AREVA

		Report No. (Department/Year/Language/Sequential No.)	Rev.
	Report	PESS-G/2010/en/0041	A
Subject/Title		Place	Creation date
Ageing Management Review - Methodology Report		Erlangen	2011-08-11

Project
Borssele

Handling
RESTRICTED AREVA
Export Classification (Reports with technical content)
AL: N ECCN: N

Proj.-Code	UAS	DCC	Contents Code	UNID	Additional document number
NDL002	BP	B DD		0620399584	

Summary Report pages: 41 Appendices: - Pages total: 41

At the end of 2013, Kerncentrale Borssele (KCB) will have been in operation for 40 years. As it is planned to extend the plant's lifetime until 2034, N.V. Elektriciteits-Produktiemaatschappij Zuid-Nederland (EPZ) is implementing a Long-Term Operation (LTO) assessment process in accordance with IAEA guidelines. This LTO assessment process is being performed to demonstrate that the plant can be safely operated until 2034.

Application of the LTO process will result in a series of Ageing Management Review (AMR) reports, which will be submitted to the responsible regulatory authority. Through a comparison of relevant ageing mechanisms and existing Ageing Management Activities it is demonstrated that ageing / degradation mechanisms are either properly managed or gaps are identified where adapted or additional activities should be implemented. This approach is in full compliance with IAEA guidance on LTO assessment.

The purpose of this document is to outline the general scope and methodology applied to perform each Ageing Management Review for Mechanical, Electrical and I&C as well as Structural Systems, Structures and Components (SSCs)

List of revisions

Rev.	Date	Chapter/page	Scope of the revision
A	Corresponds to the last release date (see cover page)	-	First issue

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2. List of Abbreviations, Plant ID Codes and Definitions

2.1 List of Abbreviations

AKS	Anlagen Kennzeichen System (Plant Identification Code)
AMR	Ageing Management Review
ASME	American Society of Mechanical Engineers
AUREST	Automated Residual Lifetime Estimation
CAM-EC	Catalog of Ageing Mechanisms for electrical and I&C Components
CAM-MC	Catalog of Ageing Mechanisms for Mechanical Components
CAM-SC	Catalog of Ageing Mechanisms for Structural Components
CFR	Code of Federal Regulations (United States Nuclear Regulatory Commission)
CLB	Current Licensing Basis
CRDM	Control Rod Drive Mechanism
DBE	Design Basis Event
EPZ	N.V. Elektriciteits-Produktiemaatschappij Zuid-Nederland
HELB	High Energy Line Break
HVAC	Heating Ventilation and Air-Conditioning
IAEA	International Atomic Energy Agency
ID	Identification
INSAG	International Nuclear Safety Group
ISI	In-Service Inspection
KCB	Kerncentrale Borssele (Nuclear Power Plant Borssele)
LTO	Long-Term Operation
MCP	Main Coolant Pump
MCPB	Main Coolant Pressure Boundary
NEI	Nuclear Energy Institute
NPP	Nuclear Power Plant
NRC	U.S. Nuclear Regulatory Commission
NRG	Nuclear Research & Consultancy Group
NSAS	Non-Safety Affecting Safety
NUREG	U.S. Nuclear Regulatory document
P&ID	Process and Instrumentation Diagram
PZR	Pressurizer
RPV	Reactor Pressure Vessel
SC	Structure and/or Component
SSC	System, Structure and/or Component
TLAA	Time-Limited Ageing Analysis

