Requirements for electromagnetic compatibility testing

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[27] IEC 61000-6: Electromagnetic Compatibility (EMC) - Part 6: Generic Standards

[28] IEC 61000: Electromagnetic Compatibility (EMC) — Part 6-1: Generic Standards — Immunity Standard for Residential, Commercial and Light-Industrial Environments

[29] IEEE Standard 323: IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations

[30] IEEE Standard 344: IEEE Standard for Seismic Qualification of Equipment for Nuclear Power Generating Stations

[31] EPRI-TR-102323: Electric Power Research Institute (EPRI) Guidelines for Electromagnetic Interference Testing in Power Plants

[32] KAA-500: The Process for Controlled Documents

[33] KAA-570: Supplier Quality Audit and Surveillance Processes

[34] KAA-614: Control of Spares Assessment and New Stock Applications

[35] KAA-688: The Corrective Action Process

[36] KAA-690: Operability Determination

[37] KAA-840: Non-conformance Process

[38] KAA 716: Shelf Life Process

[39] KAD-025: Processing of Operating Experience

[40] KGA-035: Processing of Experience Feedback Received through the EDF Co-Operation Agreement

[41] KGU-031: System Health Reporting Guide

[42] KSA-011: The Requirements for Controlled Documents

[43] KSA-012 The Storage and Preservation of Spare Parts at Koeberg Nuclear Power Station

[44] KSA-038: Requirements for Quality Records

[45] MIL-STD-461E: Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

[46] MIL-STD-462E: Measurement of Electromagnetic Interference Characteristics

[47] Regulatory Guide 1.180 Revision 1: Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems

[48] SSR-2/1: International Atomic Energy Agency Safety Standards Series No. SSR-2/1: Safety of Nuclear Power Plants: Design.

[49] SSR-2/2: International Atomic Energy Agency Safety Standards Series No. SSR-2/2: Safety of Nuclear Power Plants: Commissioning and Operation

[50] SSG-48: International Atomic Energy Agency Specific Safety Guide No. SSG-48: Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants

[51] Regulatory Guide 1.180: Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems

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[52] SSG-69: International Atomic Energy Agency Specific Safety Standards No. SSG-69: Equipment Qualification for Nuclear Installations

[53] NUREG/CR-5609: Electromagnetic Compatibility Testing for Conducted Susceptibility Along Interconnecting Signal Lines

[54] NUREG/CR-6431: Recommended Electromagnetic Operating Envelopes for Safety-Related I&C Systems in Nuclear Power Plants

[55] NUREG/CR-5941: Technical Basis for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related I&C Systems

2.3 Definitions

2.3.1 Abnormal Operating Conditions: Any deviation from normal conditions anticipated to occur often enough that the design should include a capability to withstand the conditions without operational impairment.

2.3.2 Accident Conditions: A single event not reasonably expected during plant operation that has been hypothesized for analysis purposes or postulated from unlikely but possible situations or that has the potential to cause a release of radioactive material.

2.3.3 Class 1E: Safety classification of the electrical equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential in preventing significant release of radioactive material to the environment.

2.3.4 Design Basis Events: Postulated events used in the design to establish the acceptable performance requirements for structures, systems, and components.

2.3.5 Design Extension Conditions: Accident conditions that are not considered for design basis events, but that are considered in the design process of the facility in accordance with best estimate methodology, and for which releases of radioactive material are kept within acceptable limits. Design extension conditions include severe accident conditions.

2.3.6 Electromagnetic Compatibility: The capability of electrical equipment and electronic systems to operate in the intended electromagnetic environment at designed levels of performance and efficiency.

2.3.7 Electromagnetic Interference: A conducted interfering (EMI) signal defined by an undesirable voltage or current coupled into a signal, power, or other pertinent conductor. A radiated interfering (EMI) signal is defined as a time-changing electromagnetic field that couples into system circuitry, thereby inducing undesirable voltage or currents that result in degraded performance.

2.3.8 Environmental Qualification: A process for ensuring that equipment will be capable of withstanding the ambient conditions that could exist when the specific function to be performed by the equipment is called upon to be performed under accident conditions.

2.3.9 Equipment Qualification: Generation and maintenance of evidence to ensure that the equipment will operate on demand, under specified conditions, to meet system performance requirements.

