Eskom	Manual	Nuclear Engineering

Title: **Equipment Qualification Maintenance Manual for Qualified Equipment Located in Harsh Environments**

Document Identifier:	**331-219**
Alternative Reference Number:	**KBA1222E021002**
Area of Applicability:	**Nuclear Engineering**
Functional Area:	**Programmes Engineering**
Revision:	**3**
Total Pages:	**51**
Next Review Date:	**October 2024**
Disclosure Classification:	**Controlled Disclosure**

Compiled by	Functional Responsibility	Authorised by
KI Moroka	**R Cassim**	**A Kamroodien**
Senior Engineer	**Manager**	**Middle Manager**
Materials Reliability Group	**Materials Reliability Group**	**Programme Engineering**
Date: 2021-10-27	Date: 2021-10-27	Date: 2021-10-27

Nuclear Additional Classification Information

Business Level: **3**

Working Document: **3**

Importance Classification: **CSR (S11510)**

NNR Approval: **No**

Safety Committee Approval: **No**

ALARA Review: **No**

Functional Control Area: **Programmes Engineering**

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1. Introduction

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 other conditions such as electromagnetic interference (EMI). The effects of significant ageing mechanisms are addressed as part of the equipment qualification programme.

This Equipment Qualification Maintenance Manual (EQMM) prescribes the requirements to preserve the qualification of qualified electrical and instrumentation & control (I&C) equipment located in harsh environment at Koeberg Nuclear Power Station (KNPS). These requirements are in line with the requirements set out in RG-0027, “Ageing Management and Long Term Operations of Nuclear Power Plants”, and the EQ standard 331-186, “Equipment Qualification Programme Requirements”.

2. Supporting Clauses

2.1 Scope

The scope of this document covers the equipment qualification requirements needed to preserve the qualification of in-scope electrical and I&C equipment within the scope of the EQ Programme.

2.1.1 Purpose

This document prescribes the requirements to ensure that the equipment and parts within the scope of the EQ programme are suitably qualified throughout the plant operating period including period of Long Term Operation (LTO).

2.1.2 Applicability

The requirements in this manual apply to all departments, groups and sections, who conduct, support or verify EQ related activities at Nuclear Operating Unit (NOU).

2.1.3 Effective date

The document is effective from the authorisation date.

2.2 Normative/Informative References

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

2.2.1 Normative

[1] ISO 9001: Quality Management Systems

[2] 240-155832775: Equipment Qualification Master List (EQML)

[3] 240-89294359: Nuclear Safety, Seismic, Environmental, Quality and Importance Classification

[4] 331-186: Equipment Qualification at Koeberg Operating Unit

[5] 331-187: Equipment Qualification Programme Process and Responsibilities

[6] 331-496: Equipment Qualification File Template (New Equipment And Existing Equipment)

2.2.2 Informative

[7] 08016.ROD.018: Equipment Qualification Time Limited Ageing Analysis Strategy

[8] 10CFR 50.49: Environmental Qualification of Electric Equipment Important to Safety

[9] 240-149139512: Ageing Management Requirements for Koeberg Nuclear Power Station

[10] 240-98789629: Cable Ageing Management Manual for I&C Cables and Cable Systems

[11] 240-98789276: Cable Ageing Management Manual for Low Voltage Cables and Cable Systems

[12] 240-143604773: Safety Evaluation Process

[13] 240-130611911: Environmental Qualification Requirements for Safety Related Equipment Located in Mild Environments.

[14] 240-129883544: Procurement Quality Engineering Requirements

[15] 240-95405347: Procurement of Items and Services for the Nuclear Operating Unit

[16] 331-143: The Equivalency Process to Change Plant

[17] 331-144: Standard for the Preparation of an Equivalency Study

[18] 331-3: Nuclear Engineering Documentation and Records Management Work Instruction

[19] 331-86: Design Changes to Plant, Plant Structures or Operating Parameters

[20] 331-88: Temporary Alterations to Plant, Plant Structures or Operating Parameters that Affect the Design Base

[21] 331-275: Process for the development and control of ageing management matrix at KOU

[22] 331-311: Cable Ageing Management Manual for Medium Voltage Power Cables and Cable System

[23] DS514: IAEA Qualification Safety Guide - Equipment Qualification for Nuclear Installations

[24] D02-ARV-01-176-728: Time Limited Ageing Analysis (TLAA) - Re-Analysis of Environmentally Qualified Equipment - Valcor Solenoid Valves

[25] D02-ARV-01-181-189: Time Limited Ageing Analysis (TLAA) - Re-Analysis of Environmentally Qualified Equipment - Rotork Valve Actuators

[26] D02-ARV-01-181-583: Time Limited Ageing Analysis (TLAA) - Re-Analysis of Environmentally Qualified Equipment - Jeumont-Schneider Medium Voltage Motors

[27] D02-ARV-01-182-258: Time Limited Ageing Analysis (TLAA) for Qualified Equipment – AMRI Containment Isolation Valves

[28] D02-ARV-01-181-612: TLAA Re-Analysis of Components Important to Safety – In core Thermocouples of the RIC System

[29] EDF RPMQ 900 CPY LOT VD2 Indices 1, D4550.32-08/8668

[30] EPRI Report TR-104884: Rotork Maintenance Manual

[31] EPRI Report NP-1558: A Review of Equipment Aging Theory and Technology

[32] IAEA AMP221: Equipment Qualification Re-assessment

[33] IAEA Safety Report Series No 3: Equipment Qualification in Operational Nuclear Power Plants: Upgrading, Preserving and reviewing

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

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

[36] KBA 1216 J 10 256: General Electric Installation Studies and Supply

[37] KBA 12 22 E02 034: Seismic and DBA qualification - Summary document

[38] KBA 1216 H01 271: Primary pump speed sensors (CSEE)

[39] KBA 1220 B00 003: Inner containment valve motor operated valve actuators (Rotork)

[40] KBA 1216 J10 261: Cables (DBA) (Jeumont Schneider & CGF)

[41] KBA 1215 H03 016: Electrical Penetrations (Auxitrol)

[42] KBA0915K09016: Power, Control, Measurement Cables for DBA Conditions

[43] KBA 1222 E02 031: Terminals for junction boxes and electrical penetrations (Weidmuller)

[44] KBA 12 22 E02 038: General specification for qualification to DBA conditions

[45] KBA1222E021013: Qualification Report of EGS 1-1/2” Quick Disconnect Electrical Connector Report EGS-TR-913602-01

[46] KBA0022N NEPO LOPP 054 Rev. 15; Nuclear Instrumentation (RPN) Maintenance Regime at Koeberg Nuclear Power Station

[47] KBA 1207 B05 097: RIC in-core thermocouples

[48] KAA-688: The Corrective Action Process

[49] KAA-840: Non-conformance Process

[50] KAA-641:Control of Receipt of Materials

[51] KAA-690: Operability Determination

[52] KAA-913: Integrated Equipment Reliability Process

[53] KAD-025: Processing of Operating Experience

[54] KBA 12 22 E02 038: General specification for qualification to DBA conditions

[55] KBA-0022-SRSM-000-00: Safety Related Surveillance Manual (SRSM)

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

[57] KGU-031: System Health Reporting Guide

[58] KGU-033: Failure Investigation of Plant Equipment and Evaluation of Experience

[59] KGU-035: Integrated Equipment Reliability Process: Scoping and Classification of Components

[60] L1124-EL-LIS-001: List of in-scope items for SALTO EQ TLAA

[61] L1124-EL-LIS-002: SALTO TLAA Result List

[62] L1124-EN-LIS-004: EQ Cable List

[63] L1124-GN-LIS-016: SALTO Room Master and Environmental Zones List

[64] L1124-GN-RPT-018: Time Limited Ageing Analysis Based on Initial Environmental Qualification

[65] L1124-GN-LIS-029: Equipment Zone Table

[66] L1124-GN-RPT-040: SALTO Room Master and Environmental Zones Report

[67] MR 70900-65-31-2: Qualification Summary Report for Solenoid Valve V70900-65-21 by similarity to solenoid valves V70900-65-22, V70900-87, and V70900-98

[68] NIL01 version 19: Nuclear Installation Licence

[69] Regulatory Guide 1.89: Environmental Qualification of Electric Equipment Important to Safety

[70] SAR II-1.11: Environmental Qualification of electrical equipment for accident conditions

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 the course of 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 **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 actually called upon to be performed under accident conditions. For environmental qualification, the central concern involves the threat to non-metallic components of electrical and I&C components due to stresses from severe environmental service conditions resulting from a LOCA or HELB (including SLB).