2.2 List of Relevant Plant ID Codes

Plant ID Code (AKS Designation)	System Title
EY	Emergency Diesel Generators
RA	Main Steam System
RB	Reheater System
RL	Main and Emergency Feedwater System
RS	Back-up Emergency Feedwater System
RT	Condensate Collection System
RY	Steam Generator Blowdown System
RZ	Demineralized Water Supply System
SA	Turbine Housing and Internal Steam Lines
TA	Volume Control System
TB	Nuclear Chemical Control System
TC	Main Coolant Cleaning and Degassing System
TD	Main Coolant Storage and Regeneration System
TE	Back-up Residual Heat Removal System
TF	Nuclear Component Cooling System
TG	Nuclear Fuel Storage Pool Cooling System
TJ	Safety Injection System and Residual Heat Removal System
TL	Nuclear Ventilation System
TM	Biological Shield Cooling System
TN	Steam Heating and Cold Water Cooling System
TP	Gas and Compressed Air Supply System
TR	Radioactive Waste Water Treatment System
TS	Radioactive Gas Treatment System
TV	Nuclear Sampling System
TW	Back-up Primary Injection System
TY	Nuclear Drainage and Venting System
TZ	Nuclear Building Water Drainage System
UF	High Pressure Water Fire Extinguishing System
UK	Raw Water System
UV	Cold Water System
UW	Heating and Ventilation System
VE	Back-up Residual Heat Removal Water Cooling System
VF	Auxiliary and Emergency Cooling Water System
VG	Intermediate Cooling Water System, Conventional

2.3 List of Definitions

To ensure clarity within this report, several of the technical terms used in this report have been defined as follows. This information has been taken from the Nuclear Energy Agency Glossary of Nuclear Power Plant Ageing [1], the IAEA Safety Glossary [2], as well as from a variety of other industry sources.

General Definitions

Scope:

- This term should not be confused with the term “Scoping”. The term “Scope” simply refers to the extent of a project or evaluation.

Design Basis:

- Design basis events are postulated events to which NPP SSCs must be designed and built. These events are evaluated during the design phase to establish the performance requirements for SSCs to prevent the release of fission products to the environment. These performance requirements are, in part, defined by the Safety Functions that each SSC must perform.

Isolable Valve (i.e., Isolation Valve):

- An isolable valve is one which can be fully closed, either manually or automatically (power operated). Its closure allows the isolation of a system, component or section of piping for maintenance, testing, the protection of personnel or other systems, or the diversion of flow to facilitate certain plant activities. The term “Isolation Valve” may be used to refer to an isolable valve.

Important to Safety:

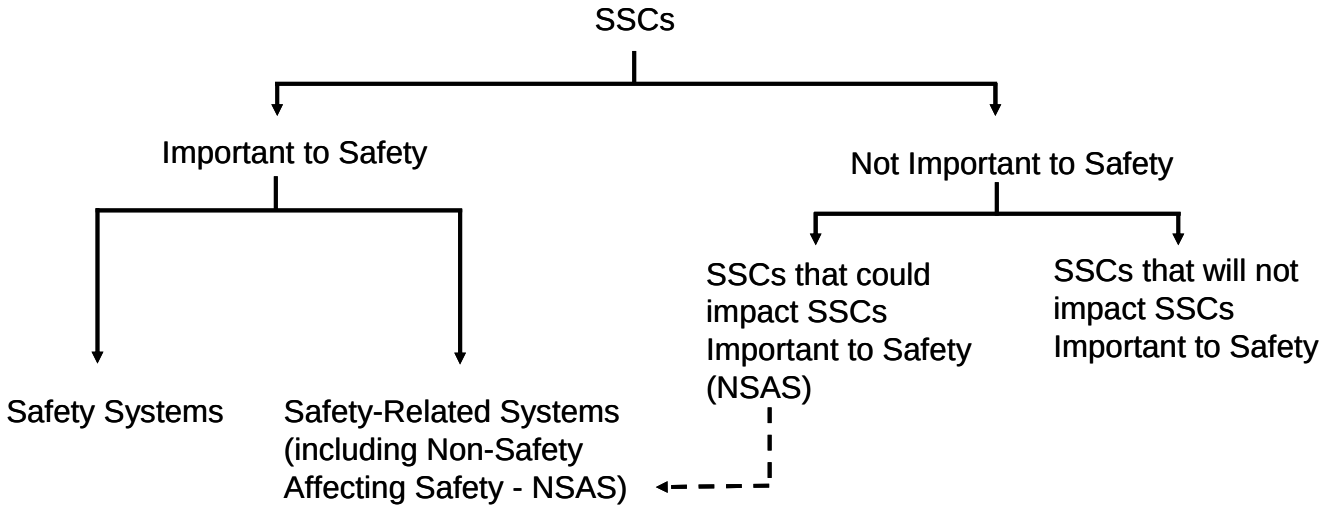
- An item that is part of a safety group and/or whose malfunction or failure could lead to radiation exposure of site personnel or members of the public. These items include those SSCs that prevent anticipated operational occurrence from leading to accident conditions, and those features that are provided to mitigate the consequences of malfunction or failure of SSCs.

