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CONTENTS

FIGURES

1. INTRODUCTION

Eskom intends operating Koeberg Nuclear Power Station (KNPS) beyond its nominal design life of forty years. This has become standard nuclear industry practice. By applying good asset management and performing a specific, plant ageing-related safety assessment, nuclear plant lifetimes of over 60 years are achievable.

This document provides the methodology that Eskom will use for performing the nuclear safety assessment and associated safety demonstration for Koeberg to continue operation until at least 2045.

2. SCOPE

The scope of this document is limited to providing the methodology for how the safe operation for Koeberg Nuclear Power Station until 2045 will be demonstrated through the Safety Aspects of Long Term Operation (SALTO) review process.

2.1 PURPOSE

The purpose of this document is to stipulate the engineering and organisational methodologies that will be used in order to develop the required documentation and processes that will enable the extension of the life of the plant.

2.2 APPLICABILITY

This document shall apply throughout the Koeberg operating unit (KOU).

3. NORMATIVE/INFORMATIVE REFERENCES

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

3.1 NORMATIVE

[1] 240-101459264: The Strategy for Demonstrating Safe Long Term Operation for Koeberg Nuclear Power Station.

[2] IAEA Safety Reports Series No. 57: Safe Long Term Operation for Nuclear Power Plants.

3.2 INFORMATIVE

[3] 10 CFR 50.49: Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants.

[4] 10 CFR 50.55a: Codes and Standards.

[5] 240-101650256 - Ageing Management Matrix.

[6] 240-102103854 - Self-Evaluation 85540: Review of the Koeberg Plant Programmes to assess alignment with the IAEA Ageing Management Programmes.

[7] 331-4: Corrective and Preventative Action Procedure.

[8] 331-127: Cable Ageing Management Programme at Koeberg Operating Unit.

[9] 331-162: Pressure Equipment Regulation Pressure Vessel & Steam Generator Listing.

[10] 331-166: Environmental Qualification (EQ) Programme.

[11] 331-173: Requirements for Flow Accelerated Corrosion Programme.

[12] 331-175: Inspection Guide for the Koeberg Nuclear Power Station Corrosion Management Programme.

[13] 331-177: Process and Final Responsibilities for the Development and Implementation of the In-Service Inspection Programme.

[14] 331-272: Thermal Performance Programme.

[15] 331-275: Process for the development and control of ageing management matrix at KOU.

[16] 36-197: Koeberg Licensing Basis Manual (KLBM).

[17] ANSI N 18.2-1973: Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants.

[18] IAEA Safety Reports Series No. 82: Ageing Management for Nuclear Power Plants: International Generic Ageing Lessons Learned (IGALL).

[19] IEEE 308-1971: IEEE Standard Criteria for Class IE Electric Systems for Nuclear Power Generating Stations.

[20] JN195/NC/ESKOM/J2/365 Rev 0: KPNS Internal Flooding Analysis.

[21] JN377/AMEC/NCI/TR/6393/rev 1: Seismic Event Fall-Down Hazard Report.

[22] KAA-501: Project Management Process for Koeberg Nuclear Power Station Modifications.

[23] KAA 802: Leak Management Process.

[24] KAA-671: Management of License Binding Civil Surveillances at Koeberg Nuclear Power Station.

[25] KAA-709: Process for Performing Safety Screenings, Safety Evaluations, Safety Justifications and Safety Cases.

[26] KAU-029: Basis and Scope for Non-Licence Binding Civil Surveillances at Koeberg Nuclear Power Station.

[27] KAU-030: Basis and Scope for Licence Binding Civil Surveillances at Koeberg Nuclear Power Station.

[28] KBA 00 22 E00 006: NSSS Design Transients.

[29] KBA 0022 N NEPO NEPP 193: Steam Generator Management Programme.

[30] KBA 0028 NES MA ISI 02: In-Service Inspection Programme Requirements Manual.

[31] KBA 0028 NES MA IST 01 Third interval In-service testing programme Requirements manual.

[32] KBA00CHEMSPEC00: Koeberg Chemistry Specifications.

[33] KGU 036: Engineering Guide for Boric Acid Corrosion Control (BACC) Programme Management.

[34] KNC-001: Chemistry Operating Specifications for Safety Related Systems.

[35] KNC-002: Chemistry Operating Specifications for Availability Related Systems.

[36] KSA-021: Standard for In-Service Inspection Programme at Koeberg Nuclear Power Station.

[37] KSA-128: Civil Preventative Maintenance Strategy for Koeberg Nuclear Power Station.

[38] KSC-003: The Chemistry Programme.

[39] KSM-LIC-001: Requirements for the Control of Maintenance.

[40] NEI 97-06, Rev 2 (2005), Steam Generator Program Guidelines.

[41] NIL-01 Variation 18.

[42] Occupation Health and Safety Act and Regulations 85 of 1993.

[43] Regulatory Guide 1.89: Environmental Qualification of electric equipment important to safety for nuclear power plant.

4. DEFINITIONS

4.1 CLASSIFICATION

Controlled disclosure: Controlled disclosure to external parties (either enforced by law, or discretionary).

5. ABBREVIATIONS

Abbreviation	Description
AMP	Ageing Management Programme
AMM	Ageing Management Matrix
ANSI	American National Standards Institute
AR	Availability Related
ASCC	Assist Atmospheric Stress Corrosion Cracking
ASME	American Society of Mechanical Engineers
BAC	Boric Acid Corrosion
BACCP	Boric Acid Corrosion Control Programme
BAU	Business as Usual
BNI	Balance of Nuclear Island
CAMP	Cable Ageing Management Programme
CAP	Corrective Action Process
CFR	Code of Federal Regulations
CSR	Critical Safety Related
DER	Design Extension Related
ECMC	Engineering Change Management Committee
EDF	Électricité de France
EMS	Electrical Maintenance Services
EPG	Engineering Programmes Group
EPRI	Electrical Power Research Institute

Abbreviation	Description
EQ	Environmental Qualification
FAC	Flow Assisted Cracking
FOS	Functional Organisational Structure
FROG	Framatome Owners Group
HELB	High Energy Line Break
I&T	Inspection and Test
IAEA	International Atomic Energy Agency
IGALL	International Generic Ageing Lessons Learned
IMS	Instrumentation Maintenance Services
INPO	Institute of Nuclear Plant Operators
ISI	In-Service Inspections
ISIPRM	In-Service Inspection Programme Requirements Manual
IST	In-Service Testing
ISTPRM	In-Service Testing Programme Requirements Manual
ISTPRM	In-Service Testing Programme Requirements Manual
KLBM	Koeberg Licensing Basis Manual
KNPS	Koeberg Nuclear Power Station
KOU	Koeberg Operating Unit
LOCA	Loss of Coolant Accident
LOPP	Life of Plant Plan
LTAM	Long Term Asset Management
LTO	Long Term Operation
MIC	Microbiology Induced Corrosion
NCR	Non-Conformance Report
ND	Non-Destruct
NDE	Non-Destructive Examinations
NEI	Nuclear Energy Institute
NNR	National Nuclear Regulator
NSA	No Safety or Availability Function
NSSS	Nuclear Steam Supply System
NTP	Nuclear Technical Plan
OEM	Original Equipment Manufacturer
PER	Pressure Equipment Regulation
PLEX	Plant Life Extension
PSA	Probabilistic Safety Analyses/ Assessment
PSR	Periodic Safety Reassessment