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

Equipment Qualification = Environmental Qualification + Seismic Qualification

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

2.3.9 **IQ Review:** A web-based software application that provides standardisation and automation of Preventive Maintenance programme requirements as PM Strategies. These PM Strategies are justified on a component level and include the required PM Tasks and details, their respective task intervals, implementation recommendations, a justification for PM Template deviations and selected tasks, and PM Basis supporting information.

2.3.10 **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.

2.3.11 **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.

2.3.12 **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.

2.3.13 **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
AMM	Ageing Management Matrix
AMP	Ageing Management Programme
AMR	Ageing Management Review
CAMP	Cable Ageing Management Programme
CSR	Critical Safety Related
DBA	Design Basis Accident
DER	Design Extension Related
EDF	Electricite de France
EPRI	Electric Power Research Institute
EQ	Equipment Qualification
EQML	Equipment Qualification Master List
EQMM	Equipment Qualification Maintenance Manual
HELB	High Energy Line Break
I&C	Instrumentation & Control

IAEA	International Atomic Energy Agency
IEEE	Institute of Electrical and Electronic Engineers
IGALL	International Generic Ageing Lessons Learned
INPO	Institute of Nuclear Operators
KOU	Koeberg Operating Unit
LOCA	Loss of Coolant Accident
LTO	Long Term Operation
NRC	Nuclear Regulatory Commission
NUREG	US Nuclear Regulatory Commission Regulation
OE	Operating Experience
QL	Qualified Life
SALTO	Safe Aspects of Long Term Operation
SLB	Steam Line Break
SR	Safety Related
SSC	System, Structure and Component
TLAAs	Time Limited Ageing Analyses
WANO	World Association of Nuclear Operators

2.5 Roles and Responsibilities

Roles and responsibilities relating to the EQ Programme are defined in procedure 331-187, “Equipment Qualification Programme Process and Responsibilities”.

2.6 Process for Monitoring

The EQ Programme Engineer performs an oversight function on the implementation of the EQ Programme in accordance with 331-148, “Programme Engineer’s Guide”.

2.7 Related/Supporting Documents

240-155832775: Equipment Qualification Master List (EQML)

3. Equipment Qualification Programme

The equipment qualification programme establishes activities in order to preserve the qualification of in-service qualified equipment. These activities are implemented to assure the adequacy of the equipment, function and installation under required conditions. The primary objective of qualification is to demonstrate with reasonable assurance that equipment important to safety can perform its safety function(s) without experiencing common-cause failures before, during, and after applicable DBE.

The guide RG-0027 and the ageing management standard 240-149139512 require that the authorisation holder should establish a specific equipment qualification programme, including consideration of ageing of SSCs. The guidance provided in the 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” was taken into account.

3.1 Qualification Requirements and Conditions

The equipment qualification requirements for NOU are provided in the EQ standard 331-186.

The conditions used for equipment qualification are provided in the Safety Analysis Report (SAR) II-1.11, Table T-II-1.11-1 and KBA 122 E02 038, “General Specification for Qualification to DBA Conditions”.

3.1.1 Qualification Methods

Type testing of actual equipment using simulated service conditions is the preferred method of qualification and has been used for most electrical equipment for Koeberg.

According to the Koeberg SAR, tests and analyses for some of the installed equipment have been conducted to comply with IEEE Standard 323-1971 or IEEE Standard 323-1974.

For modifications and replacements, tests and analyses would be conducted to comply with the IEEE 323-9174 or IEC/IEEE 60780-323, “Nuclear facilities – Electrical equipment important to safety – Qualification”.

3.1.2 Plant States

Plant states including normal operation, anticipated operational occurrences (abnormal conditions) and accident conditions are considered in equipment qualification.

The specified service conditions include operating conditions and environmental conditions associated with all plant states. The operating conditions are generally defined by the process conditions of the systems (e.g. vibration, electromagnetic interference caused by voltage surge), process conditions (e.g. voltage, current, temperature, pressure, radiation levels), fluid conditions (e.g. differential pressure, temperature, flow, fluid parameters, and chemical content) and environmental conditions in all plant states. The environmental conditions are generally defined by the ambient conditions associated with plant states within the area (zone) where the equipment is installed. The localized environmental conditions within these areas, (e.g. temperature and radiation levels) are considered, where appropriate.

3.1.3 Qualified Life Determination

Degradation with time followed by exposure to the applicable environmental extremes of temperature, pressure, humidity, radiation, vibration, chemical spray and submergence resulting from a DBE condition can precipitate failures of equipment important to safety [34]. For this reason, it is necessary to establish a qualified life for equipment with significant ageing mechanisms. The qualified life determination considers degradation of equipment capability prior to, during and in post-accident conditions as applicable. Inherent in establishing a qualified life is that a qualified condition is also established. This qualified condition is the state of degradation for which successful performance during a subsequent DBE was demonstrated.

3.1.3.1 Equipment Located in Harsh Environment

Components in the EQ Programme for harsh environment have a qualified life (QL), and the components are replaced or refurbished at the end of that qualified life as stipulated in this document unless additional life is established through reanalysis or operating experience.

A qualified life is established in initial qualification by putting test sample(s) in the state of degradation expected at the end of the qualified life, followed by simulated DBE(s) in which the ability of the equipment to perform its function important to safety is demonstrated [34].

The qualified life determination shall consider degradation of equipment capability prior to, during and in post-accident conditions as applicable. Inherent in establishing a qualified life is that a qualified condition is also established. This qualified condition is the state of degradation for which successful performance during a subsequent DBE was demonstrated.

Adjustment and extension of qualified life of existing equipment is achieved through the use of different techniques described in 331-186. These techniques are further described in Section 3.14.

The Arrhenius Methodology that may be used to determine the QL is described in the report EPRI NP-1558, “A Review of Equipment Aging Theory and Technology (Report 3002018283)”.

3.1.3.2 Equipment Located in Mild Environment

A qualified life is not required for equipment located in a mild environment and which has no significant ageing mechanisms and is operated within the limits established by applicable specifications and standards [34]. Qualification for equipment located in mild environments shall be demonstrated by providing evidence that equipment meets or exceeds the specified requirements, including those of recognized industry associations. When seismic testing is used to qualify equipment located in a mild environment, pre-ageing prior to the seismic tests is required only where significant ageing mechanisms exist[34].

A maintenance/surveillance programme based on a vendor’s recommendations or condition assessment, which may be supplemented with operating experience, should ensure that equipment meets the specified performance requirements.

The maintenance requirements for safety related components located in mild environment are provided in 240-130611911, “Ageing Management and Qualification Requirements for Equipment Located in Mild Environments”, and the plant Preventive Maintenance (PM) Programme.

3.2 Service Conditions

3.2.1 Service conditions specified for harsh environments

Harsh environments result from postulated accidents such as loss of coolant accidents, high energy line breaks and main steam line breaks. These conditions are characterized by changes of temperature, pressure, humidity, radiation levels, submergence, or by simultaneous changes in process fluid conditions, chemical composition or mechanical loads.

The bounding thermodynamic profiles and chemical effects associated with each postulated initiating event are derived from the Koeberg Safety Analysis Report and the applicable design basis documents.

Service conditions resulting from postulated initiating events such as earthquake or airplane crash are considered in the equipment qualification programme.

3.2.2 Service conditions specified for equipment located in mild environments

Equipment qualification for items located in mild environments is achieved by ensuring that the equipment meets specified acceptance criteria as specified in the maintenance manual and applicable maintenance working procures.

3.2.3 Service conditions resulting from design extension conditions

Service conditions resulting from design extension conditions are 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), under which the equipment needs to perform its safety functions.

3.3 Programme Attributes

In line with the guide 331-148 and the regulatory guide RG-0027, the requirements in this EQMM are structured in line with the nine attributes of an effective ageing management programme. These attributes are defined below.

3.3.1 Programme Scope

The EQ Programme applies to certain electrical and I&C equipment located in harsh plant environments, which are required to be qualified and whose ageing degradation in service are managed by the qualified life approach or condition-based qualification methodology. The focus is on activities in the equipment qualification programme dedicated to the preservation and re-assessment of equipment qualification of electrical and I&C in-scope as defined in document 240-155832775, “Equipment Qualification Master List (EQML) for Harsh Environment”.

A complete list (referred to as EQML 240-155832775) of qualified electrical and I&C equipment (including cables) located in harsh environments for both Unit 1 and Unit 2 is electronically available in a Microsoft Excel format which on the Koeberg Local Area Network NAL Z:*ValApp*

The EMQL was verified for completeness during the Koeberg Safety Aspects of Long-Term Operation (SALTO) Assessment Project and results are provided in the SALTO project deliverable L1124-EL-LIS-001, “List of in-scope items for SALTO EQ TLAA”, L1124-EL-LIS-002, “SALTO TLAA Result List’, and L1124-EL-LIS-004, “EQ Cables”.