Safety:

- An SSC important to safety, provided to ensure the safe shutdown of the reactor, residual heat removal from the core, or to limit the consequences of anticipated operational occurrences and design basis accidents.

Safety-Related:

- An SSC that is important to safety, but is not a “safety” SSC. This subset also includes those SSCs that are “not important to safety” but could impact SSCs that are “important to safety”.



Main Coolant Pressure Boundary:

- The purpose of the Main Coolant Pressure Boundary (MCPB) is to retain the pressure of the primary circuit, as well as limit the potential for radiological release to the environment. This is achieved through assurance of the continued integrity of structures and components composing the MCPB.
- Pressure-retaining components of an NPP, such as pressure vessels, piping, pumps, and valve bodies, which are part of or are connected to the Main Coolant System. The PWR Main Coolant Pressure Boundary comprises the following components and subcomponents (without internals):
  1) Reactor Pressure Vessel,
  2) Steam Generators (primary side),
  3) Pressurizer,
  4) Main Coolant Pump casing,
  5) Connecting piping (i.e., Main Coolant Line), weld joints and valve bodies installed between the above components,
  6) Connecting piping branching off from the above components and subcomponents, weld joints and valve bodies installed in these areas, generally up to and including the second isolable valve, and
  7) Pressure-retaining subcomponents of the Control Rod Drives and In-Core Instrumentation.

Environmental Conditions:

- Ambient physical states surrounding an SSC (e.g., temperature, radiation, humidity).

Process Conditions - Operating Conditions:

- Service conditions (e.g., temperature, pressure, flow rate, etc.) to which an SSC is subjected during normal operation (i.e., actual or service conditions).

<u>Ageing-Relevant Definitions</u>

Ageing:

- Ageing (physical ageing) is the process by which the physical characteristics of a system, structure or component change with time when subjected to a specific ambient environment. Ageing degradation may proceed through the progression of a single ageing mechanism, or a combination of several ageing mechanisms. The ageing of materials in a nuclear power plant may lead to the functional degradation of plant equipment (e.g., loss of integrity).

Ageing Assessment:

- The evaluation of appropriate information to determine the effects of ageing on the current and future ability of an SSC to function within acceptance criteria.

Ageing Management:

- Engineering, Operations and Maintenance actions that are performed to maintain the ageing degradation limits of Systems, Structures and Components (SSCs) within acceptable limits.
- Effective ageing management may be accomplished by coordinating existing Ageing Management activities, including maintenance, In-Service Inspection (ISI) and surveillance, as well as operations, technical support programs (including analysis of any ageing mechanisms) and external programs, such as research and development.

Ageing Mechanisms:

- Specific processes in which the characteristics of an SSC gradually change with time or use (examples: corrosion, wear, creep, etc.).

Ageing Effects:

- The effect that an actively progressing ageing mechanism has on a material or subcomponent causing net changes in the characteristics of an SSC with time or use (examples: change in material properties, change in dimensions, wall thinning, denting, local attack, cracking, etc.).

Ageing Management activities:

- Ageing Management activities are plant activities and measures that serve to manage the effects of ageing during operation, such that the intended structural and component function can be maintained consistent with the Current Licensing Basis (CLB). Examples of Ageing Management activities include inspection, testing, procedural changes to limit aggressive condition exposure, installation of corrosion resistant materials, and the use of plant programs (e.g., Boric Acid Corrosion) to identify and mitigate the occurrence of certain ageing effects.