Abbreviation	Description
PWROG	Pressurized Water Reactor Owners Group
RCP	Reactor Coolant System (Primary System)
RPV	Reactor Pressure Vessel
RVP	Reactor Vessel Programme
SALTO	Safe Aspects of Long Term Operation
SAP	Systems, Applications, and Products
SAR	Safety Analysis Report
SDE	System Design Engineering
SG	Steam Generator
SGMP	Koeberg Steam Generator Management Programme
SR	Safety Related
SRA	Safety Re-Assessment
SRSM	Safety Related Surveillance Manual
UT	Ultrasonic test
WANO	World Association of Nuclear Organisation

6. RELATED / SUPPORTING DOCUMENTS

This document expands on the method of achieving the LTO strategy documented in 240-101459264 (The Strategy for Demonstrating Safe Long Term Operation for Koeberg Nuclear Power Station).

7. METHODOLOGIES RELATED TO LTO

Demonstration of long term operation (LTO) can be achieved in a number of ways. Eskom has selected the approach provided by International Atomic Energy Agency (IAEA) in LTO guidance publications as an internationally acceptable way to achieve the LTO objective. As per the IAEA SALTO process, utilities are required to select safety related plant equipment for review, perform specific ageing analysis and review all age related design inputs. In addition, all established processes and procedures required to support ongoing plant operation must be reviewed and adjusted, if required for LTO.

Eskom has decided to implement all ongoing aspects of LTO into business as usual (BAU) processes in existence at the KOU. The reason for this decision is that all ongoing activities related to LTO are required until end of plant life. Some once-off activities such as inspections, verifications, studies are to be performed as part of the Koeberg SALTO Assessment Project and captured in reference documentation. For the Koeberg SALTO Assessment Project Eskom will use the ageing lessons learnt and documented in International Generic Ageing Lessons Learned (IGALL) in a comparative manner. This document describes how the LTO objective is to be achieved through adaption of the engineering programmes and processes. It also provides a perspective on what is already established and considered as business as usual.

7.1 FEASIBILITY OF LTO

Eskom completed an economic study associated with Plant Life Extension (PLEX) which concluded that although capital investment for component replacements will be required, there is no known life-limiting component (that is impossible to repair or replace) which would preclude safe plant life extension of the Koeberg units to 60 years. A feasibility study in the form of the Long Term Asset Management (LTAM) Business Case was then performed taking into account the techno-economic considerations of PLEX and found PLEX to be strongly viable. The LTAM Business Case was consequently presented to and approved by the Eskom Board of Directors.

7.2 SALTO SCOPING

Design safety class (1/2/3/1E/NC) - defines the impact on nuclear safety of functions, systems, components, structures, parts and software in accordance with the criteria defined in ANSI/ANS N18.2-1973 and IEEE 308-1971 for mechanical and electrical requirements respectively.

The Koeberg nuclear original equipment manufacturer (OEM), Framatome, now AREVA, originally provided a design classification for the plant. This classification system is used to derive the deterministic equipment and construction specifications for the plant by classifying the components into Design Safety Classes (1/2/3/1E/NC) based on ANSI N 18.2-1973 (*Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants*) and IEEE 308-1971 (*IEEE Standard Criteria for Class IE Electric Systems for Nuclear Power Generating Stations*) for mechanical and electrical requirements respectively.

However, because of the fact that the original Koeberg Safety Case, used for licensing, considered the inputs from probabilistic safety analysis (PSA), the purely deterministic classification system needed to be adapted to incorporate the knowledge from the PSA. For this reason, Eskom implemented, over and above the traditional deterministic classifications, an additional classification, called the Importance Classification.

This system classifies equipment in groups of: Critically Safety Related (CSR), Safety Related (SR), Availability Related (AR) and Not Safety or Availability Related (NSA). The process originally allowed for risk informed knowledge to be incorporated into the classification system. It was subsequently expanded to include:

- information and influences obtained from periodic safety re-assessments (PSR), and
- plant assessments performed in response to industry concerns as well as the related specific plant walk downs.

Following the Fukushima Daiichi event in 2011 Eskom decided to introduce a new classification category for Koeberg called, Design Extension Related (DER), which will, once implemented, identify the equipment that is required during an event beyond the design base assumptions of the plant, but which are not already CSR/SR.

Figure 7-1: Importance classification hierarchy portrays how the importance categories are implemented. Any piece of equipment that could be classed in multiple categories will be assigned the highest relevant classification.

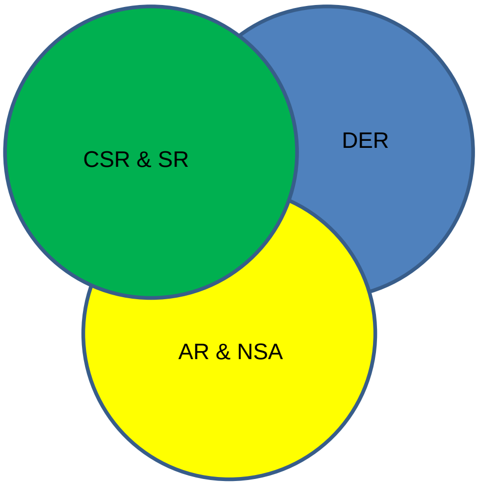

Figure 7-1: Importance classification hierarchy

The Koeberg classification system furthermore incorporates a seismic category which stipulates the level of seismic performance and assurance that is required from the equipment. This classification system incorporates the consideration that some equipment that is not necessarily safety related (NSA) could pose a risk to safety related equipment. In such a case the seismic classification of such equipment is classified as Non Destruct (ND). It must be noted that recent seismic and flooding studies have identified additional items to be uprated to ND. The interrelationship between the different classifications at Koeberg is portrayed in **Figure 7-2: Design classification interrelationship at Koeberg**.

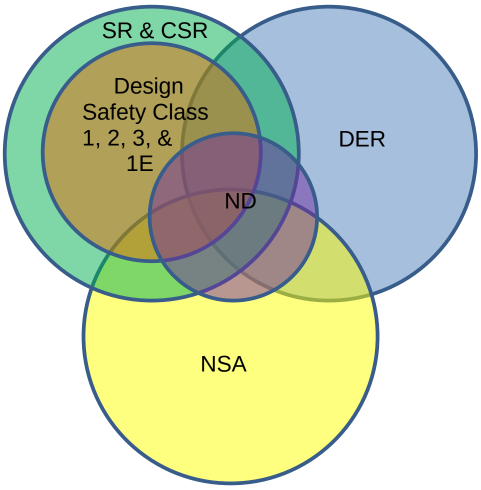

Figure 7-2: Design classification interrelationship at Koeberg

This classification system is a live system that allows Koeberg to continuously make modifications to the classification of equipment as the knowledge regarding the plant improves over time. The combination of the considerations to classify equipment as CSR/SR (which incorporates items classified as design safety class 1, 2, 3 or 1E) and as seismic classification ND is therefore aligned to what is required by the scoping considerations in IGALL as stipulated in IAEA Safety Reports Series No. 82 (*Ageing Management for Nuclear Power Plants: International Generic Ageing Lessons Learned (IGALL)*). This has resulted in Koeberg having a current list of equipment that is continuously reconsidered and improved, which will form the basis of LTO scoping. For this reason there exists no benefit in reconsidering all the equipment on the plant for the purposes of developing a standalone scoping list for LTO.