3.3.2 Preventive Actions to Minimize and Control Ageing Degradations

The maintenance actions viewed as preventive actions are covered under Section 3.4 of this document. These actions include the following:

- Establishing the equipment service condition and ageing limits (for example, qualified life or qualification condition limit);
- Identifying specific installation, inspection, monitoring, or periodic maintenance actions to maintain component ageing effects within the bounds of the qualification basis and the assumed qualified life.

- Monitoring of environmental conditions in normal operation of the plant with particular emphasis on the identification of adverse localized environments that may impact qualification of in-scope equipment; and
- Identifying age-sensitive components within in-scope equipment and replacing them with less sensitive components.

3.3.3 Detection of Ageing Effects

The maintenance actions viewed as detection of ageing effects are covered under Section 3.4 of this document. These include:

- Inspecting and testing EQ equipment periodically with particular emphasis on the identification of adverse localized environments that may impact a component's environmental qualification and
- Monitoring or inspection of certain environmental conditions or component parameters to ensure that the component is within the bounds of its qualification basis, or as a means to modify the qualified life.

3.3.4 Monitoring and Trending of Ageing Effects

EQ programme actions viewed as monitoring and trending are captured in Section 3.7 and Section 3.8. These include:

- Monitoring of environmental conditions in normal operation of the plants with particular emphasis on the identification of adverse localized environments that may impact equipment's qualified life; and
- Visual inspection of in-scope equipment and the verification installation configuration.
- Plant walk-downs to look for visible signs of anomalies attributable to ageing, as required.

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.

Necessary corrective actions are raised in accordance with KAA-688, "The Corrective Action Process", to correct any anomaly.

3.3.5 Mitigating Ageing Effects

Mitigation actions for the qualification preservation and reassessment of electrical and I&C in-scope equipment are provided in Section 3.4 and include:

- Mitigation of the ageing effects by possible modification of the ambient conditions.
- Component/Sub-Component replacement (also known as partial replacement); and
- Complete replacement of equipment.

3.3.6 Acceptance Criteria

Qualified components are maintained within the bounds of their qualification basis, including:

- The established qualified life or qualified conditions and continued qualification for the projected accident conditions.
- Refurbishment, replacement, or requalification prior to exceeding the qualified life of each installed equipment.
- Monitoring and trending used to modify the equipment qualified life or qualified conditions,
- Plant-specific acceptance criteria established based on applicable qualification methods in accordance the national regulatory requirements.

Compliance with EQ requirements provides reasonable assurance that the component can perform its intended functions during accident conditions after experiencing the effects of in-service ageing.

3.3.7 Corrective Actions

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

When unexpected adverse conditions are identified during operational or maintenance activities that affect the environment of qualified equipment, the affected EQ equipment is evaluated and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions.

When an emerging industry ageing issue is identified that affects the qualification of the EQ equipment, the affected equipment is evaluated and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions.

3.3.7.1 Equipment Failures and Degradations

A component failure is raised and addressed in accordance with KAA-688. Component failure evaluation is then performed according to KGU-033, “Failure Investigation of Plant Equipment and Evaluation of Experience”.

3.3.7.2 Non-Conforming (NC) Conditions

Appropriate corrective actions are initiated when degraded or non-conforming (NCR) conditions are identified or when plant configurations occur that could affect EQ equipment.

The requirements stipulated in procedure KAA-840, “Non-conformance Process” and procedure KAA-690, “Operability Determination” should to be followed to assess non-conforming conditions.

3.3.8 Operating Experience

Relevant plant specific operating experience is considered in the development and continuous improvement of the EQ Programme.

In accordance with the KAA-688, 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”, plant implements

a feedback process to periodically evaluate plant and industry-wide operating experience and research and development (R&D) results, and, as necessary, either modifies the programme to ensure the continued effectiveness of the ageing management.

The EQ programme includes consideration of operating experience to modify qualification bases and conclusions, including qualified life.

Sources of external operating experience includes IGALL, EPRI, INPO, EDF and IAEA working groups, US NRC information notices and generic communications.

3.3.9 Quality Management

Documented evidence of qualification needs to be available in an auditable form for the life of the plant and component including period of extended operation. Records demonstrating that EQ has been established contain information on the specific equipment items being qualified, the safety functions, applicable service conditions, qualification methods, results, limitations, justifications and relevant supporting technical data. Documents and records generated are maintained in accordance with 331-3, “Nuclear Engineering Documentation and Records Work Instruction”, and KAA-500, “The Process for Controlled Documents”.

The effectiveness review of the programme requirements are conducted in line with 331-148, “Programme Engineers Guide” as part of programme health reporting.

Periodic audits are conducted in accordance with the plant’ quality assurance (QA) process.

Audits of vendor and manufacturer quality management programmes and processes relevant to equipment qualification are performed as require by the Procurement Quality Engineering (PQE) Group in accordance with 240-129883544, “Procurement Quality Engineering Requirements”.

3.4 EQ Maintenance Requirements

The equipment qualification programme establishes activities in order to preserve the qualification of in-service qualified equipment. These activities should be implemented to assure the adequacy of the equipment, function and installation under required conditions.

To effectively implement the requirements provided in this document, the following should be in place:

- Maintenance procedures that describe the maintenance activities necessary to support the preservation of equipment qualification.
- Preventive maintenance schedule and maintenance intervals are set to ensure the qualified life of the equipment is preserved.
- Monitoring of environmental conditions to identify adverse localised environments and hot spots.
- Timely replacement of equipment or components that have exceeded their qualified life.

All maintenance work on qualified equipment should be subjected 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.

For the EDF equivalent equipment, the requirements are adopted from the EDF RPMQ, D4550.32-08/8668 and classified as follows:

- P1: Non-compliance could lead to a severe defect of the qualified equipment.
- P2: Non-compliance places the equipment out of the qualification study frame.

Section 3.4.1 up to Section 3.7 provides requirements to preserve the qualified status of the EQ equipment. These requirements must be read together with the EQML (240-155832775) spreadsheet which provides more details relating to the following:

- Equipment details
- Qualification data
- Qualified life
- Specific installation and next replacement dates

The qualified life (QL) reflected in this section is based on the calculation of the thermal qualified life and the radiological qualified life. Since ageing mechanisms occur simultaneously, ultimately the shorter period of time from either calculation defines the qualified life of the component.

For QL longer than the LTO period, the next replacement date is reflected as 2044 for Unit 1 and 2045 for Unit 2. Only the year is provided in this Section, the exact date (with day, month and year) is provide in the EQML (240-155832775).

3.4.1 Electrical Penetration Assemblies

Table 1: Requirements for the Electrical Penetrations

Task Description	Qualified Life	Frequency / Next Replacement
Replace all qualified Electrical Penetration Assemblies (Feedthroughs and connections) listed in the EQML 240-155832775 before the end of the qualified life.	60 years	04/2044 for Unit 1 *Installed in 04/1984 on Unit 1* 07/2045 for Unit 2 *Installed in 07/1985 on Unit 2*
Perform visual inspection on qualified Electrical Penetrations (Feedthroughs and connections) listed in the EQML 240-155832775. • Inspect for any cracks, loose connections, frayed wiring and corrosion. • Check for any sign of electrical distress, arcing, discolouration, changes in insulation properties.		4RO

Task Description	Qualified Life	Frequency / Next Replacement
Perform visual inspection on qualified I&C Penetrations (Feedthroughs and connections) listed in the EQML 240-155832775. • Inspect for any cracks, loose connections, frayed wiring and corrosion. • Check for any sign of electrical distress, arcing, discolouration, changes in insulation properties.		4RO

3.4.2 Cables Connected to EQ in-scope equipment

Table 2: EQ Requirements for Cables

Task Description	Qualified Life	Frequency / Next Replacement
Re-qualify cables connected to qualified equipment as in the EQML 240-155832775 before end of the qualified life of qualified. *Cables must be subjected to the requalification programme prior to end of qualified life to extend the qualified life. Otherwise a replacement plan must be developed.*	40 years	04/2024 for Unit 1 *Installed in 04/1984 on Unit 1* 07/2025 for Unit 2 *Installed in 07/1985 on Unit 2*
Perform visual and tactile inspection of qualified I&C qualified cables listed in the EQML 240-155832775 in order to identify the following ageing effects: • Softness on the outer sheath. • Discolouring, cracking, hardness cuts and voids. • Protrusions. • Bruises/ Abrasion • Exposed insulation. • Loose connections. • Cable susceptible to moisture ingress (steam, water, oil, chemical etc.). • Changes in service conditions i.e. elevated temperature and high radiation. • Poor and inadequate installation. • Cables installed against, or in close proximity to hot surfaces.		2RO Or as prescribed by the Cable Ageing Management Programme