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2.3.10 Harsh Environment: Harsh environments are the result of a LOCA or HELB (including SLB) inside containment and post-LOCA or HELB outside containment.

2.3.11 Mild Environment: An environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences.

2.3.12 Qualified Condition: Condition of equipment, prior to the start of a design basis event, for which the equipment was demonstrated to meet the design requirements for the specified service conditions. This could include certain post-accident cooling and monitoring systems that are expected to remain operational.

2.3.13 Qualified Life: The period for which equipment has been demonstrated, through testing, analysis, or experience, to be capable of functioning within acceptance criteria during specified operating conditions while retaining the ability to perform its safety functions in a design basis accident.

2.3.14 Service Conditions: Actual physical states or influences during the service life of equipment, including normal operating conditions, abnormal operating conditions, design basis event conditions and conditions following a design basis event and design extension conditions.

2.4 Abbreviations

Abbreviation	Explanation
DBE	Design Basis Event
DEC	Design Extension Conditions
EQ	Equipment Qualification
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
HELB	High Energy Line Break
I&C	Instrumentation and Control
NOU	Nuclear Operating Unit
LOCA	Loss of Coolant Accident
MSLB	Main Steam Line Break
NRC	Nuclear Regulatory Commission
OE	Operating Experience
SLB	Steam Line Break
SSC	Structure, System and Component

2.5 Roles and Responsibilities

The equipment qualification programme shall have clearly defined interfaces with other programmes and processes, and activities should be coordinated to ensure the status of qualified equipment is preserved. The process and key roles relating to the EQ Programme at NOU shall be clearly established.

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2.6 Process for Monitoring

The overall programme health shall be reported periodically via the Programme Health Report.

2.7 Related/Supporting Documents

331-18: Equipment Qualification Programme Process and Responsibilities

3. Equipment Qualification Programme

3.1 Regulatory Requirements

The Interim Regulatory Guide RG-0027 requires that the authorisation holder should establish a specific equipment qualification programme to achieve and maintain the qualified status of in-scope SSCs, including consideration of ageing of SSCs. The EQ Programme shall be consistent with the attributes of an effective ageing management programme listed in RG-0027, Appendix A. The requirements for equipment Qualification programme are given in Section 6.3.3 (b) of RG-0027. Equipment qualification should demonstrate that, at the end of its qualified life, the equipment will still be capable of performing its intended function(s) under the full range of specified service conditions.

These regulatory requirements are in line with the requirements stipulated in International Atomic Energy Agency (IAEA) specific safety guide SSG-48, ‘Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants’, specific safety requirements (SSR) No. SSR-2/1, ‘Safety of Nuclear Power Plants: Design’ and SSR-2/2, ‘Safety of Nuclear Power Plants: Commissioning and Operation’.

3.2 Scope of qualified equipment

The plant shall define a list of equipment to be qualified for accident and post-accident conditions. All qualified equipment shall be included in 240-155832775, ‘Equipment Qualification Master List (EQML)’.

The list shall include equipment that fulfils the following safety functions and are classified in accordance with the design classification document 240-899294359, ‘Nuclear Safety, Seismic, Environmental, Quality, Importance and Management System Level Classification Standard’:

- Class 1E equipment which are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential in preventing significant release of radioactive material to the environment.
- Non-safety-related equipment whose failure could prevent the satisfactory accomplishment of a safety-related function.
- Certain post-accident monitoring instruments and
- Items credited for design extension conditions (DEC).

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3.3 Qualification standards and conditions

The qualification standard IEEE-323-1974 as defined in the Koeberg Safety Analysis Report (SAR) and IEEE 344 shall be applied as a basis for evaluation of the qualification of equipment. The requirements specified in the latest IEEE standards such as IEC/IEEE 60780-323 or IEEE 323-2003 shall be considered for qualification.

The seismic qualification standard IEEE-344, 'IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations' shall be used for seismic qualification of equipment to verify the equipment's ability to perform its specified performance requirements during and/or after the specified seismic motions.

Use of alternative qualification standards or codes such as Design and Construction Rule for Electrical components of nuclear islands (RCC-E) or Nuclear Safety Standards Commission (KTA) may be considered and evaluated on a case by case basis.

