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IAEA | Safety Aspects of Long Term Operation SALTO

REPORT

OF THE

SAFETY ASPECTS OF THE LONG TERM OPERATION (SALTO)

AND

SALTO FOLLOW-UP MISSIONS

TO THE

KOEBERG NUCLEAR POWER PLANT

UNITS 1 AND 2

South Africa

22-31 March 2022

and

3-6 September 2024

DIVISION OF NUCLEAR INSTALLATION SAFETY
SAFETY ASPECTS OF LONG TERM OPERATION MISSION
IAEA-NSNI/SALTO/50F/2024

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PREAMBLE

This report presents the results of the IAEA Safety Aspects of Long Term Operation (SALTO) team review of Koeberg Nuclear Power Plant, South Africa. It includes recommendations for improvements affecting ageing management and safe long term operation for consideration by the responsible South African authorities and identifies good practices for consideration by other nuclear power plants. Each recommendation, suggestion, and good practice is identified by a unique number to facilitate communication and tracking.

This report also includes the results of the IAEA's SALTO follow-up mission. The inputs resulting from the follow-up mission can be found in the following chapters as added to the original mission information: Executive Summary, Conduct of the Mission, Main Conclusions, Detailed Conclusions for Review Areas; and in Appendix I where each issue sheet was extended with information on the hosting organization's actions to resolve the issue and the follow-up assessment by the IAEA review team. The purpose of the follow-up mission was to determine the status of all proposals for improvement, to comment on the appropriateness of the actions taken and to make judgements on the degree of progress achieved.

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EXECUTIVE SUMMARY

At the invitation of Eskom, the IAEA conducted a SALTO (Safety Aspects of Long Term Operation) mission at the Koeberg Nuclear Power Plant (NPP) (further referred to as 'the plant') from 22 to 31 March 2022.

The SALTO mission reviewed the status of activities related to long term operation (LTO) assessment of the plant against IAEA Safety Standards and international best practices. The review team consisted of two IAEA staff members (team leader and deputy team leader), six international experts and two observers, covering all six areas of the standard scope of a SALTO mission. The team reviewed the completed, in-progress and planned activities related to LTO, including ageing management of the structures, systems and components (SSCs) important to safety and revalidation of time limited ageing analyses (TLAAs). Through the review of available documents, presentations and discussions with counterparts and other members of the plant staff, the IAEA team observed that despite many challenges, the plant has addressed the most important deviations in ageing management activities and preparation for safe LTO since the Pre-SALTO mission in 2019, however many activities are still in progress to achieve full compliance with IAEA Safety Standards. The SALTO team encouraged the plant management to facilitate implementation of all remaining activities for safe LTO.

The team found the plant staff to be professional, open and receptive to proposals for improvement. The mission team observed that plant management is committed to improving plant preparedness for LTO. Walkdowns showed the plant to be in good condition. In addition, the team noted the following good performances:

- An integrated corrective action programme to extensively consider operating experience for LTO.
- A template to collect vital importance parameters from the original equipment manufacturers (OEM) to establish the extended qualified life of electrical components.
- The so-called capability index applied to characterize health, attitude and other enablers of staff members to qualify if they are fit to perform a task.

The team recognized that the plant's intention is to follow the IAEA Safety Standards in preparation for safe LTO. The team identified several areas for further improvement. Fourteen issues were raised:

- Management of the LTO programme is not effective to timely complete all actions to prepare for LTO.
- The safety analysis report (SAR) has not been adequately updated for LTO and ageing management.
- Completeness and consistency of scope setting of SSCs for ageing management and LTO are not ensured.
- The plant programmes are not comprehensively reviewed and implemented for LTO.
- Information used for ageing management review (AMR) of mechanical SSCs is not consistently managed and documented.
- Ageing management programmes (AMPs) for mechanical SSCs are not complete.
- The plant has not completely implemented a comprehensive cable ageing management programme.
- The plant has not revalidated environmental qualification for some SSCs for LTO.

- Electromagnetic compatibility has not been completely assessed.
- The plant has not revalidated the environmental qualification of qualified cables for LTO.
- A proactive approach to technological obsolescence management is not fully implemented.
- The plant has not comprehensively revalidated the TLAAs for concrete structures.
- Containment structure monitoring system is not fully functional.
- Ageing management programmes for civil structures are not fully developed and implemented.

A summary of the review was presented to the plant management during the exit meeting held on 31 March 2022. The plant management expressed a determination to address the areas identified for improvement and indicated their intention to initiate the invitation of a 'SALTO Peer Review Follow-up Mission to Koeberg Nuclear Power Plant' to be conducted in 2024.

FOLLOW-UP MISSION CONDUCT AND RESULTS

At the invitation of Eskom, the IAEA conducted a SALTO follow-up mission from 3 to 6 September 2024. The IAEA follow-up team consisted of two experts from the Czech Republic and Slovenia, and two IAEA staff members (team leader, deputy team leader).

The IAEA follow-up team reviewed the progress in resolving each of the issues from the 2022 SALTO mission. Based on the observations of the follow-up mission, the team has concluded that the plant has made a significant effort to solve all the issues. The resolution degree was determined by the team for each issue sheet separately, with the following results:

- 12 issues were assessed as issue resolved;
- 2 issues were assessed as satisfactory progress to date.

The SALTO team concluded that actions taken to solve the recommendations and suggestions are sound, well established and led to tangible improvement. The following can be highlighted:

- Issue A-1: The plant effectively managed the LTO programme to ensure LTO activities are completed in a timely manner.
- Issue D-4: The plant completed the revalidation of environmental qualification for qualified cables.
- Issue E-1: The plant completed the revalidation of TLAAs for concrete structures, including the containment TLAA.

Two issues were assessed as satisfactory progress to date, the completion of which will require continued work from the plant:

- Issue B-2: The plant should ensure that plant programmes supporting LTO are fully implemented for the LTO period.
- Issue E-2: The plant should ensure that the containment monitoring system is fully refurbished and remains fully functional during the LTO period.

A summary of the results was presented to the plant management during the exit meeting held on 6 September 2024. Plant management expressed a determination to maintain the level of preparedness for safe LTO and continue cooperation with the IAEA in the area of long term operation.

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CONTENTS

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1. INTRODUCTION

1.1. OBJECTIVES

As agreed during the preparatory meeting held virtually on 18 June 2021 a 'SALTO Peer Review Mission for Koeberg Nuclear Power Plant' ([19]-[20]) was conducted between 22-31 March 2022. The objective was to review the status and future plans for safe LTO programmes and activities performed at the plant with comparison to the relevant IAEA Safety Standards, guidance documents and internationally accepted practices and to provide recommendations and suggestions for improvement of the preparations for safe LTO.

1.2. SCOPE

In accordance with Section 3 of IAEA SALTO Guidelines [18] and the Working Note Outlines (WNO), the scope of this SALTO mission agreed during the preparatory meeting was as follows:

A. Organization of ageing management and LTO activities;

B. Scope setting, plant programmes and corrective action programme;

C. Ageing management of mechanical SSCs;

D. Ageing management of electrical and I&C SSCs;

E. Ageing management of civil SSCs;

F. Human resources, competence and knowledge management for LTO.

1.3. CONDUCT OF THE MISSION

1.3.1. Conduct of the main mission

The following documents and information were used as the basis for the review:

– IAEA Safety Standards [1-16];

– IAEA Safety Report and Review Guidelines [17-18];

– Advance Information Package [21];

– Technical experience of the team.

IAEA Safety Requirements SSR-2/1 (Rev.1) [2], Safety Requirements SSR-2/2 (Rev.1) [3], Safety Guide SSG-48 [15], Safety Guide SSG-25 on 'Periodic Safety Review' [14] and Safety Report No. 82 [17] were the basic references for the peer review.

The list of participants, including their functions during the SALTO mission and contact information, is given in Section 7.

The mission was conducted through reviews of plant documentation, meetings and discussions between the IAEA Review Team and counterpart specialists and other staff from the plant. All meetings were held at the plant and plant walkdowns were arranged as required.

Plenary sessions and parallel discussions were organized as needed. The discussions between IAEA experts and the plant counterparts were conducted in parallel for all the areas identified above in Section 1.2.

The mission team members and the team leader informed the counterparts and plant management of the team's observations daily. Each reviewer and counterpart reached agreement on the observed facts. The host plant peer attended the daily team meetings. Before the exit meeting, the

team finalized the mission report and it was presented to the counterparts and to the plant management.

This mission report summarizes the findings within the review scope, according to the SALTO Guidelines document [18]. The text reflects only those areas in which the team made an observation (either a recommendation, a suggestion, an encouragement, a good practice or a good performance). No text is included for areas of the review scope where the review did not reveal any safety related conclusions.

A formal exit meeting was held on the last day of the mission. At the exit meeting, each team member provided short conclusive statements summarizing the conclusions in the given review area.

1.3.2. Conduct of the follow-up mission

The follow-up mission was organized to review appropriateness and progress of solutions to the issues identified during the SALTO mission, as agreed during the preparatory meeting in March 2024 [22, 23].

The plant provided an updated Advance Information Package [24] describing plant actions to address recommendations and suggestions of the SALTO mission, one month before the follow-up mission, to the IAEA review team. The four-day follow-up mission included an introductory presentation of the plant, discussions, and interviews of responsible counterparts. These were the basis for the assessment of the status of issues as presented in this report.

1.4. SUMMARY INFORMATION ON THE PLANT

1.4.1. General information

Koeberg Nuclear Power Plant is the only NPP in South Africa and is owned and operated by ESKOM. It was commissioned in 1984 (Unit 1) and 1985 (Unit 2). Each unit is equipped with a reactor operating with enriched uranium (U-235) fuel and light water moderator and coolant.

The plant, unit 1 and 2, has the following characteristics:

- Reactor type: PWR
- Thermal power: 2 775 MW each
- Electric power output: 930 MW each
- Number of primary loops per unit: 3
- Volume of the primary circuit: 105 m^3 (cold) and 108 m^3 (hot)
- Pressure in the primary circuit: 15.5 MPa
- Average temperature of the primary coolant: 319.5°C (out), 286.1°C (in)
- Length/inner diameter of the vessel below nozzles: 11.9 m / 3.99 m
- Nominal enrichment of the fuel: 4.4%
- Fuel quantity per unit (U mass only): ~ 72.5 t
- Number of turbines per unit: 1 high pressure and 3 low pressure

1.4.2. Regulatory framework for ageing management and LTO

The initial licenses to operate the plant were issued by the Council for Nuclear Safety (now National Nuclear Regulator (NNR)). The NNR issued regulations related to LTO (and PSR). All required submissions relating to LTO and PSR have been made by the plant, together with a request to extend the licences of the units to 2044 and 2045 for Unit 1 and 2, respectively. Every

10 years a Periodic Safety Review (PSR) is performed. The regulatory requirements for operation beyond 40 years are documented in the Regulatory Guide (RG) RG-0027 (Interim Regulatory Guide Ageing Management and Long Term Operations of Nuclear Power Plants) and RG-0028 (Interim Regulatory Guide Periodic Safety Review of Nuclear Power Plants) issued in 2019.

1.4.3. Plant's LTO policy

The plant was initially licenced to operate for 40 years. During the initial licence term, significant milestones and activities completed include three periodic safety reviews, a post-Fukushima stress test review, two OSART reviews, regular WANO peer reviews, and continued safety improvements, and modifications.

Unit 1 LTO licence approval was obtained on 15 July 2024, and therefore, since 21 July 2024, Unit 1 has entered its period of LTO. The NNR Board has resolved to defer the decision on Unit 2 to before November 2025. The NNR LTO application review related to Unit 2 is still ongoing. The Unit 2 current licence expires on 9 November 2025.

2. MAIN CONCLUSIONS

This document is the report on the results of the SALTO mission completed in 2022 supplemented with the 'hosting organization actions to resolve issue' and 'follow-up assessment by the IAEA review team' during the follow-up visit in September 2024.

MAIN MISSION

Through the review of available documents, presentations and discussions with counterparts and other members of the plant staff, the IAEA team observed that despite many challenges, the plant has addressed the most important deviations in ageing management activities and preparation for safe LTO since the Pre-SALTO mission in 2019, however many activities are still in progress to achieve full compliance with IAEA Safety Standards. The SALTO team encouraged the plant management to facilitate implementation of all remaining activities for safe LTO.

The team found the plant staff to be professional, open and receptive to suggestions for improvement and observed that the plant management is committed to improving preparedness for LTO. Walkdowns indicated that the plant is in good condition. The most significant good performances noted by the team were in the following areas:

- An integrated corrective action programme to extensively consider operating experience for long term operation.
- A template to collect vital importance parameters from the original equipment manufacturers (OEM) to establish the extended qualified life of electrical components.
- The so-called capability index applied to characterize health, attitude and other enablers of staff members to qualify if they are fit to perform a task.

The team recognised that the plant's intention is to follow the IAEA Safety Standards in preparation for safe LTO. There are some areas which should be improved to reach the level of IAEA Safety Standards and international best practices. The team identified fourteen issues resulting in either a recommendation or suggestion for improvement:

- Management of the LTO programme is not effective to timely complete all actions to prepare for LTO.
- The safety analysis report (SAR) has not been adequately updated for LTO and ageing management.
- Completeness and consistency of scope setting of SSCs for ageing management and LTO are not ensured.
- The plant programmes are not comprehensively reviewed and implemented for LTO.
- Information used for AMR of mechanical SSCs is not consistently managed and documented.
- AMPs for mechanical SSCs are not complete.
- The plant has not completely implemented a comprehensive cable ageing management programme.
- The plant has not revalidated environmental qualification for some SSCs for LTO.
- Electromagnetic compatibility has not been completely assessed.
- The plant has not revalidated the environmental qualification of qualified cables for LTO.
- A proactive approach to technological obsolescence management is not fully implemented.
- The plant has not comprehensively revalidated the TLAAs for concrete structures.
- Containment structure monitoring system is not fully functional.
- Ageing management programmes for civil structures are not fully developed and implemented.

An evaluation of each review area is contained within the relevant subsections of Section 3. Recommendations and suggestions are introduced in Section 3 and described in detail in the individual issue sheets in Appendix I.

The plant management expressed a determination to address the areas identified for improvement and indicated the intention to initiate the invitation of a 'SALTO Peer Review Follow-up Mission to Koeberg Nuclear Power Plant' to be conducted in 2024.

FOLLOW-UP MISSION

The IAEA follow-up team consisted of two experts from the Czech Republic and Slovenia, and two IAEA staff members (team leader, deputy team leader).

The IAEA follow-up team reviewed the progress in resolving each of the issues from the 2022 SALTO mission. The 'hosting organization actions to resolve issue' provided in the issue sheets were reviewed by the IAEA team prior to the follow-up mission and confirmed in the field during the visit. The observations were documented in the 'Follow-up assessment by the IAEA Review Team' section of the issue sheets. The IAEA overall conclusion on each issue is provided in the section 'Resolution Degree'. A summary on 'Status at follow-up SALTO mission' was also prepared by the IAEA team for each review area. Based on the findings, the team has concluded that the plant has made a significant effort to solve all the issues. The resolution degree was determined by the team for each issue sheet separately, with the following results:

- 12 issues were assessed as issue resolved;
- 2 issues were assessed as satisfactory progress to date.

The SALTO team concluded that actions taken to solve the recommendations and suggestions are sound, well established and led to tangible improvement. The following issues were resolved:

- Issue A-1: The plant effectively managed the LTO programme to ensure LTO activities are completed in a timely manner.
- Issue A-2: The plant updated the safety analysis report for safe LTO.
- Issue B-1: The plant ensured a complete and consistent scope setting of SSCs for ageing management and LTO.
- Issue C-1: The plant ensured consistent management and documentation of information for AMR of mechanical SSCs.
- Issue C-2: The plant completed AMPs for mechanical SSCs.
- Issue D-1: The plant implemented a comprehensive cable ageing management programme.
- Issue D-2: The plant revalidated environmental qualification for all SSCs for LTO.
- Issue D-3: The plant completely assessed electromagnetic compatibility.
- Issue D-4: The plant completed the revalidation of environmental qualification for qualified cables.
- Issue D-5: The plant implemented a proactive approach to technological obsolescence management.
- Issue E-1: The plant completed the revalidation of TLAAs for concrete structures, including the containment TLAA.
- Issue E-3: The plant fully developed and implemented the ageing management programmes for civil structures.

Two issues were assessed as satisfactory progress to date, the completion of which will require continued work from the plant:

- Issue B-2: The plant should ensure that plant programmes supporting LTO are fully implemented for the LTO period.
- Issue E-2: The plant should ensure that the containment monitoring system is fully refurbished and remains fully functional during the LTO period.

A summary evaluation of each review was provided based on the conclusions of the review of the implementation of suggestions and recommendations, while the issue sheets in the Appendix were extended with a detailed assessment of the implementation.

A summary of the results was presented to the plant management during the exit meeting held on 6 September 2024. Plant management expressed a determination to maintain the level of preparedness for safe LTO and continue cooperation with the IAEA in the area of long term operation.

3. DETAILED CONCLUSIONS FOR REVIEW AREAS

3.1. ORGANIZATION OF AGEING MANAGEMENT AND LTO ACTIVITIES

Related regulatory requirements, codes and standards for AM and LTO and regulatory review

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Principles and approach to AM and LTO

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Organizational arrangements for AM and LTO

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Periodic safety review

The PSR reports of Safety Factor (SF)-2, SF-3 and SF-4, have not identified any deviations with high or medium safety significance. They identify only low and drop safety significance (the reports contain 6 deviations for SF-2, 4 deviations for SF-3 and 9 deviations for SF-4). There is no information in the PSR report on SF-4 that the plant identified any significant degradations of SSCs. However, in the evaluation report of SF-3, a comparison was performed between the equipment qualification programme requirements against the IEC/IEEE60780-323 (so-called dual logo) standard, but the plant did not identify as a potential gap that the design specifications for components in scope of equipment qualification do not include reference to the electromagnetic compatibility requirements. The team **encouraged** the plant to comprehensively identify potential safety improvements for LTO.

Programme for LTO

The comprehensive document ‘Safety Case for LTO’ is being prepared to demonstrate continued safe operation of the plant. The safety case is not completed and is planned to be finished by June 2022, when the plant is required to submit it to the regulatory body. The plant does not have margins for delays in any ongoing activities. Furthermore, new AMPs have not been implemented, so it is not possible to evaluate the effectiveness of AMPs on an individual nor on plant level. Revalidation of all TLAAs is not completed. Some findings from the 2nd PSR (PSR-II) and eight post Fukushima requirements are still in progress and not completed. Without effective management of the LTO programme the plant will not be able to timely implement all activities to demonstrate preparedness for safe LTO. The team made a **suggestion** in this area (issue A-1).

Configuration/modification management and design basis documentation

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Safety analysis report

The current revision of the SAR does not include a description of ageing management approach, ageing management programme results nor a list of TLAAs and results of revalidation of TLAAs. Results and adequate description of the PSR are not documented in the SAR. The current design basis as updated by considering new TLAAs are not documented and updated in the SAR yet. Without an adequately updated SAR for LTO and ageing management, the plant cannot ensure a complete safety documentation for LTO. The team made a **suggestion** in this area (issue A-2).

Status at SALTO follow-up mission

There were two issues presented by the review team in 2022, A-1 "Ineffective management of the LTO programme", and A-2 "Safety analysis report not updated for LTO".

A suggestion that, "the plant should consider ensuring effective management to the LTO programme to timely complete all actions", was raised within the **A-1 issue**.

The plant completed the 'Safety Case for LTO' and submitted it to the regulator in July 2022. The 'Safety Case for LTO' contained activities that the plant committed to complete prior to entering the LTO period and additional activities that would be completed during the LTO period. The activities that needed to be completed prior to entering LTO have been completed and the activities to be completed during the LTO period have been captured as commitments in the renewed Unit 1 licence in the form of a regulatory directive. These items are now being tracked in the LTO dashboard. The LTO dashboard is updated and presented to plant management during monthly meetings which are planned to continue during the LTO period.

Conclusion: Issue Resolved

A suggestion that, "the plant should consider updating the safety analysis report for safe LTO", was raised within the **A-2 issue**.

The plant updated the SAR to include a description of the ageing management approach, including the scope setting process, the ageing management review, how ageing management programmes are developed, and a list of applicable and revalidated TLAAs. The relevant national regulations have also been summarized and referenced in the SAR. In addition, the PSR process and results are discussed and referenced in the appropriate licencing basis documents.

Conclusion: Issue Resolved

3.2. SCOPE SETTING, PLANT PROGRAMMES AND CORRECTIVE ACTION PROGRAMME

Methodology and criteria for scope setting of SSCs for AM and LTO

The plant's scoping methodology uses the classification which is assigned to equipment based on the safety or non-safety function of the equipment. The scoping process has covered more than 200 000 structures, systems and components of the facility, and more than 80 000 of these are finally considered for ageing management evaluation for LTO. Once the list was established, five groups were assigned to the review with a specific and clearly defined focus for each group. One group was assigned to perform a deep review, the second focused on excluded components, the third on included components, and the two last groups respectively examined the generic and

specialized components scope. The team considered this original organization for reviewing the scope setting as a **good performance**.

The plant has defined a Design Extension Related (DER) class in the Importance Category to include components with a function in case of severe accidents or under extreme conditions. Although the plant is planning to perform the formal DER classification, it has not been backfitted. For future modifications of the plant, there is no written evidence that a walkdown is prescribed after modification of the plant to identify potential non-safety equipment impacting on safety equipment. In addition, the information that an SSC is included in or excluded from the LTO scope list will be stored in two separated databases, maintained by two different groups. In conclusion, completeness and consistency of scope setting of SSCs for AM and LTO are not fully ensured in time. The team made a **suggestion** in this area (issue B-1).

Maintenance programme

The plant process for determining the preventive maintenance programme requirements has been based on the 'Equipment Reliability Process' and aligned with the methodology employed by foreign operators. However, the preventive maintenance programme is still not fully implemented for LTO. Preventive Maintenance (PM) is based on templates which recommend PM tasks and task intervals, constituting the PM strategy. Most PM templates are ready for LTO, but six I&C components templates are not completed. The team observed that the implementation of generic PM task orders in SAP in line with the revised PM strategies is not complete. The team made a **suggestion** in this area (issue B-2).

In-service inspection programme

The in-service inspection (ISI) programme at the plant is governed by the ASME code Section XI requirements. A risk-informed approach is used for defining ISI to be performed on welds and components (safety classes 1 and 2) and it relies on consequences and risk of failure. Consequences of failure are estimated based on the plant's probabilistic safety analysis model. On the contrary, the risk of failure is estimated with an external probabilistic model which is the property of the consultant performing the estimations. The team **encouraged** the plant to obtain more information about the model as well as guaranteed relevance of the hypothesis and data on which it relies.

Surveillance programme

In addition to the global safety-related surveillance of the plant, a specific reactor pressure vessel (RPV) surveillance programme has been issued. This programme relies on a manual that has not been reviewed against the nine attributes of an effective ageing management programme. The revision of the RPV Surveillance Programme manual is still not completed (planned for completion by mid-2022). The team made a **suggestion** in this area (issue B-2).

Water Chemistry Programme

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Corrective action programme

A corrective action programme has been developed and implemented to identify, report, investigate, and trend occurrences, problems, events, conditions, and near misses as well as ageing-related degradations. The identification and reporting of occurrences, problems, incidents,

conditions, events, or near misses, including ageing-related degradations, is the responsibility of each person working at the plant. Events are investigated following a multistage process designed to cover, on a periodical basis, all internal events as well as the numerous external events received from different external sources, including other operators or industry related sources. This programme allows to address events that ageing could cause and provide engineers, designers and also maintenance staff and operators, with relevant outcomes and in an effective manner. The team considered this as a **good performance**.

In an LTO perspective, the corrective action programme outcomes need to be routinely reviewed by individuals responsible for the relevant AM. The plant prescribes an annual review. However, this prescription is not implemented yet and no records of the review are available. The team made a **suggestion** in this area (issue B-2).

Status at SALTO follow-up mission

There were two issues presented by the review team in 2022, B-1 “incomplete scope setting of SSCs for ageing management and LTO”, and B-2 “incomprehensive review and implementation of plant programmes”.

A suggestion that, “the plant should consider ensuring completeness and consistency of ageing management scope of SSCs for LTO”, was raised within the **B-1 issue**.

The plant updated the design processes to integrate ageing management more effectively, both in the design engineering process documents, and in working level documents such as design templates, which now include provisions for ageing management during plant modifications. Additionally, the Materials Reliability group performs data consistency checks between the design classification database and the COMSY (Condition Oriented Ageing Management System) database. The LTO scope has been updated with the previously absent safety relevant cables. A self-assessment during LTO scope determination identified anomalies in the source information for the scoping process. All the anomalies have been addressed with a conclusion that none of the anomalies had an influence on the LTO scope.

Conclusion: Issue Resolved

A suggestion that, “the plant should consider comprehensively reviewing and implementing all plant programmes for LTO”, was raised within the **B-2 issue**.

New preventive maintenance (PM) templates have been developed and implementation of PM strategies is currently underway. Key plant programmes have been reviewed and updated to align with the nine attributes of an effective ageing management programme. The plant has implemented annual failure reviews to ensure that feedback from the Integrated Equipment Reliability Process is provided for ageing management processes. The first annual failure report (331-672) has been issued which demonstrated implementation of the requirements given in the plant document “Process for the Development and Control of Ageing Management at Koeberg Nuclear Power Station.” The new programme for critical spare parts is under review now but has not yet been implemented in accordance with the nine attributes of an effective ageing management programme.

Conclusion: Satisfactory progress to date.

3.3. AGEING MANAGEMENT OF MECHANICAL SSCS

AMR of mechanical SSCs

For ageing management review (AMR) of mechanical SSCs the existing plant Ageing Management Matrix (AMM) and the IGALL AMR table version 2018 were the basis. The plant reviewed the methodology for AMR. The consistent use of IGALL AMR in the comprehensive AMR report is not demonstrated, for example some of the IGALL AMR table information is missing from it. The plant decided to transfer Ageing Management Matrix information to COMSY (Condition-Oriented Ageing Management System). Terminology used in the comprehensive AMR report and COMSY is not fully consistent. At the time of the mission the COMSY software was not available due to technical problems. As a consequence, it was not possible for the team to confirm COMSY capabilities and real data transferred from AMM and comprehensive AM report. The team made a **suggestion** in this area (issue C-1).

AMPs of mechanical SSCs

Identification of appropriate programmes for ageing management was based on existing plant programmes and IGALL AMPs. Review of existing programmes against the 9 attributes was performed in a comparison report. Updated plant programmes are aligned with the 9 attributes of an effective ageing management programme. New AMPs (e.g. One-Time Inspections) are planned to follow the IGALL AMPs structure. In the comparison report of IGALL AMPs with existing plant programmes the plant did not identify a gap regarding the non-consideration of the inspection of component external surfaces that are insulated and exposed to condensation. Development of new or not fully implemented AMPs has been initiated for main mechanical components (e.g. pressurizer, main coolant piping), based on the comprehensive AMR report and the comparison report. The team made a **suggestion** in this area (issue C-2).

TLAAs of mechanical SSCs

An approved methodology document for identification of TLAAs was developed. The information sources for screening of TLAAs were defined and used. The verified list of existing plant TLAAs was reviewed. Based on existing plant and vendor documentation, international practice and IAEA requirements, the plant systematically identified all TLAAs, and the comprehensive list of TLAAs was documented. The validation of TLAAs of 8 mechanical SSCs have not been finalized yet, however it is not expected that these will require updates to any AMPs. The team made a **suggestion** in area A (issue A-1).

Scope setting results verification for mechanical SSCs

Scoping for LTO and AMR of mechanical components was performed based on MS Excel sheets. Scoping results of mechanical SSCs are distributed in different databases (e.g. COMSY). Long term consistency of these databases may be challenged. The team made a **suggestion** in area B (B-1).

Data collection and record keeping for mechanical SSCs

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Documentation of AM and documentation in support of LTO for mechanical SSCs

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Status at SALTO follow-up mission

There were two issues presented by the review team in 2022, C-1 “inconsistent information management for AMR of mechanical SSCs”, and C-2 “incomplete AMPs for mechanical SSCs”.

A suggestion that, “the plant should consider consistently managing and documenting information for AMR of mechanical SSCs”, was raised within the **C-1 issue**.