Task Description	Qualified Life	Frequency / Next Replacement
• Burned cable sections. • Cables are bent out of shape. • Winding is too tight in loops which could also initiate cracking. • Correct radius is used when looping the cables. • Wear and Tear		
Perform visual and tactile inspection of qualified Low Voltage qualified cables listed in the EQML 240-155832775 in order to identify the following ageing effects: • Softness on the outer sheath. • Discolouring, cracking, hardness, cuts, voids and protrusions. • Bruises/ Abrasion • Exposed insulation. • Loose connections. • Cable susceptible to moisture ingress (steam, water, oil, chemical etc.). • Changes in service conditions i.e. elevated temperature and high radiation. • Poor and inadequate installation. • Cables installed against, or in close proximity to hot surfaces. • Burned cable sections. • Cables that are bent out of shape. • Winding that is too tight in loops which could also initiate cracking. • Incorrect radius is used when looping the cables.		4RO Or as prescribed by the Cable Ageing Management Programme
Perform visual and tactile inspection of qualified Medium Voltage qualified cables listed in the EQML 240-155832775 and check that: • Cables outer sheath: - have no cracks, no burn marks and no cuts, - not discoloured and not brittle, there are no protrusions and have no bruises / abrasion. • Cable outer sheath and insulation hardness is as expected and is neither significantly harder nor softer than expected. • No exposed insulation. • There are no loose connections, • Liquids are not leaking from surface and from the conductor. • Liquids or steam are not making an impact		4RO Or as prescribed by the Cable Ageing Management Programme

Task Description	Qualified Life	Frequency / Next Replacement
upon cable from external sources. • There are no chemical substance and oil discharges from the termination ends, or cable surface. • Cables are not subjected to tight bends. • Cable is not pinched by supports.		

3.4.3 Electrical Cabinets and Connection/Control Boxes

Table 3: Requirements for Electrical Cabinets and Connection/Control Boxes

Task Description	Frequency
Perform Visual inspection of electrical cabinets listed in the EQML 240-155832775 for: • Signs of mechanical damage, corrosion or conditions conducive to future corrosion. • Obvious damage to the cabinet coating. • Damage to any of the cabinet supports. • Damage to cabinets covers, doors and locking/closing mechanisms. • Water deposits on cabinet surfaces, or water dripping on surfaces that can lead to future surface degradation. • Moisture on the inner surfaces of cabinets.	4RO Or as prescribed by the Cable Ageing Management Programme
Perform Visual inspection of I&C cabinets listed in the EQML 240-155832775 for: • Signs of mechanical damage, corrosion or conditions conducive to future corrosion. • Obvious damage to the cabinet coating. • Damage to any of the cabinet supports. • Damage to cabinets covers, doors and locking/closing mechanisms. • Water deposits on cabinet surfaces, or water dripping on surfaces that can lead to future surface degradation. • Moisture on the inner surfaces of cabinets.	4RO Or as prescribed by the Cable Ageing Management Programme
Perform Visual inspection of Connection/Control Boxes for: • Signs of mechanical damage, corrosion or conditions conducive to future corrosion. • Obvious damage to the cabinet coating. • Damage to any of the cabinet supports. • Damage to cabinets covers, doors and locking/closing mechanisms.	6RO Or as prescribed by the Cable Ageing Management Programme

Task Description	Frequency
• Water deposits on cabinet surfaces, or water dripping on surfaces that can lead to future surface degradation. • Moisture on the inner surfaces of cabinets.	

3.4.4 EBA Pneumatic Valve Actuators

Table 4: Requirements for the EBA Actuators

Task Description	Qualified Life	Frequency/Next Replacement
Replace EBA actuators, EBA 001, 003, 013 and 015 AK.	60 years	04/2044 for Unit 1 *Installed in 04/1984 on Unit 1* 07/2045 for Unit 2 *Installed in 07/1985 on Unit 2*
Assessment of the proper function (performance of a load cycle) on a regular basis - Verify closing time (stroke time)		2RO
Overhaul pneumatic actuator and perform inspection for wear and measurement of leak tightness of the butterfly valves: • Visual Inspection of the joints and valve seats for abrasion and damages. • Measurement of the integral gas tightness of the butterfly valve.		6RO
Perform visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event). Check that all bolts are in place. Check that the valve is not continuously hunting, check any air leaks.		2RO

3.4.5 Residual Heat Removal (RRA) Motors

Table 5: Requirements for the RRA Motors

Task Description	Qualified Life	Frequency /Next Replacement
Replace RRA 001 MO and RRA 002 MO prior to end of qualified life.	60 years	04/2044 for Unit 1 *Installed in 04/1984 on Unit 1* 07/2045 for Unit 2 *Installed in 07/1985 on Unit 2*
Use qualified grease as required (MOBILGREASE 28) during maintenance.		As required or during maintenance
Use correct bearings: DE: 6326M; NDE: NU 324(STD) or any alternative bearings evaluated by engineering.		As required or during maintenance
Do not block the longitudinal guide of the rear bearing and do not reduce the mounting clearance.		As required or during maintenance
Protect the metallic parts and the movable upright moulded pieces while disconnected.		As required or during maintenance
Only elements from the kit provided by the manufacturer may be used. Requirements for crimping must be respected.		As required or during maintenance
The "fastening flanges" or brackets used to fix the extension component must be "metal" as well as the screws should be fitted with a stopping mechanism.		As required or during maintenance
Perform replacement of: • Seals for the housing • Sealants of the housing (if any) Check the stator insulation by measurements Perform visual inspections of the motor.		3RO
Apply grease on the bearings.		1RO

3.4.6 Pressuriser Heaters

Table 6: Requirements for the Pressuriser Heaters

Task Description	Qualified Life	Frequency/ Next Replacement
Replace the Pressuriser heaters, RCP 005 and RCP 006 RS prior to end of qualified life (Modification No.13028 (RCP))	40 years	04/2024 for Unit 1 *Installed in 04/1984 on Unit 1* 07/2025 for Unit 2 *Installed in 07/1985 on Unit 2* *Note: Modification to replace the heaters is planned for Outage 127 and Outage 227*
Perform visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event)		4RO

3.4.7 Rotork Valve Actuators

Table 7: Rotork Valve Actuators Requirements

Task Description	Qualified Life	Frequency / Next Replacement
Replace qualified Rotork Actuators listed in the EQML 240-155832775 prior to end of qualified life.	60 years	04/2044 for Unit 1 *Installed in 04/1984 on Unit 1* 07/2045 for Unit 2 *Installed in 07/1985 on Unit 2*
Perform the following inspections on the Rotork Actuator listed in the EQML 240-155832775: • Inspect for heavy pieces of equipment around the equipment (which can damage the equipment during a seismic event). • All bolts for the limit switch compartment and motor should be in place.		2RO

Task Description	Qualified Life	Frequency / Next Replacement
• No sign of oil leakage through body seals should be seen. • Check oil level and replenish if necessary. • Visually inspect for oil leaks and invoke a corrective action if any are found. • Check tightness of actuator to valve mounting bolts. • Check that all cables are properly glanded, secured in cable tray, not damaged or degraded, and clear of any hot pipework.		
Overhaul the qualified Rotork Valve Actuators listed in the EQML 240-155832775 to preserve the original environmental qualification. The measures should include the replacement of oils and lubricant and all seals in the actuator assembly.		6RO
Replace O-rings, lubricant and seals. Inspect seal joints for dirt and other objects before replacement of the seals.		Whenever the seal is broken
Exxon Spartan EP 150 oil is qualified for use in Rotork Actuators. Note: *Alternative qualified Oil may be used if evaluated and accepted by Engineering.*		As required

3.4.8 Transmitters

3.4.8.1 ITT Barton Type Transmitters

Table 8: Requirements for the qualified ITT Barton transmitters

Task Description	Qualified Life	Frequency/ Next Replacement
Replace ITT Barton transmitter listed in the EQML 240-155832775.	60 years	02/2044 for Unit 1 *Installed on 02/1999 on Unit 1*