Qualified equipment shall be qualified to the meet the qualification conditions specified in the Koeberg Safety Analysis Report (SAR) SAR II-1.11, 'Environmental Qualification of Electrical Equipment for Accident Conditions', and KBA 122 E02 038, 'General Specification for Qualification to DBA Conditions' shall be applied.

3.4 Evaluating Equipment Qualification Results

Qualification test reports and analysis reports shall be prepared for each type of qualification (e.g., seismic, environmental, and electromagnetic compatibility, functionality testing under specified dynamic loading conditions, ageing and wear through functional cycling) and shall be obtained when procuring a new qualified component.

Alternatively, a qualification summary report that evaluates the results of each type of qualification test and/or analysis shall be prepared. The qualification summary report shall provide the basis for an equipment qualification assessment, which is used to conclude that the equipment is suitably qualified for a specific application in the nuclear installation.

The qualification summary report shall contain appropriate information to serve as a reference for the long term maintenance and procurement processes, in support of the preservation of the status of all qualified equipment included in the report.

The EQ template 331-496, 'Equipment Qualification Template', shall be used to evaluate the qualified equipment if the equipment qualification test report or summary of qualification cannot be obtained from the supplier.

3.5 Overview of the Equipment Qualification Process

The equipment qualification process comprises three phases:

a) Establishment of appropriate design inputs.

b) Establishment of equipment qualification process steps.

c) Preservation of the status of qualified equipment.

These three phases and the relationship of activities within each phase are considered in sections 3.5.1, 3.5.2 and 3.5.3.

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3.5.1 Establishment of appropriate design inputs

In accordance with the RG-0027, design inputs for equipment qualification of the in-scope SSCs, including required equipment, equipment functions that need to be qualified for, service conditions in normal operation and conditions associated with postulated initiating events shall be included in the relevant plant documentation.

The design inputs that are necessary for equipment qualification shall be established and documented in the relevant plant documentation and shall include the following:

a) The performance requirements necessary to accomplish the intended safety functions.

b) The specified environmental conditions and operating conditions expected in operational states and accident conditions, including for seismic events.

c) The safety class assigned to the equipment and the corresponding supplemental classifications (e.g., seismic classification, quality classification) as per 240-899294359.

d) The interface between the electrical (seals, gaskets, penetrations, etc.) and mechanical connections.

e) The acceptance criteria for equipment qualification.

3.5.1.1 Identification of service conditions

A set of specified service conditions (operating conditions and environmental conditions) for which qualification is to be established shall be determined for all plant states.

a) Service conditions specified for operational states.

   Relevant environmental and operating conditions for operational states typically include the following:

   - Ambient pressure, temperature, radiation level and humidity
   - Steam Environments
   - Submergence / Flooding
   - Seismic vibration, and induced vibrations from neighbouring equipment or from a seismic event
   - Chemical leakages (e.g., boric acid, steam spray)
   - Chemicals in the atmosphere (e.g., salt mist, oil aerosols, dust)
   - Operating cycles, loads and duty cycles
   - Electrical and mechanical loading parameters
   - Process fluid conditions
   - Chemical composition
   - Self-heating
   - Electromagnetic interference (EMI) / Electromagnetic compatibility and power surges according to IEC 62003 and other relevant EMI/EMC standards shall be considered.

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b) Service conditions specified for equipment located in mild environments. [7].

Equipment qualification for items located in mild environments should be achieved by providing evidence that the equipment meets specified acceptance criteria, including those of recognized industry associations. When seismic testing is used to qualify equipment located in mild environments, pre-ageing prior to the seismic tests is necessary only where significant ageing mechanisms exist.

The equipment qualification parameters for items located in mild environments can be derived from the service conditions associated with the heating, ventilation and air-conditioning systems and potential consequences of accidents for those areas. When estimating these equipment qualification parameters, a margin should be included to consider malfunctions and occasional variations in the performance of the heating, ventilation and air-conditioning systems and the potential consequences of accidents for items located in mild environments.

c) Service conditions specified for harsh environments resulting from design basis accidents [7]

Harsh environments result from design basis accidents such as loss of coolant accidents, high energy line breaks and main steam line breaks.