The plant performed an update of data in the COMSY database based on a self-assessment and previous mission findings. COMSY is a database used to manage ageing-related information and is now the only tool where this information is stored. Continuous updates of the database to incorporate operating experience or new data raised from the IGALL programme is an ongoing process as per the Programme Engineer's Guide (331-148). The use of the COMSY database provides reasonable assurance that information will be adequately managed for AMR of mechanical SSCs.

Conclusion: Issue Resolved

A suggestion that, “the plant should consider completing the AMPs for mechanical SSCs”, was raised within the **C-2 issue**.

The plant developed new ageing management programmes (AMPs) for mechanical SSCs to complete the required scope. AMP119 (32-T-PE-006) fully covers components in the LTO scope that are not managed by other programmes. One-time inspections are planned within three fuel cycles, and some inspections have already been performed. The process of aligning AMPs with the nine attributes of an effective ageing management programme is established, and the Programme Health Report EA-23-136 has been developed in accordance with the nine attributes. A position paper addressing inspections of insulated components exposed to condensation is followed by an action in DevonWay to track these inspections of mechanical SSCs during the long-term operation phase.

Conclusion: Issue resolved

3.4. AGEING MANAGEMENT OF ELECTRICAL AND I&C SSCS

AMR of electrical and I&C SSCs

Interaction between the Environmental Condition Monitoring Programme (ECMP) and COMSY is included in the draft version of ECMP as a flowchart. Specific instructions and a procedure with special consideration on how the identification of hot spots will affect the equipment in scope of LTO are not available. The team made a **suggestion** in this area (issue C-1).

AMPs of electrical and I&C SSCs

The verification of in-scope cables for LTO was not systematically assessed in terms of comparison with connection lines indicating intermediate components. Current collected data, databases and databases architecture compromise the handling of information to address properly the effects of hot spots in cables. Material specific ageing related degradation mechanism effects and internal operating experience have not been incorporated to plant guidelines for cable management. The team made a **suggestion** in this area (issue D-1).

Equipment qualification programme for all SSCs

Local Temperature and Radiation (T&R) measurement devices will be installed inside the containment during the outage in 2022 of unit 2 in order to have at least one relevant reference data campaign before steam generator replacement. Mechanical equipment was excluded from the scope of environmental qualification without specific and systematic assessment to compare equipment design and operating experience with relevant standards for qualification of mechanical equipment. Environmental qualification of coatings was not properly documented or revalidated for LTO. There was no assessment to confirm that the applied coatings required to be LOCA (loss of coolant accident) proof meet the plant requirements. No further analysis for the validity of original qualification was planned. The team made a **suggestion** in this area (issue D-2).

Currently there is not enough data to establish electromagnetic compatibility (EMC) requirements for the equipment in scope of the Equipment Qualification Programme (EQP). The plant has not defined a specific standard to deal with EMC requirements such as IEC 62003. The plant has established a list of important locations in order to monitor different relevant parameters for electromagnetic interference (EMI) in the draft version of ECMP. However, the plant did not define a standard framework for the evaluation of the results. The team made a **suggestion** in this area (issue D-3)

Results of the equipment qualification TLAA indicate that for qualified cables, the qualification is not valid for the intended LTO period. The plan for requalification of these cables is still in progress. The proposed sample removal testing plan from the plant aligns with international practice. Currently the plant has not performed a detailed assessment regarding the use of cable specific qualification standards, represented samples, material specific parameters (e.g. material formulation, validity of activation energy, etc.), installed environment, work condition such as temperature (environmental temperature and self-heating effects), exposure dose rate, etc. The team made a **recommendation** in this area (issue D-4)

Technological obsolescence management for all SSCs

There is an established methodology for handling and tracking problems related to obsolescence issues, however, this Technological Obsolescence Programme (TOP) has not been implemented for addressing obsolescence in a proactive way. The team made a **suggestion** in this area (issue D-5)

Scope setting results verification for electrical and I&C SSCs

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Data collection and record keeping for electrical and I&C SSCs

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Documentation of AM and documentation in support of LTO for electrical and I&C SSCs

The plant has established an Equipment Qualification File Template. This template is used to collect qualification parameters vital for the evaluation of the component qualification and determination of the qualified life. This has proven to be useful especially in cases where the equipment qualification test reports were not available from the supplier/OEM at the design evaluation stage. The supplier/OEM has to complete the template and demonstrate that the

equipment to be supplied meets the plant's equipment qualification requirements as stated in the SAR and the design specifications. The team recognized this as a **good performance**.

Status at SALTO follow-up mission

There were five issues presented by the review team in 2022, D-1 "incomplete implementation of the cable ageing management programme", D-2 "incomplete revalidation of environmental qualification for LTO", D-3 "incomplete assessment of electromagnetic compatibility", D-4 "incomplete revalidation of environmental qualification of qualified cables", and D-5 "lack of proactive management of technological obsolescence".

A suggestion that, "the plant should consider completing the implementation of the cable ageing management programme", was raised within the **D-1 issue**.

The plant has established and implemented a comprehensive cable ageing management programme that is in line with international guidelines. The programme scope includes all main cable types at the plant in normal and adverse environment as well as their connections. The programme covers medium voltage, low voltage and instrumentation and control cables. Some of the methods used for condition monitoring of cables include environmental condition monitoring, visual inspection and diagnostic testing methods. All staff involved in the CAMP implementation are qualified. The scope of diagnostic testing for low voltage and instrumentation and control cables was finalized in 2023 and the testing requirements were loaded into SAP for execution. Outages 127 and 227 are the earliest opportunities for the execution of the selected testing and thus no trending of testing data has been performed. However, visual, and tactile inspections on low voltage and instrumentation and control cables have been performed.

Conclusion: Issue resolved.

A suggestion that, "the plant should consider completing the revalidation of environmental qualification for all the SSCs in the scope of the environmental qualification programme", was raised within the **D-2 issue**.

The plant has implemented an EQ programme for all qualified equipment, which defines EQ zones with all known parameters, as well as the adverse environment location parameters. The plant has implemented the environmental condition monitoring programme and the results for local temperatures and radiation measurements are available. Mechanical equipment was evaluated as part of the EQ scope and documented in a separate reference document in line with ASME QME-1. The requirements for protective coatings were updated to include reference to design basis accidents. Time limited ageing analysis (TLAAs) for all EQ equipment requiring TLAAs have been performed (containment isolation valves, in-core thermocouple, medium voltage motors, valve actuators, solenoid valves, electrical cables, electrical penetrations, and pressurizer heaters). All qualified equipment with a qualified life less than 60 years was replaced or is planned to be replaced prior to qualified life expiry in the LTO period.

Conclusion: Issue resolved

A suggestion that, "the plant should consider completing an assessment of electromagnetic compatibility", was raised within the **D-3 issue**.

The plant established and implemented electromagnetic compatibility (EMC) requirements from reference standards. All EQ and design documentation was updated to refer to the relevant standards. A site survey for electromagnetic interference (EMI) was conducted. No malfunctions

of any equipment at the plant were attributed to EMI or EMC concerns. The plant has assessed the impact of EMI on qualified components.

Conclusion: Issue resolved

A recommendation that, "the plant should complete the revalidation of environmental qualification for qualified cables", was raised within the **D-4 issue**.

The plant has compiled a TLAA report for qualified cables in harsh environments which extended the qualified life of the cables. Requalification of cables has therefore been completed for LTO. No qualified cables located inside the containment have expired qualified lives and thus no replacements for these are planned. In addition, naturally aged samples have been removed from the plant, using selection criteria, for additional qualification tests. The preliminary results showed the cables are qualified beyond the actual license requirements and are still in a good condition.

Conclusion: Issue resolved

A recommendation that, "the plant should establish proactive approach to technological obsolescence management", was raised within the **D-5 issue**.

The plant has implemented a proactive technological obsolescence management process by using the POMS database to handle and track problems related to obsolescence issues. The process for proactive obsolescence management has been initiated by sending all the plant components data to the contractor to verify them for efficient use in POMS. Example of an obsolescence prioritisation matrix calculation was presented, and the subsequent top 10 obsolescence issues were shown on the obsolescence dashboard.

Conclusion: Issue resolved

3.5. AGEING MANAGEMENT OF CIVIL SSCS

AMR of civil SSCs

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

AMPs of civil SSCs

The containment monitoring system is not fully functional. Some thermocouples linked to the strain gauges of the containment monitoring system are not functional. Some strain gauges are out of service or provide erratic values. Four pendulums in unit 1 show non-realistic behaviour compared to strain gauge evaluations in the same area. The pendulums need to be examined, refurbished and re-set. Without a fully functional containment monitoring system, the data required to demonstrate structural integrity of the containment during LTO may not be sufficient. The team made a **recommendation** in this area (issue E-2).

Some remedial measures related to safety related structures were identified for implementation on an immediate basis during the last outage and are still pending. The various activities related to monitoring of spent fuel pools are currently performed by different departments whose analysis is not integrated. The development of an AMP related to spent fuel pools is not complete. Leakages have been noted in unlined sumps of the Nuclear Auxiliary Building. The procedure for corrective measures is in progress. The team made a **suggestion** in this area (issue E-3).

TLAAs of civil SSCs

A TLAA for creep and shrinkage of concrete structures has not been identified as required. TLAA301: "Containment reanalysis" revalidates concrete containment tendon pre-stress of units 1 and 2 without incorporation of effects of various repaired defects such as large-scale delamination, progressing concrete carbonation front and chloride front, concrete cracks, exposed and corroded reinforcement bars. The analysis utilizes measurements of the containment monitoring system, which has many limitations. The team made a **suggestion** in this area (issue E-1).

The structural revalidation of aseismic bearings for the LTO period is not completed yet. The team made a **suggestion** in this area (issue A-1)

Scope setting results verification for civil SSCs

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Data collection and record keeping for civil SSCs

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Documentation of AM and documentation in support of LTO for civil SSCs

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Status at SALTO follow-up mission

There were three issues presented by the review team in 2022, E-1 "incomprehensive revalidation of TLAAs for concrete structures", E-2 "not fully functional containment structure monitoring system", and E-3 "incomplete development and implementation of ageing management programmes for civil SSCs".

A suggestion that, "the plant should consider improving revalidation of TLAAs for concrete structures", was raised within the **E-1 issue**.

The plant revised its TLAA301 to evaluate creep and shrinkage based on design and measurement values and using an analytical calculation with a conservative extrapolation to 60 years. The calculation methodology and results were confirmed by an independent expert. According to the original equipment manufacturer's (OEM) statement for non-containment structures the plant's structures ageing management programme can be applied. The plant obtained a report containing a qualified statement and advice from the OEM on how to consider the containment and containment monitoring system degradation in TLAA revalidations. The report also verified the adequacy of the plant's applied analysis methodology. The report supports that the current condition of the containment structure and measurement devices and the analysis methodology are adequate for TLAA301 revalidation. Concerning the acceptability of containment concrete delamination situation, the plant also performed a finite element analysis which was reviewed and confirmed by an independent engineer. A plant analysis also confirmed that the conditions for containment tendon corrosion do not currently exist.

Conclusion: Issue resolved

A recommendation that, "the plant should ensure full functionality of the containment structure monitoring system", was raised within the **E-2 issue**.

The plant fully inspected, refurbished, and realigned the Invar wires and the pendulums for Unit 1 in 2024. The dynamometers on Unit 1 were recalibrated in 2023. The refurbishment work on the Unit 2 Invar wires and pendulums is in progress and will be completed by December 2024. Hence, the Invar and pendulum wires on both containments will be fully functional and available for the upcoming integrated leakage rate tests (ILRT) in 2025. Since the pendulums and Invar wires are prone to corrosion and breakages, the plant established partial capability to repair them in house and scheduled preventive maintenance containing full replacement of these devices every 5 years, while their inspection is planned every 3 months. The faulty strain gauges and thermocouples are not replaceable, therefore the plant decided to install a new fibre optic cable-based system both on Unit 1 and Unit 2 in 2027 and 2028, respectively. As a bridging strategy the plant will install additional sensors for the ILRTs in 2025 that will be left on the containment after the test, to provide additional strain measurement data until the installation of the new final strain measuring system.

Conclusion: Satisfactory progress to date

A suggestion that, "the plant should consider completing and implementing the ageing management programmes of civil SSCs", was raised within the **E-3 issue**.

The plant completed the outstanding AMP for stainless steel lined compartments and epoxy coated sumps. The AMP integrates the various actions executed by the various departments and also references the specific procedures and instructions. The relevant inspection procedure was also approved and contains the trending requirement for any potential coating degradation. The plant also accelerated the process for remedial actions on civil structure defects by establishing a civil system health report function that provides for continuous surveillance and regular reporting. The plant decided not to initiate repair actions on the spent fuel pool because the spent fuel pool was not confirmed as the source of the minor leaks, the leaks were orders of magnitude less than the spent fuel pool leakage acceptance criteria, and the location of the pool (20m above ground level on the Seismic Raft) allows for timely detection of any leak before it could enter the groundwater. Separately, ongoing actions are in place to detect tritium in groundwater from any potential source, including the spent fuel pool.

Conclusion: Issue resolved

3.6. HUMAN RESOURCES, COMPETENCE AND KNOWLEDGE MANAGEMENT FOR LTO

Human resources policy and strategy to support LTO

No recommendations, suggestions, encouragements, good practices or good performances were identified in this area.

Competence management for LTO and recruitment and training/ qualification processes for personnel involved in LTO activities

The plant works on creating LTO awareness through:

- Leadership engagement sessions where topics on LTO were communicated;

- Nuclear Awareness Seminars specific on LTO;
- A specific survey on LTO awareness has been performed;
- Open forums for all employees in which LTO topics: October/November 2021 & March 2022 is for all employees;
- Quarterly Nuclear News publications by the Chief Nuclear Officer;
- Daily Newsletters;
- Meetings with trade unions where LTO topics are discussed.

The team considered this as a **good performance.**

The plant has an Authorization Index in place; the plant recognized that not only technical skills and knowledge are important to perform a job, but also health, attitude, and enablers to perform specific jobs without assistance have to be taken into account to decide if someone is fit to perform a task in the plant. Therefore, a so-called Capability Index has been created. It is supported by a web based tool in which the employees can check their own profile (capability, development actions, and training) and line managers can do real-time analysis of authorizations and capabilities, identify development opportunities and perform projections (simulations) to meet future needs for their team with regard to the impact of employees leaving the team due to retirement, promotion, and leave. Based on this simulation line managers can, on a proactive way, assure that knowledge and competences are not lost and stay at the needed level. The team considered this as a **good performance.**

Knowledge management and knowledge transfer for LTO

A knowledge management process is set up. It was tested at a part of the Nuclear Engineering Department as a pilot. Afterwards it was implemented throughout the whole Nuclear Engineering Department. Initiatives are started for further implementation. The team **encouraged** the plant to fully implement the knowledge management process for the whole nuclear organization unit.

Status at SALTO follow-up mission

There was no issue identified by the review team in 2022 in this area.

4. SUMMARY OF RECOMMENDATIONS AND SUGGESTIONS

The following table summarises the issues identified by the hosting organization (Self R / Self S) and by the IAEA team (R / S) in the six main 'Review Areas' of the original mission and the status of the issues at the follow up mission (1: Issue resolved, 2: Satisfactory progress to date, 3: Insufficient progress to date). The complete set of issue sheets is presented in Appendix I of this report.

Issue No.	**Fundamental Overall Problem**	**Rec/Sugg**	**Status at follow up**
Review Area A: Organization of ageing management and LTO activities			
A-1	Management of the LTO programme is not effective to timely complete all actions to prepare for LTO.	S	1
A-2	The safety analysis report (SAR) has not been adequately updated for LTO and ageing management.	S	1
Review Area B: Scope setting, plant programmes and corrective action programme			
B-1	Completeness and consistency of scope setting of SSCs for ageing management and LTO are not ensured.	S	1
B-2	The plant programmes are not comprehensively reviewed and implemented for LTO.	S	2
Review Area C: Ageing management of mechanical SSCs			
C-1	Information used for AMR of mechanical SSCs is not consistently managed and documented.	S	1
C-2	AMPs for mechanical SSCs are not complete.	S	1
Review Area D: Ageing management of electrical and I&C SSCs			
D-1	The plant has not completely implemented a comprehensive cable ageing management programme.	S	1
D-2	The plant has not revalidated environmental qualification for some SSCs for LTO.	S	1
D-3	Electromagnetic compatibility has not been completely assessed.	S	1
D-4	The plant has not revalidated environmental qualification of qualified cables for LTO.	R	1
D-5	A proactive approach to technological obsolescence management is not fully implemented.	S	1
Review Area E: Ageing management of civil SSCs			

E-1	The plant has not comprehensively revalidated the TLAAs for concrete structures.	S	1
E-2	Containment structure monitoring system is not fully functional.	R	2
E-3	Ageing management programmes for civil structures are not fully developed and implemented.	S	1
Review Area F: Human resources, competence and knowledge management for LTO			
	No issue identified		

5. DEFINITIONS

Recommendation

A recommendation is advice on what improvements in operational safety should be made in the activity or programme that has been evaluated. It is based on inadequate conformance with the IAEA Safety Requirements and addresses the general concern rather than the symptoms of the identified concern. Recommendations are specific, realistic and designed to result in tangible improvements.

Suggestion

A suggestion is advice on an opportunity for safety improvement not directly related to inadequate conformance with the IAEA Safety Requirements. It is primarily intended to make performance more effective, to indicate useful expansions to existing programmes and to point out possible superior alternatives to ongoing work.

Good Practice

A good practice is an outstanding and proven programme, activity or equipment in use that contributes directly or indirectly to operational safety and sustained good performance. A good practice is markedly superior to that observed elsewhere, not just the fulfilment of current requirements or expectations. It should be superior enough and have broad enough application to be brought to the attention of other nuclear power plants and be worthy of their consideration in the general drive for excellence. A good practice:

- is novel;
- has a proven benefit;
- is replicable (it can be used at other plants); and
- does not contradict an issue.

Normally, good practices are brought to the attention of the team on the initiative of the plant.

Encouragement

If an item does not have sufficient safety significance to meet the criteria of a ‘recommendation’ or ‘suggestion’, but the expert or the team feels that mentioning it is still desirable, the given topic may be described in the text of the report using the phrase ‘encouragement’ (e.g. the team encouraged the plant/research reactor to…).

Good performance

A good performance is a superior objective that has been achieved or a good technique or programme that contributes directly or indirectly to operational safety and sustained good performance, that works well at the nuclear installation. However, it might not be necessary to recommend its adoption by other nuclear installation, because of financial considerations, differences in design or other reasons.

Issue resolved

All necessary actions have been taken to deal with the root causes of the recommendation rather than to address each individual fact identified by the team. A management review has been carried out to ensure that actions taken have eliminated the root cause. Actions have also been taken to

check that it does not recur. Alternatively, the issue is no longer valid due to, for example, changes in the hosting organization.

Satisfactory progress to date

Actions have been taken, including root cause determination, which lead to a high level of confidence that the recommendation will be resolved within a reasonable timeframe, after the follow-up mission. These actions might include budget commitments, staffing, document preparation, increased or modified training, equipment purchases, etc. This category implies that the recommendation could not reasonably have been resolved prior to the follow-up visit, either due to its complexity or the need for long-term actions. This category also includes recommendations, which have been resolved using temporary or informal methods, or when resolution has only recently taken place and its effectiveness has not been fully assessed.

Insufficient progress to date

Actions taken or planned do not lead to the conclusion that the issue will be resolved within a reasonable timeframe. This category includes issues in response to which no action has been taken.

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7. TEAM COMPOSITIONS

7.1. IAEA SALTO REVIEW TEAM

IAEA STAFF MEMBERS:		
	Team Leader	IAEA, NSNI, OSS,
	Deputy Team Leader	IAEA, NSNI, OSS,
IAEA EXTERNAL EXPERTS:		
	Reviewer A	CEZ, Dukovany NPP, Head of Ageing Management and LTO Department
	Reviewer B	IRSN, Head of Department
	Reviewer C	MVM Paks NPP, Senior Ageing Management Expert
	Reviewer D	CNEA, Head of Equipment Qualification Department
	Reviewer E	PAEC, Head of Corporate Ageing Management Department
	Reviewer F	Engie Electrabel, Programme Manager
OBSERVERS:		
	Observer Area C	– IDOM, Plant Coordinator for Ageing Management and Equipment Qualification
	Observer Area B	– OKG, Oskarshamn NPP, Competence Developer

7.2.THE PLANT AND OTHER ORGANIZATIONS

KOEBERG NUCLEAR POWER PLANT COUNTERPARTS:		
Mr. Anton Kotze	Host plant peer	Chief Engineer
Ms. Ditsietsi Malale	Area A	Integration Engineering Manager
Mr. Raymond Maapola	Area B	Design Engineer
Ms. Garetshose Mdluli	Area C	Mechanical Engineer
Mr. Alan Nambiar	Area D	Electrical Engineer
Ms. Magrieta Koopman	Area E	Civil Engineer

Ms. Linda Lukwe	Area F	Acting Integrated Management and Training Manager

7.3. IAEA SALTO FOLLOW-UP REVIEW TEAM

IAEA STAFF MEMBERS:		
	Team Leader, Reviewer A	IAEA, NSNI, OSS
	Deputy Team Leader, Reviewer E	IAEA, NSNI, OSS
IAEA EXTERNAL EXPERTS:		
	Reviewer B and C	Czech Republic, State Office for Nuclear Safety, Head of Mechanical Components and Material Issues
	Reviewer D	Slovenia, Krsko NPP, Lead Electrical Engineer, Cable Ageing

7.4.PLANT ORGANIZATION FOR FOLLOW-UP MISSION

KOEBERG NUCLEAR POWER PLANT COUNTERPARTS:		
Ms. Bravance Mashele	Host plant peer	Senior Manager
Ms. Ditsietsi Malale	Area A	Integration Engineering Manager
Mr. Raymond Maapola	Area B	Design Engineer
Ms. Garetshose Mdluli	Area C	Mechanical Engineer
Mr. Abu-Bakr Jakoet	Area D	Electrical Engineer
Ms. Magrieta Koopman	Area E	Civil Engineer

APPENDIX I - ISSUE SHEETS

1. ISSUE IDENTIFICATION	**Issue Number: A-1**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Organization of ageing management and LTO activities	

1.1 – ISSUE TITLE:

Ineffective management of the LTO programme

1.2 – FUNDAMENTAL OVERALL PROBLEM:

Management of the LTO programme is not effective to timely complete all actions to prepare for LTO.

2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022

2.1 – FACTS:

F1) The plant risks and challenges resulting from preparation of LTO identified by the management of the LTO Programme and presented to Eskom management on February 28, 2022 (presentation "LTO Dashboard") are: resources, completion of TLAAs and AMPs implementation.

F2) The comprehensive document, 'Safety Case for LTO' is to demonstrate continued safe operation of the plant and will be submitted for approval to the regulator body. The safety case is not completed and is planned to be finished in by June 2022, when the plant is required to submit the safety case to the regulatory body. The plant does not provide margins for delays in any ongoing activities.

F3) The plant intends to include in the safety case among others:

- effectiveness of the ageing management programme necessary for ensuring that required safety functions of structures, systems and components are fulfilled over the period of LTO of the nuclear installation;
- revalidation of the TLAAs to ensure continued acceptability of the analysed structures, systems or components for the planned period of LTO;
- utilization of the results of the periodic safety review to justify LTO of the nuclear installation.

The new AMPs have not been implemented, so it is not possible to evaluate the effectiveness of AMPs on individual nor on a plant level. Revalidation of all TLAAs is not completed.

F4) Nuclear Project Management and Design Engineering deliverables (Technical Requirements Specification, Detailed Design, Safety Evaluation…) are captured in various storage places. However, there is no single software application that support the entire process.

F5) The validation of TLAAs of 8 mechanical SSCs have not been finalized yet, some of them are still not contracted (e.g. TLAA106 Environmentally-assisted fatigue; RPV internals neutron embrittlement – fast fracture analyses).

F6) The structural revalidation of aseismic bearings for the LTO period is not completed and is scheduled for completion in 2024.

F7) Some findings from PSR-II and eight post Fukushima requirements are still in progress and not completed.

F8) Different plant databases contain different parts of the design basis documentation. Some of the documents are in the Excalibur database and some of them in the PIGO database. The plant is preparing a project to substitute these two databases by a software (SPO).

2.2 – SAFETY CONSEQUENCE:

Without effective management of the LTO programme the plant will not be able to timely implement all activities to demonstrate preparedness for safe LTO.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider ensuring effective management to the LTO programme to timely complete all actions.

2.4 – IAEA BASIS:

GSR Part 2

Requirement 10: Management of processes and activities

Processes and activities shall be developed and shall be effectively managed to achieve the organization's goals without compromising safety.

4.28. Each process shall be developed and shall be managed to ensure that requirements are met without compromising safety. Processes shall be documented and the necessary supporting documentation shall be maintained. It shall be ensured that process documentation is consistent with any existing documents of the organization. Records to demonstrate that the results of the respective process have been achieved shall be specified in the process documentation.

GS-G-3.1

3.17. Senior management should be fully committed to the management system and should regard it as a tool for use in managing the organization. The commitment of senior management should foster long term commitment and engagement on the part of the management and of all individuals of the organization, through a process of participation and consultation.

GS-G-3.5

2.3. Senior management of the operating organization should be the sole source of operational direction for the installation. The management system should define the responsibilities of those persons responsible for each process (sometimes referred to as 'process owners') and of the managers and functions in the organizational structure, so that there are clear lines of authority and accountability. The persons responsible for each process should support the operational direction by assuming responsibility for developing effective processes and ensuring that they remain effective. The managers and functions in the organization should implement the

processes within their areas of responsibility. More information regarding the operating organization can be found in Ref. [3].

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7.3. The operating organization should adopt a comprehensive project structure or similar organizational arrangements for the preparation and implementation of the programme for long term operation, which should take into account the arrangements for the management of physical ageing, as described in Section 5. The organizational arrangements for the management of physical ageing, including technological obsolescence, should be properly implemented and should be one of the prerequisites for a decision to pursue long term operation of the nuclear power plant.

7.4. In addition to the existing obligations associated with ageing management, the operating organization should clearly define the additional responsibilities and authorities associated with the preparation for, and implementation of, long term operation, after considering all the regulatory requirements relevant to long term operation. The operating organization should ensure that appropriate resources are available to support these assigned responsibilities and accountabilities.

2.5 – DOCUMENTS REVIEWED:

- R. 266 National Nuclear Regulator Act (47/1999): Regulations on the long term operation of Nuclear Installations, March 2021;
- RG-0027, Rev. 0 Interim Regulatory Guide, Ageing Management and Long Term Operations of Nuclear Power Plants, March 2019;
- 240-157754316, Rev. 1 Structure and Content of the LTO Safety, 22/03/19;
- 240-160692496, Rev. 3 Long Term Operation (LTO) Programme Management Manual, 2021/09/22;
- 240-160692514, Rev. 2 Long Term Operations Programme Organisation, 05/2021
- 240-149139512, Rev.1 Ageing Management Requirements for Koeberg Nuclear Power Station, 12/2020;
- 08016-S-LIC, Rev.2 Nuclear Licensing Strategy for Koeberg SALTO Assessment Project, 03/2017;
- 36-197, Rev.2 Koeberg Licensing Basis Manual, 10/2021;
- 08016-S-PMP, Rev. 2 Nuclear Project Management Plan (PMP) , 2020/02/25
- 238-6, Rev 5, Nuclear document and records management requirements, 2020/06/27;
- 240-106374366, Rev. 2 SALTO Project Scope and Work Breakdown Structure (WBS) Report, 2021/01/20;
- 240-106374672, Rev. 1 SE 35244: Koeberg Pre-SALTO Self-Assessment Report , 2017/10/24;
- 240-108035478, Rev. 2 The Eskom Nuclear Objectives, 2019/06/05;
- 240-164729849, Rev. 1 Original Designer Control Strategy, 2021/08/27;
- 240-84975495, Rev. 5, Engineering Change Management Committee for Koeberg Operating Unit, 2021/08/31;
- 240-88257644, Rev. 5 Nuclear Operating Unit Functional Organisation Structure (F.O.S) Nuclear Engineering, 2021/05/31;
- 240-99837788, Rev 2 NOU Configuration Management Process Manual, 2020/03/19;
- 240-160692514, Rev. 2 Long Term Operations Programme Organisation, 05/2021;
- 331-148, Rev. 3 Programme Engineer's Guide, 2021/03/02;

- 331-149, Rev. 2 Engineering Programmes Change Control Process, 2020/07/30;
- 331-85, Rev. 4 Design Documentation Change Process, 2020/10/29;
- 331-86, Rev. 3 Design Changes to Plant, Plant Structures or Operating Parameters, 2021/11/25;
- KAA-501, Rev. 11 Project Management Process for Koeberg Nuclear Power Station Modifications, 2019/09/23;
- Rev 0, Nuclear News - October 2021 - Strategic Projects;
- Rev 0, LTO Dashboard presentation - Status shown as of 28 February 2022.