Some groups of equipment, which do not get used in the normal plant operational documentation, do not carry the standard plant equipment identifiers. This equipment will therefore not be listed under the standard classification listings. Examples of this equipment are electrical cables and cable trays. For electrical cables, the classification depends on the auxiliary components that are supplied.

A comprehensive listing of plant equipment with detailed classifications is found in SAP, a business software package designed to integrate all areas of a business. The scope for LTO will be drawn from SAP and will include:

- Class 1, 2, 3 and 1E design safety class equipment;
- SR and CSR importance category equipment (augmented with relevant cable and cable tray listings); and
- ND seismic category equipment;

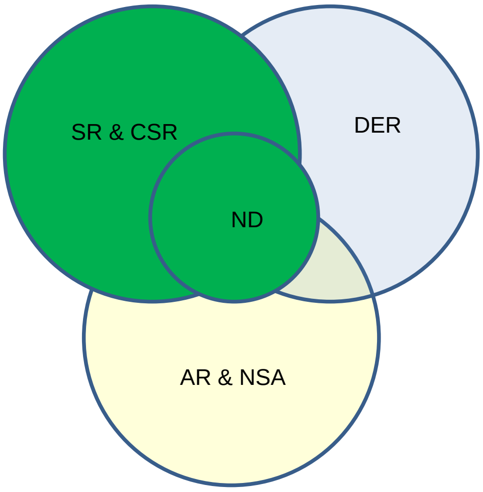

Figure 7-3: Scoping for Koeberg SALTO

Once the scoping list has been extracted from SAP for screening, it will be revision controlled and updated appropriately with relevant plant changes during the SALTO preparation process. This will include alterations due to modifications such as the SG and PTR tank replacement modifications.

Figure 7-4 below provides a simplified but systematic process that will be used at to determines which of the many SCs listed on SAP are to be included in the scope of the LTO.

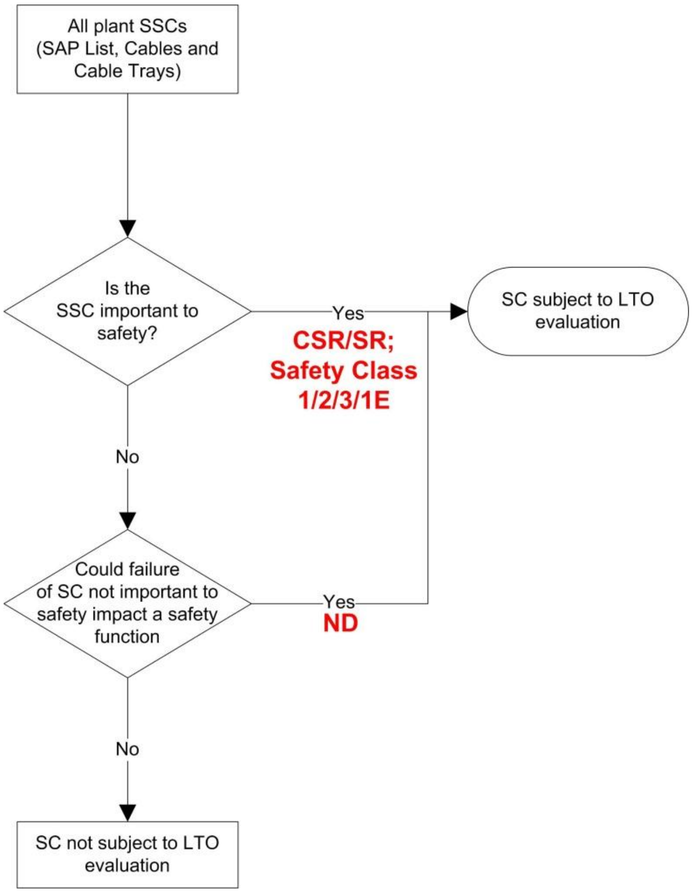

Figure 7-4: Scoping flow diagram for Koeberg SALTO

SCs determined to be within the scope of LTO as described above are subject to a screening assessment to determine which SCs are subject to revalidation of analyses that involved time limited assumptions and which SCs require evaluation of programmes for managing ageing.

7.3 SALTO SCREENING/ KOEBERG AGEING MANAGEMENT MATRIX

The requirement of screening in the SALTO process requires the review of all in scope equipment to identify potential degradation and ageing effects in accordance with Figure 7-5 and Figure 7-6. Koeberg intends to utilise the existing ageing management matrix (240-101650256) to perform this task.

The Koeberg ageing management matrix (AMM) was developed based on international benchmark and an internal Eskom requirement to ensure all equipment ageing and degradation is being managed. Development of a comprehensive ageing matrix is a huge task and as the CP1 units of Électricité de France **(**EDF) are very similar to Koeberg, it was decided to start with the EDF ageing matrix and adjust it to make it Koeberg specific. The ageing matrix of EDF is a spreadsheet that represents all safety related equipment against all potential degradation stemming from the operating environment and use. Where the degradation could be confirmed (or potential thereof) a “couple” is created. The equipment could have multiple degradation mechanisms and therefore the relationship between the equipment and the couples can be one-to-many i.e. there could be multiple couples for each item of equipment.

Each couple is then independently evaluated and confirmed to be managed, often by means of one of the existing plant programmes. Where gaps are identified, these are tracked until resolved as "fully managed". A review and adaptation of the EDF matrix has resulted in the generation of the AMM. The process stipulated in 331-275 (*Process for the development and control of ageing management matrix at KOU*) will be followed for controlling the AMM. Each ageing couple is assessed with regard to resolution, in line with the guidelines as stipulated by the IAEA methodologies, i.e. disposition (through engineering position papers), ageing management programme (AMP), time limited ageing analysis (TLAA) or replacement. One of the SALTO screening actions is to verify that all Koeberg equipment have been considered/included in the AMM. The other SALTO action is to review the couples for adequate LTO management.