The accident conditions for design basis accidents are characterized by changes in temperature, pressure, humidity, radiation levels, submergence, flooding, and vibrations or by simultaneous changes in process fluid conditions, chemical composition, and mechanical loads.

Other postulated initiating events might need to be considered in the equipment qualification programme if they produce conditions that are more severe than those produced by loss of coolant accidents or high energy line breaks.

The bounding thermodynamic profiles and chemical effects associated with each postulated initiating event should be derived from the design basis and the safety analysis report for the nuclear installation.

Service conditions resulting from postulated initiating events such as earthquake or aircraft crash should be considered in the equipment qualification programme.

Equipment qualification should consider the mission time for the equipment in applicable accident conditions.

d) Service conditions resulting from design extension conditions with core melting [7]

Service conditions resulting from design extension conditions with core melting should be specified through a consideration of appropriate accident profiles that describe the harsh ambient conditions (e.g., pressure, temperature, humidity, radiation dose and dose rates at various stages of the severe accident, exposure to toxic gases, flooding levels) in which the equipment needs to perform its safety functions.

The thermodynamic profile of the containment should consider the potentially harsh environmental conditions that are likely to exist prior to the occurrence of a severe accident and should be estimated through simulation using severe accident codes. As well as determining the environmental conditions associated with design extension conditions, this approach can help to determine accident monitoring instrumentation ranges (including margins) and mission times.

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Representative environmental conditions for equipment performance during design extension conditions with core melting should be estimated using modelling applied to locations inside the containment that are subjected to such conditions, as well as for locations outside the containment. On the basis of the results of the modelling, test profiles for each of the parameters should be developed to support the assessment of the capability of the equipment to perform reliably.

The mission time for each item of equipment used for monitoring the integrity of fission product barriers, or each item of equipment used for mitigating the consequences of severe accidents and each item of equipment used for monitoring their adequate performance should be derived from analyses of the various stages of the severe accident. This equipment needs to remain functional beyond the achievement of a safe state and should have a reliability commensurate with the functions it is required to fulfil.

e) Electromagnetic Interference Testing

The requirements contained in the IEC 62003 and other relevant EMI/EMC standards shall be considered.

Equipment qualification for electromagnetic interference should address the combination of the system design and the component design to minimize the coupling of electromagnetic interference between the source and other electrical components.

3.5.2 Establishment of equipment qualification process steps

Equipment qualification shall be based on a selection of the following methods:

a) Type tests
b) Analysis
c) Evaluation of operating experience
d) Where appropriate, an assessment of equipment capability for design extension conditions
e) A combination of the above methods

The method or combination of methods and the assumptions used for equipment qualification shall be properly justified. These methods are described below.

3.5.2.1 Qualification by Type testing

Qualification by type testing which is a preferred approach as per the Koeberg Safety Analysis Report (SAR), refers to a test or a series of tests on a representative sample of the equipment (including its interfaces) that simulates the effects of significant ageing mechanisms in normal operation. A type test subjects a representative sample of equipment, including its interfaces, to a series of tests, simulating the effects of significant ageing mechanisms during normal operation.

Equipment qualification testing shall be performed with equipment functioning in a state representative of its intended use in actual operation and subsequently subjected to accelerated ageing test.

A successful type test demonstrates that the equipment at the end of its qualified life can perform the intended safety function(s) for the required operating time before, during, and/or following the DBE.

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3.5.2.2 Qualification by analysis

Analysis of data and tests for material properties, equipment rating, and environmental tolerance may be used to supplement the demonstration of qualification. However, analysis alone shall not be used to demonstrate qualification.

Qualification should comprise a logical assessment, similarity evaluation or a valid mathematical model of the equipment to be qualified. The bases for analysis typically include physical laws, results of test data and operating experience in line with the qualification standard defined in section 3.2.

3.5.2.3 Evaluation of operating experience

Operating experience may be used as supplementary information to help demonstrate the reliability of equipment to perform safety functions. Qualification by operating experience alone is not sufficient for safety systems and should, therefore, be combined with additional qualification testing of the equipment.

The validity of any operating experience feedback provided by the manufacturer should be confirmed by a third party, i.e., another operating organization with relevant experience of the use of the equipment. It should also be ensured that adequate documentation of the service conditions is available.