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE | **Date:** 30/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

The fundamental overall problem was defined as

"*Management of the LTO programme is not effective to timely complete all actions to prepare for LTO*"

Analysis of the problem was performed, and the root cause was found to be an inadequate understanding of the LTO programme and therefore, inadequate prioritisation of resources to execute the LTO related tasks. The review of this issue focused on the closure of the SALTO related actions, reasons for extending the tasks, and the time to execute the tasks.

The LTO programme was developed by the SALTO project team in conjunction with NE IPDK (Integrated Plant Design Koeberg), activities related to the plant (i.e., under control of Engineering, Maintenance, and other plant personnel) were sent to the relevant groups for execution. Minutes of meeting SMOC.19.001, SMOC.19.003 in 2019 (and others) shows that there was lack of urgency by line groups to execute LTO actions. For example, there were delays in the implementation of the AMPs caused by the inadequate prioritization of the resources to implement them (i.e. line groups not having resources to write the AMPs, then followed by resources to compile service notifications, and then placing of the service notifications on SAP). Some line groups reported that they could not focus on the LTO tasks due to insufficient human resources to execute the LTO related inspections (and activities) because of conflicting priorities such as outages and ongoing commitments. Delays to completion of TLAAs are linked to the process used to validate the TLAAs, i.e. screening, simple analysis. Some TLAAs were not successfully revalidated and required optimized analyses and the time required was underestimated.

In 2020-2022, despite the LTO programme being presented to the plant personnel, there was still a lack of understanding by most plant personnel of the urgency. Some line groups did not understand the importance of executing the LTO actions in a timely manner, hence reluctance to prioritise resources to execute the actions. In recent history (2023-2024), upon realization that the actions will enable the plant to acquire a licence, LTO senior managers led the implementation of LTO activities, which created a need for line groups to outsource the activities through contracts. Senior management made commitments to close out actions, there was also a formation of an LTO meeting where senior managers held employees accountable for their actions. This enhanced the plant's priority created a sense of urgency, and plant personnel responded to the urgency. Processes were put in place to support LTO preparatory activities.

3.2 – CORRECTIVE ACTIONS:

- In 2020, LTO actions escalated to MANCOM for Engineering scope

- In 2020 a decision was made to track ODs as LTO-CAs as CAs are more punitive than GA
- In 2024 Senior management started convening a LTO oversight meeting outside of SMOC.
- Close tracking of LTO activities using the LTO dashboard

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

The corrective actions have been effective as all activities required before entry into LTO were completed and sent to the regulator for review.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) The Safety Case for LTO was completed and submitted to the regulator (July 2022). The outstanding LTO items identified in the 2022 SALTO mission (i.e. revalidation of TLAAs, implementation of AMPs) were completed.

F2) The Safety Case for LTO included activities that the plant committed to complete prior to entering the LTO period and additional activities that would be completed during the LTO period. The activities to be completed during the LTO period have been captured as commitments in the renewed Unit 1 licence in the form of a regulatory directive. These items are now being tracked in the LTO dashboard.

F3) The LTO dashboard has been updated to address the ongoing LTO commitments. The dashboard is reviewed by plant management during monthly meetings (LTO Review Meeting). These meetings are planned to continue during the LTO period.

F4) The structural revalidation of the aseismic bearings has been successfully completed for LTO. Additional analysis related to the updated seismic evaluation is in progress and is being tracked in the LTO dashboard.

F5) Several Safety Re-Assessment (SRA-II) and Fukushima items are still being tracked in the LTO dashboard; however, these items were not required for LTO. Their identified due dates have been justified and will continue to be tracked in the LTO dashboard.

F6) The Excalibur and PIGO databases have been replaced by Open Text and Smart Plant Owner/Operator (SPO) software.

4.2 – DOCUMENTS REVIEWED:

- National Nuclear Regulator (NNR) Letter K10001925N, NNR Directive: Outcome of Assessment for Long Term Operation, 19 July 2024;
- 331-618, Safety Case for Long-Term Operation of Koeberg Nuclear Power Station, Revision 3, 2023/10/23;
- 331-645, Elastomeric Aseismic Bearings – Current Position and the Way Forward, Revision 3, 2024/04/30;
- 240-150483693, Ageing Management and Plant Programmes List, Revision 3, 2024/08/28;
- Unite 2 Licence Activities and NNR Directive Dashboard Presentation - Status shown as of 19 August 2024;
- 240-89284686, Locating Technical Documents in the Nuclear Operating Unit, Revision 3, 2023/06/07;

− Project change request (PCR), 239-12031 VAR PCR0(T), Rev. 0, 2024/07/08.

4.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: A-2**
NPP: Koeberg	**Unit: 1 and 2**

Reviewed Area: Organization of ageing management and LTO activities

1.1 – ISSUE TITLE:

Safety analysis report not updated for LTO

1.2 – FUNDAMENTAL OVERALL PROBLEM:

The safety analysis report (SAR) has not been adequately updated for LTO and ageing management.

2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022

2.1 – FACTS:

F1) The current revision of the SAR does not include a description of ageing management approach, ageing management programme results nor a list of TLAAs and results of revalidation of TLAAs.

F2) The current design basis as updated by considering new TLAAs are not documented and updated in the SAR yet.

F3) The current licensing basis (for example R. 266 National Nuclear Regulator Act (47/1999): Regulations on the LTO of Nuclear Installations and 36-197, Rev.2 Koeberg Licensing Basis Manual) is not described nor updated in the SAR.

F4) The results and adequate description of the PSR are not documented in the SAR.

2.2 – SAFETY CONSEQUENCE:

Without an adequately updated SAR for LTO and ageing management, the plant cannot ensure a complete safety documentation for LTO.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider updating the safety analysis report for safe LTO.

2.4 – IAEA BASIS:

SSR-2/2 (Rev. 1)

Requirement 15: Records and reports

The operating organization shall establish and maintain a system for the control of records and reports.

4.52. The operating organization shall identify the types of record and report, as specified by the regulatory body, that are relevant for the safe operation of the plant. Records of operation, including maintenance and surveillance, shall be kept available from initial testing during the startup of each plant system important to safety, including relevant off-site tests. The records of operation shall be retained in proper archives for the periods required by the regulatory body. All records shall be kept readable, complete, identifiable and easily retrievable [3]. Retention times for records and reports shall be commensurate with their level of importance for the purposes of operation and plant licensing and for future decommissioning.

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3.8. Where the PSR is to be used in decision making for long term operation or licence renewal, the review should pay particular attention to the following plant programmes and documentation, as these are of significant importance for continued safe operation:

- Plant programmes to support the safety factors relating to plant design, the actual condition of SSCs important to safety, equipment qualification and ageing;
- A management system that addresses quality management and configuration management;
- Safety analyses involving time limiting assumptions relating to the proposed lifetime;
- Programmes for promoting safety culture focused on the pursuit of excellence in all aspects of safety management and human factors.

3.9. The programmes and documentation listed in para. 3.8 should be properly documented in an updated final safety analysis report for long term operation and/or in other licensing basis documents, and a clear and adequate description should be provided of the current licensing documents or the current design basis requirements for operation of the nuclear power plant.

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3.11. Ageing management should be addressed in the safety analysis report and other licensing documents. The description of ageing management in the safety analysis report should include general information on the following topics:

- The strategy for ageing management and prerequisites for its implementation;
- Identification of all SSCs of the plant that could be affected by ageing and are in the scope of the ageing management;
- Proposals for appropriate materials monitoring and sampling programmes in cases where it is found that ageing effects may occur that may affect the capability of SSCs to perform their intended function throughout the lifetime of the plant;

- Ageing management for different types of in-scope SSCs (e.g. concrete structures, mechanical components and equipment, electrical equipment and cables and instrumentation and control equipment and cables) and means to monitor their degradation;
- Design inputs for equipment qualification (see Section 4) of the in-scope SSCs, including required equipment, and equipment functions that need to be qualified for service conditions in normal operation and associated with postulated initiating events;
- General principles stating how the environment of an SSC is to be maintained within specified service conditions (e.g. by means of proper location of ventilation, insulation of hot SSCs, radiation shielding, damping of vibrations, avoiding submerged conditions and proper selection of cable routes);
- Appropriate consideration of the analysis of feedback of operating experience with respect to ageing.

4.2 Each plant programme and analysis should be properly documented in safety analysis reports or in other current licensing basis documents, which should clearly and adequately describe the current licensing basis or the current design basis requirements for operation of the nuclear power plant.

4.3 The policy on ageing management and the justification of long term operation should be properly documented in the current licensing basis, in particular in such documents as the safety analysis report, reports of periodic safety reviews (if applicable) or other licensing basis documents.

4.4 The safety analysis report should be kept updated to reflect the results of the ageing management review.

4.5 The safety analysis report or other licensing documents should provide descriptions of activities in support of safe long term operation to ensure that the operating organization maintains the necessary information to reflect the current status of the plant and addresses new issues as they arise.

2.5 – DOCUMENTS REVIEWED:

- Nuclear Energy Act, 47/1999 – high level document;
- R. 266 National Nuclear Regulator Act (47/1999): Regulations on the long term operation of Nuclear Installations, March 2021;
- RG-0019, Rev 0, INTERIM GUIDANCE ON SAFETY ASSESSMENTS OF NUCLEAR FACILITIES, 2020;
- 238-8, Rev. 5, Nuclear Safety and Quality Manual, 07/2020;
- 240-107926907, Rev.1 Nuclear Licensing Strategy for Koeberg SALTO Assessment Project, 03/2017;
- 08016-S-LIC, Rev.2 Nuclear Licensing Strategy for Koeberg SALTO Assessment Project, 03/2017;
- 238-6, Rev 5, Nuclear document and records management requirements, 2020/06/27
- 240-119744497, Rev 2, Control of the Safety Analysis Report, 2020/11/30;
- 240-163876252, Rev 1, KNPS 3 PSR Global Assessment and Integrated Implementation Plan Methodology, 2021/08/23.

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE	**Date:** 30/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

The fundamental overall problem was defined as

"*The safety analysis report (SAR) has not been adequately updated for LTO and ageing management*"

The delayed update of the SAR with a description of ageing management was caused by inadequate clarity on the requirements for ageing management. The national regulation related to LTO was issued in the form of an Interim Regulatory Guide (RG-0027) in March 2019, followed by R. 266 National Nuclear Regulator Act (47/1999): Regulations on the long-term operation of Nuclear Installation in March 2021. After issuance of RG-0027, the plant's ageing management standard was developed, and issued in 2020. During the period from 2019 to 2022, a substantial amount of work was done to comprehensively address all requirements for ageing management, but most of the work remained incomplete, and caused a delay in updating the SAR. Furthermore, the SAR could only be updated on completion of the AMPs, TLAAs, and many other SAR related updates on an ongoing basis, and many of the safety studies were still ongoing. The SAR will continue to be updated in accordance with the SAR change process, as committed in the LTO safety case.

3.2 – CORRECTIVE ACTIONS:

- OD 11.2 was raised for update to the SAR with a description of ageing management.

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

The SAR was updated with a description of ageing management (see SAR I-4.0). Many other parts of the SAR were updated due to completed safety studies and analyses. This is an ongoing process when SAR related items are changed and updated.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) Chapter 4.0 of the SAR has been updated to include a description of the ageing management approach, including scope setting, the ageing management review, how ageing management programmes are developed and a list of applicable TLAAs.

F2) Chapter 4.0 of the SAR includes clear references to additional licencing basis documents that provide additional details on LTO preparation and the plant's ageing management activities.

F3) Table T-I-4.4-1 in the SAR includes a list of applicable TLAAs and clear references to the original calculations and the revalidated calculations for LTO.

F4) Interim Regulatory Guide for Ageing Management and Long-Term Operation (RG-0027) has been added as a reference to the SAR.

F5) The Koeberg Licencing Basis Manual references the plant document that manages the periodic safety review process at the plant (240-161618963). This document clearly states that PSR must be completed at least every 10 years with an emphasis on completing a PSR

prior to LTO. The results of the previous PSR are captured in the Safety Case for LTO and in the plant's 3rd Periodic Safety Review Final Report.

4.2 – DOCUMENTS REVIEWED:

- SAR Chapter 4.0 I-4.0
- 240-150483693, Ageing Management and Plant Programmes List, Revision 3, 2024/08/28;
- 240-149139512, Ageing Management Requirements for Koeberg Nuclear Power Station, Revision 2, 2022/06/13;
- 240-119744497, KAA-697: Control of the Safety Analysis Report, Revision 3, 2023/11/01;
- RG-0027, NNR Interim Regulatory Guide – Ageing Management and Long Term Operations of Nuclear Power Plants, Revision 0, March 2019;
- 331-86, Design Changes to Plant, Plant Structures or Operating Parameters, Revision 3, 2021/11/25;
- 36-197, Koeberg Licencing Basis Manual, Revision 2, 2019/08/28;
- 240-161618963, 238-147: Period Safety Review of Koeberg Nuclear Power Station, Revision 1, 2021/02/22;
- 331-607: KNPS 3rd Periodic Safety Review Final Report, Revision 2, 2023/10/26.

4.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: B-1**
NPP: Koeberg	**Unit: 1 and 2**

Reviewed Area: Scope setting, plant Programmes and corrective action programme

1.1 – ISSUE TITLE:

Incomplete scope setting of SSCs for ageing management and LTO

1.2 – FUNDAMENTAL OVERALL PROBLEM:

Completeness and consistency of scope setting of SSCs for ageing management and LTO are not ensured.

2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022

2.1 – FACTS:

F1) There has not been systematic walkdowns for reviewing every room containing safety class SSCs for identification of non-safety related SSCs whose failure may prevent SSCs from fulfilling their intended safety functions components.

F2) No deterministic analysis was used to define the rooms for scope setting review with the walkdowns for all safety class components, except for previous fire, explosion, and seismic oriented walkdowns implemented several years ago. The walkdowns for confirming the comprehensiveness of the scope were limited to the most significant components based on PSA.

F3) Scoping results are distributed in two databases (e.g. COMSY, design classification database), there is no process to check the long term consistency of these databases as they are maintained by two different groups. Currently the modification process is used to ensure consistency between the two databases.

F5) In the scoping list (L1124-GN-LIS-020) there are 4 steam generators with level 1 safety classification and 2 steam generators with level 2 safety classification. A task order of the SALTO Project is still not completed for managing the anomalies discovered during the scoping process (began in June 2021 and still on-going until Mid-2022 at least).

F6) Classification of SSCs (for safety and other classifications) is recorded in a classification database. The LTO scope inclusion is automated based on the classification status. However, it has to be done manually for certain cases (fire, explosion or flooding hazards) of SSCs.

F7) The plant has defined a Design Extension Related (DER) class in the Importance Category to include components with a function in severe accident or extreme condition. DER was introduced in 2018. Although the components for Design Extension Condition (DEC) events were identified during scope setting and the plant is planning to perform the formal DER, the classification is not in place yet for most of the SSCs in the scope of AM.

F8) Cable materials and manufacturers are included in the consideration for scoping and grouping of cables in the Cable Ageing Management Programme (CAMP, 331-127) and associated CAMP manuals (240-98789629, 240-98789276). However, reconstruction of manufacture data is still in progress and not fully incorporated in the CAMP scope list.

F9) There is no written evidence that a walkdown is prescribed before or after modification of the plant to identify non-safety related SSCs whose failure may prevent SSCs from fulfilling their intended safety functions.

2.2 – SAFETY CONSEQUENCE:

With incomplete or inconsistent scope setting of SSCs, ageing management and safety function of some SSCs important to safety could be compromised.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider ensuring completeness and consistency of ageing management scope of SSCs for LTO.

2.4 – IAEA BASIS:

SSR-2/2 (Rev.1)

Requirement 16: Programme for long term operation

Where applicable, the operating organization shall establish and implement a comprehensive programme for ensuring the long term safe operation of the plant beyond a time-frame established in the licence conditions, design limits, safety standards and/or regulations.

SSR-2/2 (Rev.1)

4.54. The comprehensive programme for long term operation shall address:

(a) Preconditions (including the current licensing basis, safety upgrading and verification, and operational programmes);

(b) Setting the scope for all structures, systems and components important to safety;

(c) Categorization of structures, systems and components with regard to degradation and ageing processes;

(d) Revalidation of safety analyses made on the basis of time limited assumptions;

(e) Review of ageing management programmes in accordance with national regulations;

(f) The implementation programme for long term operation.

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5.16. The following SSCs should be included in the scope of ageing management:

(a) SSCs important to safety that are necessary to fulfil the fundamental safety functions [1]:

- Control of reactivity;
- Removal of heat from the reactor and from the fuel store;
- Confinement of radioactive material, shielding against radiation and control of planned radioactive releases, and limitation of accidental radioactive releases.

(b) Other SSCs whose failure may prevent SSCs important to safety from fulfilling their intended functions. Examples of such potential failures are:

- Missile impact from rotating machines;
- Failures of lifting equipment;
- Flooding;
- High energy line break;
- Leakage of liquids (e.g. from piping or other pressure boundary components).

(c) Other SSCs that are credited in the safety analyses (deterministic and probabilistic) as performing the function of coping with certain types of event, consistent with national regulatory requirements, such as:

- SSCs needed to cope with internal events (e.g. internal fire and internal flooding);

- SSCs needed to cope with external hazards (e.g. extreme weather conditions, earthquakes, tsunamis, external flooding, tornados and external fire);
- SSCs needed to cope with specific regulated events (e.g. pressurized thermal shock, anticipated transient without scram and station blackout);
- SSCs needed to cope with design extension conditions [1] or to mitigate the consequences of severe accidents.

2.5 – DOCUMENTS REVIEWED:

- 240-89294359, Rev. 02, Nuclear Safety, Seismic, Environmental, Quality, Importance and Management System Level Classification Standard, 2021-03-26;
- 331-93, Rev. 03, Guide for Classification of Plant Components, Structures, Parts Services and Software. 2021-06-29;
- Ref. JN195/NCI/ESCOM/J2/365, Rev. 00, Koeberg Nuclear Power Station Internal Flooding Analysis, June 2002;
- 07C03014-S2, Rev. 01, Seismic Event Fall-Down Hazard Report for Koeberg NPP, March 2008;
- 08016.ROD.012, Rev. 0.2, SALTO Non-Safety affecting Safety equipment scope verification, 2019-12-12;
- 240-125839632, Rev. 02, Koeberg Safety Aspect of Long Term Operation (SALTO) Scoping Methodology, 2020-10-20;
- 240-149139512, Rev. 01, Ageing Management Requirements for Koeberg Nuclear Power Station, 2020-06-12;
- 240-156945472, Rev. 01, SALTO Ageing Management Assessment Report (Interim), 2020-11-09;
- KAA-501, Rev. 11, Project Management Process for Koeberg Nuclear Power Station Modifications, 2019-09-23;
- KGU-023, Rev. 06a, Guide for Components Engineers, 2020-10-01;
- KGU-035, Rev. 04, Integrated Equipment Reliability Process: Scoping & Classification of Components, 2019-11-18;
- L1124-EL-LIS-001, Rev. 02, Complete List of in-scope items for SALTO EQ TLAA, 2020-01-30;
- L1124-EL-LIS-003, Rev. 03, Cable List, Missing (Date of file: 2019-12-06);
- L1124-GN-LIS-006A, Rev. 02, IGALL Commodity group linking table, 2020-01-29;
- L1124-GN-LIS-006B, Rev. 02, Ageing Management Matrix_linking table, 2020-0-10;
- L1124-GN-LIS-020, Rev. 03, Comprehensive List of all SSCs, 2020-02-27;
- L1124-GN-LIS-027, Rev. 03, AMR Data Tables for Commodity Groups, 2021-03-17;
- L1124-GN-RPT-004, Rev. 04, Boundary Definition by Bigramme, 2019-09-30.

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE	**Date:** 30/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

The issue raised is potentially incomplete scope setting of SSCs for ageing management and LTO.

A high-level scoping methodology document (240-125839632) was first developed in 2019. The scoping methodology was based on the plant's classification system (240-89294359)

for SSCs, which is used for categorizing systems, components, and parts based on their function, purpose, and impact as it relates to nuclear safety. The classification system takes into account non-safety SSCs that may pose a hazard to SSCs important to safety. The classification system forms part of the business-as-usual process for the plant and was not conceived for use as part of the SALTO assessment.

The 2022 SALTO mission considered this method potentially incomplete or as inconsistent scope. Lack of plant walkdowns, as part of scoping, was highlighted as one of the main issues even though, the scoping process was supplemented by previously completed hazard analysis studies (such as fire risk analysis, flooding study, and hydrogen explosion study) for the purpose of identifying non-safety SSCs with a potential effect on important-to-nuclear safety SSCs.

The other issue identified in the 2022 SALTO mission was an insufficient process for managing the scope list, since the scope list is distributed in two information sources, namely the Design Engineering's classification database and the Materials Reliability Group's COMSY database (used for ageing management). At the time, the process for maintaining data integrity for SALTO was not fully implemented within the responsible Department, namely Design Engineering and the Materials Reliability Group.

3.2 – CORRECTIVE ACTIONS:

Analysis of the issue resulted in several corrective actions assigned with Output Deliverable (ODs) numbers. These actions were also raised to ensure compliance with the NNRs RG-0027, and they were tracked within the SALTO project and DevonWay (plant CAP system). The actions are listed below:

Activity ID	DevonWay No	Activity Name
OD_4.11	SE 38545-015 CA	Update Plant Modification Design Eng Processes (331-83, 331-86, etc) to comply with RG-0027
OD_4.12	SE 38545-016 CA	Update Equivalency Studies to comply with RG-0027
OD_5.8	CR 116870-002 CA	Capture SALTO NSAS walk-down findings and follow-up actions in report
OD_12.18	CR 120304-004 GA	SALTO Scope list updated with the correction of the anomalies identified through SALTO Assessment.
OD_20.13	CR 133538-036 CA	Complete the gathering of materials and manufacturers data and update Cable Scoping List.
OD_20.15	CR 133538-017 CA	Verify the completeness of the SALTO in-scope cables as reflected in L1124- EL-LIS-003.

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

- SE 38545-015 & SE 38545-016 CA (OD_4.11&OD_4.12): An aspect of ageing management was added to the design processes (e.g. consideration for ageing management was introduced into 331-86). An ageing management section was added to the design template, to ensure that the designs for plant changes consider possible impact on SSCs included in the SALTO scope; this includes walkdowns for non-safety which may impact on safety, as result of plant modifications. An extra requirement was added, to necessitate an additional review of the design for impact on COMSY (software used for ageing management and maintaining commodity

groups) by the respective custodian (from the Materials Reliability Group) and to ensure data integrity between the ageing management scope list (in Design Engineering) and COMSY (in the Materials Reliability Group). A similar approach was introduced into the equivalency process.

- CR 120304-004 GA (OD_20.13): Various anomalies associated with the scope list were identified as part of the SALTO assessment. These included inconsistency in the safety class for steam generators as identified in the 2022 SALTO mission. A compiled Record of Decision (ROD-08016.ROD.027) with the scope and corrective actions were raised and approved by SMOC (SALTO Management Oversight Committee). As a result, a Technical Requirement Specification was compiled, and a project was initiated for rectifying these anomalies. The anomalies were mostly comprised of inconsistencies between source documentation, SSCs, and classifications as listed in the SALTO scope. The project concluded in February 2024 with a report 331-627 (Report – Evaluation and Rectification of SALTO Anomalies), and ageing management lists comprising electrical, mechanical, and civil scope. This work did not result in material changes of the SALTO scope list.
- CR 133538-036 CA & CR 133538-017 CA (OD_20.13 & OD_20.15): Missing cable information such as materials, OEM, cable type was gathered for electrical and C&I cables in the ageing management scope list to facilitate the Cable Ageing Management Programme (CAMP) (see ODCOF No. 08016.ODCOF.297) and this action was closed in May 2024. Sample verification of the complete list of electrical cables concluded that potentially some cables connected to electrical components or instruments important to nuclear safety, was excluded from the scope list. The 15% electrical cables verified to be excluded from the SALTO scope are connected to electrical components or instruments important to nuclear and are therefore included into SALTO scope as per scoping methodology 240-125839632, 'Koeberg Safety Aspects of Long-Term Operation (SALTO) Scoping Methodology'. An action (GA 43509) was raised to evaluate the electrical cables list excluded from the SALTO scope in L1124-EL-LIS-003 GA and to update the SALTO scope. This action remains incomplete and is due on 30 November 2024.
- CR 116870-002 CA (OD_5.8): An action to perform plant walkdowns to supplement the scoping activities was captured in ROD 08016.ROD.012. The requirement for walkdowns is linked to a need to verify comprehensiveness of the list of in-scope SSCs due to limitations of previously undertaken seismic hazards assessment, flooding, and fire studies used in the scoping assessment. A graded approach to plant walkdowns was decided upon. The approach is based on verification of the most safety significant equipment as identified via the plant PSA. The plant walkdowns for non-safety impacting on safety, utilised the most risk-significant components based on the current plant PSA Risk Spectrum as provided by the Deterministic and Probabilistic Safety Analysis group. The findings of the walkdowns are captured in ODCOF No. 08016.ODCOF.110 and report 240-160675265, 'Plant-Walkdowns for SALTO Scope Confirmation Report'. The report did not identify any significant concerns that required adjustment of the scope list. The plant walkdowns coupled with the fact that the plant's classification takes into account non-safety impacting on nuclear safety provide assurance that scoping of non-safety SSCs posing a hazard to nuclear safety is considered adequate.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) The aspect of ageing management is considered in various design engineering process documents, such as 331-93, 331-86, and 331-87. The design template 240-143890978 was

updated after the previous SALTO mission to incorporate ageing management during plant modifications (a new section 3.15 was added).

F2) A review systematically performed by the Materials Reliability group from the ageing management point of view is now a part of the standard design process (331-87). From that document there is a reference to 240-143890978: Design Template (appendix D), that details required actions. This ensures that the data between the design classification database and COMSY are consistent when a modification is performed. This template was implemented in 2023 and to date no new modification has been processed on the updated template, so effectiveness of the process could not be demonstrated yet.

F3) Updating the COMSY database to ensure the consistency of data between the design classification database and COMSY in the equivalency process is tracked through specific actions in the DevonWay system. The process was demonstrated on equivalency number I016/24 together with a respective action in the DevonWay system.

F4) Walkdowns are standard parts of the design modification process (331-87). The design template 240-143890978 gives guidance on what has to be considered when it comes to possible non-safety impact on nuclear safety, however, the template does not explicitly mention plant walkdowns that focus on identifying potential spatial interactions between non-safety-related components and safety-related components after modifications. Additionally, there is no specific walkdown template, that includes this task, which means there is no evidence that these walkdowns are adequately addressing the potential spatial interactions.

F5) Due to inconsistencies between the source documentation used for the scoping process, nearly 4000 anomalies were identified during a self-assessment conducted as part of the ageing management project. The project for rectifying these anomalies was completed in February 2024. The report 331-627 (Evaluation and Rectification of SALTO Anomalies), along with an Excel sheet (L1173-Tracking-WIP-23-4-2924), were provided as evidence. All anomalies in L1173-Tracking-WIP-23-4-2924 were corrected in the source documents with no impact on the SALTO scope list. A follow-up action is raised in DevonWay under the number GA 43702, to upload the corrected fields, associated with classifications, into the design classification database. However, the ageing management scope list remains complete and is not impacted by this action. When the action is finished, a new action in DevonWay will be raised to update COMSY accordingly.

F6) The formal process of classifying Design Extension Related (DER) components has started but is not yet finished. However, on a sample of components listed in L1173-GN-LIS-021 it was demonstrated that DER components are already included in the scope for ageing management. Thus, formal classification of these components has no impact on the SALTO scope list. Formal DER classification is part of the standard classification process described in 331-93.