Task Description	**Qualified Life**	**Frequency/ Next Replacement**
		07/2045 for Unit 2 *Installed in 07/1998 on Unit 2*
Renew O-rings on the outer lid (cover) and transmitter housing every time the transmitter covers are removed. Note: *Apply Dow Corning High Vacuum Grease to O-rings prior to installation.*		Every time the transmitter covers are removed.
Renew O-rings on 2 adjustment plugs (if installed) every time the transmitter covers are removed.		As required
When the lid is closed, torque the cap screws to 4 - 5 N-m, dry (3-4 ft.-lbs) for ITT Barton Transmitters. Verify that the M&TE calibration is still valid.		When replacing the transmitter covers.
When electrical housing cover is replaced, torque the cover to 22.4 N-m (16.5 ft-ibs) Verify that the M&TE calibration is still valid.		When replacing the transmitter covers.
Verify that the lid, housing and the adjustable plugs O-rings are present prior to closing the transmitter.		Prior to replacing the covers and adjustment plugs screws.
Perform internal inspection of the Barton Transmitters for whiskers and clean the any whiskers if present.		6RO

3.4.8.2 Rosemount Type Transmitters Model 1153 and 1154

Table 9: Requirements for the Rosemount Model 1150 series

Task Description	Qualified Life	Frequency / Next Replacement
Replace transmitters • 1 ETY 201 MP • 1 ETY 202 MP	45 years	05/2044 *Sensors were installed in 05/2021 (Outage 125)*
Replace transmitters • 2 ETY 201 MP • 2 ETY 202 MP	22 Years	01/2022 *Sensors installed in 11/1998* *Replacement of the sensors is planned for Outage 225 – 01/2022*
Perform internal inspection of the Transmitters for whiskers and clean the any whiskers if present.		6RO

3.4.9 EGS Quick Disconnect Connectors

Table 10: EGS Connectors requirements (Transmitters)

Task Description	Qualified Life	Frequency / Next Replacement Date
Replace the EGS Connector (Complete Unit) installed an qualified transmitters listed in the EQML 240-155832775	60 Years	08/2044 for Unit 1 *Installed in 08/2009 on Unit 1* 08/2045 for Unit 2 *Installed in 08/2009 on Unit 2*
Replace O-ring on EGS connectors whenever the seal is broken, on assemblies that have been installed for longer than 1 week at service temperature. Inspect to check the O-ring is present before closing the covers.		Whenever the seal is broken, on assemblies

3.4.10 RCP Narrow Range Sensors

Table 11: Requirements for the RCP Narrow Range Sensors

Task Description	Qualified Life	Frequency / Next Replacement
Replace RCP Narrow Range Sensors (Weed Instrument Ultra Electronics type) listed in the EQML 240-155832775	60 Years	05/2044 for Unit 1 *Installed in 05/2018 on Unit 1* 12/2045 for Unit 2 *Installed in 12/2018 on Unit 2*
Renew the Pyrocontrole Sensors, Model DT 38, as required. (Only installed on Unit 2, Loop 3: RCP 057, 058, 060, 061 MT.)	40 years	07/2025 *Installed in 07/2003 on Unit 2* *Modification to replace sensors is planned for Outage 225 – 2022. The replacement is due to drift experienced by EDF.*
Visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event).		2RO

3.4.11 Solenoid Valves

Table 12: Requirements for the Valcor Solenoid Valves

Task Description	Qualified Life	Frequency / Next Replacement
Replace Valcor Solenoid Valve Assembly listed in the EQML 240-155832775.	60 Years	10/2044 for Unit 1 *Installed in 10/2010 on Unit 1* 05/2045 for Unit 2 *Installed in 05/2011 on Unit 2*

Task Description	Qualified Life	Frequency / Next Replacement
Replace O-rings installed in the Valcor Solenoid Valves with quality O-rings		10/2024 –Unit 1 *Installed in 10/2010 on Unit 1* 05/2025 – Unit 2 *Installed in 05/2011 on Unit 2* *Replacements of O-rings planned for Outage 226 and Outage 127*
Replace gaskets and seals to support the qualified life of the Valcor solenoid valve		6RO
Perform periodic testing to preserve the initial qualification during long term operation		6RO
Perform the visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event).		2RO

3.4.12 Primary Pump Speed Sensors

Table 13: Requirements for the RCP Pump Speed Sensors

Task Description	Qualified Life	Frequency / Next Replacement
Replace RCP Pump Speed Sensors. • RCP, 140, 141, 240, 241, 340, 341 MC	40 Years	04/2024 for Unit 1 *Installed in 04/1984 on Unit 1* 07/2025 for Unit 2 *Installed in 07/1985 on Unit 2* *Replacement is planned for Outage 225 and Outage 126*

Task Description	Qualified Life	Frequency / Next Replacement
Perform the visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event).		2RO

3.4.13 RIC In-Core Thermocouples

Table 14: Requirements for the RIC In-Core Thermocouples

Task Description	Qualified Life	Frequency / Replacement
Replace RIC In-Core Thermocouples. • RIC 001 – 051 MT	60 Years or based on the failure rates	04/2044 for Unit 1 *Installed in 04/1984 on Unit 1* 07/2045 for Unit 2 *Installed in 07/1985 on Unit 2*
Perform the replacement of the TC-RIC temperature measurement lines.		2022 for Unit 2- Outage 225 2024 for Unit 1- Outage 127 *Modification No. 07232 is planned for Outage 225 and Outage 127*
Perform the insulation resistance (wire against sheath) of the thermocouple. • If the insulation resistance is in the range of kOhms (less than a MOhm), a stress corrosion induced damage of the sheath is very likely (see also the values at thermocouples in document that are still marked		1RO

Task Description	Qualified Life	Frequency / Replacement
as operable). • As a consequence, a replacement of the thermocouple should be planned.		
Monitor the temperature value of all installed thermocouples during the normal operation of the plant. • Unacceptable deviations from specified reference values and deviation between adjacent thermocouples should be evaluated. • If unacceptable deviations have occurred during a fuel cycle, the root cause must be identified during the next outage. If the root cause is not the thermocouple, the component that reveals the malfunction should be replaced.		1RO
Perform the visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event).		2RO

Task Description	Qualified Life	Frequency / Replacement
Follow correct regarding the disconnection and subsequent storage of connectors during head operations. Covers must be used to ensure protection against humidity ingress and damage to the thermocouple connectors on the vessel head as well as the on the plug-board. The following actions must be considered during maintenance activities: • Use of plugs on the connectors to avoid damages to the thermocouple connectors on the vessel head as well as the on the plug-board. • Using adapted tools to carry out insulation measurement and troubleshooting to avoid damages on the thermocouples connectors. • Development of an anti-rotating device to avoid the loss of the hydraulic coupling during the tensioning to the torque of the thermocouples connectors.		As required

3.4.14 Limit Switches (Motorised Valves)

Table 15: Requirements Namco Limit Switches

Task Description	Qualified Life	Frequency / Next Replacement
Replace entire assembly, EA180-Series Limit Switch (EC290-Series receptacle) listed in the EQML 240-155832775 *Note: No intrusive maintenance and replacement of parts is allowed.*	60 Years	10/2044 for Unit 1 *Installed in 10/2010 on Unit 1* 03/2045 for Unit 2 *Installed in 03/2011 on Unit 2*

Task Description	Qualified Life	Frequency / Next Replacement
Perform the visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event)		2RO

3.4.15 RRA Pressure and Flow Transmitters

Table 16: Requirements for the RRA ITT Barton transmitters

Task Description	Qualified Life	Frequency / Next Replacement
Replace RRA transmitters RRA 004 MP and RRA 006 MD.	60 years	02/2044 for Unit 1 *Installed in 02/1999 on Unit 1* 05/2045 for Unit 2 *Installed in 05/1998 on Unit 2*
Renew O-rings on the outer lid (cover) and transmitter housing Note: *Apply Dow Corning High Vacuum Grease to O-rings prior to installation.*		Whenever the transmitter covers are opened
Renew O-rings on 2 adjustment plugs (if installed).		Wherever the adjustable plugs are opened
When the lid is closed, torque the cap screws to 4 - 5 N-m, dry (3-4 ft.-lbs) for ITT Barton Transmitters		When replacing the transmitter covers
When electrical housing cover is replaced, torque the cover to 22.4 N-m (16.5 ft-ibs)		When replacing the transmitter covers
Verify that the lid, housing and the adjustable plug O-rings are present prior to closing the transmitter.		Prior to replacing the covers and adjustment plugs screws

3.4.16 RCP Wide Range RTDs

Table 17: Requirements for the RCP Wide Range Sensors

Task Description	Qualified Life	Frequency / Next Replacement
Replace RCP Wide Rage sensors • RCP 028 MT • RCP 043 MT • RCP 055 MT	60 Years	05/2044 for Unit 1 *Installed in 2018 on Unit 1* 05/2045 for Unit 2 *Installed in 05/2018 on Unit 2*
Perform the visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event) Including the visual inspection of the AMP Lugs and Raychem Sleeves.		2RO