The data from operating experience should be based on service conditions and performance requirements that are equivalent to, or more severe than, the equipment to be qualified.

When qualification for mild environment is required, performance data from equipment of similar design that has successfully operated under known service conditions may be used in qualifying other equipment to equal or less severe conditions. Applicability of this data depends on the adequacy of documentation establishing past service conditions, equipment performance, and similarity against the equipment to be qualified.

A demonstration of required operation during applicable design basis event(s) shall be included in equipment qualification programs based on operating experience, when DBA qualification is required.

3.5.2.4 Combined methods

Equipment may be qualified by combinations of type test, operating experience, and analysis. For example, where type test of a complete assembly is not possible, component testing supplemented by analysis may be used. In some cases, the overall equipment qualification is dependent on the qualification of the most limiting individual component within that equipment.

3.5.2.5 Assessment of equipment capability for design extension conditions

Equipment should have the capability, as appropriate, to perform its intended safety functions for the necessary mission time in severe accident conditions. The mission time for each item of equipment used for mitigation or for monitoring in a severe accident should be derived from the analyses of the various stages of the severe accident. For example, some equipment may be needed to perform a safety function during a design basis accident and also to remain functional throughout design extension conditions with core melting.

The specific functions of the equipment to be accomplished at each stage of a severe accident should be defined. The capability of the equipment to reliably perform those functions in such severe accident conditions should be assessed.

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3.5.3 Preservation of the status of qualified equipment

The status of each item of qualified equipment shall be preserved and properly documented throughout the lifetime of the installation. The preservation of equipment qualification includes the need for periodic replacement of component parts (e.g., seals, gaskets, lubricants, filter) that degrade more readily. Such parts may need to be periodically replaced during maintenance activities specifically undertaken for equipment qualification purposes.

3.5.3.1 Establishing the qualified life

In accordance with RG-0027, equipment qualification shall establish the qualified life of equipment within which ageing effects would not prevent satisfactory performance of the equipment if a postulated accident were to occur within the established operating period (including LTO).

Equipment qualification should demonstrate that, at the end of its qualified life, the equipment will still be capable of performing its intended function(s) under the full range of specified service conditions.

The qualified life of equipment shall be reassessed during its lifetime, considering progress in the knowledge, and understanding of degradation mechanisms and the actual operating environment of the equipment. If the qualified life is to be increased, a thorough safety demonstration should be provided.

A qualified life is not required for equipment located in a normal and mild environment and which has no significant ageing mechanisms and is operated within their design an operational limit.

3.5.3.2 Ageing effects and qualified life

When new ageing mechanisms or increases in the effects of previously known ageing mechanisms are identified, the relevant parts of the equipment qualification programme should be reviewed to determine whether changes in the qualified life or maintenance of the equipment are needed.

Periodic preventive maintenance, predictive maintenance, equipment calibration, surveillance, testing, condition monitoring, corrective action, identification of trends in equipment failures, and operating experience reviews are acceptable methods for identifying and mitigating unanticipated ageing degradation that was not accounted for when establishing the original equipment qualification.

The results of processes that identify ageing-related failures or significant material degradation of qualified equipment should be used to assess the need to revise the maintenance, surveillance and replacement programmes that are related to equipment qualification. These revisions should be reflected in the equipment qualification documentation.

3.5.3.3 Monitoring of Environmental Conditions

Appropriate periodic condition monitoring shall be implemented to determine whether actual degradation due to ageing is occurring at a higher rate than expected, which would indicate that corrective actions may be necessary to ensure that the status of qualified equipment is preserved. The results of condition monitoring should also be used to investigate Whether service conditions are more severe than previously assumed, the assumptions in the equipment qualification are consistent with the ambient conditions and whether initial assumptions on ageing contain uncertainties that were not originally considered. ageing mechanisms have been identified that were not fully evaluated or simulated when the equipment qualification was established.

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Premature failures, degradations, and performance anomalies of equipment important to safety shall be identified, evaluated, and documented.

This analysis should consider the stressors acting on the equipment (e.g., service temperature, radiation, submergence, local vibration, electromagnetic interference, radio frequency interference, toxic chemical exposure) to determine whether the actual environmental conditions are more severe than assumed.