Both international and internal operational experience and knowledge are included into the matrix. The information is mostly obtained through the engineering links discussed under Knowledge Management. In most cases, this information results in the detail in the ageing matrix being augmented. However, in some cases it results in the creation of new couples. A couple can be resolved through one of four interventions as reflected in Figure 7-5:

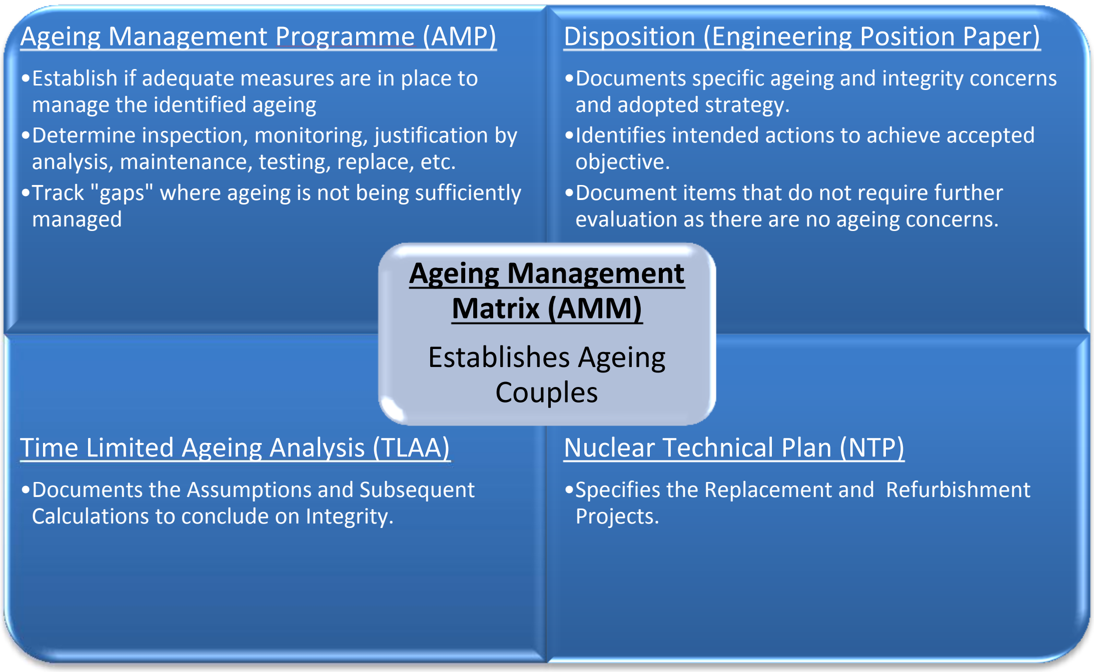

Figure 7-5 : Ageing Management Matrix (AMM)

7.3.1 Disposition

Ageing effects can be dispositioned at the level where the couple is identified. These arguments are documented in a number of supporting documents which could include, engineering position papers, specialised studies and research papers. The reference to the supporting documents will be reflected in the AMM.

7.3.2 Ageing Management Programme (AMP)

Where an ageing mechanism requires resolution through inspection and tracking, the resolution is transferred to one of the AMPs or one of the classical engineering programmes. The reference to the specific chapter in the AMP is provided in the AMM. Koeberg has implemented a number of AMPs as listed in Section 7.5.

Koeberg has furthermore already identified the need to implement the following additional AMPs:

- Reactor Vessel Programme (RVP);
- Bolting;
- Ground Water Monitoring.

Other necessary programmes will be identified during the Koeberg SALTO Assessment Project as well as those stemming from the EPG routine self-evaluation report, 240-102103854 (*Self-Evaluation 85540: Review of the Koeberg Plant Programmes to assess alignment with the IAEA Ageing Management Programmes*).

The inspections stemming from the programmes are performed by relevantly skilled groups in KOU, including SDE (civil monitoring), IMS, EMS (and inspection and test (I&T) group. These groups plan, qualify and perform all required inspections as well as the tests that inform plant integrity. If an inspection or test does not meet the required parameters, a defect is submitted to the maintenance department in order to repair the plant. In cases where the plant cannot be repaired in time, but a case can be made to justify further operation for a limited period of time, the system engineer makes use of the non-conformance process (NCR) to document an argument for continued operation. Depending on the safety significance of the failure, this argument could extend to a safety evaluation or justification in accordance with KAA-709 (*Process for Performing Safety Evaluations, Screenings, and Safety Justifications*).

All programmes will be reviewed against the nine attributes listed in the IAEA standards and, where applicable and achievable, will be aligned.

7.3.3 Time Limited Ageing Analysis (TLAA)

The Koeberg Safety Analysis Report (SAR) discusses and references a number of TLAAs originally performed when the station was designed. However, these are not listed in any particular section of the SAR and forms part of the general design base of the station. Since Eskom follows the EDF methodology a number of TLAAs are kept current by being updated on a periodic basis. Examples of the TLAAs that are being kept current are:

- Reactor vessel fluence;
- Containment tendons;
- Equipment Qualification.

The Koeberg SALTO Assessment Project will identify and update all the TLAAs that are required to extend the design of the plant beyond 40 years.

For the Koeberg SALTO Assessment Project a review will be performed of the existing TLAAs as documented in the SAR. Where required these will be updated, re-analysed and justified to meet the LTO objective. An evaluation of expected TLAAs (as per IGALL) will be performed to confirm that these are not required by Koeberg or they will be developed or generated if they are required.

7.3.4 Replacement Plan

The Koeberg system engineers maintain life of plant plans (LOPP) for the plant systems in accordance with KGU-011 (*Preparation of Life of Plant Plans (LOPPs)*). These documents discuss the system conditions and specify all the major maintenance, refurbishment and replacement work that will be done for the remaining operational life of the plant. The LOPPs form the technical and financial basis of the Station Life of Plant Plan (that span a 60 year operational life) and the Nuclear Technical Plan.

Eskom furthermore conducts periodic safety reviews (PSRs) to identify areas where the plant or processes have potentially fallen beyond world norms and practices. The outcomes of these assessments result in actions to be implemented, some of which are for the upgrade of plant equipment and installation of new systems and features.

All these items are incorporated into the nuclear technical plan (NTP) which is updated every year. This plan also lists all the upgrades and replacements that are required for extending the life of the plant. The plan currently covers the next 10 years, but will be updated to reflect the full anticipated life of the station, including decommissioning.

Figure 7-6 below shows a screening process to identify SCs for which safety analyses need to be revalidated or for which plant programmes need to be reviewed and modified or new programme initiated.