F7) Reconstruction of missing cable information was completed and documented in ODCOF No. 08016.ODCOF.297 that was approved on 22.5.2024. Information was collected and listed in L1124 SALTO B project cable list, which is the new consolidated cable list for the CAMP.

F8) A sample verification by the plant of the SALTO cable list to check for completeness identified that approximately 15% of the cables in the sampled scope were mistakenly excluded. As a result, the identified 15% were included in the scope list and a new action (GA43509) was raised in DevonWay to evaluate all previously excluded cables and update

the SALTO scope accordingly. This action is due by the end of November 2024. In addressing the action, additional cables were identified and added to the scope, as part of the cable information reconstitution. This information will be used to close out the action GA43509. All cable trays are covered by the Civil AMP manual (240-165425812).

F9) Maintaining the scope (updates etc.) is part of the standard classification process (plant standard for this process is KSA-010 and it is detailed in the lower-level document 331-93 Guide for Classification of Plant Components, Structures, Parts, Services and Software). The process is linked also to the CAP process in a case of deviation.

4.2 – DOCUMENTS REVIEWED:

- 331-86, Rev. 03, Design Changes to Plant, Plant Structures or Operating Parameters, 2021-11-25
- 240-143890978, Detailed Design Template, Rev. 3
- 331-83, Rev. 4, Requirements for Plant Changes affecting the Design of Koeberg Nuclear Power Station, 2021-11-26
- 331-93, Rev. 04, Guide for Classification of Plant Components, Structures, Parts Services and Software. 2023-02-09;
- 331-87, Rev.11, Design Engineering Guide, 2021-09-21
- 331-627, Rev.1, Report – Evaluation and Rectification of SALTO Anomalies, 2024-02-27
- 331-143, Rev. 3, Equivalency Study Process to Change the Plant, 2021-09-01
- 331-144, Rev. 6, Standard for the Preparation of an Equivalency Study, 2023-06-29
- L1173-Tracking-WIP-23-4-2924
- L1173-GN-LIS-021
- 240-165425812, Rev. 2, Civil Ageing management programme manual, 2023-07-26
- I016/24, Rev.0, Solenoid Valve, 2024-07-25

4.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: B-2**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Scope setting, plant Programmes and corrective action programme	
1.1 – ISSUE TITLE: Incomprehensive review and implementation of plant programmes	
1.2 – FUNDAMENTAL OVERALL PROBLEM: The plant programmes are not comprehensively reviewed and implemented for LTO.	
2. ASSESSMENT OF THE STATUS	**Date:** 29/03/2022

2.1 – FACTS:

F1) The process for the development and control of ageing management at the plant prescribes an annual review of all equipment (component) failures to confirm that these are covered in the ageing management matrix. However, this prescription is not implemented yet and no record of the review is available.

F2) A preventive maintenance template is a pre-defined maintenance approach for a particular component type (or family of components) that lists significant failure modes and failure causes, constituting the failure mode analysis (FMA). The preventive maintenance template also recommends preventive maintenance tasks and task intervals, constituting the preventive maintenance strategy. For I&C components, six preventive maintenance templates are not completed yet.

F3) The objective of the plant is to have all preventive maintenance tasks directly assigned to the maintenance staff in SAP as an automated outcome of the preventive maintenance software IQ Review. However, the implementation of generic preventive maintenance task orders in SAP in line with the revised preventive maintenance strategies of IQ Review is not complete. In that case, preventive maintenance task orders in line with the revised preventive maintenance strategies of IQ Review will thus have to be issued manually as standalone task orders for the upcoming outages.

F4) The RPV surveillance programme relies on a manual that has not been reviewed against the 9 attributes of an effective ageing management programme. Revision of the RPV surveillance programme manual is still in progress (planned for completion by mid-2022).

F5) There is a list of critical spare parts but there is no critical spare parts programme to help in prioritizing actions among the numerous spare parts which belong to safety class components.

F6) The chemistry programme was reviewed against IGALL AMP103 and the conclusion of the comparison report between existing plant programmes and IGALL AMP requirements is that there are no gaps. However, the review was not documented, and there is no written evidence of the review result nor reference to AMP103 in the justification for the plant's Chemistry Operating Specification document.

2.2 – SAFETY CONSEQUENCE:

Without comprehensive revision and implementation of the plant programmes, safety function of SCCs in scope of plant programmes cannot be ensured.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider comprehensively reviewing and implementing all plant programmes for LTO.

2.4 – IAEA BASIS:

SSR-2/2 (Rev.1)

Requirement 31: Maintenance, testing, surveillance and inspection programmes

The operating organization shall ensure that effective programmes for maintenance, testing, surveillance and inspection are established and implemented.

8.1. Maintenance, testing, surveillance and inspection programmes shall be established that include predictive, preventive and corrective maintenance activities. These maintenance activities shall be conducted to maintain availability during the service life of structures, systems and components by controlling degradation and preventing failures. In the event that failures do occur, maintenance activities shall be conducted to restore the capability of failed structures, systems and components to function within acceptance criteria.

8.3. The operating organization shall develop procedures for all maintenance, testing, surveillance and inspection tasks. These procedures shall be prepared, reviewed, modified when required, validated, approved and distributed in accordance with procedures established under the management system.

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3.21. The operating organization should ensure that programmes and documentation relevant to the management of ageing (see Sections 4 and 5) and technological obsolescence (see Section 6) are implemented during the operation stage. Where necessary, new programmes and documentation should be developed or existing programmes and documentation should be reviewed and modified to ensure that they will be effective for managing ageing.

4.17. Existing programmes that are credited for ageing management and used in evaluations for long term operation should be consistent with the nine attributes listed in Table 2, in Section 5.

4.42. Surveillance programmes using representative material samples (e.g. material specimens for surveillance of the reactor pressure vessel, cable samples and corrosion coupons) should be reviewed and extended or supplemented for ageing within the period of long term operation, if necessary.

4.44. Appropriate testing procedures and evaluation methods should be considered for defining the set of specimens to be included in the supplementary material surveillance programme for the reactor pressure vessel, if necessary, in particular for alternative assessments such as the master curve approach for assessing fracture toughness.

2.5 – DOCUMENTS REVIEWED:

- 331-275, Rev. 02, Process for the Development and Control of Ageing Management at Koeberg Operating Unit, 2018-04-06;
- 240-97087308, Rev. 03, Fourth Interval In-Service Testing Programme Requirements Manual (ISTPRM), 2019-08-08;
- KOEB-005-001, Rev. 01, Risk-Informed ISI Periodic Evaluation and Update for the Koeberg Nuclear Power Station in Conjunction with End of the First Period of the Fourth Interval, 2021-08-22;
- 240-101650256, Rev. 02, Ageing Management Matrix, 2021-06-28;
- 240-102103854, Rev. 01, Review of the Koeberg plant programmes to assess alignment with the IAEA Ageing Management Programmes, 2015-11-13;
- 240-110745414, Rev. 03, Standard for the In-Service Inspection Programme at Koeberg Nuclear Power Station, 2020-02-03;

- 240-119362012, Rev. 02, Fourth Interval In-Service Inspection Programme Requirements Manual (ISIPRM) for Koeberg Nuclear Power Station, 2021-08-03;
- 240-143109187, Rev. 01, Reactor Pressure Vessel Management Programme Manual, 2019-04-05;
- 240-149139512, Rev. 01, Ageing Management Requirements for Koeberg Nuclear Power Station, 2020-06-12;
- 240-156945472, Rev. 01, SALTO Ageing Management Assessment Report (Interim), 2020-11-09,
- 331-23, Rev. 04, Processing of industry Operating Experience in Nuclear Engineering, 2020-12-07;
- 08016.ROD.025, Rev. 0.3, Comparison of the existing Plant Programmes with IAEA IGALL-AMP Requirements, 2020-06-25;
- KBA 0022 N NEPO NEPP 176, Rev. 02, Critical Spares Listing, 2020-12-28;
- KAA-716, Rev. 04, Shelf Life Process, 2019-10-31;
- KSA 012, Rev. 04, The Storage and Preservation of Spare Parts at Koeberg Nuclear Power Station, 2020-10-28;
- L1124-GN-RPT-030, Rev. 04, Comparison Report Existing KNPS Plant Programs with IGALL-AMP requirements, 2020-02-17;
- KAA-614, Rev. 10, Control of Spares Assessments and New Stock Applications, 2021-07-06;
- KAA-617, Rev. 05a, Identification and Resolution od Spares Problems and Anomalies, 2013-04-23;
- KAA-852, Rev. 03, Equipment Reliability Index, 2019-10-30;
- KAA-913, Rev. 02, The Integrated Equipment Reliability Process, 2021-02-26;
- KAD-025, Rev. 02, Processing of Operating Experience, 2019-09-26;
- KAA 830, Rev. 02, Justification for Koeberg NPS Chemistry Operating Specifications, 2019-05-06,
- KBA-0022-SRSM-000-00, Rev. 01, Safety Related Surveillance Manual, 2011-11-14;
- KGU-033, Rev. 04, Failure Investigation of Plant Equipment and Evaluation of Experience, 2020-07-27;
- KGU-034, Rev. 02, Guide for Reliability Engineers, 2019-05-31;
- KGU-035, Rev. 04, Integrated Equipment Reliability Process: Scoping & Classification of Components, 2019-11-18;
- KGU-037, Rev. 02, Integrated Equipment Reliability Process: Developing PM Templates, 2021-03-25;
- KGU-039, Rev. 02, Integrated Equipment Reliability Process: Developing PM Strategies, 2021-03-25;
- KLA-005, Rev. 03, Koeberg Event Classification and Reporting Criteria Listing, 2020-09-01;
- KLM-005, Rev. 21, Mandatory Preventive Maintenance Listing, 2020-03-30;
- KNC-001, Rev. 17, Chemistry Operating Specifications for Safety Related Systems, 2020-09-08;
- KNC-002, Rev. 10, Chemistry Operating Specifications for Availability Related Systems, 2021-10-06;
- KNM-001, Rev. 06, Maintenance Welding Programme, 2020-07-29;
- KSA 012, Rev. 04, the Storage and Preservation of Spare Parts at Koeberg Nuclear Power Station, 2020-10-28;
- KSA-913, Rev. 01, Integrated Equipment Reliability Standard, 2020-10-22;
- KSC-003, Rev. 06, The Chemistry Programme, 2020-09-25;
- KSC-006, Rev. 10, Chemistry Standards and Expectations, 2020-09-25;
- KSM-015, Rev. 09, Maintenance History Recordings, 2020-10-27;

- L1124-GN-RPT-027, Rev. 02, Report on OE for the Review of Existing TLAAs, 2019-07-18;
- L1124-GN-RPT-030, Rev. 04, Comparison Report Existing KNPS Plant Programs with IGALL-AMP requirements, 2020-02-17;
- KSA-011, Rev. 14, The Requirements for Controlled Documents, 2017-12-20;
- KSA-038, Rev. 06, Requirements for Quality Records, 2020-07-08;
- 240-153945942, Rev. 01, User Requirements Specification for Management of SALTO Anomalies Evaluation and Rectification, 2020-06-24;
- EA-20-160, Response to CR 115457-015_017, 2020-11-06;
- KAA-638,1Rev. 04, Communication Process with EDF, 2019-07-25;
- KAA-688, Rev. 09, Corrective Action Process, 2020-06-30;
- KGA-035, Rev. 04, Processing of Experience Feedback Received Through the EDF Co-Operation Agreement, 2019-06-24.

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE | **Date:** 30/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

The issue raised in the 2022 SALTO mission was a potential incomprehensive review, update and implementation of plant programmes. In the 2022 SALTO mission several plant programmes were reviewed, and it was found that either the programme was not reviewed against the nine attributes of an effective ageing management programme, or the review was not complete. The other issue raised was that plant programmes were either not implemented yet or not fully developed. A review of the plant programmes against the IGALL AMPs and the nine attributes of an effective programmes was never a requirement until the plant embarked on a project for extending the life of the plant. The requirement was introduced when regulation was issued and the plant standard on ageing management was authorised.

3.2 – CORRECTIVE ACTIONS:

- OD_4.18 (CR 133538-021 CA): Review all component failures annually, to confirm ageing management coverage of these components. Prepare and submit the annual management report to the NNR as per 331-275 including the review of the component failures.
- OD_7.102 (CR 116340-016 CA): Update Preventive Maintenance (PM) Programme for SALTO scope as identified through Mechanical AME review.
- OD_7.103 (CR 116340-017 CA): Validate PM Programme Strategies on SAP as per the SALTO scope as identified through the Mechanical AME review.
- SE 38545 (GA): Various actions raised for reviewing programmes to ensure consistency with the nine attributes of an effective AMP. (e.g. SE 38545-035 GA (Update the Reactor Vessel Surveillance Programme (240-143109187) to comply with RG-0027 and to ensure consistency with the nine attributes of an effective AMP).

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

- OD_4.18 (CR 133538-021 CA): The annual review of all component failures, to confirm ageing management coverage of these components as required by the ageing management standard has been implemented. The first submission of the annual ageing management report to the NNR is under correspondence letter K-29471-E.
- CR 116340-016 CA & CR 116340-017 CA (OD_7.102 & OD_7.103): All SALTO identified changes (new/updates) to PM strategies were compiled, reviewed and approved on IQReview (ER Software application). This means that all functional locations were identified from the list of commodities, and then the PM strategies for

these functional locations were compiled (new/updates) and approved. This was followed by a validation carried out on a sample, according to the PM Templates applied. The findings of the validation, as identified in closeout form 08016.ODCOF.247 are now included in the implementation actions associated with the entire batch of PM Strategies.

- SE 38545: an assessment was performed to verify alignment of all plant programmes with IGALL AMP requirements (nine attributes of an effective AMP), documented in L1124-GN-RPT-030 (Report Comparison Report of the Existing KNPS Plant Programmes with IGALL-AMP Requirements). This resulted in several corrective actions being raised and recorded in a Record of Decision (ROD) 08016.ROD.025. The intent of these actions was to review the existing plant programmes and processes used for ageing management, to ensure full alignment with the attributes of an effective AMP. These actions were all addressed and closed by the Materials Reliability Group in 2022.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) The evaluation of component failures is a standard activity under the Integrated Equipment Reliability Process (KAA-913). On workflow it was demonstrated that feedback is provided to the AMM within the standard process. The first annual failure report 331-672 was provided as evidence that the requirement on annual review of component failures per 331-275 has been implemented.

F2) Outstanding PM templates have been prepared under the Integrated Equipment Reliability Process that is described in KAA-913. Implementation of PM strategies to SAP is underway according to Programme Implementation Plan (PIP), Rev. 1 (2023-03-29) with no deadline established. Revision of the PIP is under preparation. The transition to fully automated task orders has not been finished yet, but all required plant activities/tasks for the foreseeable future have been raised as stand-alone tasks.

F3) Review against the nine attributes of an effective AMP (including The Reactor Vessel Surveillance Programme Manual and The Chemistry Programme) was demonstrated on action status list SE 38548 exported form the DevonWay system, on Chemistry programme KSC-003, Rev. 7, 2023-20-09 and also on Reactor Vessel Surveillance programme (331-604), that was sent to the Nuclear National Regulator for approval in 03/2024.

F4) Based on the finding of the 2022 SALTO Mission, a new Critical Spare Parts programme has been developed, however it is not yet implemented in accordance with the nine attributes (the process/procedure is now under review with due date for finalization in 10/2024).

4.2 – DOCUMENTS REVIEWED:

- KSC-003, The Chemistry Programme, Rev. 7, 2023-20-09
- KAA-913, Rev.2, Integrated Equipment Reliability Process, 2021-02-26
- 331-624, Rev. 1, The Reactor Vessel Surveillance Programme Manual, signed by acting manager MRG 2024-03-15 (not approved yet)
- 331-275, Rev. 03, Process for the Development and Control of Ageing Management at Koeberg Nuclear Power Station, 2022-03-28
- 08016.ODCOF.247, OD_7.103 – Validate PM Programme Strategies on SAP as per SALTO schope as identified through Mechanical AME review, 2022-03-31
- Action status list SE 38548 exported from DevonWay system

4.3 – RESOLUTION DEGREE:		
1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	X
3.	**Issue resolved**	

1. ISSUE IDENTIFICATION	**Issue Number: C-1**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of mechanical SSCs	

1.1 – ISSUE TITLE:

Inconsistent information management for AMR of mechanical SSCs

1.2 – FUNDAMENTAL OVERALL PROBLEM:

Information used for AMR of mechanical SSCs is not consistently managed and documented.

2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022

2.1 – FACTS:

F1) The plant performed a data transfer from the ageing assessment including the previous AMM (Ageing Management Matrix) to COMSY. The objective for the implementation of COMSY is to provide access to several stakeholders involved in ageing management such as design engineers, maintenance, and system engineer. Data related to environmental and condition monitoring of SSCs in the scope of LTO are also expected to be handled and distributed through this software tool. At the time of the mission the COMSY software was not available due to technical problems. As a consequence, it was not possible for the team to confirm COMSY's capabilities and real data.

F2) Report 331-275 is being updated in order to incorporate COMSY as a replacement of the previous AMM. The update has not been issued yet.

F3) Information from L1124-GN-RPT-023 (AMR comprehensive report) was migrated to COMSY, however the following inconsistencies were identified:

- Terminology used for degradation mechanisms and other ageing management related terms in AMR comprehensive report and COMSY is not consistent, e.g. for pressurizer 'cyclic loading' (see 4.3.1. "IGALL" in L1124-GN-RPT-023) vs. 'fatigue'.
- For pressurizer, fatigue was not referenced in the AMR comprehensive report (L1124-GN-RPT-023 p. 40) based on IGALL AMR, nevertheless fatigue was added to COMSY based on the AMM.
- TLAA106 for "Pressurizer" was not listed, regardless the high initial CUF=0.889 for heather sleeves (without environmentally assisted fatigue).
- AMP119 is foreseen only for the Pressurizer Spray Head (p. 42/1108), regardless of the future potential critical results of TLAA106 for pressurizer (e.g. for heater sleeves).

- Steam generator closure bolting is not indicated neither in nor out of the scope of the table extracted from COMSY, however in L1124-GN-RPT-023 Chapter 7 AMR Class 1-3 and non-classified bolting are reported.
- IGALL AMP114 for steam generator was not listed in the AMR comprehensive report (L1124-GN-RPT-023 p. 64) based on IGALL AMR, however they are included in the COMSY database.
- There are 3 different commodity groups (CGs) for the Steam Turbine System valves (L1124-GN-RPT-023 p. 485-488), however in the list of CGs in L1124-GN-LIS-027 there is only 1 line (Nr. 362).
- There are 6 different CGs for Fire Protection Pumps (L1124-GN-RPT-023 p. 103), however in the list of CGs in L1124-GN-LIS-027 there are only 5 lines for pumps (365, 380, 381, 789 and 793).
- For Diesel Fuel Oil System there are 3 CGs (L1124-GN-RPT-023 p. 106), however in the list of CGs in L1124-GN-LIS-027 there are 2 more CGs for this system: "Ducting and Components" and "AnyMT".

F4) Edition 2018 of the IGALL AMR table was the basis for the AMR report (L1124-GN-RPT-023), however systematic use of that IGALL AMR table is not evident, since some of the IGALL AMR table information is missing, e.g.:

- In the final conclusion for main components (RPV, steam generator, pressurizer etc.) critical locations with the ageing effect and degradation mechanism are not explicitly connected to the relevant TLAA in L1124-GN-RPT-023.
- For pressurizer components (p. 39/1108) the IGALL line with 'Cracking due to fatigue' is not mentioned.
- AMP115 bolting is not mentioned for the pressurizer as a connected IGALL AMP (p. 40/1108).
- Selective leaching is considered for CG 'WWS_V_03_B_0_CM' (p. 579/1108), however in conclusion AMP120 is not listed.

F5) According to L1124-GN-RPT-023 (p.23/1108) for valves: "IAEA IGALL degradation mechanisms only consider the pressure boundary (body) of valves". Nevertheless, the IAEA IGALL AMP143 Safety Related Valves was referred as basic document, the review of ageing effects and degradation mechanisms for components with active function is not a part of L1124-GN-RPT-023.

F6) Based on L1124-GN-RPT-023 (p. 25/1108) for pumps, there is no information of maintenance on active safety function in the comprehensive ageing management report.

F7) Identification of potential ageing effects and degradation mechanism for components with an active safety function is essential for AMR, however it is stated in the Advance Information Package (p. 54) that "not all Koeberg PM templates identify the relevant failure modes and causes". Based on SE 35244-049SE the status of this action is 90% complete.

2.2 – SAFETY CONSEQUENCE:

Without consistent management and documentation of information, the ageing management review of mechanical SSCs cannot identify in a consistent manner ageing effects that can challenge safety functions for LTO.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider consistently managing and documenting information for AMR of mechanical SSCs.

2.4 – IAEA BASIS:

SSR-2/2 (Rev. 1)

Requirement 14: Ageing management

The operating organization shall ensure that an effective ageing management programme is implemented to ensure that required safety functions of systems, structures and components are fulfilled over the entire operating lifetime of the plant.

4.50. The ageing management programme shall determine the consequences of ageing and the activities necessary to maintain the operability and reliability of structures, systems and components. The ageing management programme shall be coordinated with, and be consistent with, other relevant programmes, including the programme for periodic safety review. A systematic approach shall be taken to provide for the development, implementation and continuous improvement of ageing management programmes.

4.51. Long term effects arising from operational and environmental conditions (i.e. temperature conditions, radiation conditions, corrosion effects or other degradations in the plant that may affect the long term reliability of plant equipment or structures) shall be evaluated and assessed as part of the ageing management programme. Account shall be taken in the programme of the safety relevance of structures, systems and components.

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5.22. An ageing management review for in-scope SSCs should be performed to ensure and demonstrate that ageing will be effectively managed.

5.23. The ageing management review should systematically assess ageing effects and the related degradation mechanisms that have been experienced or are anticipated. The assessment should include an evaluation of the impact of the ageing effect on the in-scope SSCs' capability to perform their intended functions as specified in para. 5.16, including consideration of the current condition of the SSC.

5.26. An ageing management review should be performed for each in-scope structure or component or commodity group of structures or components and should consist of the following essential elements:

(a) Assessment of the current condition of the structure or component;

(b) Identification of ageing effects and degradation mechanisms based on fundamental knowledge for understanding ageing (e.g. the design basis, materials, the environment and stressors; see 'Understanding ageing' in Fig. 1);

(c) dentification of the appropriate programme for ageing management;

(d) Reporting of the ageing management review to demonstrate that the ageing effects and degradation mechanisms are being managed effectively.

5.33. Once the approach for managing ageing effects and degradation mechanisms has been determined, documentation should be prepared that logically demonstrates that the ageing effects will be adequately managed.

7.25. The ageing management review should provide a clear demonstration that ageing effects will continue to be identified and managed for each structure or component in the scope of long-term operation for the planned period of long-term operation.

2.5 – DOCUMENTS REVIEWED:

- 08016.ROD.023, Review of the Mechanical Ageing Management Evaluation (AME) Consortium Report L1124-GN-RPT-023 and Decisions by Eskom, 2020, July
- 240-101650256, Ageing Management Matrix, 2020,
- 331-275, Process for the Development and Control of Ageing matrix Management at Koeberg Operating Unit, 2019, July 01
- L1124-GN-LIS-020, Comprehensive List of all SSCs, 2020, February 27
- L1124-GN-RPT-023, AME Degradation Assessment Results Mechanical, 2020, March 26

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE	**Date:** 30/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

Issue C-1 highlighted the inconsistencies noted in managing and documenting of information used for the ageing management review (AMR) of mechanical SSCs. The root cause for the inconsistencies was due to numerous information sources that were used for the AMR of in-scope SSCs. Such information sources, as listed in paragraph 2.5 above, were not integrated or centralized in the AMR database (COMSY) at the time of the mission. Furthermore, COMSY could not be accessed due to an unexpected licencing issue at the time of the IAEA SALTO mission and therefore some aspects of the AMR could not be validated and hence an issue was raised relating to the potential inconsistent information management for AMR of mechanical SSCs.

At the time of the 2022 SALTO mission, most of the newly required AMPs were not implemented, thus, effectiveness of ageing for in-scope SCCs could not be demonstrated and was not documented. This is linked to issue C-2.

The required actions to fully address the issue were documented in the record of decision (ROD) No. 08016.ROD.030, “IAEA SALTO (2022) New Scope” and presented to the plant’s oversight committee, SALTO Management Oversight Committee (SMOC).

3.2 – CORRECTIVE ACTIONS:

A review of the COMSY Database and other relevant documents were tracked under corrective action CR 133538-003 CA. Where relevant, COMSY was updated to ensure consistent AMR information relating to mechanical SSCs. In some cases, the review concluded that no updates were required as documented in the close-out form ODCOF No. 08016.ODCOF.254.

The COMSY licencing issue experienced at the time of the 2022 IAEA SALTO mission was subsequently resolved by the plant IT/IM and the COMSY service provider.

As IGALL, industry and internal ageing management operating experience evolve, relevant updates to COMSY will continuously be managed via application of 331-275 (Process for Ageing Management at Koeberg Operating Unit) and 331-148 (Programme Engineer's Guide).

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

– CR 133538-003 CA has been closed and the Issue C-1 adequately addressed.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) The close out form No. 08016.ODCOF.254 was provided. Facts F1, F3 and F4 collected during the 2022 SALTO mission were addressed, following the actions that had been addressed under the 08016.ROD.023. Newly developed AMPs were based on IGALL 2020.

F2) The COMSY database serves as a collection of ageing management related information (AMR table). Report L1124-GN-RPT-023 has been archived and is not used anymore as it is a project document providing a snapshot. Updates stem from IGALL. Supporting analyses on information stored in COMSY are managed independently. The process is outlined in 331-275.

F3) The information in COMSY (AMR) was based on IGALL AMR 2018 edition. The plant is currently not technically capable of updating all information in COMSY without external technical support. Contracting activities are ongoing to gain in-house skills for these activities. However, it has been demonstrated that the process of considering new information (such as operating experience) is required and is being performed continually, as described in 331-148 (Programme Engineer's Guide, Rev. 5). The COMSY database has been updated where relevant based on activities under 08016.ROD.023.

F4) Document 331-148, Programme Engineer's Guide mandates that changes to IGALL databases must be reviewed at least every two years.

F5) A new Pressurizer AMP manual (AMP154 – 240-165295505) was developed, addressing the shortcomings listed under Fact 4 of the 2022 SALTO mission.

F6) Although TLAA106 for the pressurizer is not listed in COMSY directly, it is covered by AMP 240-165295505 to which COMSY refers.

F7) Pressurizer components cracking due to fatigue are covered in the Pressurizer AMP manual (240-165295505).

F8) Fact 7 from the 2022 SALTO mission has been resolved by 08016.ODCOF.247, followed by implementation of PM strategies.

4.2 – DOCUMENTS REVIEWED:

– 08016.ROD.030, IAEA SALTO 2022 New Scope, 2022-09-01
– 08016.ROD.023, Review of the Mechanical Ageing Management Evaluation (AME) Consortium Report L1124-GN-RPT-023 and Decisions by Eskom, 2020-08-28
– 08016.ODCOF.254, Update COMSY database with the relevant and latest source inputs. Ensure that SALTO IAEA 2022 report issue sheet C-1, Fact 1, 3 and 4 are addressed, 2023-04-25
– 08016.ODCOF.247, OD_7.103 – Validate PM Programme Strategies on SAP as per SALTO scope as identified through Mechanical AME review, 2022-03-31

– 240-165295505, Rev. 1, Pressuriser Ageing Management Programme Manual, 2022-10-25 – 331-275, Rev. 03, Process for the Development and Control of Ageing Management at Koeberg Nuclear Power Station, 2022-03-28 – 331-148, Rev. 05, Programme Engineering Guide, 2024-08-26 – 331-86, Rev. 03, Design Changes to Plant, Plant Structures or Operating Parameters, 2021-11-25
4.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: C-2**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of mechanical SSCs	
1.1 – ISSUE TITLE: Incomplete AMPs for mechanical SSCs	
1.2 – FUNDAMENTAL OVERALL PROBLEM: AMPs for mechanical SSCs are not complete.	
2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022
2.1 – FACTS: F1) The plant's strategy to manage one-time inspections is not described, the programme is not developed (see page 65 of AIP). The plant is developing a programme in compliance with IGALL AMP119. F2) The plant developed a list of about 3000 items for the scope of the one-time inspection programme, but the relevance of components in the list and the completeness of the list is not demonstrated. F3) A 'Failure' column appears in the spreadsheet containing the list of components in the scope of the one-time inspection programme and this column shows a failure mode acronym for some 153 components; the origin and the use of this information is not indicated. F4) According to document L1124-GN-RPT-030, which compares IGALL AMPs with existing plant programmes, it is stated that there are no gaps for AMP134. It was checked that component external surfaces that are insulated and exposed to condensation have to be periodically inspected every 10 years; this requirement has not been taken into account in any of the existing plant programmes.	