An environmental condition monitoring programme must be implemented to provides the requirements for the monitoring, recording, and trending of environmental data during normal operation.

Monitoring and trending of the system performance are performed in accordance with the System Health reporting guide, KGU-031, 'System Health Reporting Guide'. This is to identify problems and age-related concerns before they adversely affect the functionality of the component.

3.5.3.4 Periodic Maintenance and Surveillance Requirements

Requirements for periodic surveillance of qualified equipment shall be implemented to ensure the following:

- That operation and maintenance activities do not compromise the status of qualified equipment by changing the configuration, mounting orientation (horizontal or vertical supports) or electrical, pneumatic, or hydraulic interfaces.
- That systems and components continue to meet their performance requirements.
- That abnormalities in the configuration of the equipment are detected, and that corrective actions are completed in a timely manner to preserve the status of qualified equipment.
- Those criteria for identifying premature ageing degradation are specified.
- Maintenance activities necessary to support the preservation of equipment qualification are implemented.
- Appropriate maintenance schedule and maintenance intervals to ensure the qualified life of the equipment are preserved.

During periodic surveillance, if unexpected degradation is observed, the effect of this degradation on the capability of the equipment to perform safety function should be evaluated.

Periodic maintenance and replacement of qualified equipment shall be identified as part of the EQ programme to maintain the equipment so that it remains in its qualified configuration.

Maintenance activities shall be performed to preserve the status of qualified equipment, in accordance with the in accordance with the EQMM 331-219 and relevant maintenance procedures. Unless justified by engineering evaluation, a minimum set of maintenance activities as prescribed in the EQMM 331-219 shall be performed.

All maintenance work on qualified equipment shall be subject to appropriate oversight to ensure that qualified replacement parts are used, that appropriate maintenance procedures are followed, and that the status of qualified equipment is preserved.

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3.5.3.5 Replacement equipment

Replacement equipment shall be identical to the original qualified equipment. If the replacement is not identical, it should be evaluated to determine whether the substituted equipment is acceptable, and the conclusions of this evaluation should be documented. Equipment qualification documentation should be updated, as necessary, to reflect any substitutions that alter the bases for qualification, configuration, maintenance, or procurement.

The requirements for the replacement of qualified equipment and parts with alternative components shall be in line with the 331-144, 'Standard for the preparation of an Equivalency Study', and 331-143, 'The Equivalency Process to Change Plant'.

3.5.3.6 Plant Modifications

The process for making modifications to the installation should ensure that equipment qualification documentation is updated to reflect any design changes.

Any modification involving qualified equipment should be carefully planned before the modification is implemented. This includes ensuring the following:

- All documentation affected by the modification, such as the safety analysis report, operational limits and conditions, drawings, operating procedures and emergency procedures, periodic maintenance and testing procedures and equipment indexes, has been updated and is available.
- The as-built configuration of modified systems is reflected in the design basis documentation.

Modifications that only involve items not important to safety, but which might affect items important to safety should also be evaluated for the possible impact on qualified equipment.

Plant procedures for controlling plant modifications shall require the evaluation of changes to assess their impact on EQ. The requirements for modifications are governed by 331-83, 'Standard for Plant Changes affecting the Design of Koeberg Nuclear Power Station', and 331-86, 'Design Changes to Plant, Plant Structures or Operating Parameters'.

3.5.3.7 Management of Technological Obsolescence

The process defined in 331-146, 'Obsolescence Management Programme' shall be followed to address the obsolescence issues relating to qualified equipment.

3.5.3.8 Evaluation of Failures and non-conformities

Premature failures, degradations, or performance anomalies of equipment important to safety shall be identified and documented. These deficiencies should be addressed through a corrective action programme as defined in the KAA-688, 'The Corrective Action Process'.

If an EQ component is found to be outside the bounds of its qualification basis and the acceptance criteria, the corrective actions shall be implemented in accordance with the plant corrective action programme as defined in KAA-688.

Applicable operating experience will be incorporated in accordance with the existing Koeberg processes. Appropriate corrective actions shall be initiated when degraded or non-conforming conditions are identified on EQ equipment or when plant configurations occur that could affect EQ equipment in line with procedures KAA-840, 'Non-conformance Process', and KAA-690, 'Operability Determination'.