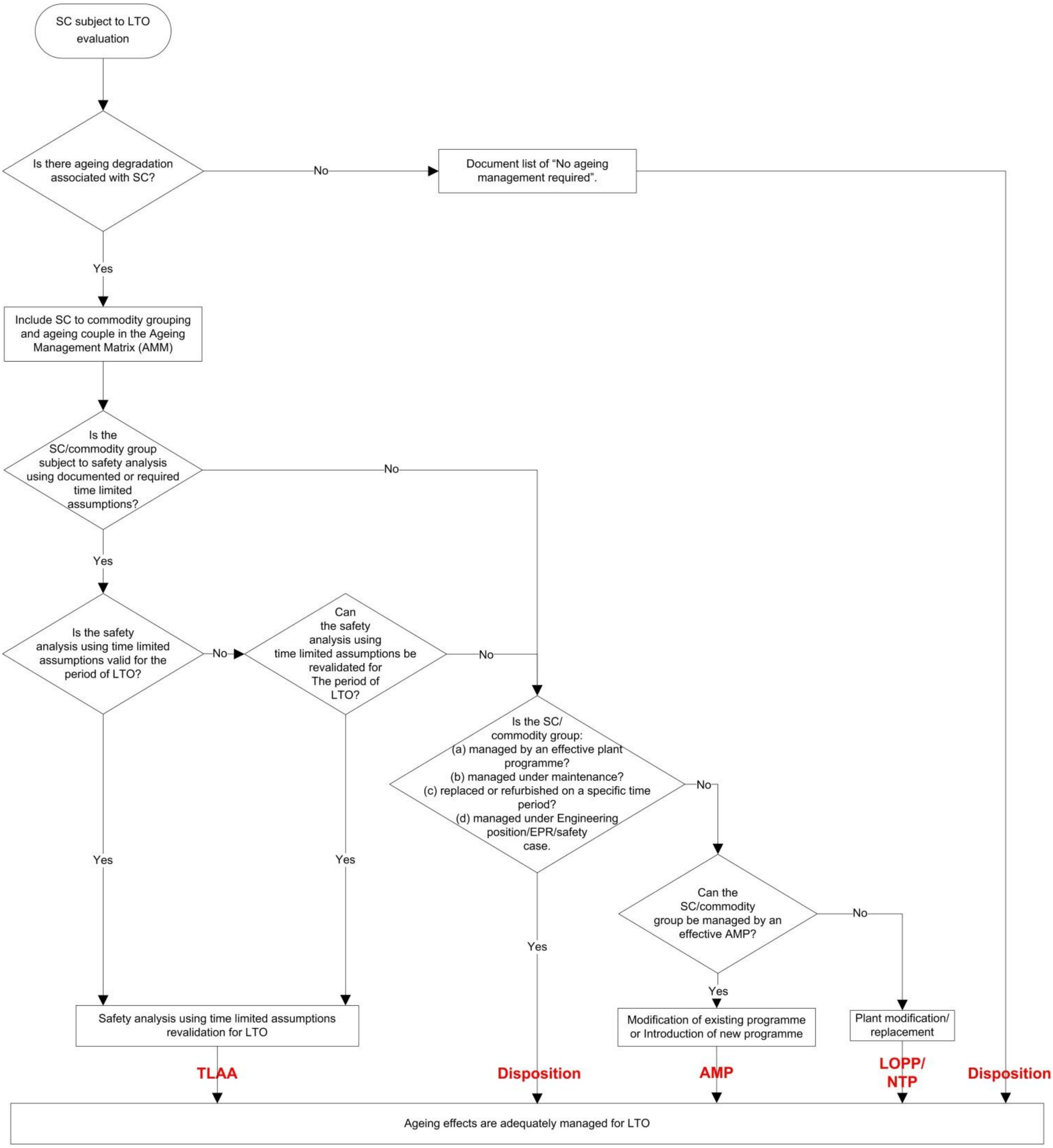

Figure 7-6: Screening flow diagram for Koeberg SALTO

7.4 KNOWLEDGE SOURCES

Figure 7-7: Design References

In order for Koeberg to identify potential ageing mechanisms that might affect plant components, the plant has working relations and memberships with a number of organisations. Eskom uses the engineering information and experience from these organisations, which represent different levels of industry alignment and design representation, to update the design and ageing matrix. Figure 7-7 lists these organisations that Koeberg uses to inform the ageing mechanisms that are incorporated into the matrix. The sources are listed in order of detailed design applicability.

These organisations are the following:

7.4.1 Reference plants

Koeberg is a Framatome (now Areva) constructed CP1 series plant. Koeberg was the first nuclear power plant constructed by Framatome, outside of France. For this reason the equipment at Koeberg is, in many cases the same as the equipment installed on the EDF operated CP1 power plants. Eskom has therefore, since the construction of Koeberg, maintained a close relationship with EDF, with Tricastin being the reference plant for Koeberg and also used as the Safety Re-Assessment (SRA) reference plant for Koeberg.

Eskom therefore often uses the knowledge base and operational experience inside EDF. Long term contracts between Eskom and EDF ensure that this environment of mutual cooperation is maintained.

These contracts provide Eskom with access to EDF information and documentation to assist with the safe operation of the station. A large proportion of this information pertains to ageing of plant equipment.

7.4.2 Industry links

South Africa and therefore, by implication, Eskom is a member of the IAEA. Through this membership KOU has access to industry knowledge and experience with regard to the IGALL. This information provides a consolidated reference for the latest information with regard to equipment ageing.

7.4.3 OEM links

Eskom has maintained a close relationship with AREVA, the Koeberg nuclear OEM. This relationship is supported through long term contractual agreements.

Eskom is furthermore a member of the Framatome Owners Group (FROG), which consists of all the utilities who operate nuclear power plants using Framatome and AREVA designed and constructed Nuclear Steam Supply Systems (NSSS). Through this forum Eskom receives knowledge regarding operational challenges and concerns which includes equipment ageing and degradation.

7.4.4 Technology links

Eskom is a member of the Pressurized Water Reactor Owners Group (PWROG), to which most utilities that operate pressurized water reactors (PWR) belong. Through this membership KOU has access to industry knowledge and experience.

7.4.5 Research links

Eskom is a member of the Electrical Power Research Institute (EPRI) which performs extensive research on issues affecting the nuclear power industry. EPRI has published a vast set of technical documentation detailing engineering and operational information that is used by KOU to maintain the level of knowledge in line with international norms.

7.4.6 Corrective action process (CAP)

The corrective action process (CAP) at Koeberg is followed to identify and capture data related to Non-Conformities, events and incidents, the investigations of their cause, the recording and tracking to completion, and the effectiveness review of all actions taken to correct the situation and prevent recurrence. Ageing related non-conformities at Koeberg are identified and addressed through this process.

7.5 PLANT PROGRAMMES

Over the operational life of Koeberg, the need for various plant programmes has been recognised and programmes established as required. At times the need was driven by regulator demands while other times the basis was safety or asset management considerations or international benchmarks. These programmes also provide a part of the overall operational safety assurance. Each of these programmes, in some form or fashion, scopes the equipment that is included in the programme according to a declared classification system. The programmes are listed below and are briefly described in Appendix A:

- Safety Related Surveillance Manual (SRSM);
- In Service Inspection (ISI) Programme;
- In Service Testing (IST) Programme;
- Maintenance;
- Chemistry Programme;
- Fatigue Monitoring (NSSS Design Transient) Programme;
- Steam Generator (SG) Programme;
- Boric Acid Corrosion (BAC) Programme;
- Flow Accelerated Corrosion (FAC) Programme;
- Microbiologically Induced Corrosion (MIC) Programme;
- Atmospheric Stress Corrosion Cracking (ASCC) Programme;
- Corrosion Monitoring Programme;
- Civil Structures Monitoring Programme;
- Cable Ageing Management Programme (CAMP);
- Environmental Qualification (EQ) Programme;
- Pressure Equipment Regulation (PER) Programme;
- Obsolescence Programme;
- Fire Systems Programme.

7.6 DOCUMENTATION

Design information can be considered in six different categories as represented in Figure 7-8. These categories are subdivided into two groups being the plant design and the operational documentation.