3.4.17 RRA Temperature Sensors

Table 18: Requirements for the RRA Temperature Sensors

Task Description	Qualified Life	Frequency / Next Replacement
Replace RRA temperature sensors RRA 005 MT and 007 MT	40 Years	10/2024 for Unit 1 *Installed in 10/2010 on Unit 1* 03/2025 for Unit 2 *Installed in 03/2011 on Unit 2* *Replacement is planned for Outage 225 and Outage 126.*

Task Description	Qualified Life	Frequency / Next Replacement
Perform the visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event) Including the visual inspection of the AMP Lugs and Raychem Sleeves.		2RO

3.4.18 Transmitters Located in the VVP Main Steam Bunker

Table 19: Requirements for the Transmitters located in the VVP Main Steam Bunker

Task Description	Qualified Life	Frequency / Next Replacement
Replace Steam Pressure transmitters • VVP 007 MP • VVP 008 MP • VVP 009 MP • VVP 010 MP • VVP 011 MP • VVP 012 MP • VVP 013 MP • VVP 014 MP • VVP 015 MP	45 Years	10/2044 for Unit 1 *Sensors installed in October 2019* 05/2045 for Unit 2 *Sensors installed in May 2020*
Perform the visual inspection of the equipment and verification at there are no heavy pieces around the equipment (which can damage the equipment during a seismic event)		2RO

3.4.19 Steam Dump to Atmosphere Valve Actuators (GCTa)

Table 20: Requirements for the Steam Dump to Atmosphere Valve Actuators (GCTa)

Task Description	Frequency / Next Replacement
Overhaul the GCTa Rotork Valve Actuators listed in the EQML 240-155832775 to renew the original environmental qualification prior to LTO The measures should include the replacement of oils and lubricant and all seals in the actuator assembly.	04/2024 for Unit 1 *Installed in 04/1984 on Unit 1* 07/2025 for Unit 2 *Installed in 07/1985 on Unit 2*
Overhaul the Rotork Valve Actuators to preserve the original environmental qualification. The measures should include the replacement of oils and lubricant and all seals in the actuator assembly.	6RO
Inspect of the Rotork Actuator cover seals whenever the actuator is opened	Whenever the seal is broken
Exxon Spartan EP 150 oil is qualified for use in Rotork Actuators.	As required
Visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event).	2RO

3.4.20 Solenoids Valves on VVP 127, 128 and 129 VV

Table 21: Requirements for the Solenoids Valves VVP 127, 128 and 129VV

Task Description	Qualified Life	Frequency / Next Replacement
Replace Valcor solenoid valve assembly on Unit 1 • Valcor Solenoids Valves for 1 VVP 127, 128 and 129	60 Years	05/2044 for Unit 1 *Installed in Outage 125 – 05/2021*

Replace Valcor solenoid valve assembly on Unit 2 • Valcor Solenoids Valves for 2 VVP 127, 128 and 129	40 Years	10/2025 for Unit 2 *Installed in 10/2011 on Unit 2* *Unit 2 - replacement of the Valcor solenoids is planned for in Outage 225 (2022)*
Replace gaskets and seals to support the qualified life of the Valcor solenoid valve		6RO
Perform the visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event)		2RO

3.4.21 NAMCO Limit Switches on VVP 127, 128 and 129 VV

Table 22: Requirements for the NAMCO Limit Switches on VVP 127, 128 and 129 VV

Task Description	Qualified Life	Frequency / Next Replacement
Replace entire NAMCO Limit Switches listed in the EQML 240-155832775 before end of qualified life. ***(****No intrusive maintenance and replacement of parts are allowed.)*	60 years	10/2044 for Unit 1 *Installed in 10/2010 on Unit 2* 03/2045 for Unit 2 *Installed in 03/2011 on Unit 2*
Perform the visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event).		2RO

3.4.22 Neutron Power Range Detectors

Table 23: PM Requirements Neutron Power Range Detectors (RPN)

Task Description	Frequency / Next Replacement
Replace RPN Power Neutron Detectors: • RPN 010, 020, 030 & 040 MA	10RO *Unit 1 - Replaced in Outage 115 – 2005* *Unit 2 - Replaced in Outage 215 – 2006*
Perform the visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event)	2RO

3.4.23 Post-Accident Gamma Detectors

Table 24: Requirements for the Post-Accident Gamma Detectors (KRT)

Task Description	Qualified Life	Frequency / Next Replacement
Replace Gamma detector KRT 022 / 023 MA	40 Years	04/2024 for Unit 1 *Installed in 04/1984 on Unit 1* 07/2025 for Unit 2 *Installed in 071985 on Unit 2* *Replacement of sensors is planned for Outage 225 and Outage 126*
Visual inspection of the equipment and verification that there are no heavy pieces around the equipment (which can damage the equipment during a seismic event).		2RO

3.5 EQ equipment that are periodically replaced

The EQML provides a list of EQ items that are periodically replaced based on the current maintenance strategy. The replacement tasks and frequencies are given in IQReview.

Table 25: Requirements for the Pressure Regulating Valves

Task Description	Frequency
Renew the following Fisher /SEREG Filter Regulators: • RRA030 FR • RRA032 FR • RRA033 FR • RRA035 FR • RRA031 FR • RRA034 FR • RCV002 FR • RCV003 FR • RCV007 FR • RCV008 FR • RCV009 FR • RCV082 FR • RCV227 FR • RCV250 FR • RCV257 FR • REN101 FR • REN102 FR • REN121 FR • REN122 FR • REN123 FR • REN124 FR • REN161 FR • REN162 FR • REN163 FR • REN231 FR • REN235 FR • RIS 122 FR • ETY 043 FR • ETY 044 FR • RCV310 FR • RPE 002 FR • RPE 017 FR • RPE 027 FR • RPE 055 FR	6RO

Task Description	Frequency
Renew the following filter regulators: • GCT131 FR • GCT132 FR • GCT133 FR	6RO
Renew the following filter regulators: • VVP127FR • VVP128FR • VVP129FR	3RO

Table 26: Requirements for the GCT 131/132/133 VV Pneumatic Valve Actuator

Task Description	Frequency
Renew the following Pneumatic Valve Actuators • GCT131 AK • GCT132 AK • GCT133 AK	6RO

Table 27: Requirements for the Joucomatic Solenoid Valve

Task Description	Frequency
Rene the following Joucomatic Solenoids installed on VVP 001, 002 and 003 VV • VVP 161 EL • VVP 170 EL • VVP 171 EL • VVP 172 EL • VVP 180 EL • VVP 181 EL • VVP 182 EL • VVP 260 EL • VVP 261 EL • VVP 270 EL • VVP 271 EL • VVP 272 EL • VVP 280 EL • VVP 281 EL • VVP 282 EL	6RO

Task Description	Frequency
• VVP 360 EL • VVP 361 EL • VVP 270 EL • VVP 372 EL • VVP 380 EL • VVP 381 EL • VVP 382 EL • VVP 162 EL • VVP 371 EL	

3.6 Metrology Tools

This refers to calibration and measuring instruments used for qualified items.

Table 28: Measuring instruments used on qualified items

Task Description	Comments
Check and verify the metrology tools, i.e. Torque wrench, multimeter, pressure measurements tools, etc.	Before each use check expiry date on the tool calibration certificate and record it in the history record.

3.7 Monitoring of environmental conditions

Monitoring of environmental conditions is implemented in order to get additional information necessary for the assessment of ageing effects on the equipment due to operating environment.

The design ambient conditions under normal operation inside the reactor building temperature limits for Koeberg are given in KBA 1216 J 10 256.

Trends from InSQL database, temperature labels and temperature data loggers, conditions are assessed to determine the impact on the condition of qualified equipment and to identify corrective actions, if necessary.

The monitoring of environmental conditions in the nuclear installation during operation should verify the following:

- The assumptions in the equipment qualification are consistent with the ambient conditions in the part of the installation in which the equipment is installed;
- The design limits of the equipment are not exceeded;
- The status of qualified equipment remains valid.

Monitoring of environmental conditions may also be used to support the evaluation of remaining qualified life by determining if an item of equipment is suitable for continued service.