F5) Review and updating of existing AMPs are finished, however the following new AMPs are being developed with their effectiveness not demonstrated and their status is as follows:

- AMP 120 - Selective leaching (comments addressed, ready for approval);
- AMP 121 - One-time inspections Class 1 small-bore piping (manual review comments are addressed);
- AMP 135 - Inspection of internal surfaces in miscellaneous piping and ducting components (manual review comments are addressed);
- AMP 137 - Monitoring of neutron absorbers other than Boraflex (manual still under development);
- AMP 154 - PWR pressuriser (manual review comments are addressed);
- AMP 156 - PWR main coolant piping (manual review comments are addressed);
- AMP 157 - Internal coatings and linings (manual review comments are addressed).

2.2 – SAFETY CONSEQUENCE:

Without complete AMPs for mechanical SSCs, the plant cannot ensure preserving the safety function of SSCs for LTO.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider completing the AMPs for mechanical SSCs.

2.4 – IAEA BASIS:

SSR-2/2 (Rev. 1)

Requirement 14: Ageing management

The operating organization shall ensure that an effective ageing management programme is implemented to ensure that required safety functions of systems, structures and components are fulfilled over the entire operating lifetime of the plant.

4.50. The ageing management programme shall determine the consequences of ageing and the activities necessary to maintain the operability and reliability of structures, systems and components. The ageing management programme shall be coordinated with, and be consistent with, other relevant programmes, including the programme for periodic safety review. A systematic approach shall be taken to provide for the development, implementation and continuous improvement of ageing management programmes.

4.51. Long term effects arising from operational and environmental conditions (i.e. temperature conditions, radiation conditions, corrosion effects or other degradations in the plant that may affect the long-term reliability of plant equipment or structures) shall be evaluated and assessed as part of the ageing management programme. Account shall be taken in the programme of the safety relevance of structures, systems and components.

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3.24. The operating organization should ensure the timely detection and characterization of significant ageing effects through the inspection and monitoring of in-scope structures or

components, and the assessment of observed ageing effects to determine the type and timing of any actions required.

5.51. The ageing management programmes should be implemented in a timely manner to ensure that the intended functions of structures or components continue to be performed.

5.52. Detailed implementation procedures that describe preventive and mitigatory actions, monitoring or inspection and assessment actions, acceptance criteria, and corrective actions should be established and shared among the different units of the nuclear power plant (e.g. operations, maintenance and engineering units) that are responsible for implementing ageing management programmes.

5.53. As part of the implementation of the ageing management programmes, appropriate data should be collected and recorded to provide a basis for decisions on the type and timing of ageing management actions.

2.5 – DOCUMENTS REVIEWED:

- 08016.ROD.023, Review of the Mechanical Ageing Management Evaluation (AME) Consortium Report L1124-GN-RPT-023 and Decisions by Eskom, 2020, July
- 240-101650256, Ageing Management Matrix, 2020, November 23
- 331-275, Process for the Development and Control of Ageing matrix Management at Koeberg Operating Unit, 2019, July 01
- KAA-652, Accounting of Transients, 2020, January 30
- KBA 00 22 E00 006, NSSS Design Transients, 2001, July 13

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE	**Date:** 30/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

Issue C-2 states that new ageing management programmes for mechanical SSCs were incomplete. The root cause for the issue was the fact that the newly required mechanical AMPs were at the time, still in the process of development in accordance with 331-148 (Programme Engineer's Guide), and as per 331-618 (Safety Case for LTO of KNPS) commitment.

The required actions to fully address the issue were documented in the record of decision (ROD) No. 08016.ROD.030, “IAEA SALTO (2022) New Scope” and presented to the plant’s oversight committee, SALTO Management Oversight Committee (SMOC).

3.2 – CORRECTIVE ACTIONS:

The scope of work for new AMPs included civil, electrical, and mechanical SSCs, and was tracked under CR 112454-006 CA / OD_7.42. All programme manuals, including those of the subject AMPs for mechanical SSCs, were developed, reviewed, and authorized in accordance with 331-148. The table below provides the document references and authorisation dates for each of the developed programmes, along with the IGALL reference.

IGALL Ref.	AMP Title	Koeberg AMP Document Ref.#	Date Authorised
	Mechanical		

AMP 120	Selective Leaching	240-166959251	2022/03/17
AMP 119	One-time inspections	32-T-PE-006	2022/05/11
AMP 121	One-time inspections class 1 SB piping	32-T-PE-007	2022/05/20
AMP 154	Primary Pressuriser	240-165295505	2022/10/25
AMP 137	Spent Fuel Pool AMP Manual	240-167231099	2024/06/04
AMP 156	Main Reactor Coolant System (RCP) Piping Ageing Management Programme	331-610	2024/06/21
AMP 157 & 135	Internal Surfaces, Coatings and Linings Ageing Management Programme Manual	32-T-PE-010	2022/05/06
	Heat Exchanger Programme	240-154215724	2020/07/28
	Electrical		
AMP 210	Environmental Condition monitoring of Elec and I&C Cables	240-165386950	2022/04/25
AMP 218 & 213	Whiskers, Capacitors & Electronic equipment	240-165424554	2022/05/16
AMP 220	Lightning protection and grounding	240-166957253	2022/03/07
AMP 212 & 215	Elec enclosures & Switchgears, Breakers	240-164966115	2021/11/08
	Civil		
AMP 306	Structures Monitoring	240-165425812	2021/12/01
AMP 309	Non-metallic liners	240-166959159	2022/06/02

The National Nuclear Regulator conducted an inspection, KPD-23-16.0 on mechanical AMPs (120, 119, 121, 154, 157 & 135), electrical AMPs (210, 218 & 213, 220) and civil AMPs (306, 309) for compliance to the requirements of the Interim Regulatory Guide, RG-0027, Ageing Management and Long Term Operations of Nuclear Power Plants. The inspection was completed with no findings against the submitted programme manuals.

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

All required AMPs for mechanical, electrical, and civil SSCs have been completed (CR 112454-006 CA closed).

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM | **Date:** 06/09/2024

4.1 – FACTS:

F1) Outstanding AMPs, as listed in part 3.2, were developed and approved as a follow-up action on decision 08016.ROD.023. As evidence, AMP156 (331-610) and AMP119 (32-T-PE-006) were provided.

F2) The effectiveness of most of the newly developed programmes cannot be demonstrated yet as they have just entered the execution part of the process. However, the process for programme updates is established in the Programme Engineer's Guide (331-148). For Unit 2, some required data will be collected during the upcoming shutdown.

F3) The scope of components included in 32-T-PE-006 fully covers the components that are in the SALTO scope but not managed under any other AMP or plant programme. It was demonstrated that requirements for one-time inspections are developed in SAP (work orders).

Some inspections have already been performed, while all planned inspections will be completed within three fuel cycles (5 years from entering the LTO period).

F4) The plant developed a strategy for performing a one-time inspection through a commodity representative sample. 32-T-PE-006 describes the rules for choosing the representative components to be inspected and outlines follow-up actions in case any degradation is found.

F5) The alignment process of AMPs with the 9 attributes of an effective ageing management programme is in place and described in 331-148. A specific chapter on operational experience is included in the document.

F6) The Programme Health Report EA-23-136 has been developed in line with the 9 attributes.

F7) A position paper to address the SALTO mission finding on inspection of component external surface that are insulated and exposed to condensation was provided followed by action GA 43571 in DevonWay to track inspections within the LTO phase.

4.2 – DOCUMENTS REVIEWED:

- 32-T-PE-006, Rev. 01, One-Time Inspection Ageing Management Programme Manual, 2022-05-11
- 331-610, Rev. 02, Main Reactor Coolant System (RCP) Piping Ageing Management Programme, 2024-06-21
- 331-268, Rev. 03, Corrosion Under Lagging in the Containment Building, 2023-10-13
- 331-148, Rev. 05, Programme Engineering Guide, 2024-08-26
- EA-23-136, The Programme Health Report, 2024-01-15

4.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: D-1**
NPP: Koeberg	**Unit: 1 and 2**

Reviewed Area: Ageing management of electrical and I&C SSCs

1.1 – ISSUE TITLE:

Incomplete implementation of the cable ageing management programme

1.2 – FUNDAMENTAL OVERALL PROBLEM:

The plant has not completely implemented a comprehensive cable ageing management programme.

2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022

2.1 – FACTS:

F1) The verification of in-scope cables for LTO was not systematically assessed in terms of comparison with connection lines indicating intermediate components.

F2) Material's information of cables has been incorporated recently but has not been considered for prioritization for the cable ageing management programme (CAMP) related activities such as condition monitoring techniques, frequency of inspections, etc.

F3) Currently the Pericles database has all relevant information regarding cable and cable trays for supporting CAMP related activities. However, it is not user-friendly and database architecture is limited.

Example: Pericles can be used for identification of cables, cable routes (cable trays and rooms), however a full list of cable trays associated with a specific room in the plant cannot be readily and directly obtained. This can be done by searching on drawings of cable trays but most of them are available only in hard copy. This can impact the correct identification of hot spots.

The plant is in the process of migrating Pericles to an Access database through an in-house project. In the long term the plant is planning to migrate fully to a cable database.

F4) Interaction between Environmental Condition Monitoring Programme (ECMP) and COMSY is included in the draft version of ECMP as a flowchart. Specific instructions and a procedure with special consideration on how the identification of hot spots will affect the equipment in scope of LTO are not available.

F5) Document 331-417 is used as a guideline for visual inspection of cables. Material specific ARDM effects such as plasticizer migration or extrusion in PVC cables are not incorporated. Internal operating experience from visual inspections such as EA-18-329 has not been incorporated yet.

F6) There is still an open action in DevonWay database for training regarding enhancement of visual inspection of cables (128539-007GA).

F7) From plant walkdown:

- Several cable trays or cable supporting structures such as 'cable case' had no visible label from floor level.
- Cable manufacture information is difficult to identify from cables trays due to aggrupation and overlapping of cables.

On the cabling floor L341 close to battery rooms/electrical building HLX- LAA-LBA electrical buildings HLY LBF LBB LCB. Corridor W350, the following were observed:

- Some parts in cable corridors presents poor illumination.
- Cable trays overloaded in terms of space in the cable trays. In consequence some cable parts are not completely supported by a cable supporting structure.
- There is a big concentration of cables in very small area in the cable corridors especially when cables pass through a fire wall.
- It is not possible to identify a singular cable in the cable trays just by visual inspection. Nevertheless it is normally possible to identify the cable train through periodic colour marks along the cable layout.

Cables in room L511 relaying common:

- cable trays present overload in terms of space and some cables were partially not supported by metal supporting structure. Generally the addition of a new cable in current cable trays is a complicated task.

F8) The manuals for CAMP refer to a non-approved document (ECMP) as if it was already implemented.

2.2 – SAFETY CONSEQUENCE:

Without implementing a comprehensive ageing management programme, safety function of safety related cables cannot be demonstrated.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider completing the implementation of the cable ageing management programme.

2.4 – IAEA BASIS:

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5.38 Each ageing management programme should be consistent with the generic attributes of an effective ageing management programme listed in Table 2.

5.41 If the programme used to manage ageing effects involves inspection by sampling from a specific population of structures or components, the programme should describe and justify the methods used for selecting the samples to be inspected and the sample size, and should demonstrate that the sampling is adequate to provide reasonable assurance that ageing effects on the structure or component will not prevent the performance of its intended functions throughout its lifetime.

5.43 Ageing management programmes specific to ageing effects and degradation mechanisms or specific to structures and components should be developed. Existing plant programmes should be coordinated and maintained to cover the activities shown in para. 5.39. If necessary, a new programme that includes or supplements these activities should be developed. Such existing or newly developed programmes can be at different levels of detail (e.g. at a structure or component level, commodity group level or system level) depending on their complexity and importance to safety.

5.46 All programmes developed should comply with relevant national regulatory requirements, codes and standards and the ageing management policy of the plant (see para. 4.3) and should be consistent with the nine attributes of Table 2. If a programme is of such a nature that doesn't meet all of the nine attributes, its use should be properly justified and the justification should be documented.

4.42 Surveillance programmes using representative material samples (such as material specimens for surveillance of the reactor pressure vessel, cable samples and corrosion coupons) should be reviewed and extended or supplemented for ageing within the period of long term operation, if necessary.

4.43 The documentation on the relevant initial conditions of the material samples used for surveillance should be identified, the adequacy of the information should be assessed, and the documentation should be supplemented as necessary.

5.51 The ageing management programmes should be implemented in a timely manner to ensure that the intended functions of structures or components continue to be met.

5.9 Data collection and record keeping system should be in place as a necessary base for the support of ageing management. Examples of data that should be included in the data collection and record keeping system are described in Ref. [21].

2.5 – DOCUMENTS REVIEWED:

- 331-127, Rev 2, Cable Ageing Management Programme at Koeberg Operating Unit (2019)
- 240-98789629: Cable Ageing Management Manual for Instrumentation, Control and Measurement Cables and Cable Systems.
- 240-98789276: Cable Ageing Management Manual for Low Voltage Electrical Cables and Cable Systems.
- 331-417, Visual and tactile inspections for medium voltage, low voltage, and Instrument and Control Cables, Rev 2, (2020).

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE	**Date:** 22/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

In issue D-1, the review identified an incomplete implementation of the cable ageing management programme (CAMP). This issue was also raised during the previous Pre-SALTO mission that took place in 2019. A review of the issue and the associated facts were assessed including verification of the programme, the requirements, and the implementation status. The root cause for the incomplete or delayed implementation of the CAMP was due to resource constraints which resulted in the delayed time frame to implement the programme.

To fully address the issue, corrective actions were identified for the enhancements to the programme documentation, programme scope and the implementation of the programme requirements on SAP. These actions were documented in the record of decision (ROD) No. 08016.ROD.030, “IAEA SALTO (2022) New Scope”.

3.2 – CORRECTIVE ACTIONS:

The corrective actions that were raised to ensure complete implementation of the CAMP included:

- Verification of the SALTO in-scope cables and the update of the CAMP manuals with the relevant information required for the prioritization and grouping of cables within the scope of cable ageing management programme (CR 133538-017 CA, CR 133538-018 CA, and CR 133538-029 CA).
- Consideration of the internal operating experience based on previous inspections in order to provide better guidance for the visual inspection and testing of the in-scope cables (CR 133538-019 CA).
- Performing a detailed plant walkdown of the cable trays to identify anomalies and then raise maintenance actions to address these anomalies (CR 133538-020 CA).

- Implementing the CAMP requirements on the work management database, SAP, to ensure automatic download of the required periodic inspections and testing for the specific outages (GA 41506). The implementation of the CAMP requirements followed the plant's work management process, KAA-820.
- Purchase of cable ageing testing equipment, i.e. the VLF-TD machine and the Partial Discharge machine (PO 4503166287), and on-the-job training for maintenance personnel, CR 128539-007 GA.

Additionally, external resources were used to supplement internal resources, to ensure timely implementation of the CAMP.

The corrective actions were tracked via the plant's corrective action process as defined in KAA-688. The implementation of the programme requirements was monitored by the Programme Oversight Committee (POC).

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

All corrective actions identified above to complete the implementation of the CAMP have been adequately addressed, closed and the programme requirements are now implemented on the work management system, SAP.

This programme will be continuously monitored for effectiveness through the programme health reporting, and improvement will be performed based on inspection history and international operating experience.

The CAMP documentation was reviewed for implementation and management of the programme during the planned plant internal QA Audit A171 (Engineering Programmes Audit) in April 2024. A sample of inspections and testing of Medium Voltage (MV) cables was selected from the CAMP manual 331-311, revision 3, Cable Ageing Management Manual for Medium Voltage Cables and Cable Systems, and the review of the inspection results by the CAMP Programme Engineer was performed. No anomalies were reported during the internal QA audit.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) The standard 331-127 Cable Ageing Management Programme (CAMP) at the plant was established with specific implementation documents and descriptions including all the 9 attributes of an effective ageing management programme. This includes diagnostic techniques for medium voltage (MV) (331-311), low voltage (LV) and instrumentation and control (I&C) cables, with acceptance criteria defined for each test method in the referenced guides and documents:

- An approved document for the Environmental Condition Monitoring Programme (ECMP) 240-165386950 with CAMP specifics has been included. Demonstration of examples for adverse environment measurements in cable trays or specific cables for temperature, radiation, relative humidity was presented.
- The plant has procedures with defined basic testing equipment and acceptance criteria for specific LV cable/test set, I&C and MV cables.
- The plant has defined qualification requirements for the personnel responsible for CAMP implementation in the engineering department. The training was accomplished by a contractor and repeated for different departments. An

authorization training for different systems is conducted for maintenance via the SAT system. A CAMP training was provided to the maintenance personnel by the programme engineer as well as by the contractor.

- Programme health reporting (PHR, EA-23-136) implementation is done each year and an example for the last CAMP PHR was presented for the year 2023. This report contains all the trending data and results of the tests and analyses annually.

F2) Systematic manuals with scoping of different cable groups in the CAMP were demonstrated by the plant in different manuals grouped by voltage, functionality, materials of cables and manufacturer:

- 331-311 Rev.3, "CAMP Manual for MV Cables and cable systems" for MV cables: 274 cables were scoped in for visual inspection and testing using the criteria provided in the CAMP manuals. An example of testing conducted was presented along with the report EA-21-302, which trended and analysed the data. Approximately 90% of all the MV cables scoped in for testing have been completed. 10% of cables are those non-1E systems cables scoped in due to adverse environment (wet conditions, submergence) identified by the Environmental Condition Monitoring Programme. All safety related cables have been tested at least once.
- 240-98789276 for scoping LV cables in the CAMP: 2593 cables were scoped in for visual and tactile inspection. To date, more than 80% of these LV cables were inspected. This data was gained from the Cable Master List spreadsheet. In outage 225 (2022), 248 LV cables were inspected and only 2 findings were observed on cables of LBC (125 V dc Equipment Control Supplies) and LDA (30 V dc Analogue Control Supplies) systems. Testing is recommended for about 700 LV cables and the testing for the selected scope is planned for outages 127 and 227 in the year 2025 and 2026. The selection of scope for testing was finalized in 2023 and the testing requirements were loaded in SAP for execution. Outages 127 and 227 are the earliest opportunities for the execution of the selected sample scope. The tests which are planned to be executed include insulation resistance, TDR, and FDR-LIRA. Besides the results of the visual and tactile inspections, no example of testing data for LV cables was presented and thus no trending of testing data was performed or analysed at the time of this review.
- 240-98789629, Cable Ageing Management Manual for Instrumentation, Control and Measurement Cables and Cable Systems in the CAMP: 24 000 I&C cables were scoped in for LTO, in harsh environments, 1052 samples were selected for visual and tactile inspection. In outage 126 (2023) 180 I&C cables were inspected and only 1 finding was observed on a GCT (Turbine Bypass-Steam Dump System) system cable (WO 723995762). The selection of scope for testing was finalised in 2023 and the testing requirements were loaded in SAP for execution. The tests which are planned to be executed include insulation resistance, TDR, and FDR-LIRA. Implementation/execution of the CAMP requirements is in the Maintenance Execution Department. In-house resources have been allocated for the implementation of the programme requirements, supplemented by contractors. Besides the results of the visual and tactile inspections, no example of testing data for I&C cables was presented and thus no trending of testing data was performed or analysed at the time of this review.

F3) Specific procedure for Visual and Tactile Inspection for Medium Voltage and Instrument and Control Cables (331-417) with instruction for identification of adverse environment (hot spot) was implemented. It includes polymers properties, description, and specifics (i.e. plasticizer migration), labels in all parts of, mechanical impact, overfilled cable trays.

F4) The Pericles database was used as basic information for electrical cables data migration to an Excel spreadsheet Cable Master list with ~64000 cables. However, some new cables after modifications (~ 3000 cables) still need to be migrated. To identify material properties of cable polymers the Technical Specification must be used as well. Cables are pulled according to a pulling schedule by a contractor according to work order scope defining all required data connected in the purchasing package. In addition, multiple spreadsheets are in use for trending cable testing historical data and no central location exists to trend the data currently besides in the programme health report. A central location for all testing records is however established, the records are available, retrievable and traceability is ensured.

F5) Testing of cables are performed by contractors and in-house experts. Their qualification requirements are in CAMP manuals. The Training Manual (EA-23-176) for programme owner exists and the CAMP programme engineer was appointed via the letter EA-21-052. The maintenance manager sets their own training programme via the SAT (systematic approach to training) system with specific training as required for the CAMP. Training of personnel working on CAMP is completed by all involved in visual inspection, environmental monitoring, and diagnostic testing of cables implemented by an external organisation or internal resources (programme owner).

F6) Connections are included in CAMP activities, as described in different manuals of the cable groups. Connections are also included in KGM-005 IR Thermographic inspections. Ohmic Resistance tests are described in programmes and are implemented in the plant for in-scope cables of the CAMP. When diagnostic cable testing is performed, connections are also included in the specific cable test. Connections are also covered by visual inspection, all bolts are torqued, motors connections are in the preventive maintenance programme for motors and similarly for switchboards and switchgears. The ohmic resistance measurements for important to safety components and its cables as well as connections are performed periodically in outages as part of the preventive maintenance programme scope.

F7) Responsibilities between different AMP discipline owners – mechanical-electrical-civil are described in specific programmes.

4.2 – DOCUMENTS REVIEWED:

- 08016.ROD.030, “IAEA SALTO (2022) New Scope”, ROD.022 Review E&I&C AM Evaluation
- 331-127, Rev 3, Cable Ageing Management Programme at Koeberg Operating Unit (2023)
- 331-198, Rev.3, CAMP Roles and Responsibilities at NOU (2024)
- 331-311, Rev.3, CAMP Manual for MV Cables and cable systems (2024)
- 240-98789629, Cable Ageing Management Manual for Instrumentation, Control and Measurement Cables and Cable Systems
- 240-98789276: Cable Ageing Management Manual for Low Voltage Electrical Cables and Cable Systems
- 331-417, Visual and tactile inspections for medium voltage, low voltage, and Instrument and Control Cables, Rev 2, (2020).
- EA-21-302 Very Low Frequency (0,1 Hz) – Tan delta (VLF Tan d) test result on the 9 LGR001 TA6,6 kV electrical cables
- 240-156591753, Position paper detailing the assessment of the inspection and testing of the 132kV conductors, July 2023
- 240-165386950, Rev.1, Environmental Condition Monitoring Programme (ECMC) for Electrical Cables and Qualified Equipment, April 2022

4.3 – RESOLUTION DEGREE:		
1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: D-2**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of electrical and I&C SSCs	
1.1 – ISSUE TITLE: Incomplete revalidation of environmental qualification for LTO	
1.2 – FUNDAMENTAL OVERALL PROBLEM: The plant has not revalidated environmental qualification for some SSCs for LTO.	
2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022

2.1 – FACTS:

F1) The plant performed several local temperature measurements campaigns in addition to live data available in the 'InSQL' (database for online plant measurements retrievable from the beginning of operation) since 2012. Localized radiation measurements were not performed.

F2) The environmental condition monitoring programme is still in draft, and it is planned to be approved in the next two months. This programme will include localized measurement of temperature and radiation. Results are expected to be reported through Programme Health Reports.

F3) Combined temperature and radiation (T&R) measurement devices will be installed inside the containment during the outage in 2022 of Unit 2 in order to have at least one relevant reference data before the steam generator replacement. The same combined T&R measurements devices are to be installed in Unit 1 after the steam generator replacement. The plant assumes that local T&D data from the previous year of operation of unit 2 will be representative for both units since in the case of unit 1 there will be no data measured before the replacement.

F4) Mechanical equipment was excluded from the scope of environmental qualification based on justification provided in document report 240-109728634. It contains only general statements and there is no equipment specific and systematic assessment to compare original equipment design and operating experience with relevant standards for qualification of mechanical equipment (such as ASME QME-1).

F5) The report 331-170 (requirements for protective coatings for use at the plant) does not mention nor refer to other documents with DBA requirements (accident profile, total integrated dose, etc.) or specific standards for qualification of LOCA proof coating.

F6) There was no assessment to confirm that the applied coatings required to be LOCA proof meet the plant requirements. The plant has performed visual inspection and the coatings are in good condition, but no further analysis for the validity of original qualification was planned.

F7) The KAA-771 (Outage Scope Control Process, rev 9 (2021)) contains the form KFX-001 "Outage scope control removal form", rev 14, (issued in 2020) that mentions the control of "Environmental qualification section" instead of "Equipment qualification programme" (that includes seismic).

2.2 – SAFETY CONSEQUENCE:

Without a complete revalidation of environmental qualification of the relevant components, their ability to perform safety functions cannot be demonstrated for LTO.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider completing the revalidation of environmental qualification for all the SSCs in the scope of the environmental qualification programme.

2.4 – IAEA BASIS:

SSR-2/2 (Rev. 1)

Requirement 13. The operating organization shall ensure that a systematic assessment is carried out to provide reliable confirmation that safety related items are capable of the required performance for all operational states and for accident conditions.

4.48. Appropriate concepts and the scope and process of equipment qualification shall be established, and effective and practicable methods shall be used to upgrade and preserve equipment qualification. A programme to establish, to confirm and to maintain required equipment qualification shall be launched from the initial phases of design, supply and installation of the equipment. The effectiveness of equipment qualification programmes shall be periodically reviewed.

4.49. The scope and details of the equipment qualification process, in terms of the required inspection area(s), method(s) of non-destructive testing, possible defects inspected for and required effectiveness of inspection, shall be documented and submitted to the regulatory body for review and approval. Relevant national and international experience shall be taken into account in accordance with national regulations.

SSG-48

4.23 An equipment qualification programme to achieve and maintain the qualified status of in-scope SSCs should be in place in order to meet Requirement 30 of SSR-2/1 (Rev. 1) and Requirement 13 of SSR-2/2 (Rev. 1).

4.25 Environmental 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.

7.17 Time limited ageing analyses should be re-evaluated for the planned period of long term operation and it should be demonstrated that they meet the criteria of para. 5.67.

SSG-69

2.14. Qualified life is the period for which a structure, system or component has been demonstrated, through testing, analysis or experience, to be capable of functioning within acceptance criteria during specific operating conditions while retaining the ability to perform its safety functions in accident conditions for a design basis accident or a design basis earthquake.

2.15. A qualified life should be established for all equipment that is subject to significant performance degradation mechanisms that could occur under the range of specified service conditions for operational states.

3.23. 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 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.

3.24. 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.

3.25. Service conditions resulting from postulated initiating events such as an SL-2 earthquake or aircraft crash should be considered in the equipment qualification programme.

3.26. Equipment qualification should take into account the mission time for the equipment in applicable accident conditions.

5.26. As qualified equipment approaches the end of its qualified life, additional periodic monitoring of its condition should be implemented to determine whether actual ageing is occurring at a slower rate than expected, which would indicate that it may be possible to extend the qualified life of the equipment.

5.27. The combination of monitoring environmental conditions and monitoring the condition of equipment should be used to support the reassessment of the qualified life of equipment.