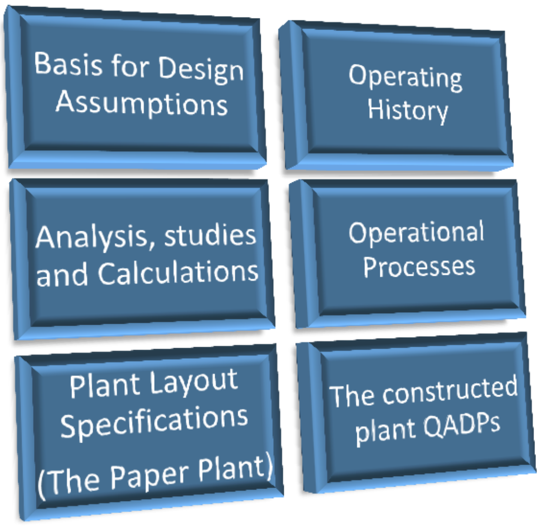

Figure 7-8: Documentation Management

Figure 7-8: Documentation Management provides a graphic representation of the areas that were considered for configuration management:

- The basis for the design assumptions refers to the original assumptions and considerations on which the original ANSI/ANS design codes and methodologies were based. This information is generally available from the OEMs on request and will not be reconstituted.
- Analysis, studies and calculations is the information supporting the plant design and layout. This documentation provides the justification and detailed engineering analysis proving the design and confirming that it is safe. The safety analysis for the plant is currently being updated as part of the steam generator replacement project. The rest of the documentation applicable to LTO will be updated as part of the TLAA revalidations.
- The plant layout and specifications represent the actual paper plant. The documentations stipulating the detailed plant is well configured and managed. However, a lot of the original documentation is degrading with time. In order to preserve this information Eskom will be recapturing it in electronic format as part of the LTO activities.
- The constructed plant represents the documentation which provides proof that the plant was constructed according to the requirements of the "paper plant". The documentation which is required to be updated in order to provide validation of the TLAAs will be revisited as part of LTO.
- Operational processes refer to the standard operation processes documentation. This suite of documentation will be unaffected by LTO and will not be updated as part of the Koeberg SALTO Assessment Project.
- The operating history of the plant is populated on an ongoing basis. The processes that create this documentation have been considered and needs some minor improvements.

7.7 ORGANISATION AND SKILLS FOR LTO

The LTO scope of work can be split into two distinct areas:

- SALTO preparation: Once off bulk work and process improvements that are required in preparation of the SALTO mission prior to entering LTO.
- "Business as usual" work that is already in place at KOU and will continue through LTO, but may need to be increased to accommodate for engineering and maintenance of the ageing plant.

7.7.1 SALTO Preparation work

7.7.1.1 Once-off bulk work

The once-off bulk work involves the work that is required to be done only once and that will not become part of the business as usual. This scope of work has a definite start and end and is grouped into the following categories:

- Validate the current equipment scoping for which Koeberg will be using the classification process.
- Update the ageing matrix with any new operational experience and new knowledge stemming from a comparison with IGALL.
- Update the existing AMPs as required;
- Develop and implement new AMPs;
- Update all the affected TLAAs, or create new items as required;
- Document the results of the Koeberg SALTO Assessment Project in comprehensive report format.

In accordance with the strategy document, this work will be performed by external resources that will be contracted into the organisation. For the once off bulk work the skills of the personnel that will be contracted will be stipulated by the specification used in the contract. Each contractor will be required to prove the competence of each individual through a process equivalent to the Koeberg processes.

Informed buyer skills will be resourced internally making use of the newly acquired skills trained under the steam generator replacement project.

7.7.1.2 Once off process improvements

Once off process improvements involves the updating and improving of the current business as usual processes and associated documents. This work will be performed by the permanent Eskom employees with support from contracted resources through the Koeberg SALTO Assessment Project.

7.7.2 Business as usual

The business as usual work refers to the continued updating and maintenance of the plant documentation and equipment using the current processes as well as the new and updated programs and ageing matrix within the updated processes once implemented. The work scope has no definite start or end. This work has always been and will in future be performed by the permanently employed Eskom staff. This staff compliment will have to be assessed as a result of the additional scope of work that will result from the Koeberg SALTO Assessment Project. Standard training and authorisation activities will be required for any new positions/staff.

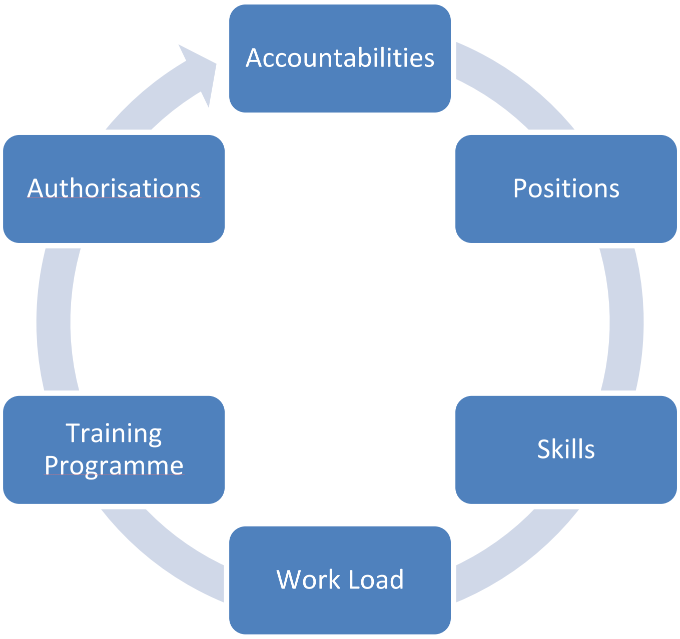

Figure 7-9: Skills Management

In accordance with **Figure 7-9: Skills Management**, the Koeberg processes are driven through a set of accountabilities. Accountabilities are listed in the departmental and group mandates, also referred to as functional organisation structures (FOS). These mandates will have to be elaborated into specific positions and job descriptions.

Each area requiring specialised skills has to develop a skills matrix. This matrix links the technical outputs of a particular job or task to the skills that are required in order to perform such a task. The skills matrix stipulates both the types of jobs and the required quantities of the respective number of individuals. The skills matrix therefore links each of these jobs to the skill associated with each task that needs to be performed and subsequently concludes on number of skills required. The number of skills required is cascaded into a document stipulating the expected work load.

Each group requires the development of a Training Programme stipulating the training curriculum that will be used to ensure that staff obtain and maintain all the required capabilities, knowledge and specialised skills that an individual needs in order to be authorised to perform a certain function. For each skill set there needs to be an initial qualification curriculum and a recurring training curriculum. The training curriculum is managed through a formal training process being governed by the Engineering Curriculum Management Committee (ECMC).

The organisation has to ensure that each job position is filled with and each task is performed by a suitably skilled and competent person. When an individual is ready to be authorised, the organization has to have a process that confirms the individual to be competent after which the individual is authorised in writing to perform a certain set of duties.

In order to consistently ensure there are enough technical skills at Koeberg while also making sure that new, younger, people are introduced into the business, the Koeberg senior management tries to keep the staff attrition between 4 and 6 percent per year. This is done by making use of retention initiatives or separation initiatives.

7.8 REGULATORY REVIEW

The NIL-01 licensing conditions were considered in determining the regulatory approval process that is appropriate for LTO approval. NIL-01 does not specify a license termination period so a change to NIL-01 is not required. NNR approval will however be required for changes to the SAR and the associated safety evaluation or safety justification as required in terms of KAA-709 (*Process for Performing Safety Evaluations, Screenings, and Safety Justifications*). It is also anticipated that several other licensing basis documents will require an update and subsequent approval by the NNR. This will include the updated approach to ageing management at Koeberg. Additional licensing basis documents will be identified during the course of the Koeberg SALTO Assessment Project. For this purpose, in order to maintain rigorous configuration control, the KAA-501, (*Project Management Process for Koeberg Nuclear Power Station Modifications*) procedure will be applied.