As part of the SALTO assessment project, environmental zones where established. The purpose of environmental zoning was to provide a basis for ageing analysis of in-scope systems, structures

and components. SALTO report L1124-GN-RPT-040; “SALTO Room Master and Environmental Zones Report” provides details of all the buildings, rooms and locations for SALTO in-scope equipment. Each room/ location is assigned to an environmental zone. The report defines the environmental zones and specifies the prevailing environmental conditions to which the in-scope equipment is exposed in each zone. Details of the zones are further captured in in L1124-GN-LIS-029, “Equipment Zone Table” and “L1124-GN-LIS-016 SALTO Room Master and Environmental Zones List”.

Measured values were given priority, for example those obtained by plant walkdown, data downloaded from the Plant Data System, radiation surveys performed during on-line containment entry and monthly routine radiation surveys. Design-values were used where data from walkdowns or the Plant Data System were not available.

Table 29: Environmental Zones (source L1124-GN-LIS-016)

T_Min °C	T_Max °C	T_Ave °C	Zones	Zone Description & associate Ventilation System
20.0	24.0	25.5	C1	Electrical Building 15m & 19m. DVC (HVAC) System
10.0	40.0	25.3	E1	Electrical Building Cable Floor & Battery Rooms +3.4m. Only 1 zone. DVE (HVAC)
15.0	45.0	30.0	G1	Peripheral Rooms. RGL & ASG Rooms. DVG (HVAC) System
5.0	55.0	29.0	H1	NAB. RCV/ RIS Pump Rooms. DVH (HVAC) System
15.0	40.0	21.6	I1	NAB. RRI Pumps/ Hx Rooms. DVI (HVAC) Rooms
15.0	30.0	25.4	K1	Fuel Building Zone 1. DVK (HVAC) System. 15 to 30 DegC DSE Operating Spec
15.0	35.0	33.7	K2	Fuel Building Zone 2. DVK (HVAC) System. 15 to 35 DegC DSE Operating Spec
15.0	40.0	27.5	K3	Fuel Building Zone 3. DVK (HVAC) System. 15 to 40 DegC DSE Operating Spec
15.0	35.0	33.7	K4	Fuel Building Zone 4. Submerged Liners FB Compartments. K2 Parameters Used
15.0	35.0	29.0	L1	Electrical Building -6, -3, 0m, 7m, 11m. Only 1 zone. DVL (HVAC) System
15.0	45.0	28.1	N1	NAB - Majority of Rooms. DVN (HVAC) System. Other NAB Rooms in W Zone
15.0	45.0	28.1	N2	NAB - Filter Rooms. RP Red Zone DVN (HVAC) System
10.0	36.0	22.0	Q1	Low Level Waste - Cask Storage Room. DWL (HVAC) System.
18.0	60.0	28.0	R1	Rx Building Zone 1. Unique Areas: RPN, Rx Pit/Cavity, Rx Vessel, C-Rods. EVC, RRM, RIC
21.6	29.5	25.7	R2	Rx Building Zone 2. -3 to 5m level. EVR (HVAC) System
25.0	35.0	30.0	R3	Rx Building Zone 3. 8 to 20m level. EVR (HVAC) System
37.8	43.0	39.8	R4	Rx Building Zone 4. 23 to 50m level. EVR (HVAC) System

T_Min °C	T_Max °C	T_Ave °C	Zones	Zone Description & associate Ventilation System
29.5	34.1	31.7	R5	Rx Building Zone 5. RCV Valves & Hx Rooms. EVR (HVAC) System
31.9	40.0	34.7	R6	Rx Building Zone 6. SG's, Pumps, PZR. EVR (HVAC) System
18.0	60.0	28.0	R7	Rx Building Zone 7. Submerged Liners HRX Compartments. R1 Parameters Used
15.0	50.0	32.5	V1	GCT, VVP & ARE bunkers. DVW and DVY (HVAC) Systems
15.0	45.0	27.9	W1	Peripheral Rooms. DVW (HVAC) System
10.0	36.0	22.0	X1	Emergency Diesels. No HVAC System. Fire Station, CAS Building, SEK Plant, Low Level Waste/ Cask Storage, Emergency Control Centre, PTR Tank room, ASG tank room, Turbine Hall
10.0	36.0	22.0	X2	SEC Plant, SEC Galleries, other corridors, tunnels, trenches

Note 1: T_Min: Minimum Temperature; T_Max: Maximum Temperature; T_Ave: Average Temperature °C.

For requirements for the monitoring of the environmental conditions at certain plant locations to ensure the temperatures established for the environmental zones are not exceeded are listed in Table 30 below:

Table 30: Monitoring of Temperatures

Requirements	Frequency	Sensors/ Devices
Monitor and trend Containment Dome Temperature (Upper) Inside containment	1RO	InSQL Trends ETY 101 MT & ETY 002 MT
Monitor and trend Containment Lower Part Temperature Inside containment	1RO	InSQL Trends ETY 103 MT & ETY 004 MT
Temperatures in selected location inside containment	1RO	InSQL Trends - Ventilation Systems Temperatures: • Rx Vessel, C-Rods. EVC, • Rx Building Zone 2. -3 to 5m level. EVR (HVAC) • Rx Building Zone 3. 8 to 20m level. EVR (HVAC)

Requirements	Frequency	Sensors/ Devices
		• Rx Building Zone 4. 23 to 50m level. EVR (HVAC) • Rx Building Zone 5. RCV Valves & Hx Rooms. EVR • Rx Building Zone 6. SG's, Pumps, PZR. EVR
Verify the Containment in the Steam Bunker, as required	As required	GCT, VVP & ARE bunkers. DVW & DVY (HVAC) HOBO Temperature Data Loggers as required

Note: Environmental Condition Monitoring Programme (ECMP), 240-165386950, provides additional requirements to capture environmental data during normal operation for further ageing analyses of electrical cables and re-assessments of qualified equipment

The radiation levels inside containment will continuously be monitored as follows:

Table 31: Monitoring of Radiation inside containment

Requirements	Frequency	Sensors/ Devices
Radiation levels in various parts inside containment	1RO	InSQL Trends - KT 008 MA & KRT 009 MA Radiation Surveys, as required

3.8 Flooding/Submergence

The in-scope qualified equipment were not identified as equipment at risk of flooding as per Koeberg flooding analysis report. Credit is taken for the following mitigating items protecting equipment against loading.

- Doors
- Drains
- Sumps
- Sump pumps

- Bund Walls
- Covers
- IP rated Enclosures

3.9 Seismic events and vibrations

The seismic specification document KBA 12 22 E02 008, “Qualification of Safety Related Electrical Equipment (class 1E) General Seismic Test Specification”, defines the procedure and method for the seismic test for safety related electrical equipment so as to meet the requirements of IEEE 344-1971. These requirements are intended for the qualification of safety related equipment that is required to operate during and after a design basis earthquake or safe shutdown earthquake (SSE).

All qualified equipment should meet meets the requirements stipulated in the seismic specification document KBA 12 22 E02 008 as well as document KBA 12 22E02 039, “General Evaluation Report on Class 1E Electrical Equipment Seismic Test Results”, which verified the seismic qualification performed for the Koeberg plant, taking into account the updated spectra in document KBA 00 22 E01 020, “Floor Response Spectra for the Design of Equipment and Piping Systems”.

Procedure 240-144389653 (KAA-561), “The Control of Free-Standing Equipment that could affect Safety Related Equipment” should be followed ensures that free-standing equipment and material used on the plant is secured in such a way that nearby safety related electrical equipment is not affected or damaged in the event of a seismic event.

3.10 Electromagnetic Interference

Electromagnetic interference can affect electrical equipment including instrumentation and control systems and components.

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.

The electromagnetic interference tests should be performed as part of the type testing on a different test specimen to that which is subjected to tests for operational ageing and seismic events and other design basis events.

Detailed equipment qualification specifications and acceptance criteria for electromagnetic interference should be determined.

A site survey, if required, of sources of electromagnetic interference should be performed during normal operation, and should include monitoring for the effects of operating and maintenance activities to establish and verify the basis for equipment qualification.

3.11 Periodic tests, Calibrations and Validations

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.

Instrument calibrations and validations are carried out periodically which check and maintain instrument accuracy and drift. For Koeberg, periodic tests, surveillance, calibrations and validations are documented in the Safety Related Surveillance Manual (SRSM) and IQReview.

3.12 Plant Change Management

Replacements and modifications of EQ components should be performed in accordance with 331-144, “Standard for the Preparation of an Equivalency Study” and 331-186’ “Design Modification Process” respectively.

EQ specifications stipulated in 331-496, “Equipment Qualification File Template” must be adhered to unless justification is provided by Engineering.

Temporary alterations (TAF) to plant, plant structures or operating parameters that could affect the design and safe operation should be assessed, approved, safely implemented, and withdrawn in a systematic and controlled manner as described 331-188.