2.5 – DOCUMENTS REVIEWED:

- L1124-GN-RPT-018, Rev 4, Time Limited Ageing Analysis Based on Initial Qualification, (2020)
- 331-219 Equipment Qualification Maintenance Manual for Equipment Located in Harsh Environments, Rev 3, (2021).
- D02-ARV-01-189-248 Requalification Program for Qualified Cables Installed Inside the Containment and other Installation Positions Pertaining to the Harsh Environment at Koeberg Nuclear Power Station, Rev B, (2022)
- KAA-771, Outage Scope Control Process, Rev 9 (2021)

- KFX-001 "Outage scope control removal form" (rev 14, issued in 2020)
- 240-105643933, Specification for Reactor Coolant Pump Speed Measurement, Rev 0, (2016)
- 240-90276632, Instrument Specification for Safety Class 1E Absolute, Differential and Relative Pressure Transmitters, Rev 1, (2015)
- 331-170, Requirements for Protective Coatings for use at Koeberg Nuclear Power Station, (2019)

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE	**Date:** 22/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

During the SALTO review the IAEA suggested that the plant should consider completing the revalidation of environmental qualification for all the SSCs in the scope of the environmental qualification programme. An assessment of the issue raised by IAEA team was performed, together with the associated facts. The required actions to fully address the issue were documented in the record of decision (ROD) No. 08016.ROD.018, 'Equipment Qualification Time Limited Ageing Analysis Strategy', and ROD No. 08016.ROD.030, "IAEA SALTO (2022) New Scope" and presented to the plant's oversight committee, SALTO Management Oversight Committee (SMOC).

3.2 – CORRECTIVE ACTIONS:

The corrective actions were tracked via the plant's corrective action process as defined in KAA-688. The actions were tracked under the condition reports CR 133538 and CR 117512 which included:

- Re-analysis of the Unit 1 and Unit 2 qualified equipment before the start of the LTO period (2024).

TLAA re-analysis was performed for these components and the results were documented in the following reports:

- D02-ARV-01-182-258 Rev. B, "Time Limited Ageing Analysis (TLAA) for Qualified Equipment - Containment Sweeping Ventilation System (EBA) AMRI Containment Isolation Valves",
- D02-ARV-01-181-612 Rev. C, "TLAA Re-Analysis of Components Important to Safety – Incore Thermocouples of the RIC System",
- D02-ARV-01-181-583 Rev. B, "Time Limited Ageing Analysis (TLAA), Re-Analysis of Qualified Equipment - Jeumont-Schneider Residual Heat Removal (RRA) Medium Voltage Motors",
- D02-ARV-01-181-189 Rev. B, "Time Limited Ageing Analysis (TLAA) for Qualified Equipment – Rotork Valve Actuators", [8], and
- D02-ARV-01-176-728 Rev. B, "Time Limited Ageing Analysis (TLAA) - Re-Analysis of Environmentally Qualified Equipment - Valcor Solenoid Valves".

Additionally, the following qualified equipment for both Unit 1 and Unit 2 have been subjected to a re-assessment and the results were documented in the following reports:

- Electrical Cables (including Cable connections associated with in-scope EQ Cables) 331-665, Re-assessment of the cable TLAA Revalidation Limitations.

- Electrical Penetrations (EPP 513, 515, 520, 521, 529, and 530 TW) 331-688 Rev. 1 Re-assessment of the Electrical Penetration Assemblies EQ TLAA Revalidation Limitations.

- Pressurizer Heaters (RCP 005 and 006 RS) 331-687 Rev. 1 Report - Qualification Revalidation of Pressuriser Fixed Heaters RCP 005 RS and RCP 006 RS.

- Environmental Condition Monitoring Programme, 240-165386950.

The Environmental Condition Monitoring Programme (ECMP) has been developed and implemented. Actions have been instituted to monitor and trend the environmental conditions that prevail on locations where EQ items are located.

Temperature and radiation data from the InSQL database is continuously being trended and assessed to determine the impact on the condition of qualified equipment and to identify any follow up actions.

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

Revalidation and re-analysis of all the EQ TLAAs have been completed for all the qualified equipment in the scope of the EQ programme and the ECMP has been compiled and implemented.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) The plant has an EQ programme implemented for all qualified equipment, defined EQ zones with all known parameters, and adverse environment location parameters. The parameters used for qualification for temperature, radiation, humidity, chemicals, mechanical damage. The parameters are obtained from implementation of the ECMP (240-165353024) and the EQ Programme (331-219). The documents developed include:

- EQ Master Equipment List (EQMEL) (240-155832775);
- EQ Supporting Equipment List (EQSEL) for mild environment (240-130611911)
- Environmental Qualification Zones (EQ Zones) (ECMP and in EQML);
- Environmental Qualification Assessment Reports (EQAR) (EQ Template 331-146);
- EQ workmanship standards (EQWS) and procedures: 331-186, 331-187, various implementation procedures;
- Environmental Qualification System Walk Down Reports (EQWD) are captured by Systems Engineers in IQReview system and life of plant plans (LOPP). Example: KBA0022NNEPPOLOPP044.

F2) The plant demonstrated the results for local temperatures and radiation measurements on critical points with exposed cables for at least two cycles. The temperature, gamma and neutron monitoring has been carried out with data loggers consisting of 30 temperature labels, 20 HOBOs (temperature loggers), 40 Alanine dosimeter points (for radiation) for both units.

F3) Results were reported and demonstrated also in the Programme Health Report for ECMP (EA-23-136) and EQ Programme.

F4) The plant has demonstrated measured values of gamma and neutron radiation and highest temperatures on exposed cables/connections for both units. Highest average measured values of temperatures at higher levels of the containment were below 43°C, while gamma dose rates were under 10 mSv/h including neutron dose during containment entries at power. The values were found lower than the analysis assumed for the 60-year qualified life.

F5) Mechanical equipment was evaluated as part of the EQ scope documented in a separate reference document (240-109728634 Equipment Qualification for Mechanical Equipment). It contains a systematic assessment to compare the original equipment design and operating experience with relevant standards for qualification of mechanical equipment (such as ASME QME-1).

F6) The report "requirements for protective coatings for use in the plant" (331-170) was corrected and updated in 2023 with DBA requirements (T, TID, LOCA qualification).

F7) Visual inspection of the coatings was completed and further analysis for the validity of original qualification was documented after the SALTO mission in 2022. Assessment and confirmation if the applied coatings required to be LOCA proof to meet the plant requirements are included in the document EA 23-036.

F8) The plant provided an updated/corrected version of the form KFX-001 "Outage scope control removal form", that mentions the control of "Environmental qualification section" instead of "Equipment qualification programme" (that includes seismic) in the KAA-771 Outage Scope Control Process.

F9) The plant demonstrated completion of corrective actions in paragraph 3.2 with providing assurance and documentation of completed re-analysis of the Unit 1 and Unit 2 qualified equipment before the start of the LTO period (2024) including:

- TLAA analysis completed for Qualified Equipment: Containment Sweeping Ventilation System (EBA) AMRI Containment Isolation Valves (D02-ARV-01-182-258);
- Incore Thermocouples of the RIC System (D02-ARV-01-181-612);
- Jeumont-Schneider Residual Heat Removal (RRA) Medium Voltage Motors (D02-ARV-01-181-583);
- Rotork Valve Actuators (D02-ARV-01-181-189) and Valcor Solenoid Valves (D02-ARV-01-176-728);
- Additionally, the following qualified equipment for both Unit 1 and Unit 2 have been subjected to a re-assessment and results are documented in the following reports:
  - Electrical Cables and connections associated with in-scope EQ Cables (331-665),
  - Electrical Penetrations (331-688),
  - Pressurizer Heaters (331-687) and
  - Environmental Condition Monitoring Programme (240-165386950)
- Actions were taken to replace qualified equipment with a qualified life less than 60 years as tracked in report 08016 ROD.018 Equipment Qualification TLAA Strategy and with SAP orders. All replacements on Unit 1 have been completed. Some equipment has been reassessed and justified for longer qualified life (i.e. RRA005 and RRA007MT(EA-123-128)). Most replacements on Unit 2 have been completed with few items scheduled to be replaced in the current outage 226 (2024).

- Although the electrical penetrations are qualified for 60 years, they will be replaced in outage 227 (2026) due to operating experience (potential in service failures) regarding terminal blocks that will be replaced with splices.
- Pressurizer heaters have been reassessed for a qualified life of 60 years, however they will be replaced due to potential stress corrosion cracking, as experienced internationally.

F10) The plant's specific procedure for managing EQ as part of design modifications is the document Design Modification with checklist to each Design Modification packages (331-86).

4.2 – DOCUMENTS REVIEWED:

- 08016.ROD.018 EQ TLLA Strategy (2020),
- 08016.ROD.030 IAEA SALTO 2022 New Scope, (2022)
- 240-165353024 ECMP
- 240-109728634 Equipment Qualification for Mechanical Equipment, rev.4, 2024
- 331-219 EQ program manual
- EA-23-136- Program Health Report for EMCP
- 331-186 EQ equipment qualification
- 331-187 EQ process and responsibilities
- 331-219 Equipment Qualification Maintenance Manual for Equipment Located in Harsh Environments
- 331-170 Requirements for protective coatings, Rev.2, 2023
- EA 23-036 Response to CR 133538-011 CA Evaluate and update the qualification of protective coating (2023)
- KAA-771 Outage Scope Control Process, Form KFX-001 "Outage scope control removal form", Rev.15, 2024
- EA-123-128 Evaluation of Residual Heat Removal (RRA) System temperature sensors RRA 005MT and RRA007MT, October 2023
- 331-86 Design Changes to plant, plant structures or operating parameters

4.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: D-3**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of electrical and I&C SSCs	

1.1 – ISSUE TITLE:

Incomplete assessment of electromagnetic compatibility

1.2 – FUNDAMENTAL OVERALL PROBLEM:

Electromagnetic compatibility has not been completely assessed.

2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022

2.1 – FACTS:

F1) Currently there is not enough data to establish electromagnetic compatibility (EMC) requirements for the equipment in scope of the Equipment Qualification Programme (EQP). The plant has not defined a specific standard to apply EMC requirements such as IEC 62003.

F2) In the DevonWay database there was a corrective action (CA35071) opened and closed in 2015 to include the electromagnetic interference (EMI) in the equivalency check sheet (used for replacement of equipment). The field was included in the check list without further information regarding standards or requirements to be considered.

F3) The plant raised an action in DevonWay (RC17486) to perform electromagnetic field mapping in order to address EMC. This action does not define any reference standard, framework for acceptance criteria or limits for the results. The mapping was not performed. The action was closed in 2015 and there was no definition for any standard or requirement framework to be used in future.

F4) In 2016 the plant raised a general action (DevonWay CR96957-002 GA) to perform an impact assessment on potential generators/transmitters of EMI which could affect the plant instruments. The action was still not completed.

F5) The plant has established a list of important locations in order to monitor different relevant parameters for EMI in the draft version of the environmental condition monitoring programme. There is no explicit standards and codes framework for the evaluation of the results.

F6) The design specifications (240-105643933) for speed sensors and (240-90276632) for transmitters, which also include the connectors, do not have reference to specific qualification standards apart from IEEE 323-74. There is no EMC specific requirement.

F7) The document 331-186 defines equipment qualification as the sum of environmental qualification and seismic qualification, without any consideration of EMC.

2.2 – SAFETY CONSEQUENCE:

Without a complete assessment of electromagnetic compatibility, the safety function of electrical components with regard to EMC cannot be demonstrated.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider completing an assessment of electromagnetic compatibility.

2.4 – IAEA BASIS:

SSR-2/2 (Rev. 1)

Requirement 13. The operating organization shall ensure that a systematic assessment is carried out to provide reliable confirmation that safety related items are capable of the required performance for all operational states and for accident conditions.

4.48. Appropriate concepts and the scope and process of equipment qualification shall be established, and effective and practicable methods shall be used to upgrade and preserve equipment qualification. A programme to establish, to confirm and to maintain required equipment qualification shall be launched from the initial phases of design, supply and installation of the equipment. The effectiveness of equipment qualification programmes shall be periodically reviewed.

4.49. The scope and details of the equipment qualification process, in terms of the required inspection area(s), method(s) of non-destructive testing, possible defects inspected for and required effectiveness of inspection, shall be documented and submitted to the regulatory body for review and approval. Relevant national and international experience shall be taken into account in accordance with national regulations.

SSG-69

2.5. As indicated in para. 2.1, equipment qualification is required to demonstrate that the equipment will be capable of performing its intended safety functions under the range of service conditions specified for the nuclear installation in operational states and accident conditions. This includes an evaluation of the ability of systems or components to perform these safety functions under the effects caused by specified service conditions during plant states and during external events not excluded by the design of the nuclear installation (e.g. seismic events, electromagnetic phenomena such as arcing, lightning). In contrast, internal fires, explosions, internal flooding, tornadoes and hurricanes are not normally considered in equipment qualification because the design generally protects the equipment from the effects of these events.

2.30. Test specifications, test reports and analysis reports should 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).

3.8. The set of specified service conditions should include operating conditions and environmental conditions associated with all plant states. The operating conditions are generally defined by the service conditions of the systems (e.g. vibration, electromagnetic interference caused by voltage surge), operating conditions (e.g. voltage, current, temperature, pressure, radiation levels), fluid conditions (e.g. differential pressure, temperature, flow, 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, also referred to as a ‘zone’, of the nuclear installation where the equipment is installed. The localized environmental conditions within these areas, (e.g. temperature and radiation levels) should be considered, where appropriate. Other stressors (e.g. wear, operational cycles, temperature cycles) causing ageing degradation should also be considered.

3.13. Relevant operating conditions for operational states typically include the following:

- Power surges;
- Operating cycles (e.g. electrical, mechanical, water hammer);
- Electrical loading parameters (e.g. voltage, frequency, current);
- Mechanical loads (e.g. thrust; torque; displacement; non-seismic vibration including flow induced vibration, condensing mode vibration and quenching vibration);

- Process fluid conditions (e.g. pressure, temperature, chemical composition, flow rate, water hammer);
- Chemical composition;
- Loads and duty cycles;
- Self-heating;
- Submergence;
- Electromagnetic interference.

3.16. Electromagnetic interference, including radiofrequency interference, can be caused by electrical equipment, electrical surges (e.g. voltage spikes resulting from switching transients or lightning) and electrostatic discharges.

3.17. 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.

3.18. Detailed equipment qualification specifications and acceptance criteria for electromagnetic interference should be determined in accordance with international industry standards or, alternatively, on the basis of individual system requirements. A list of international standards relating to equipment qualification is provided in the Annex.

3.19. A site survey 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.

3.20. Electromagnetic fields within a specified location within a nuclear installation may change with time as a result of the operation of equipment or replacement of equipment in the area (zone). Therefore, when changes to electrical inputs or electrical equipment occur within an area (zone), additional site survey measurements of electromagnetic fields should be performed to identify and quantify sources of electromagnetic interference in order to ensure that the status of qualified equipment will be preserved.

2.5 – DOCUMENTS REVIEWED:

- DevonWay data base.
- 331-186, Rev 2, Equipment Qualification Programme, (2020).
- 331-219 Equipment Qualification Maintenance Manual for Equipment Located in Harsh Environments, Rev 3, (2021).
- 240-105643933, Specification for Reactor Coolant Pump Speed Measurement, Rev 0, (2016).
- 240-90276632, Instrument Specification for Safety Class 1E Absolute, Differential and Relative Pressure Transmitters, Rev 1, (2015).

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE	**Date:** 22/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

Issue D-3 states that an incomplete assessment of Electromagnetic Compatibility was performed by the plant at the time of the 2022 SALTO mission review. The reason for the issue being highlighted is due to the fact that the SALTO team was unaware of a previous electromagnetic interference (EMI) site survey and Electromagnetic Compatibility (EMC) analysis that was performed during the implementation of the Ovation/KIT Project at the plant

in 2008. The new electrical AMPs (AMP 210, AMP 213 & 218, AMP 220, and AMP 212 & 215) including 240-165386950 "Environmental Condition Monitoring Programme", were also at the time, still in the process of development in accordance with 331-148 (Programme Engineer's Guide), and as per 331-618 (Safety Case for LTO of KNPS) commitments.

3.2 – CORRECTIVE ACTIONS:

Corrective actions were raised in accordance with the plant's corrective action process, KAA-688 "The Corrective Action Process" and ratified at the SALTO Management Oversight Committee (SMOC), SMOC TOR 240-145571138, with the review and acceptance of Record of Decisions 08016.ROD.030 and 08016.ROD.010.

The following corrective actions were raised to address the facts and the overall concern of issue D-3:

- GA 43122 - Update Equivalency Check Sheet 331-412 to include reference to the EMC standard IEC 62003 (Nuclear power plants – Instrumentation, control, and electrical power systems – Requirements for electromagnetic compatibility testing).
- CR 133538-014 CA (OD_19.32) was raised for the plant to perform a site survey of electromagnetic interference and to define the requirements for EMC.
- CR 133538-015 CA (OD_19.33) – Assess the qualification of qualified equipment against the EMC requirements.
- CR 133538-016 CA (OD_19.34) – Update the relevant EQ documents to include reference to EMC / EMI specific standards such as IEC 62003.
- CR 121535-013 CA (OD_19.12) was raised to highlight that the plant needed to implement an environmental condition monitoring programme to monitor and trend the service conditions at locations where qualified equipment and cables were installed. The programme is also required to be implemented to monitor and trend the environmental parameters of adverse localised environments, which could possibly accelerate the ageing of electrical and I&C equipment and cables.

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

The Equivalency Check Sheet, 331-412 was updated to include reference to the EMC standard IEC 62003 and GA 43122 closed.

The documented review and a plant position on the EMI site survey is documented in memo EA-23-089 (CR 133538-014 CA) - Assessment of Electromagnetic Compatibility (EMC) for Sensitive Equipment. In addition, EA-23-089 addresses the recommended practices to limit EMI control equipment emissions from new and existing EMI / RFI sources which are stipulated in the Electric Power Research Institute (EPRI) Guidelines for Electromagnetic Interference Testing in Power Plants report TR-102323-R1.

In order to assess and address CR 133538-015 CA, EA-23-129 was compiled and contains the assessment results and presents additional measures to limit EMI sources that could have a potential impact on the qualified equipment. The qualified components were assessed based on the plant's previously measured EMI levels and the measures that are implemented at the plant to limit EMI sources that could have a potential impact on the qualification of the in-scope equipment. The assessment considered the initial qualification of the components, the design of the components to identify any digital subcomponents which may be vulnerable to EMI, available EMC / EMI standards and practices, and the measures recommended in the EPRI report TR-102323 to minimise the EMI source.

The EQ documents 331-186, 331-187, and 331-219 were updated to include reference to Electromagnetic compatibility (EMC) standard IEC 62003 and CR 133538-016 CA closed.

The programme manual, 240-165386950 "Environmental Condition Monitoring Programme" has been implemented to monitor and trend the environmental parameters of adverse localised environments, which could possibly accelerate the ageing of electrical and I&C equipment and cables or affect their ability to function, and CR 133538-015 CA closed.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) The plant provided the following documents:

- Two Records of Decision: 08016.ROD.030 and 08016.ROD.010;
- an Equivalency Check Sheet (331-412);
- Assessment of Electromagnetic Compatibility (EMC) for Sensitive Equipment (EA-23-089, CR 133538-014 CA).
- Assessment of the equipment qualification of qualified equipment based on the survey measurements of electromagnetic fields (EA-23-129);
- EQ documents: 331-186 and 331-187 that were updated with an EMC reference standard.

F2) EMC requirements were established, and implementation commenced by considering recommendations from standards IEC 62003 and EPRI TR-102323 (Guidelines for Electromagnetic Interference Testing in Power Plants), as documented and assessed in EA 23-089.

F3) The field test results for electromagnetic interference (EMI) were conducted during a digital modification in 2009 (KIT Ovation Mod). During these tests, the plant areas sensitive to EMI, where digital equipment may be installed in future, were surveyed. The results are available in Gerotek Test reports 7836 and 9249.

F4) No malfunctions of any equipment at the plant were attributed to EMI or EMC concerns. No anomalies during lightning storms have been detected at the plant since suitable lightning protection systems are installed and maintained in line with IGALL AMP220.

F5) During all plant change processes, such as modifications and equivalencies, the review of EMC is triggered by the check sheet referencing the applicable EMC standard. This ensures that any future digital equipment installed at the plant is verified for EMC.

F6) The EMI impact assessment on potential generators/transmitters was performed (EA 23-089 and EA 23-129).

F7) The design control documents, such as the design template and equivalency check sheet (240-143890908) were updated with specific standards and requirements for EMC testing (e.g. IEC 62003, Nuclear power plants – Instrumentation, control, and electrical power systems – Requirements for electromagnetic compatibility testing).

4.2 – DOCUMENTS REVIEWED:

- Record of Decision 08016.ROD.030
- Record of Decision 08016.ROD.010

– Memo EA-23-089 (CR 133538-014 CA) Assessment of EMC for sensitive equipment, 2023 – Memo EA-23-129 Assess the Equipment qualification of qualified equipment based on the survey measurements of electromagnetic fields, 2023 – 331-186, Rev.4, EQ program, 2023 – 331-187, Rev.4, Equipment Qualification Roles and responsibility, 2023 – 331-412, Equivalency Check List – 240-143890908, Design Check List Template
4.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: D-4**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of electrical and I&C SSCs	
1.1 – ISSUE TITLE: Incomplete revalidation of environmental qualification of qualified cables	
1.2 – FUNDAMENTAL OVERALL PROBLEM: The plant has not revalidated the environmental qualification of qualified cables for LTO.	
2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022
2.1 – FACTS: F1) One of the results of the equipment qualification TLAA issued in 2020 (L1124-GN-RPT-018) is that for qualified cables in harsh environments, the qualification is valid until the end of current operational license term. The plant received from its contractor guidelines and recommendations for the requalification of qualified cables. The development of the plan for the requalification of cables is still in progress. F2) D02-ARV-01-189-248 contains a proposal for requalification of cables in line with AMP210 of condition monitoring of qualified cables for LTO. However, a specific cable qualification standard is not referred, and consideration of fire-retardant behaviour is not addressed in this document. F3) The proposed sample removal testing plan aligns with international practice; however, a detailed assessment of the represented samples has not considered: material specific parameters (e.g. material formulation, validity of Activation Energy, etc.), installed environment, work condition such as temperature (environmental temperature and self-heating effects), exposure dose rate, etc.	

F4) An assessment on the amount and length of samples required to satisfy the requalification process requirements as well as future condition-based qualification testing have not been performed.

2.2 – SAFETY CONSEQUENCE:

Without a complete revalidation of environmental qualification of cables, the ability to perform their safety functions cannot be demonstrated.

2.3 – RECOMMENDATION/SUGGESTION:

R) The plant should complete the revalidation of environmental qualification for qualified cables.

2.4 – IAEA BASIS:

SSR-2/2 (Rev. 1)

Requirement 13. The operating organization shall ensure that a systematic assessment is carried out to provide reliable confirmation that safety related items are capable of the required performance for all operational states and for accident conditions.

4.48. Appropriate concepts and the scope and process of equipment qualification shall be established, and effective and practicable methods shall be used to upgrade and preserve equipment qualification. A programme to establish, to confirm and to maintain required equipment qualification shall be launched from the initial phases of design, supply and installation of the equipment. The effectiveness of equipment qualification programmes shall be periodically reviewed.

4.49. The scope and details of the equipment qualification process, in terms of the required inspection area(s), method(s) of non-destructive testing, possible defects inspected for and required effectiveness of inspection, shall be documented and submitted to the regulatory body for review and approval. Relevant national and international experience shall be taken into account in accordance with national regulations.

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4.23 An equipment qualification programme to achieve and maintain the qualified status of in-scope SSCs should be in place in order to meet Requirement 30 of SSR-2/1 (Rev. 1) and Requirement 13 of SSR-2/2 (Rev. 1).

4.25 Environmental 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.

7.17 Time limited ageing analyses should be re-evaluated for the planned period of long term operation and it should be demonstrated that they meet the criteria of para. 5.67.

SSG-69

2.14. Qualified life is the period for which a structure, system or component has been demonstrated, through testing, analysis or experience, to be capable of functioning within acceptance criteria during specific operating conditions while retaining the ability to perform its safety functions in accident conditions for a design basis accident or a design basis earthquake.

2.15. A qualified life should be established for all equipment that is subject to significant performance degradation mechanisms that could occur under the range of specified service conditions for operational states.

3.23. 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 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.

3.24. 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.

3.25. Service conditions resulting from postulated initiating events such as an SL-2 earthquake or aircraft crash should be considered in the equipment qualification programme.

3.26. Equipment qualification should take into account the mission time for the equipment in applicable accident conditions.

5.26. As qualified equipment approaches the end of its qualified life, additional periodic monitoring of its condition should be implemented to determine whether actual ageing is occurring at a slower rate than expected, which would indicate that it may be possible to extend the qualified life of the equipment.

5.27. The combination of monitoring environmental conditions and monitoring the condition of equipment should be used to support the reassessment of the qualified life of equipment.

2.5 – DOCUMENTS REVIEWED:

- L1124-GN-RPT-018, Rev 4, Time Limited Ageing Analysis Based on Initial Qualification, (2020)
- 331-219 Equipment Qualification Maintenance Manual for Equipment Located in Harsh Environments, Rev 3, (2021).
- D02-ARV-01-189-248 Requalification Program for Qualified Cables Installed Inside the Containment and other Installation Positions Pertaining to the Harsh Environment at Koeberg Nuclear Power Station, Rev B, (2022)
- KAA-771, Outage Scope Control Process, Rev 9 (2021)
- KFX-001 “Outage scope control removal form” (rev 14, issued in 2020)
- 240-105643933, Specification for Reactor Coolant Pump Speed Measurement, Rev 0, (2016)
- 240-90276632, Instrument Specification for Safety Class 1E Absolute, Differential and Relative Pressure Transmitters, Rev 1, (2015)
- 331-170, Requirements for Protective Coatings for use at Koeberg Nuclear Power Station, (2019)

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE	**Date:** 22/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

Issue D-4 states that an incomplete environmental qualification of in-containment cables was performed by the plant at the time the review was performed. The reason for the issue being highlighted is due to the timing of the review since the plant had already identified the issue during a prior self-assessment and was in the process of addressing it.

3.2 – CORRECTIVE ACTIONS:

The report, 331-665 "Re-assessment of the Qualified Cables TLAA Revalidation Limitations" was compiled and sent to the NNR for review and acceptance. This justifies the use of cables for LTO.

In addition, cable testing will also still be performed for enhanced knowledge, understanding and future use. Corrective actions were raised in accordance with the plant's corrective action process, KAA-688 "The Corrective Action Process" and ratified at the SALTO Management Oversight Committee (SMOC), SMOC TOR 240-145571138, with the review and acceptance of Record of Decision 08016.ROD.031 and the compilation of EA 23-057 - "Strategy for the Requalification of Qualified Cables in Harsh Environments for Long Term Operation."

The following corrective actions were raised to address the facts and the overall concern of issue D-4:

- CR 133539-001 CA - OD_19.35 - Prepare work packages to remove identified LV cable samples from the plant locations for type testing in order to deterministically validate the qualified life of the entire population for LTO.
- CR 133539-002 CA - OD_19.36 - Prepare work packages to remove the identified I&C cable samples from the plant locations for type testing to deterministically validate the qualified life of the entire population for LTO.
- CR 133539-003 CA - OD_19.37 - Procure cables as per the Material Request for the line group to replace the entire cable length where the samples are taken.
- CR 133539-004 CA - OD_19.38 - Cut and remove the identified LV cable samples from the plant locations for type testing in order to deterministically validate the qualified life of the entire population for LTO.
- CR 133539-005 CA - OD_19.39 - Cut and remove the identified I&C cable samples from the plant locations for type testing in order to deterministically validate the qualified life of the entire population for LTO.
- CR 133539-006 CA - OD_19.40 - Ensure the proper packaging of the sample cables for shipping to the laboratory.
- CR 133539-007 CA - OD_19.41 - Initiate a Contract to submit the cable specimens removed from the plant for type testing and condition-based qualification.
- CR 133539-008 CA - OD_19.42 - Review and accept the EQ TLAA report and validate the requalification testing results for LTO.
- CR 133539-009 CA - OD_19.38A - Cut and remove the identified LV cable samples from the plant locations for type testing to deterministically validate the qualified life of the entire population or LTO.

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

Justification for LTO of qualified cables was documented in 331-665 using additional information not available at the time of 2022 SALTO review, submitted to and accepted by the NNR.

All the corrective actions listed above have been completed besides the review and acceptance of the type testing and condition-based qualification results (CR 133539-008 CA - OD_19.42). The specimens have been shipped to the laboratory for testing as part of the deterministic qualification as prescribed by the implemented Cable Ageing Management (CAMP) and the Equipment Qualification (EQ) Programmes.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) The plant provided the justification documents for LTO of qualified in-containment cables (331-665) and explained how the limitations noted during the SALTO mission were resolved. The resolution of the limitations of report TLAA L1124-GN-RPT-018 (2020) regarding qualified cables was discussed and demonstrated by reviewing section 6 of 331-665. Thus, there are no cables with expired qualified life (QL) installed in containment as all qualified cables have been re-analysed and demonstrated for LTO.