Within the South African regulatory framework, Eskom will utilize the IAEA SALTO process as the core set of guidelines for assessing and updating the Koeberg licensing basis for LTO and obtaining necessary regulatory approvals, in accordance with KAA-709 (*Process for Performing Safety Evaluations, Screenings, and Safety Justifications*).

Revisions

Date	Rev.	Compiler	Remarks
November 2015	0	D Bissell	Original document.

APPENDIX A: KOEBERG PLANT PROGRAMMES (LTO RELATED)

A.1 SAFETY RELATED SURVEILLANCE MANUAL (SRSM)

The SRSM lists the set of tests that have to be performed on a periodic basis to demonstrate the compliance of the plant systems and components to the accident analysis and to validate the input assumptions of the accident analysis.

A.2 IN SERVICE INSPECTION (ISI) PROGRAMME

Koeberg In-Service Inspection Programme Requirements Manual (ISIPRM) is based on ASME Section XI as modified by 10CFR 50.55a and augmented by manufacturing and operating experience. The implementation of the Koeberg ISI programme is a statutory licensing requirement as stated in KLBM and NIL-01 Variation 18 and documented in KSA-021 (*Standard for the In-Service Inspection Programme at Koeberg Nuclear Power Station*).

The main purpose of the ISI programme, notwithstanding regulatory compliance itself, is to ensure monitoring for the detection and characterisation of in-service degradation. This programme is conducted over the life of the plant. By the application of non-destructive examinations (NDE), in-service inspections are conducted periodically to look for change from the baseline fingerprint.

Where changes in conditions are identified, they are evaluated against acceptance standards detailed in the ISIPRM as derived from ASME Section XI, for acceptability or found acceptable through engineering evaluation or made acceptable by repair replacement activities.

A.3 IN SERVICE TESTING (IST) PROGRAMME

The In-Service Testing Programme Requirements Manual (ISTPRM) is developed in accordance with the American society of mechanical engineers (ASME) OM Code subject to limitations and modifications of 10CFR50.55a(b)(3). This is documented in KBA 0028 NES MA IST 01 and controlled by the Koeberg licence binding standard KSA 021 and the administrative procedure 331-177.

The ISTPRM establishes active equipment testing and examination requirements to assess the operational readiness of safety related components that are important in fulfilling a nuclear safety role and check for degradation from the last performed test. The scope comprises the following:

- pumps and valves required to perform a specific function in shutting down the reactor to the safe shutdown condition, to maintain the safe shutdown condition, or to mitigate the consequences of an accident;
- pressure relief devices that protect systems or portions of systems that perform one or more of the above three functions from a design base overpressure condition;
- dynamic restraints (snubbers) used in systems that perform one or more of the three functions or ensure the integrity of the reactor coolant pressure boundary.

A.4 MAINTENANCE

The plant maintenance programme has been updated based upon the recommendations contained in INPO AP-913, (*Equipment Reliability Process Description*) and also aligned with the methodology employed by EDF.

The top tier document governing the maintenance process is KSM-LIC-001, (*Requirements for the Control of Maintenance*). This document provides the high level requirements and controls needed for the maintenance process to ensure compliance with the requirements of the Nuclear Licence. National Nuclear Regulator (NNR) approval is required for changes to this document. This document prescribes the high level requirements for the control of:

- The PM basis;
- Planning and scheduling of work;
- Working documentation;
- Failure analysis and the integration of operating experience;
- Execution of work;
- Post-maintenance requalification;
- Equipment history and plant asset configuration;
- Programme compliance;
- Maintenance effectiveness and performance monitoring;
- Action plans;
- Quality;
- Staff training and authorisation.

The existing maintenance requirements have been derived from supplier recommendations, international benchmarks and operational experience. The requirements are captured in SAP that automatically downloads the regularly performed maintenance and described in service notes that provide preparation and execution details. Ad-hoc maintenance and repairs are performed when required and controlled via a work control planning function that is based on a 12 week schedule.

A.5 CHEMISTRY PROGRAMME

Koeberg makes use of the EPRI chemistry guidelines to manage the chemistry programme which is described in:

- KSC-003 (The Chemistry Programme);
- KBA00CHEMSPEC00 (Koeberg Chemistry Specifications);
- KNC-001 (Chemistry Operating Specifications for Safety Related Systems);

- KNC-002 (Chemistry Operating Specifications for Availability Related Systems).

On primary plant, an elevated pH programme is established to minimise corrosion of system materials. Zinc acetate is injected to reduce out-of-core radiation fields and it also helps with reducing PWR SCC crack initiation. On secondary plant, a volatile amine is injected and has been optimised to have protection from FAC in both water and steam phase. Feedwater iron is measured to determine effectiveness of the treatment and to have knowledge regarding material transport to the SGs.

The primary system chemistry is controlled according to the EPRI PWR Reactor Primary Water Guidelines, Revision 7. There are control parameters for the safety related and most critical parameters for corrosion control. Limit values, target values, surveillance frequencies and actions to take when control limits are exceeded are listed and complied with. There are surveillance frequencies and limits for diagnostic parameters which are also complied with. Secondary system water is treated with ethanolamine and ammonia to maintain a favourable pH for mitigation of FAC especially in the two-phase regions. Reducing conditions are maintained by the addition of hydrazine. Aggressive impurities are eliminated by employing strict criteria on demineralised make-up water and chemical quality control. All auxiliary circuits have chemical control regimes related to enhancing long-term operations and reducing corrosion.

A.6 FATIGUE MONITORING (NSSS DESIGN TRANSIENT) PROGRAMME

The Nuclear Steam Supply (NSSS) Design Transients Accounting Programme ensures that all fatigue related transients are identified, accounted for and confirmed to be within design analysis criteria for the life cycle of the NSSS and balance of nuclear island (BNI) auxiliary systems. Any change or variation of plant or system temperature or pressure parameters affecting a section or all of the RCP and auxiliary systems that exceed an established or design threshold (set point) is required to be accounted for.

The evolution of an accountable transient generally follows Framatome's NSSS design transient curves determined for Koeberg (document reference KBA 00 22E 00 006). All fluid system pressure, temperature and flow transients have been considered when designing the reactor coolant system components. Each transient or steady state condition is classified under the ASME Section III NB design code as Category I (Design), II (Normal and Upset), III (Emergency) and IV (Faulted). Each transient has a maximum allowable number of cycles/occurrences for the life of the station. The allowed number of cycles combined with the component stresses generated when moving from one plant state to another determine the ASME Section III NB design code cumulative usage factor for the component. This value must be less than 1 to ensure that fatigue initiation does not occur during the lifetime of the plant.

The Koeberg transients are constantly recorded and documented and verified to remain within the window provided by the original TLAA for the plant.