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3.5.3.9 Procurement and Storage of Qualified Equipment

Qualified equipment and spare parts shall be procured in accordance with procurement criteria specified in the applicable equipment qualification summary report.

Following procurement, qualified equipment should be inspected upon receipt, and stored in a controlled manner to ensure that the status of qualified equipment is preserved.

Qualified equipment (including subassemblies, spare parts, and materials) in storage should be marked as qualified.

The storage of qualified equipment with a defined shelf life should be controlled to ensure that, upon installation, the status of qualified equipment is preserved. A reliable means should be established to ensure that shelf life expiration dates are not exceeded.

The requirements for the storage and preservation of spares shall be determined in accordance with KSA-012, 'The Storage and Preservation of Spare Parts at Koeberg Nuclear Power Station'.

Procedure KAA-614, 'Control of Spares Assessment and New Stock Applications', provides the procurement and materials management requirements for the procurement cycle process.

Shelf life of polymers shall be management in accordance with the process defined in KAA-716, 'Shelf Life Process'.

3.6 Ageing Management Requirements

In accordance 240-149139512, 'Ageing Management Requirements for Koeberg Nuclear Power Station', when new ageing mechanisms or increases in the effects of previously known ageing mechanisms are identified, the relevant parts of the equipment qualification programme should be reviewed to determine whether changes in the qualified life or maintenance of the equipment are needed.

Periodic preventive maintenance, predictive maintenance, equipment calibration, surveillance, testing, condition monitoring, corrective action, identification of trends in equipment failures, and operating experience reviews are acceptable methods for identifying and mitigating unanticipated ageing degradation that was not accounted for when establishing the original equipment qualification.

The results of processes that identify ageing-related failures or significant material degradation of qualified equipment should be used to assess the need to revise the maintenance, surveillance and replacement programmes that are related to equipment qualification. These revisions should be reflected in the equipment qualification documentation.

3.7 Use of Operational Experience

Industry operational experience and research results within the industry will also be elements of preserving equipment qualification in line with relevant station processes such as KAD-025, 'Processing of Operating Experience', 331-23, 'Processing of Industry Operating Experience in Nuclear Engineering', and KGA-035, 'Processing of Experience Feedback Received through the EDF Co-Operation Agreement'.

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3.8 Management of plant transients

Plant operational and design transients shall be managed in accordance with the Design Transient Monitoring Programme in accordance with document 240-149867926, 'Nuclear Steam Supply System Design Transient Monitoring Programme' implemented at Koeberg Nuclear Power Station (KNPS).

The programme provides the requirements for a transient monitoring, and the process of recording and documenting design transients. Materials Reliability Group (MRG) performs a yearly review of the NSSS Design Transient Monitoring Programme results. The effects of these transients on EQ equipment shall be evaluated and appropriate corrective action taken.

3.9 Reassessment of the Qualified Life

The qualified life of equipment should be reassessed during its lifetime, considering progress in the knowledge, and understanding of degradation mechanisms and the actual operating environment of the equipment. If the qualified life is to be increased, a thorough safety demonstration should be provided. Monitoring of actual environmental conditions should be implemented in order to get additional information necessary for the assessment of ageing effects on the equipment in its actual operating environment.

If the qualified life of equipment is to be extended, the technical basis for this shall be provided. In addition, any conclusions regarding the status of qualified equipment shall be re-evaluated to consider any changes in performance requirements or installation conditions. Methods chosen for reassessment of the qualified life of equipment should be justified and documented.

The re-assessment methods specified in dual logo standard IEC/IEEE 60780-323, 'Nuclear facilities - Electrical equipment important to safety – Qualification' shall be used for reassessing the qualified life of in-scope equipment.

If qualification cannot be extended by the reassessment through these methods, complete replacement of equipment shall be required.

The reassessment is performed in a timely manner (that is, sufficient time is available to replace, refurbish or requalify the equipment if extension of qualification is unsuccessful).