3.13 Ageing Management Review

The ageing management process 331-275, “Process for the development and control of ageing management at Koeberg Operating Unit” defines the ageing management review (AMR) process for ageing evaluation of SSCs important to safety.

3.14 Re-assessment of Qualified Life

In accordance with 331-186, the qualified life of equipment should be reassessed throughout the lifetime of the installation to take into account changes in the actual service conditions, such as temperature and radiation levels, and development in the knowledge and understanding of degradation mechanisms. If the qualified life of equipment is to be extended a technical basis for the extension shall be provided.

The following methods are to be considered for reassessing the qualified life in accordance with the IEC/IEEE standard (Nuclear facilities - Electrical equipment important to safety – Qualification”, IEC/IEEE 60780-323).

The Time Limited Ageing Analysis (TLAA) of qualified equipment was performed and documented in report, L1124-GN-RPT-018, “EQ TLAA report” and the associated list L1124-EL-LIS-002, “SALTO TLAA Result List”. This report provides justification for the extension of qualified life for some components; identified components with qualified life shorter than 60 years that require reanalysis or replacement prior to start of the LTO period.

The results of the revalidation and the re-analysis of the EQ TLAA have been incorporated in this EQMM.

The following methods are to be considered for continuously reassessing the qualified life in accordance with the IEC/IEEE dual logo standard.

3.14.1 Method 1: Using conservatism

Evaluation of conservatisms in original assumptions for environmental conditions, failure criteria, and acceleration factors may identify that actual conditions are less severe, and the qualified life may be adjusted accordingly with due consideration of the required margins. Limitation of use of

accelerating factors (e.g. time period extrapolation, synergy between effect of temperature and radiation, dose rate effect), verification of ageing models, and proper assessment of environmental conditions are considered.

3.14.2 Method 2: Type test on aged samples from the plant

Install additional qualified equipment in identical service conditions or use qualified equipment aged in the plant. Remove in-service equipment before the end of the qualified life and demonstrate its safety function performance during and after DBE(s) or other environments as defined in accordance with national regulatory requirements for equipment qualification after further artificial ageing to establish additional qualified life[21].

3.14.3 Method 3: Performing type test for longer qualified life

A longer qualified life can be achieved by either performing additional artificial ageing on the test sample from the initial qualification for additional duration or begin ageing on a new sample while the qualified equipment is in service. Equipment safety function is then demonstrated by successfully passing accident condition test.

3.14.4 Method 4: Component replacement

Identify age-sensitive components of equipment and replace them with new, identical components or with less sensitive components to extend qualification. Consideration is given to time required to have the component accessible for the replacement. This method is not used if the disassembly of the equipment can alter its performance in service conditions (including accident conditions).

3.15 Procurement and storage of qualified equipment

3.15.1 Procurement of goods

The process and responsibilities for procuring goods and services via the material request route at Koeberg Nuclear Power Station as defined in procedures 240-95405347, “Procurement of Items and Services for the Nuclear Operating Unit”.

3.15.2 Procurement quality requirements

Procedure 240-129883544, “Procurement Quality Engineering Requirements” provides monitoring, verification and quality assurance programme requirements for procured items and services with a designated quality level.

Qualified equipment and spare parts should be procured in accordance with design or procurement specification. Design or procurement specifications should contain the qualification requirements, equipment specifications and specified service conditions for the equipment to be purchased.

3.15.3 Receipt Inspection

Procedure KAA-641, “Control of Receipt of Materials”, defines the responsibilities, and process for receipt of material from receipt to delivery of material to the user or storage.

3.15.4 Storage of equipment

Document KSA-012, “The Storage and Preservation of Spare Parts at Koeberg Nuclear Power Station”, details the requirements for the control and storage of spare parts and materials at Koeberg Nuclear Power Station for the following:

- Packaging and cleaning
- Protective Coating
- Storage Level
- Storage Handling
- Preventive Maintenance
- Shelf Life

3.15.5 Control of Shelf Life

The process to manage the stores shelf life of items is defined in KAA-716, “Shelf Life Process’. The process includes actions to:

- Identify items that are required to be managed with the shelf life programme.
- Specify shelf life programme requirements.
- Receive items and update shelf life expiry dates and batch numbers on SAP database when processing Goods Receipt on SAP.
- Store item in the correct storage environment and package.
- From the shelf life SAP database, review all expired shelf life items on a monthly basis.

3.15.6 Procurement documentation

Procurement documents should reflect the responsibility of the vendor and/or the manufacturer to demonstrate that the equipment supplied is identical to that ordered by the operating organization. The procurement documentation should state that the operating organization should be notified when changes to equipment design and manufacturing occur

3.16 Management of plant transients

Plant operational and design transients should 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 Materials Reliability Group (MRG) performs a yearly review of the NSSS Design Transient Monitoring.

The effects of these transients on EQ equipment should be evaluated and appropriate corrective action taken.

3.17 Interfaces with other programmes and processes

The equipment qualification programme interfaces with the following programmes and processes, amongst others, to ensure the status of qualified equipment is preserved.

- Licensing Department
- Maintenance Execution
- Work Management;
- Operating Experience Group;
- Corrective Action Programme
- Quality Assurance
- Procurement Quality Engineering
- Systems Engineering
- System Design Engineering
- Cable Ageing Management Programme
- Obsolescence Management Programme
- Reliability Engineering (PM Programme/IQReview)

3.18 Documentation

Equipment qualification documentation should include the following:

- A list of items important to safety that are subject to equipment qualification;
- Criteria for equipment qualification;
- Equipment specifications;
- Equipment qualification analyses and tests;
- Equipment qualification summary reports;
- Instructions for preserving the status of qualified equipment.

The qualification summary report should 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

3.19 Training

To ensure that EQ related tasks are performed in a consistent, technically acceptable manner, the personnel involved need to possess adequate skills and relevant authorisations.

4. Acceptance

This document has been seen and accepted by:

Name	Designation
Ahmed Kamroodien	Programmes Engineering Manger
Rida Cassim	Materials Reliability Group Manager
Nozipho Bongelo	Senior Technologist - Materials Reliability Group
Vivian Phalane	Specification Engineering – Senior Advisor
Liezl Hugo	Reliability Engineering - Senior Advisor
Jason Roberts	Instrumentation Maintenance Services – Senior Advisor
Ashley Oosthuizen	Project Engineer - SALTO
Les Borrill	Senior Engineer - Materials Reliability Group
Abu-Bakr Jakoet	Senior Engineer - Materials Reliability Group
Alan Nambiar	Chief Engineer – IPDK

5. Revisions

Date	Rev.	Compiler	Remarks
October 2021	3	K Moroka	Document updated to: • Align with the requirements set out in RG-0027 and 331-186. • Include the Results of the EQ TLAA Revalidations and SALTO AME results. • CR 117512-009 CA OD_19.24 - Update the EQ Maintenance Manual 331-219 to achieve EQ strategy as described in SALTO 08016.ROD.018. • CR 121535-014 CA OD_19.14 - Updated EQ MM 331-219 for LTO to include the result of the SALTO AME and TLAA (2015). • To address the PSR General Conditions CR 123106 & CR 123276
November 2017	2	K Moroka	Document reviewed to align with the IAEA IGALL AMP 207 and to align with nine attributes of an effective ageing management programme as defined in 331-148).
November 2015	1	K Moroka	Complete review of the EQ maintenance manual. The equipment within the scope on the EQ programme listed separately. Qualified Life and next replacement date added to EQML.
April 2014	0	K Moroka	KBA 1222 E02 1002 Rev 2 reviewed in line with the new template for Nuclear Engineering and allocated a new document number 331-219. Updated to incorporate 1E equipment located outside containment and the NSF-classified equipment inside

			containment.
May 2012	2	K Moroka	Changed the document tittle to “Environmental Qualification Maintenance Manual” in accordance with KSA 125 Rev 0, “Standard for Environmental Qualification at Koeberg Nuclear Power Station. Incorporated the recommendation as described in the Safety Re-Assessment II, Oakridge report, “OAK_KBG_EEIS_EQ_ DELIVERABLES_02”. Incorporated the plant walk-down information.
November 2009	1	K Moroka	The document was revised to incorporate the requirements of the EDF RPMQ EQ document and the Outage 117 plant walk down information. The review of the EdF RPMQ was performed and documented in memorandum, SPT-6244/09 (EA 49611). For the Rotork actuators, the EQ requirements were adopted from the EPRI document TR-104884.
Jul 2008	0	L Nieuwoudt	This document was created to prescribe the minimum preventive maintenance requirements in order to ensure that the qualification of equipment is maintained.

6. Development Team

Not applicable.

7. Acknowledgements

Not applicable.