A.7 STEAM GENERATOR (SG) PROGRAMME

The Koeberg Steam Generator Management Programme (SGMP) encompasses the inspection, repair and online monitoring of the steam generators. KBA 0022 N NEPO NEPP 193, (*Steam Generator*

Management Programme), describes the various elements of this programme which is in line with NEI 97-06, Rev 2 (2005), (*Steam Generator Program Guidelines*).

Koeberg has decided to align the monitoring and management of the SGs to the EDF PBMP (maintenance basis) and strictly follow the requirements for SG monitoring and inspection.

A.8 BORIC ACID CORROSION (BAC) PROGRAMME

The Boric Acid Corrosion Control Programme (BACCP) was developed following the Davis-Besse RPV head wastage incident. As a response to this incident and other boric acid corrosion incidents elsewhere in the world - US (Generic Letter GL 88-05) and France (Affaire Parc AP 9202) - Koeberg took a decision to develop BAC programme to manage the risk associated with boric acid leaks and corrosion. The BACCP objectives are to ensure early detection of boric acid leaks and proper management of the situation when a leak has been identified

The programme guidelines are contained in KGU 036 and depend on the identification of boric acid leaks by specific leak search plant walkdowns undertaken by maintenance, I&T and plant system engineers. Once a leak is identified the evaluation is performed by the BAC engineer. Recovery actions are stipulated and, if required, the leak is included in the continuous leak management process covered by KAA 802 and administered by plant engineering.

A.9 FLOW ACCELERATED CORROSION (FAC) PROGRAMME

Koeberg adopted the EDF FAC programme, thus utilising the EDF developed BRT-CICERO software for FAC modelling and prediction. The vast EDF operating experience has been included in the approach. The software is used to calculate predicted corrosion rates based on the chemistry applied, the plant geometry and physical conditions, as well as actual wall thickness measurements obtained from ultrasonic test (UT) inspections. Based on the predictions inspection scopes are determined. Due to the difficulty of modelling the flow pattern of small bore piping, the software is not used to model piping under 3 inches in diameter. In this case the scope is determined from a susceptibility analysis.

All programme requirements are documented in 331-173 (*Requirements for Flow Accelerated Corrosion Programme*).

A.10 MICROBIOLOGICALLY INDUCED CORROSION (MIC) PROGRAMME

Microbiologically induced corrosion (MIC) has been observed in several systems and concerns were raised with regard to the safe operation of the plant as a consequence of such microbial activity. A programme for monitoring and management of MIC was developed based on potential susceptibility and the requirements documented in ISIPRM module AUG-15 rev 1.

A.11 ATMOSPHERIC STRESS CORROSION CRACKING (ASCC) PROGRAMME

Both units at Koeberg were identified to suffer from a low temperature SCC phenomena and required extensive equipment replacements and ongoing monitoring. Koeberg termed this phenomena atmospheric stress corrosion cracking (ASCC) and it affects essentially the grade 304 and grade 304L stainless steel components, due to exposure to the chloride laden marine environment. The phenomena has been described, justified and included in the SAR. The ongoing monitoring of ASCC resulted in an inspection scope that is clearly defined in augmented module 14 of the ISIPRM.

A.12 CORROSION MONITORING PROGRAMME

The Koeberg Corrosion Monitoring Programme was developed to manage the long-term effects of atmospheric and process-related corrosion on the reliability and overall availability of the entire plant. The programme provides for comprehensive monitoring of all equipment by visual means, identification of corrosion concerns, evaluation and planning of corrective actions and influencing the specified corrosion protection measures.

All programme requirements are documented in 331-175 – (*Inspection guide for the Koeberg Nuclear Power Station Corrosion Management Programme*). This programme has not been developed to execution stage.

A.13 CIVIL STRUCTURES MONITORING PROGRAMME

The management and monitoring of all civil structures from civil related degradation have led to the development of a programme that covers the entire plant. Specific safety related structures are specifically referenced in the nuclear licence and requires regular submissions to the regulator. The civil monitoring requirements are documented in standard KSA 128 and executed according to KAA 671. The frequencies of the inspections are conducted as required in the program schedules, KAU-029 and 030.

A.14 CABLE AGEING MANAGEMENT PROGRAMME (CAMP)

Based on international concern of especially medium voltage cable degradation with age and exposure, Koeberg embarked on a process to establish a cable ageing management programme. The development of the programme is based on gaining theoretical knowledge, identifying applicable scope, identifying specific cables that are at risk due to their environment and performing physical baseline tests. Thereafter regular cable testing and evaluation is to be established.

The CAMP scope requirements are in accordance with 331-127 (Standard for Cable Ageing Management Programme at Koeberg Operating Unit).

A.15 ENVIRONMENTAL QUALIFICATION (EQ) PROGRAMME

An Environmental Qualification (EQ) programme has been established and implemented to demonstrate that safety classified electrical and instrumentation & control (I&C) components located in harsh plant environments are qualified to perform their safety function in those surroundings even after the effects of in-service ageing. Harsh plant environments refers to those areas of the plant that could be subject to the harsh environmental effects of design basis events such as of a loss of coolant accident (LOCA), high energy line breaks (HELBs), main steam line break (MSLB) or post-LOCA radiation. The effects of significant ageing mechanisms are addressed as part of environmental qualification. The requirements for the Koeberg EQ programme are provided in 331-166 (*Environmental Qualification (EQ) Programme at Koeberg Operating Unit*). The programme has been developed in line with the US EQ Rule as stipulated in 10 CFR 50.49 (*Environmental Qualification of Electric Equipment Important to Safety at Nuclear Power Plants)*.

A.16 PRESSURE EQUIPMENT REGULATION (PER) PROGRAMME

The Koeberg requirements for the development and implementation of the Pressure Equipment Regulation (PER) Programme are derived from the pressure equipment regulations of the Occupation Health and Safety Act and Regulations 85 of 1993. The PER defines and regulates requirements such as manufacturing, inspection, testing, repair and modification of pressure equipment.

The regulations are applicable to manufacturers, importers, sellers and users of pressure equipment. The regulations require all pressure vessels to undergo a 36 monthly internal, external inspection and pressure test. It also offers the user of the equipment the opportunity to implement a risk based inspection (RBI) approach for each of its vessels.

At Koeberg, all the pressure vessels under the regulation are listed in 331-162 (*Pressure Equipment Regulation Pressure Vessel & Steam Generator Listing*). This list is used to generate the required inspections and tests.

A.17 OBSOLESCENCE PROGRAMME

Koeberg has a programme that continually evaluates the availability of spares critical to safety and production. Once a part or component is identified that is no longer available in the market, an equivalence request is submitted to specification engineering. An equivalence study is performed to identify a different part that would fit in the same position as the obsolete part and comply with the form and function of the original. If an equivalent part cannot be identified, a modification is raised for a new solution to be engineered.

A.18 FIRE SYSTEMS PROGRAMME

The Fire Protection System piping design is comprised predominantly of carbon steel. Hence, MIC remains a threat to the material condition of the system. Therefore, Fire System piping is included in the MIC (ISIPRM module AUG-15 rev 1) module described in Section A.10.

The compilation of the latest Fire Hazard Analysis for Koeberg Nuclear Power Station is currently in progress. Once complete, this information is expected to form part of a new Engineering Program with the purpose of ensuring that this document is always kept up-to-date.