F2) No qualified cables located inside the containment have expired qualified lives and thus no replacements for these are planned or expected because of expired qualified life. Spares are however available (purchased following a sample removal), and should any anomalies be found due to hotspots or other failures, they can be replaced as required. Expiry of QL for cables within the LTO period is not expected based on the analysis performed in L1124-GN-RPT-018 and 331-665. As part of the ongoing qualification, the plant has removed naturally aged samples from the plant, which are representative of the population, to be type tested using guidance in D02-ARV-01-189-248.

F3) The plant demonstrated that the requirements of EQ cables selected for requalification testing are in line with the guidance provided in D02-ARV-01-189-248 and the plant is utilizing partial type testing and condition-based qualification techniques. The requirement to reperform fire retardant behaviour of qualified cables was considered by the plant along with industry experts involved in re-qualification and found not to be required for a re-qualification campaign of this nature (due to the fire mitigating aspects not being subject to ageing). The original cable qualification included the fire-retardant behaviour in line with NF C32-070.

F4) Cable material samples from harsh environments were taken from the containment with specific parameters (e.g. material formulation, validity of Activation Energy), installed environment, operating conditions such as temperature (environmental temperature and self-heating effects), exposure dose rate which were required for the requalification for samples removed from plant. The plant described the process for selecting the replacement cables for samples taken for requalification. The new cables, used to replace those removed for samples, were supplied using the existing plant procurement processes and the specification KBA0915K09016. This is the original specification for qualified cables. Procurement quality engineering ensured that a suitable qualified cable supplier was identified and that the newly supplied cables met the original specification and qualification procedure. The plant previously purchased qualified cables from this supplier for the RRA motor cable replacement.

F5) MV RRA motor cable samples have been removed (MV, LV I&C) and shipped to laboratories for type testing and preliminary results are available. The results confirmed that the original qualified RRA cables are suitable for use beyond the original life.

F6) The action plan for cable requalification using testing is documented in 08016.ROD.031 and EA 23-057 - "Strategy for the Requalification of Qualified Cables in Harsh Environments for Long Term Operation." The work orders were assigned, resources allocated, and contracts placed for the removal of the samples and reinstallation of the new cables. A task order was also raised for the cable testing with the original equipment manufacturer (OEM). No qualified cables are planned to be replaced during the LTO period and no qualified cables were replaced at the plant due to the expiry of qualified life, similarly to other nuclear power plants around the world using EPR insulation.

F7) Currently, elongation at break (EAB) values are proposed to be used as a condition indicator of qualified cables in laboratory testing since this parameter was also measured throughout the original qualification campaign, as well as dielectric withstand testing and insulation resistance. The methods described in the cable ageing management programme are applicable for the monitoring of qualified cables.

4.2 – DOCUMENTS REVIEWED:

- 331-665, Rev.1, Re-assessment of the Qualified Cables TLAA Revalidation Limitations, 2023
- EA-23-057, strategy of Requalification of Qualified Cables in Harsh Environments for LTO, 2023
- L1124-GN-RPT-018, EQ TLAA Report, 2020
- D02-ARV-01-189-248, Requalification programme cables installed inside the Containment and other positions pertaining to the Harsh Environment at Koeberg NPS, Framatome, 2022

4.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: D-5**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of electrical and I&C SSCs	

1.1 – ISSUE TITLE:

Lack of proactive management of technological obsolescence

1.2 – FUNDAMENTAL OVERALL PROBLEM:

A proactive approach to technological obsolescence management is not fully implemented.

2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022

2.1 – FACTS:

F1) There is an established methodology for handling and tracking problems related to obsolescence issues, this TOP (Technological Obsolescence Programme) methodology has been implemented, however the proactive part of the process has not been fully implemented.

F2) The plant previously adopted the POMS as a tool for a proactive approach. The licence of POMS expired, and the plant is in the process of acquiring a new service for the obsolescence management tool. The plant does not have access to any tool to proactively identify obsolescence.

F3) The plant established an Obsolescence Management Process (331-146) since 2019, which has been reviewed 3 times. One of the outcomes was the establishment of the Obsolescence Steering Committee and a requirement for periodic meetings to decide on obsolescence resolution strategies. However, the monthly meetings of this Committee only started recently.

F4) The 331-146 Obsolescence Management Process is expected to establish and report the top 10 list of obsolete items according to international practices. This information is to be tracked at the Steering Committee and reported in the Programme Health Report (PHR). The last PHR does not contain or refer to the Top 10 list.

F5) The Obsolescence Management Process provides factors to be considered in the prioritization matrix. However, the details regarding the weighing of each factor to be considered is not provided in the document.

F6) The current procedure will be updated in order to describe how the findings of the TOP will influence the prioritization in the procurement process. These changes are expected to be introduced in Revision 4 of the procedure (in draft).

2.2 – SAFETY CONSEQUENCE:

Without a proactive technological obsolescence management, the plant risks unavailability of SSCs important to safety.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider completing the implementation of a proactive approach to technological obsolescence.

2.4 – IAEA BASIS:

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6.1 Technological obsolescence of the SSCs in the plant should be managed through a dedicated plant programme with foresight and anticipation and should be resolved before any associated decrease in reliability and availability occur.

6.2 A technological obsolescence programme should be prepared and implemented to address all SSCs important to safety and spare parts required to maintain those SSCs.

6.3 The technological obsolescence programme should involve participation of the engineering, maintenance, operations and work planning units, plant senior management, and supply chain organizations

6.5 The technological obsolescence programme should be made available to the regulatory body for review and assessment at a level of detail defined by national regulatory requirements.

6.11 The operating organization should periodically assess the effectiveness of the technological obsolescence programme and should continuously seek to improve performance and efficiency. Self-assessments should be performed concerning the obsolescence programme, its implementation and its effectiveness and any lessons learned should be acted on.

2.5 – DOCUMENTS REVIEWED:

- 331-146, Rev 3., Obsolescence Management Process, 2021

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE	**Date:** 22/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

Issue D-5 states that there was a lack of proactive management of technological obsolescence at the plant at the time the 2022 SALTO review was performed. The reason for the issue being highlighted is due to the timing of the review since the plant had already identified the issue during a prior self-assessment and was in the process of addressing it.

3.2 – CORRECTIVE ACTIONS:

Corrective actions were raised in accordance with the plant's corrective action process, KAA-688 "The Corrective Action Process" and ratified at SALTO Management Oversight Committee (SMOC), SMOC TOR 240-145571138, with the review and acceptance of Record of Decision 08016.ROD.030

The following corrective actions were raised to address the overall concern:

- CR 133538-007 CA - OD_15.2 - Implement the proactive aspect of the TOP process as defined in 331-146 to proactively handle and track problems related to obsolescence issues.

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

The NOU has implemented the TOP process, defined in 331-146, to manage obsolescence issues. The NOU has mostly dealt with obsolescence issues in a reactive mode, and to implement the proactive aspect of the obsolescence process the NOU required an obsolescence management services contract.

The plant has signed a contract (4600074469) with a vendor to provide the obsolescence management services (action tracked by AU 38269-002 QA). Procurement has closed AU 38269-002 QA. This contract includes the service of contacting manufacturers and suppliers, industry-wide, to proactively identify obsolete equipment. Placement of this contract enables the NOU to identify and address obsolescence issues relating to equipment installed at the plant, in a proactive mode, as per 331-146 "Process for the Technological Obsolescence Management Programme (TOMP)".

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) The plant defined the corrective action CR 133538-007 CA - OD_15.2 which was closed with implementation of the TOP process as defined in 331-146 to proactively handle and track problems related to obsolescence issues.

F2) The plant has purchased POMS and is in the process of migrating the material data to POMS in order to login and access the network POMS database. This is in accordance with the approved project schedule, with the site acceptance test scheduled for 15.11.2024. At the time of review the plant was unable to access to database. The plant holds an active licence and access to POMS since the placing of the contract. To confirm the programme implementation, a completed process implementation of a technological obsolescence issue was described by the programme owner with the records of documents 331-146 (TOMP) and other references specified in section 4.2. The contracted scope will be checked for plant requirements before installation by other internal department experts (i.e. with equivalency evaluation or modification by design or system engineers) according to plant document 331-143, "Equivalency Study Process" to change the plant. The process is well established and will be updated with data as collected and implemented.

F3) The responsible programme owner described reactive and proactive approaches of the plant, including obsolescence before demand from the plant. To provide the obsolescence management services for 59444 material groups and 233978 functional locations, data was sent to the contractor to be checked and to confirm its accuracy.

F4) A Terms of Reference (Rev. 2) for the Obsolescence Steering Committee (OSC) was developed as described in 240-129906353. The OSC consists of 13 responsible persons with minimum quorum of five required for decisions. In the last two years 12 regular meetings have been held as demonstrated with minutes of meetings (MoM) and conclusions.

F5) As an example a copy of the MoM OSC2401 from 5 May 2024 was demonstrated. The process was described and solutions to specific issues (as ranked by prioritization) demonstrated on the obsolescence dashboard (developed in Power BI):

- Examples of EDG CR 117477 was demonstrated with functions, materials and DevonWay Actions as required.
- Example of EDG CR 148661 Solenoid Valve was prioritised to a value of 1.45.
- 222 obsolescence issues are currently tracked via unique actions, represented on the obsolescence dashboard Power BI database which is connected and traceable in other databases such as DevonWay and SAP.

F6) Future proactive obsolescence issues received via POMS will be raised and tracked in DevonWay and represented on the dashboard with prioritization based on the score of matrixes in 331-146.

F7) The plant has established a top 10 list in Power BI and presented document 331-146 regarding calculation of weighing of each factor for prioritization. Examples of updated findings of TOP prioritization were demonstrated in Power BI.

F8) The plant participates actively in obsolescence workshops (INUOG) and user group meetings (POMS) to share experience and gain knowledge.

4.2 – DOCUMENTS REVIEWED:

- KAA-688, The Corrective Action Process, Rev.20, 2023/06/30
- CR 133538-007 OD_15.2SALTO Condition Report for 08016.ROD.030- IAEA SALTO (2022) NEW SCOPE CA Corrective actions task No 007 status: closed, 2023/10/31
- 240-129906353, Obsolescence Steering Committee (OSC) Terms of Reference, Rev.2, 2022/01/19
- 240-145571138, SALTO Management Oversight Committee (SMOC), Rev.2, 2021/03/29
- 331-146, Technical Obsolesce Programme, Rev.4, 2023/07/05
- OSCM2401 Virtual Meeting Minutes with Item 3.5 Splitting EDG CR into the individual obsolescence issues (CR 117477), 2024/05/02
- Power BI reports for tracking status CR117477 and CR148661 and Top 10 priority calculated factors, Print screen report, 3pages 2024/09/03
- 331-143, Equivalency Study Process to Change Plant, Rev.4, 2022/07/22
- EA-23-136, Program Health Report, October2022-September 2023, 2024/01/15

4.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: E-1**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of civil SSCs	

1.1 – ISSUE TITLE:

Incomprehensive revalidation of TLAAs for concrete structures

1.2 – FUNDAMENTAL OVERALL PROBLEM:

The plant has not comprehensively revalidated the TLAAs for concrete structures.

2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022

2.1 – FACTS:

F1) The TLAA for creep and shrinkage of concrete structures has not been identified.

F2) TLAA301: “Containment reanalysis” revalidates containment tendon pre-stress of units 1 and 2 with the original design data. The recent containment inspection reports clearly describe numerous surface damages as large scale delamination, progressing concrete carbonation front and chloride front, concrete cracks, exposed and corroded reinforcement bars and required repair measures to avoid further deterioration of the concrete structure. The effects of these deteriorations in the behaviour of the structures have not been incorporated in the analysis.

F3) The analysis is not based on finite element model which can be used for modelling of complex containment structure including concrete, rebars, tendons and liner. Instead, the excel files used for trending of monitored data of containment monitoring system, were used for TLAA301.

F4) Monitored strain gauge results are extrapolated to LTO from 40 years to 60 years. However, there are only a few strain gauges available for unit 1 and 2 containment dome. The plant has not evaluated the risk of failure of additional strain gauges during the next 20 years in LTO and has not taken action to perform compensatory measures to supplement the missing data. The evaluation to address this risk is in progress.

F5) There is missing or inadequate temperature calibration/correction of strain gauge measurements. Temperature monitoring is a precondition for accurate evaluation of results of strain gauges, pendulums and invar wires.

F6) Due to wire breakages and loss of data, data collection of Invar wire has started from 2005. The available data of invar wire measurements was not sufficient to analyse the global ageing behaviour of the containment structure during design lifetime. Therefore, monitoring data of Invar wire was not used in the report.

2.2 – SAFETY CONSEQUENCE:

Without comprehensive revalidation of the TLAAs, the plant cannot demonstrate maintenance of the safety function of concrete structures.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider improving revalidation of TLAAs for concrete structures.

2.4 – IAEA BASIS:

SSR-2/2 (Rev.1)

4.54 The comprehensive programme for long term operation shall address: (d) Revalidation of safety analyses made on the basis of time limited assumptions;

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2.32. If a decision is taken to pursue long term operation, justification of the adequacy of ageing management for the planned period of long term operation should be provided, based on the results of periodic safety reviews [7] or the results of an adequate evaluation process (that includes scope setting, ageing management review and revalidation of time limited ageing analyses, as described in this Safety Guide), and this justification should be evaluated for adequacy by the regulatory body.

3.34. For in-scope structures or components, the operating organization should identify all time limited ageing analyses and should demonstrate either that all these analyses will remain valid for the planned period of long term operation, or that the structures or components will be replaced, or that further operation maintenance or ageing management actions will be implemented.

5.67. The validity of time limited ageing analyses over the intended period of operation should be ascertained by demonstrating satisfaction against one of the following criteria [5]: (a) The analysis should remain valid for the intended period of operation. The time dependent parameter value for the intended operating period should not exceed the time dependent parameter value used in the existing analysis. (b) The analysis should have been projected to the end of the intended period of operation. The value of the analysis parameter value should be changed on the basis of the time dependent parameter projected for the intended operating period, and the value of the analysis parameter should continue to meet the regulatory limit or criterion. (c) The effects of ageing on the intended function(s) of the structure or component should be adequately managed for the intended period of operation. The value of the analysis parameter should be managed (using an ageing management programme) to ensure that ageing effects are adequately managed and that the value of the analysis parameter will continue to meet the regulatory limit or criterion throughout the intended period of operation.

7.28. Time limited ageing analyses should be reviewed to determine the continued acceptability of the analysed structure or component for the planned period of long term operation, in accordance with para. 5.67. The time dependent parameter should be determined from a re-evaluation or analysis of the operating history of the plant (including its projection to the end of the planned period of long term operation) to define a value of the parameter that applies to or bounds the expected value of the parameter at the end of the planned period of long term operation. The value of the time dependent parameter applicable to the period of long term operation should be used to re-evaluate the time limited ageing analyses, as described in para. 5.67.

2.5 – DOCUMENTS REVIEWED:

- TLAA 301: D02-ARV-01-183-095_Koeberg, Rev. C. “Containment Reanalysis”, 11-10-2021
- L1124-GN-RPT-027, Rev. 2, Report on Operational Experience for the review of existing Koeberg TLAAs, 18-07-2019
- L1124-GN-RPT-045, Rev. 0, KNPS Civil TLAA 304 Foundation Settlement Assessment Report, 15-08-2019

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE	**Date:** 30/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

Issue E-1 states that the plant has not comprehensively revalidated the TLAAs for concrete structures and thus suggested that the plant should consider improving revalidation of TLAAs for concrete structures. The reason for the issue being highlighted, is the fact that:

TLAA-302 for Creep and Shrinkage of Concrete Structures was not identified in L1124-GN-LIS-010 Comprehensive List of TLAA's. However, TLAA-302 was considered and validated as part of L1124-GN-RPT-024, *AME Degradation Assessment Results Civil*, with explicit expert input (from Framatome) concluding that the stresses caused by creep and shrinkage in concrete structures other than the containment building (in TLAA-301), are negligible. The load cases used in the design of the plant for safety related structures include shrinkage always

combined with dead load and live load. The governing load cases also include shrinkage with other extreme loads. The proportion of the design load caused by creep and shrinkage is negligible compared to the extreme load cases. Furthermore, the shrinkage of concrete at this stage of concrete structures life is very unlikely as shrinkage typically happens in the 1st few years of plant life, whereas creep is ongoing in structures with sustained loading. Furthermore IGALL AMP306: Structures monitoring covers inspection of mechanisms shrinkage and creep, which was translated into 240-165425812, Civil Ageing Management Programme Manual at KNPS.

TLAA-301 for the Concrete Containment Tendon Pre-Stress, was revalidated in D02-ARV-01-183-095. However, concerns and shortcomings were raised since the online monitoring equipment has not been fully functioning for some years, that has subsequently resulted in gaps in the data/results used for TLAA-301 re-analysis. Furthermore, the concrete deterioration effects experienced, the methodology applied for the re-analysis and assumptions made, were not comprehensively documented in D02-ARV-01-183-095.

3.2 – CORRECTIVE ACTIONS:

Corrective actions were raised in accordance with the plant's corrective action process, KAA-688 "The Corrective Action Process" and ratified at SALTO Management Oversight Committee (SMOC), with the review and acceptance of Record of Decision 08016.ROD.030.

The following corrective actions were raised to address the facts and the overall concern in issue E-1:

- Although TLAA302 for creep and shrinkage of concrete structures, was not identified in L1124-GN-LIS-010 Comprehensive List of TLAAs, it can be confirmed that TLAA302 was validated, as documented in L1124-GN-RPT-024, *AME Degradation Assessment Results Civil*. No further action was thus taken.
- OD16.18 / CR 133538-023 CA - Input from the original compilers of D02-ARV-01-183-095, was obtained, to confirm how the recent deterioration effects in the behaviour of the structures have been incorporated in the TLAA301 analysis and are documented in 08016.ODCOF.249.
- OD16.19 / CR 133538-024 CA - Framatome was invited to confirm how the analysis of TLAA301 was performed and whether a Finite Element Model was used. Input from the original compilers of D02-ARV-01-183-095, was obtained to confirm how the analysis of TLAA301 was performed and are documented in 08016.ODCOF.249.
- OD16.20 / CR 133538-025 CA – Requires the evaluation to confirm how many and the specific sensors that are required for containment monitoring, by means of retrofitting monitoring devices, pose complex challenges, and it might be difficult to measure the actual strain of the old concrete, as is the intent of adding new strain gauges. It is impossible to measure the current strain of the concrete with new devices, and the installation date will essentially be a new datum, which can supplement monitoring in the future. Therefore, the feasibility study (as part of the modification process), which will form the basis of modification 23002, will evaluate the practicality of installing external monitoring devices and the possibility of utilising new technologies such as fibre optic sensors. The final solution on the specific sensors (critical number, locations, type of sensors) required for a fully functional Containment Online Monitoring (COLM) System, to ensure that the plant containments are adequately monitored during LTO (considering the unique problems historically experienced), will thus be provided as part of the engineering feasibility study associated with the COLM modification process. Please refer to 08016.ODCOF.255 for more detail.

- OD16.21 / CR 133538-026 CA - Confirm the reliability of the strain gauge data. Input from the original compilers of D02-ARV-01-183-095, was obtained to confirm the reliability of the strain gauge data and is documented in 08016.ODCOF.249.
- OD16.22 / CR 133538-027 CA – Raise modification 23002 for the refurbishment of the COLM equipment. This modification was approved for implementation in 2027 to supplement and eventually supersede the current containment online monitoring equipment, as documented in 08016.ODCOF.250.
- OD16.24 / CR 133538-028 CA – Required input from the original compilers of D02-ARV-01-183-095, as to the missing Invar wire data. This was obtained and the expert evaluation that assesses the impact regarding the missing Invar data, is documented in 08016.ODCOF.249.
- OD16.25 / CR 133538-037 CA – Identified the need of improvement of E&S Maintenance capability to attend to Containment Monitoring Equipment related failures/repairs through upskilling, and this action is in progress.
- OD16.26 / CR 133538-038 CA – Identified the need of improvement of IMS Maintenance capability to attend to the containment monitoring equipment related failures/repairs through upskilling. This action has been completed as documented in 08016.ODCOF.295.

Furthermore, two additional documents, 331-623 "Engineering Position on Containment Structures for Long-Term Operation" and 331-691 "Containment Re-Analysis for Long-Term Operation", were developed that expanded on the TLAA301 revalidation in D02-ARV-01-183-095 and to address the identified shortcomings/concerns mentioned in the previous sections as follows:

i. 331-623 "Engineering Position on Containment Structures for Long-Term Operation", validates the findings in D02-ARV-01-183-095, using state-of-the-art finite element software. It discussed the condition of the on-line monitoring equipment, the inspection and maintenance programme as well as the upcoming Impressed Current Cathodic Protection (ICCP) modification and the Integrated Leak rate Test (ILRT).

ii. 331-691 "Containment Re-Analysis for Long-Term Operation" – the purpose of this document is multi-fold. A holistic overview of the on-line monitoring equipment installed on the containment structures and the original assumptions relating to the design, review of the available on-line monitoring results and analyse the shortcomings that exist w.r.t the online monitoring equipment and results and addressing certain comments by the National Nuclear Regulator (NNR), throughout the document.

Both documents 331-623 and 331-691 have concluded that none of the concerns/shortcomings identified, jeopardise the re-analysis of TLAA-301. The containment structures re-analysis was performed by considering the embedded strain gauges. Where required, engineering assumptions and interpretations were made. There is good confidence in the results of the strain gauges, and where required, conservative, assumptions were made. The re-analysis verifies that the containment structures will remain in compression and indicates that during a LOCA accident, at the predicted 60-year time related ageing, the stress in the containment structures will be in compression at 0.05 MPa at the dome. The cylindrical walls have a greater margin. It was reiterated that the containment integrity is verified for LTO (based on the TLAA and the analysis conducted). Thereby the containment structures are validated for LTO.

Note: Modification 16002 for the ICCP system on Unit 1 and Unit 2 containment buildings was initiated to install a duly designed ICCP system on both containment buildings. The ICCP detailed design has been submitted to the NNR for their acceptance. Importantly, to note that

the ICCP and patch repairs do not influence the TLAA and does not change the conclusion of the re-analysis (unless the assumptions are invalidated through the surveillance programme when the re-analysis will be required to be re-visited).

Furthermore, the review of all new IGALL TLAAs, (and IGALL AMPs) issued after 2018 for applicability and implementation, are part of the plant's Ageing Management process (240-149139512) where an annual review of new IGALL items is identified and actioned.

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

All civil TLAAs (inclusive of TLAA-302 and TLAA-301 (2018 revision)) up to 2018 as part of the SALTO project scope, were validated for LTO and the associated actions/ODs were mostly completed, with OD16.25 / CR 133538-037 CA (improving E&S maintenance capability to attend to containment monitoring equipment related failures/repairs through upskilling) currently in progress for completion by 30/11/2024.

Note: The statuses of actions taken to improve/ensure functionality of the containment online monitoring equipment are dealt with in more detail in Issue E-2.

Reviews of the following IGALL TLAAs (revisions post 2018) that are being updated, are in process, as part of the plant's Ageing Management Process.

Note: Due to continued evolution of the IGALL AMPs and TLAAs, continuous reviews of the IGALL AMPs and TLAAs are required for alignment purposes as part of 240-149139512.

- A new TLAA-305 for Irradiation of Concrete Biological Shield Structures (post 2018), was identified and is in the process of being reviewed and more guidance to be obtained through the IGALL working groups as to how to perform the analysis.
- TLAA-302: Effects of Creep and Shrinkage on Performance of Concrete Structures.
- TLAA-303: Cumulative Fatigue Damage of Containment Liners and Penetrations.
- TLAA-304: Foundation Displacements due to Expansive Supporting Material.

The IGALL TLAA reviews are being tracked as part of Self-Assessment SE 43971 - AFI-03: Review the updates on Civil Programme and new Civil AMPs and TLAAs for applicability and identify improvements, if any, and raise the necessary action as required. Due date: 30/09/2024.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) At the plant, IGALL TLAA302 on creep and shrinkage for the containment is addressed in TLAA301.

F2) For non-containment structures the plant's original equipment manufacturer (OEM) report L1124-GN-RPT-024 states that creep and shrinkage is negligible in the plant and can be detected and monitored by the plant AMP for civil structures 240-165425812. This document contains shrinkage as a degradation mechanism and although creep is not explicitly mentioned, the potential ageing effects (loss of strength and cracking) are included.

F3) The plant's TLAA301 (Containment reanalysis for LTO) was internally revised to address the comments from the SALTO mission and the regulatory body. The revised TLAA systematically covers creep and shrinkage of the containment. Design values and measurement

values were taken into account in the reanalysis and an extrapolation was made up to 60 years that indicated an acceptable situation.

F4) The plant chose to use the three extrapolation methods the OEM and similar design plants applied (linear extrapolation of latest years' results, exponential extrapolation of the whole lifetime results as well as an applied factor of 20% applied to the 40-year result). The analysis was done by the plant using Excel calculation tables as used by the OEM who compiled the original TLAA301 in document D02-ARV-01-183-095.

F5) The calculation method was discussed with the OEM experts, who confirmed the correctness of the methodology. An independent expert has also reviewed and accepted the calculation method and the internally developed TLAA report.

F6) Related to the loss of data issue the plant requested the assistance of the OEM to assist with a solution. The OEM made the following statements (240-156591753, 08016.ODCOF.249):

For concrete degradations

- >90% of the delamination has been repaired.
- Delamination has mainly a localised (very weak global) impact on the compression state of the containment concrete and the impact of detected cracks is also negligible.
- The OEM provided an expert opinion on the tolerable size of delamination and when the need of repairs is required to protect the tendons and rebars, with special urgence if exposed reinforcement is detected. The OEM added that the repaired concrete will not fully replace the function of the original concrete, due to the localised loss of compressive stress (negligible impact as per previous bullet).
- Chloride profiling test of the containment concrete showed that the adopted corrosion limit of 0.4% has been exceeded up to 50 mm in depth.
- The loss of rebar sections due to corrosion of exposed parts is very low and does not impact the function of the reinforcement.
- Small, detected surface cracks can be repaired by an elastic coating.

For the lack of FEM analysis

- The OEM stated that analytical formulas are applicable to analysis of the common parts of the containment structure, while the non-common parts are designed with strengthening, so the stresses are in the same range. For reanalysis of the unmodified structure no FEM analysis is needed.
- It is sufficient to use the available strain gauge results instead of the missing pendulum and invar wire results to analyse the global structural ageing behaviour of the containment during its lifetime.

Temperature gauge calibration

- Although the temperature values calculated from coil resistance measurements are less accurate, the large number of measurements and representative locations provide adequate results for determining strain for long term evaluation. To improve accuracy more thermocouples should be installed, and the non-functioning temperature gauges should be replaced (see also the bridging strategy and modification 23002, documented in Issue E-2).

Missing Invar wire monitoring data

- Invar wire monitoring is not considered sufficiently accurate to be able to detect minor shrinkage of the containment and it is recommended to replace them with fibre optic strain gauges instead. (Plant comment: despite this opinion by the vendor, the plant, in report 331-691, was able to compare the extrapolation of the Invar wires to the strain gauge predictions)

F7) The plant performed a finite element method analysis of the large delamination areas detected on the containment concrete structure. While the OEM proposed an area of 25 m^2 as an acceptance value for the affected areas (based on engineering judgement), the plant analysis justified an area of 215 m^2 to be acceptable. The plant showed a report on comments and resolutions as the evidence of an independent engineer review of the analysis and the report in which the engineer accepted the conclusions.

F8) The plant performed an analysis of the found corrosion issues of tendon ducts. Based on a sampling test, corrosion affected tendon ducts only near construction joints. An external consultant confirmed the plant conclusion that since the low chloride content of the ambient concrete (0.06%<0.4% which is the threshold for corrosion) the corrosion will not affect the tendons themselves.