3.10 Documentation Requirements

The result of a qualification programme shall be documented to demonstrate the ability of equipment to perform its safety function(s) during its qualified life and applicable design basis events. All activities that are required to maintain qualification during the qualified life shall be included in the documentation. The documentation shall allow verification by competent personnel, other than the qualifier, that the equipment is qualified. The documentation shall include:

- Equipment Qualification Master List (i.e., a list of items important to safety that are subject to equipment qualification).
- Test reports relating to equipment qualification or equipment qualification summary reports (i.e., Evaluation report for equipment qualification).
- Results of temperature monitoring and radiation monitoring in the plant, if applicable.
- Requirements for preserving the status of qualified equipment during installation, commissioning, operation, and maintenance of the equipment.

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- Evaluation report for equipment qualification.
- Reports of TLAA's relating to equipment qualification (for evaluation for long-term operation) or reports of another suitable equivalent analysis.

For equipment important to safety which is required in a mild environment, the maintenance and surveillance requirements and results shall be included in the documentation.

Documents and records generated for harsh and mild environments shall be maintained in accordance with 331-3, 'Nuclear Engineering Documentation and Records Management Work Instruction', and KAA-500, 'The Process for Controlled Documents'.

3.11 Quality Requirements

The equipment qualification programme shall be subject to a quality assurance programme that includes a variety of elements, such as equipment design control, procurement document control, manufacturing quality control, qualification assessment (e.g., testing, analysis, combined testing and analysis, and experience), storage, installation and commissioning, installation surveillance and maintenance, periodic testing, and documentation.

Procurement quality assurance requirements will be assigned in accordance with 240-129883544 (KSA-089), 'Procurement Quality Engineering Requirements'.

The equipment qualification programme shall have clearly defined interfaces with other programmes and processes and activities should be coordinated to ensure the status of qualified equipment is preserved.

3.12 Effectiveness Review and Audits

An assessment of the effectiveness of the equipment qualification programme shall be periodically performed. This assessment typically includes reviews of the following:

- Compliance with the regulatory requirements.
- The adequacy of qualification documentation in terms of programme implementation and technical accuracy.
- The effectiveness of interfaces with other programmes.
- The effectiveness of training relevant to equipment qualification.
- The effectiveness of corrective actions.
- Maintenance activities relevant to equipment qualification.
- Vendor and manufacturer audit quality management programmes and processes relevant to equipment qualification.

The following factors that can adversely impact the established equipment qualification shall be considered in the review:

- Deviations from appropriate installation and maintenance procedures.
- Changes to the design basis or safety analysis.
- Changes in regulatory requirements and in licensing conditions.
- Modifications and equivalencies.

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- Deviations in service conditions from those assumed in the equipment qualification.
- Feedback on adverse operating and maintenance experiences.
- Unavailability of qualified spare parts.
- Storage conditions of the qualified equipment and spare parts.
- Obsolescence of the equipment or spare parts.
- Recent qualification tests or research results that challenge or modify the original assumptions or test or analysis results.

3.13 Training Requirements

The personnel involved in equipment qualification activities (including contractors and personnel involved in the oversight of these activities) should receive suitable training so that they possess the necessary skills, knowledge, and attitudes. This training should be part of the equipment qualification programme.

4. Acceptance

This document has been seen and accepted by:

Name	Designation
A Kamroodien	Middle Manager - Programmes Engineering Department
R Cassim	Manager - Materials Reliability Group
N Ryland	Middle Manager - Systems Engineering Department
A Kotze	Middle Manager (Acting) - Design Engineering Department
A Jakoet	Senior Engineer – Environmental Condition Monitoring Programme
N Bongelo	Senior Technologist – Cable Ageing Management Programme

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5. Revisions

Date	Rev.	Compiler	Remarks
November 2023	4	K Moroka	To include reference to EMC/EMI specific standard once the EMC assessment is completed (CR 133538-016 CA - OD_19.34) and align with SSG-69.
November 2021	3	K Moroka	To address the PSR General Conditions CR 123106 & CR 123276
November 2020	2	K Moroka	Full Cycle Review. Document reviewed to align with the requirements of RG-0027 as per SE 38545-021 GA
May 2017	1	K Moroka	Full cycle review as per GA 36405
February 2014	0	K Moroka	Updated to align with the new Nuclear Engineering organisation document structure and procedure template. Procurements requirements clarified as per RC 17494.
April 2010	0	L Nieuwoudt	New standard written to facilitate the creation of the EQ programme.

6. Development Team

Not applicable

7. Acknowledgements

Not applicable

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