4.2 – DOCUMENTS REVIEWED:

- Closeout of the below ODs documented in 08016.ODCOF.249, approved on 22 March 2023 (Form Identifier: ESKOM, 240-156591753, July 2023)
- OD_16.18 – Confirm how the recent deterioration effects in the behaviour of the structures have been incorporated in the TLAA-301 analysis,
- OD_16.19 - Framatome to confirm how the analysis of TLAA-301 was performed and was a Finite Element Model used;
- OD_16.21 - Confirm the reliability of the strain gauge data; and
- OD_16.24 – TLAA-301 Report should include an expert evaluation that assesses the impact regarding the missing Invar Data Civil Ageing Management Programme Manual at KNPS, 240-165425812, Revision 2,, 2023-07-26
- Engineering Position on Containment Structures for Long-Term Operation, 331-623, ESKOM, Revision 1, 2022-09-06
- Containment Re-Analysis for Long-Term Operation, ESKOM, 331-691, Revision 1b, 2024-06-30

4.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X

1. ISSUE IDENTIFICATION	**Issue Number: E-2**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of civil SSCs	

1.1 – ISSUE TITLE:

Not fully functional containment structure monitoring system

1.2 – FUNDAMENTAL OVERALL PROBLEM:

Containment structure monitoring system is not fully functional.

2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022

2.1 – FACTS:

F1) Temperature monitoring is a precondition for accurate evaluation of results of strain gauges, pendulums and invar wires. However, some thermocouples linked to the strain gauges of containment monitoring system of unit -1 are not functional. The temperatures were calculated from coil resistances. This method does not provide accurate temperature values.

F2) Some strain gauges of containment dome of unit 1 are partially out of service and the strain gauges of unit 2 are out of service or are providing erratic values.

F3) The modification of the containment monitoring system is in the initial stage.

F4) Four pendulums in unit 1 named P2-A, P4-A, P1-B and P3-B show non-realistic behaviour compared to strain gauge evaluations in the same area. According to TLAA 301 (containment reanalysis report), one possible cause of the non-realistic behaviour is concrete repairs in this area with the consequence of corrosion effects. According to TLAA301, these pendulums need to be intrusively examined, refurbished and re-set, which is not completed.

2.2 – SAFETY CONSEQUENCE:

Without a fully functional containment monitoring system, not all necessary data for the containment structure will be available to demonstrate the intended safety function during LTO.

2.3 – RECOMMENDATION/SUGGESTION:

R) The plant should ensure full functionality of the containment structure monitoring system.

2.4 – IAEA BASIS:

SSR-2/2 (Rev.1)

Requirement 14: Ageing management

The operating organization shall ensure that an effective ageing management programme is implemented to ensure that required safety functions of systems, structures and components are fulfilled over the entire operating lifetime of the plant.

4.51. Long term effects arising from operational and environmental conditions (i.e. temperature conditions, radiation conditions, corrosion effects or other degradations in the plant that may affect the long term reliability of plant equipment or structures) shall be evaluated and assessed as part of the ageing management programme. Account shall be taken in the programme of the safety relevance of structures, systems and components.

Requirement 16: Programme for long term operation

Where applicable, the operating organization shall establish and implement a comprehensive programme for ensuring the long term safe operation of the plant beyond a time-frame established in the licence conditions, design limits, safety standards and/or regulations.

Requirement 31: Maintenance, testing, surveillance and inspection programmes

The operating organization shall ensure that effective programmes for maintenance, testing, surveillance and inspection are established and implemented.

8.2 The operating organization shall establish surveillance programmes for ensuring compliance with established operational limits and conditions and for detecting and correcting any abnormal condition before it can give rise to significant consequences for safety.

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4.37. Surveillance programmes, including functional tests, that are consistent with NS-G-2.6 [10] should be in place and properly implemented for ageing management and evaluations for the long term operation of applicable in-scope SSCs.

NS-G-2.6

8.51 Defective items, whether or not they have been removed from the plant, should be repaired in accordance with established procedures such as those for issuing equipment isolation work permits and work order authorizations, as appropriate.

2.5 – DOCUMENTS REVIEWED:

- TLAA 301: D02-ARV-01-183-095_Kooeber, Rev. C. “Containment Reanalysis”, 11-10-2021;
- KWR-IP-CIV-017, Rev. 0, Online Containment Monitoring – Measuring Vertical Displacement Using the Vertical Invar Wires, 08-11-2017;
- KWR-IP-CIV-018, Rev. 0, Pendulum wire measurements, 08-11-2017.

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE	**Date:** 30/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

Issue E-2 states that the containment structure monitoring system is not fully functional and thus recommended that the plant should ensure full functionality of the containment structure monitoring system.

The Containment Online Monitoring (COLM) equipment is used to measure data for monitoring and trending performed every 3-months, in accordance with the licensing requirements in 240-166148961 (KAU-030) Basis and Scope for License Building Civil Surveillances at KNPS. Since the COLM equipment has not been fully functional for some years, it has resulted in gaps in the monitoring data trends, challenging the reliability of monitoring data sets used for the TLAA-301 revalidation.

Furthermore, the maintenance response time to replace broken Invar and Pendulum wires and recalibration of Dynamometers, has been ranging from 2,5 to 5 years (whilst monitoring data are collected every 3 months) due to ownership concerns amongst the maintenance groups.

The on-line monitoring equipment remains a crucial aspect of ensuring the behaviour of the structures are as expected in the periods between ILRT tests for the planned LTO period.

3.2 – CORRECTIVE ACTIONS:

Corrective actions were raised in accordance with the plant's corrective action process, KAA-688 "The Corrective Action Process" and ratified at SALTO Management Oversight Committee (SMOC), with the review and acceptance of Record of Decision 08016.ROD.030.

The following corrective actions were raised to address the facts and the overall concern:

It was confirmed in 331-691, that the residual COLM equipment is sufficient to provide the basis for establishing long term trends of the containment structural behaviour, (although the increasing number of non-functioning monitoring devices is a concern). Both 331-623 and 331-691 concluded that none of the concerns/shortcomings identified, jeopardise the re-analysis of TLAA-301. The containment structures re-analysis was performed by considering the embedded strain gauges. Where required, engineering assumptions and interpretations were made. There is good confidence in the results of the strain gauges, and where required, conservative assumptions were made. The re-analysis verifies that the containment structures will remain in compression and indicates that during a LOCA accident, at the predicted 60-year time related ageing, the stress in the containment structures will be in compression at 0.05 MPa at the dome. The cylindrical walls have a greater margin. It was reiterated that the containment integrity is verified for LTO (based on the TLAA and the analysis conducted). Thereby the containment structures are revalidated for LTO.

Thus, as part of OD16.22 / CR 133538-027 CA, modification 23002 for the refurbishment of the COLM equipment is required and was approved for implementation in 2027 to supplement and eventually supersede the current containment online monitoring equipment, as documented in 08016.ODCOF.250.

OD16.20 / CR 133538-025 CA, identified actions to form part of a feasibility study (as part of modification process), which will form the basis of modification 23002, to evaluate the practicality of installing external monitoring devices and the possibility of utilising new technologies such as fibre optic sensors. The final solution on the specific sensors (critical number, locations, type of sensors) required for a fully functional COLM system, to ensure that the plant containments are adequately monitored during LTO (considering the unique problems historically experienced), will thus be provided as part of the engineering feasibility study associated with the COLM modification process. Refer to 08016.ODCOF.255 for more detail.

As an interim bridging strategy, the plant plans to install additional monitoring devices on the containment structures during the upcoming ILRTs.

The following actions were raised to address specific COLM equipment maintenance related concerns:

- OD16.25/CR 133538-037 CA - was raised to the E&S maintenance group to improve the capability to attend to containment monitoring equipment (specific to the Invar and Pendulum wires) related failures/repairs through upskilling, which is in progress.

- SAP IMP 42621 – was raised for 5-yearly repair/refurbishment of the Invar and Pendulum wires, to be performed by the E&S maintenance group in accordance with KBA 0022 N NEPO LOPP 164. SAP IMP 42621. The service notification was implemented and scheduled on SAP.

- SAP IMP 42539 - was raised to I&T to perform 3-monthly COLM equipment inspections that originate from 240-166148961 (KAU-030) Basis and Scope for License Building Civil Surveillances at KNPS. SAP IMP 42539. The service notification was implemented and scheduled on SAP.

- OD 16.26/CR 133538-038 CA – The requirement to upskill IMS maintenance staff associated with the dynamometer calibrations, has been completed and resulted in the development of procedure KWM-IC-EAU-001, to be used for the future 10-yearly dynamometer calibrations scheduled as per SAP IMP 42529. IMS was able to support with specific investigation requests from the civil engineering team related to the existing strain gauges and thermocouples. Furthermore, IMS has been identified (and accepted) to be the responsible maintenance group to respond to future dynamometer recalibrations (and strain gauges and thermocouples repair/replacement requirements to be established as part of modification 23002), as documented in 08016.ODCOF.295.

- SAP IMP 42529 - Dynamometer recalibration is required to be performed every 10 years by the IMS maintenance group, based on the plant's operating experience and the Responsible Engineer's recommendation, contained in 240-166148961 (KAU-030). SAP IMP 42529, service notification was implemented and scheduled on SAP.

- OD 16.27/CR 133538-039 CA and OD 16.28/CR 133538-040 CA - Repairs to the Unit 1 containment Invar and Pendulum wires have been performed and completed 31 May 2024, whilst the repairs of the Unit 2 containment Invar and Pendulum wires are in progress.

- OD 16.29/ CR 133538-041 CA - The Dynamometer recalibrations were performed and completed during the fourth quarter of 2023 and documented in 08016.ODCOF.288. Dynamometer 157 and 158 continued to behave erratically post recalibration. Following the trouble shooting process followed, it was concluded that the faulty dynamometer signal cables (1EAU431LK and 1EAU432LK) will be replaced, which is tracked by GA 43899 for completion by 31 August 2024.

- OD 16.23/CR 133538-008 CA/CR 132024-032 CA - A civil system health report function within Systems Engineering was established and developed, to regularly report the actual health conditions of civil SSCs at the appropriate management forums, in terms of KGU-002 – refer to 08016.ODCOF.282 for close-out details.

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

These actions/ODs are in progress and being tracked as follow:

- Replacement of faulty dynamometer signal cables 1 EAU 431 LK and 1 EAU 432 LK is being tracked under GA 43899 for completion by 31 July 2024.

- OD 16.27/CR 133538-039 CA and OD 16.28/CR 133538-040 CA - Repairs to the Unit 1 containment Invar and Pendulum wires have been performed and completed 31 May

2024, whilst the repairs to the Unit 2 containment Invar and Pendulum wires are in progress for completion by 30 Nov 2024.

- OD16.25/CR 133538-037 CA - was raised to the E&S maintenance group to improve the capability to attend to the containment monitoring equipment (specific to the Invar and Pendulum wires) related failures/repairs through upskilling, which is in progress for completion by 30 Nov 2024.
- The COLM equipment modification 23002 is scheduled for implementation during 2027 and 2028.
- An ILRT bridging strategy will be implemented during outages 127 and 227.
- All other related actions have been completed.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) There are four Invar wires per unit to measure vertical movement/displacement of the containment. The wire ducts housing the Invar wires were probably disturbed during containment repairs, which resulted in inappropriate measurement values. Full inspection, refurbishment and realignment of the Invar wires and measurement equipment was completed during 2024 for unit 1. Currently all the Invar wires on Unit 1 are fully operable, while on Unit 2 the inspections are complete, and repairs are ongoing with a deadline of end December 2024.

F2) Four groups of three pendulums, installed near the vertical Invar wires are used in each unit to measure horizontal movement of the containment structure. The pendulums also provided erratic results and were not repaired for some time. Their full inspection was done in 2024 for both units and on Unit 1 all of them have been refurbished and are operable, while the repairs on Unit 2 are in progress, for completion by the end of December 2024.

F3) Strain gauges situation in July 2024 (JN930-NSE-ESKB-L-9773):

- There are 106 embedded strain gauges and thermocouples in Unit 1. Eighteen of the strain gauges and twenty thermocouples are not operable.
- There are 62 strain gauges and thermocouples in Unit 2. Nine strain gauges and thirteen thermocouples are not operable.

That means approximately 20-30% of the devices have failed. Some of the strain gauges and thermocouples have failed permanently, but some of them intermittently operate during the measurements done quarterly. The results of the operable strain gauges were sufficient to perform the TLAA revalidation of the containment in 2023 and is used for ongoing monitoring.

F4) The pre-stressed tendon monitoring system (installed on 4 ungrouted tendons out of 633 Unit 1 tendons) contains dynamometers that are used for measurements every 3 months. Two dynamometers failed since 2020 and showed erratic values. All four dynamometers were recalibrated in 2023 and will be recalibrated with a 10 year periodicity. Two dynamometers are awaiting electrical cable replacements at the terminal boxes, because they still show erratic values. The due date for this replacement is 30 September 2024, which is also aligned to a planned 72-hour test to demonstrate the operation. According to an expert statement (*EDF expert opinion on dynamometer data analysis*) identical dynamometers installed in similarly designed plants are not considered important for containment integrity assessments (not part of

"Optimal Monitoring Device") and are not required to be replaced upon failure within the EDF fleet. This is because the Invar wires, pendulums and strain gauge measurements are sufficient to assess the mechanical behaviour of the containment.

F5) The integrated leakage rate tests (ILRT) of the Unit 1 and 2 containments are scheduled for outages 127 and 227 (starting January 2025 and November 2025). During the test, the pendulums and Invar wires are required to be operational. The test lasts 4-5 days in order to determine the leak rate and also to check the physical expansion/contraction of the structure. During the test, strain measurements are taken and compared with the previous test results and with results from the EDF fleet, which has similar containment designs.

F6) The pendulums and Invar wires are prone to corrosion and break (if the ducting is not sealed well). Historically, repairs had to be performed by external contractors and this caused delays due to commercial constraints. The plant has now established partial capability to repair the devices within the plant which will accelerate the repair process (e.g. the recent refurbishment process took place within a couple of months). Preventive maintenance is also now scheduled for every 5 years when all pendulums and Invar wires will be replaced. Another improvement has been the inclusion of an inspection of the equipment during the monitoring that takes place every 3 months.

F7) The failed strain gauges and thermocouples cannot be replaced or repaired as they are embedded, so the plant plans to install a completely new (fibre optic cable based) system in 2027 and 2028 for Unit 1 and 2, respectively. The modification investment and the schedule have been approved by the plant to perform the feasibility study, selection of solution, contracting, licensing, and finally the implementation.

F8) Until the new system is operational, the plant decided to follow a bridging strategy: the contractor implementing the integrated leak rate test for the plant was requested to install additional sensors that will be left on the containment after the test, to provide additional strain measurement data. The order for this action has been placed, in accordance with User Requirement Specification, URS/ILRT/SIT/2023/ILRT/011, financial plan approved, and the test will not be implemented without these devices being installed. The additional devices were determined in a manner to obtain a complex picture of the strain situation of the dome and the cylindrical part of the containments:

- 2 optical fibre cables will be installed on the dome,
- 1 vertical optical fibre cable will be installed outside the vertical cylinder;
- 1 horizontal optical fibre cable will be installed outside the vertical cylinder.

4.2 – DOCUMENTS REVIEWED:

- Email from ESKOM/EDF liaison officer on EDF expert opinion request on dynamometer data analysis, KT ref: 9158, 28 August 2024
- Project plan for pendulum and Invar replacement conducted on unit 1, 2024
- DA-2024-0079 documenting the Containment On-Line Monitoring – Current Status and Bridging Strategy, Revision 0 dated 2024-09-02.
- Structural Integrity Test (SIT) in Support of the ILRT in Outages 127 and 227, in User Requirements Specification, URS/ILRT/SIT/2023/ILRT/011 dated 2023-08-01.
- Nuclear Portfolio Investment Plan (PIP) for Modification 23002 for the defective Containment Monitoring Equipment, 1st implementation in 2027 and 2nd implementation in 2028, in 240-11475132, 2024-05-02

– GA 43899 for the replacement of the two faulty Dynamometer signal cables, in Devonway extended from 2024-07-31 to 2024-09-30 – Containment Online Monitoring Results Third Quarter 2024, JN930-NSE-ESKB-L-9773

4.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	X
3.	**Issue resolved**	

1. ISSUE IDENTIFICATION	**Issue Number: E-3**
NPP: Koeberg	**Unit: 1 and 2**

Reviewed Area: Ageing management of civil SSCs

1.1 – ISSUE TITLE:

Incomplete development and implementation of ageing management programmes for civil SSCs

1.2 – FUNDAMENTAL OVERALL PROBLEM:

Ageing management programmes for civil structures are not fully developed and implemented.

2. ASSESSMENT OF THE STATUS	**Date:** 31/03/2022

2.1 – FACTS:

F1) Leakage through leakage collection system of spent fuel pool of unit 2 was observed irregularly during the plant life, it has even stopped for a few years. An investigation was performed, but the root cause of the leak and disappearance of leak could not be found.

F2) Some remedial measures related to safety related structures were identified for implementation on an immediate basis during the last outage or inspection cycle (for example in Unit 2 Containment during External Outage 223 and External Outage 224) are still pending as confirmed from the SAP database.

F3) Leakages have been noted in sumps of the Nuclear Auxiliary Building 2, e.g., sumps located in N281 and N032 which belong to the Nuclear Islands Vents and Drains System (RPE). White residue and deposits are observed along cracks in the concrete on structural elements around or below these sumps. In both cases the sumps are unlined, and their contents are highly radioactive. The procedure to address unlined sumps is not completed yet.

F4) According to "Section 2.6: Process for Monitoring" of "331-148, Programme Engineer's Guide", the reporting frequency of programme Health Reports (PHRs) by the programme engineer is defined. However, the frequency to evaluate the effectiveness of the PHRs and impact on the plant safety and reliability by the Programme Oversight Committee (POC) and Engineering Programmes Technical Review Meeting is not defined.

F5) The various activities related to monitoring of spent fuel pool are currently performed by different departments whose analysis are not integrated.

F6) The development of an AMP related to spent fuel pool is not completed yet.

F7) The Table 1 of 240-165425812, Civil Ageing Management Programme Requirements Manual identifies the need for trending of concrete coating degradation. The related inspection procedure is being updated.

2.2 – SAFETY CONSEQUENCE:

Without complete implementation of ageing management programmes for civil SSCs, preservation of safety functions cannot be ensured.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider completing and implementing the ageing management programmes of civil SSCs.

2.4 – IAEA BASIS:

SSR-2/2 (Rev.1)

Requirement 14: Ageing management

The operating organization shall ensure that an effective ageing management programme is implemented to ensure that required safety functions of systems, structures and components are fulfilled over the entire operating lifetime of the plant.

4.51. Long term effects arising from operational and environmental conditions (i.e. temperature conditions, radiation conditions, corrosion effects or other degradations in the plant that may affect the long term reliability of plant equipment or structures) shall be evaluated and assessed as part of the ageing management programme. Account shall be taken in the programme of the safety relevance of structures, systems and components.

Requirement 16: Programme for long term operation

Where applicable, the operating organization shall establish and implement a comprehensive programme for ensuring the long term safe operation of the plant beyond a time-frame established in the licence conditions, design limits, safety standards and/or regulations.

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5.51. The ageing management programmes should be implemented in a timely manner to ensure that the intended functions of structures or components continue to be performed.

5.52. Detailed implementation procedures that describe preventive and mitigatory actions, monitoring or inspection and assessment actions, acceptance criteria, and corrective actions should be established and shared among the different units of the nuclear power plant (e.g. operations, maintenance and engineering units) that are responsible for implementing ageing management programmes. 5.53. As part of the implementation of the ageing management programmes, appropriate data should be collected and recorded to provide a basis for decisions on the type and timing of ageing management actions.

2.5 – DOCUMENTS REVIEWED:

- 1607525, Civil structure Inspection Report: Containment Unit 1- Visual Inspection (Vertical), 19-04-2021
- 1591696, Civil structure Inspection Report: Containment Unit 1- Visual Inspection (External), 16-03-2020
- 1575355, Civil structure Inspection Report: Unit 2 Containment Structure Internal Outage 223, 04-10-2019
- Draft Report 240-166959159, Rev.0, AMP for stainless steel lined compartments and epoxy coated sumps, (in progress)

3. HOSTING ORGANIZATION ACTIONS TO RESOLVE ISSUE | **Date:** 30/07/2024

3.1 – RESULTS OF THE ISSUE ANALYSIS:

Issue E-3 states that the ageing management programmes for civil structures are not fully developed and implemented.

At the time, the required updates to the high-tier civil AMP/programme documents and the development of 240-165425812, Civil Ageing Management Programme Manual (AMP-306), were completed and as such these authorised documents were shared with the IAEA reviewer. However, the draft 240-166959159, for Stainless Steel Lined Compartments and Epoxy Coated Sumps and the draft updated lower-tier inspection documents (inclusive of KGR-008) were subsequently also shared with the IAEA reviewer during the 2022 mission discussions, to show progress.

The reason for the issue being highlighted is due to the fact that the new 240-166959159 "(AMP 309) for stainless steel lined compartments and epoxy coated sumps" and the updates to the existing civil inspection procedures (inclusive of KGR-008), in accordance with 08016.ROD.024, 331-148 (Programme Engineer's Guide) and as per 331-618 (Safety Case for LTO of KNPS) commitments, were still in the process and not complete, at the time.

3.2 – CORRECTIVE ACTIONS:

To respond to issue E-3, corrective actions were raised in accordance with the plant's corrective action process, KAA-688 "The Corrective Action Process" and ratified at SALTO Management Oversight Committee (SMOC), with the review and acceptance of Record of Decision 08016.ROD.030.

The following corrective actions were raised to address the facts and the overall concern:

OD 6.12/CR 115457-020 CA - The required Ageing Management Programme Manual 240-166959159, for Stainless Steel Lined Compartments and Epoxy Coated Sumps, was subsequently completed, authorised, and implemented, which incorporated the following aspects:

- The various operational activities related to the monitoring of the spent fuel pool (SFP) performed by different departments on a regular basis.
- The exterior concrete surveillances of the SFP (support walls and slabs) and sumps as part of the civil programme surveillances.
- To provide acceptance criteria and the associated technical basis for each of the monitored parameters, which concluded that;

a. Based on previous leakages observed, that were investigated, monitored, it was confirmed as very small leakages (2004=12ml/h and 2021=13ml/h) that are well within the acceptance criteria of 5 l/h. The SFP is fitted with a leak detection system (monitored daily by OPS), level alarm sensors (limits as per OTS), and make-up activities are automatically monitored. The Nuclear System Engineer performs trending regularly to determine whether an adverse trend in make-up is developing. As long as the monitoring continues and the leak remains acceptably small, the plant can remain with do nothing more.

   Note: Based on international OE referenced in 240-166959159, utilities around the world have opted to monitor leaks as opposed to locating and repairing minor defects, as long as the acceptable leak rate of the SFP remain within the acceptance criteria.

b. If the leak ever returns and is extensive, a thorough investigation to comprehensively understand the root cause is required in accordance with the provisions in 240-166959159.

Furthermore, the current monitoring provisions contained in 240-166959159 for Stainless Steel Lined Compartments and Epoxy Coated Sumps, and the concrete surveillances as part of the updated civil programme procedures, are considered adequate to control and manage ageing effects of Stainless-Steel Lined Compartments and Epoxy Coated Sumps effectively.

All civil low-tier monitoring procedures (inclusive of KGR-008) were subsequently updated and make provision for the trending of concrete coating degradation in 240-165425812 and for the specific monitoring requirements in 240-166959159.

Surveillance actions are executed as part of the existing SAP service notifications, which reference the updated civil surveillance procedures of the following in-scope structures where unlined sumps, epoxy-lined sumps, as well as the stainless steel-lined compartments are located.

- Reactor Buildings Unit 1/2;
- Fuel Buildings Unit 1/2;
- Emergency Diesel Generator Buildings 1LHP, 2LHP, 1LHQ, 2LHQ, 9LHS;
- Refuelling Water Storage (PTR) Tank Rooms Units 1/2;
- Auxiliary Feedwater Tanks (ASG) Unit 1/2;
- Electrical Building Unit 1/2/9;
- Essential Service Water (SEC) Pumping Stations Unit 1/2;
- Nuclear Auxiliary Building Zone A to F;
- Aseismic Vault;
- Cask Storage and Low-Level Waste Building.

OD 16.23/ CR 133538-008/ CR 132024-032 CA - A civil system health report function was established and rolled-out within Systems Engineering, that monitors the actual health condition of civil structures based on defects/structural/safety concerns reported through the surveillance programme. Civil system health reports were developed for all in-scope civil structures and conditions will be reported and presented at the appropriate management forums, regularly in accordance with KGU-002 – refer to 08016.ODCOF.282 for details.

The continued evolution of the IGALL AMPs, reviews of new and updated IGALL AMPs issued after 2018 for applicability and implementation at the plant, form part of the Ageing Management process at the plant, contained in 240 -149139512.

3.3 – STATUS OF CORRECTIVE ACTIONS IMPLEMENTATION:

All required AMPs for mechanical, electrical, and civil SSCs have been completed (CR 112454-006 CA closed).

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 06/09/2024

4.1 – FACTS:

F1) The ageing management documents, and the related inspection procedures were in draft at the time of the SALTO mission. Since the mission, the AMP for stainless steel lined compartments and epoxy coated sumps was approved (June 2022).

F2) The AMP integrates the actions: daily, annual, 2-yearly and as required inspections and checks are included to be executed by the operations, maintenance, system engineering, civil engineering and chemistry departments and it also references the specific procedures and instructions.

F3) The relevant inspection procedure (KGR-008) was also approved and contains the trending requirement for any potential coating degradation.

F4) The plant identified the root cause of slow responses when remedial actions are needed for civil structures defects and as a result, a civil system health report function was established that monitors the actual health condition of civil structures based on defects/structural/safety concerns. A pilot has been completed for the containment (System health report for 2023 Q3 in System IQ, dated to 29 November 2023.). Reporting is typically done quarterly and bi-annually based on the actual condition and status of the building/structure, according to the requirements in 'System Health Reporting Guide' KGU-031 (authorized 2020-12-07) and "The Guide for System Engineers' KGU-002 (authorized 2021-07-26), that allows for information to be kept updated.

F5) Spent fuel pool (SFP) leakage: the historical leakages were very small and only occurred a few times for short periods (2004=12 ml/h and 2021=13 ml/h), while the acceptance criterion is 5 l/day. The plant investigation concluded that the leakage may not have come from the SFP. The plant considers the leakages small compared to international experience and since they stopped the plant does not plan to initiate a repair action. Monitoring is ongoing.

F6) The SFP is located 20 m above ground level on the Seismic Raft which results in any potential leaks ending up in sumps that are regularly sampled. Undetected leakage from the SFP into the groundwater and the environment is not credible. The walls and slabs supporting the SFP are inspected on a 6 month frequency. Annual inspections are performed on all structures located on the Seismic Raft as well as the Aseismic Vault (also fitted with collection sump that is monitored). The plant included in the AMP (for stainless steel lined compartments and epoxy coated sumps) an action on bi-annual groundwater sampling to confirm that there is no leakage from the SFP containing radioactive material (or any other source). Currently the groundwater is sampled bi-annually from the boreholes downstream of the plant's nuclear island. Monitoring includes tritium content of ground water, and only acceptable results have been recorded. Acceptance criteria for groundwater gamma concentration (10000 Bq/l) has not been exceeded, and historical trends for tritium does not reach the investigation level of 200 Bq/l either.

4.2 – DOCUMENTS REVIEWED:

- AMP for Stainless Steel Lined Compartments and Epoxy Coated Sumps, 240-166959159, 2022
- 08016.ODCOF.282 for OD16.23, Initiate a periodic Civil System Health report, Nov 2023
- Pilot System health Report Unit 1 from System IQ, Nov 2023
- KGR-008, Guide for the Analysis and Classification of Defects on Civil Buildings and Structures, revision 2, 2022-06-21
- 08016.ODCOF.263 for OD_6.12 NEW & OD_7.47 A new Liner Programme for the Spent Fuel Pool liners, Reactor Pool liners and all Steel & Epoxy Lined Sumps, dated 2023-06-21.
- KGU-002, The Guide for System Engineers, 2021-07-26
- KGU-031, System Health Reporting Guide, 2020-12-07

4.3 – RESOLUTION DEGREE:

1.	**Insufficient progress to date**	
2.	**Satisfactory progress to date**	
3.	**Issue resolved**	X