Ageing Management Review Definitions

Commodity Group (i.e. Component Type):

- US Nuclear Industry guidance recommends the establishment of commodity groups of like structures or components to disposition the entire group with a single AMR [6] [8]. These structures or components can be grouped by characteristics, such as similar design, similar materials of construction, similar ageing management practices and similar environments. If the environment in which the structure or component operates suggests the potential for different environmental stressors, then the commodity group determination also could consider service time, operational transients, previous failures and any other conditions that would suggest different results. Appendix B of NEI 95-10 contains a list of typical plant components, structures and commodity groups, including a determination of whether the group is active or passive. The majority of US plants use Appendix B to NEI 95-10 in determining structures and components subject to an AMR.

Long-Term Operation (LTO):

- Long-Term Operation refers to power generation by a Nuclear Power Plant (NPP) beyond an established time frame (i.e., originally approved period of plant operation) as determined by, for example, operating term, design, standards and/or regulations. LTO is justified by safety assessment, with consideration given to life limiting processes and features of SSCs [5].
- The LTO review process followed to substantiate continued operation beyond the originally approved period of plant operation includes the evaluation of both active and passive SSCs. After the Scoping and Screening steps have been completed, in-scope passive components (e.g., MCL piping) and passive subcomponents of active components and subcomponents (e.g., Main Coolant Pump casing) were evaluated in the Ageing Management Reviews process.

Scoping Process:

- This step of the LTO Review Process involves the system-level identification of SSCs that are important to plant safety. The Scoping Process is reported in NEPS-G/2008/en/0056 [8].

Screening Process:

- This step of the LTO Review Process involves the identification of active and passive structures and components and their intended functions that support the SSCs identified in the “Scoping” process. The screening process identified mechanical SCs at a system-level, whereas the electrical and structural SCs are divided into commodity groups. Passive structures and components identified during this process are subject to Ageing Management Review (AMR) to substantiate long-term plant operation. The Screening Process is reported within NTCM-G/2009/en/0144 .

Ageing Management Review (AMR) Process:

- This step of the LTO Review Process involves evaluation to demonstrate that the effects of ageing on in-scope structures and components will be adequately managed so that the intended function(s) will be maintained consistent with the NPP licensing basis for the designated period of extended operation. This process involves the performance of a detailed technical evaluation of structures and components determined to be in-scope during the “Screening” process.
- Documents regarding existing plant measures and activities were reviewed during this step to determine where existing programs are adequate without modification and where existing programs should be augmented for the extended period of operation.

Ageing Management activities:

- Ageing Management activities are plant activities and measures that serve to manage the effects of ageing during operation, such that the intended structural and component function can be maintained consistent with the Current Licensing Basis (CLB). Examples of Ageing Management activities include inspection, testing, procedural changes to limit aggressive condition exposure, installation of corrosion resistant materials, and the use of plant programs (e.g., Boric Acid Corrosion) to identify and mitigate the occurrence of certain ageing effects.

Passive Structures and Components:

- Structures and components whose intended functions are performed without moving parts or a change in configuration or properties. This designation includes piping, as well as passive subcomponents of active components (e.g., pump casing).

Active Structures and Components:

- Structures and components whose intended functions are performed using moving parts or a change in configuration or properties. For example, this designation includes pumps, as well as active subcomponents of a pump (e.g., pump impeller).

Time-Limited Ageing Analyses (TLAA) [5]:

- Analyses and calculations that:
  1) Involve SSCs within the scope of evaluation for Long-Term Operation,
  2) Consider the effects of ageing,
  3) Involve time-limited assumptions defined by the current operating period (i.e., 40 years),
  4) Were determined to be relevant by the licensee in making a safety determination,
  5) Involve conclusions or provide the basis for conclusions related to the capability of the SSC to perform its intended functions, and
  6) Are contained or incorporated by reference in the licensing basis.

3. Introduction

The Kerncentrale Borssele (KCB) will have been in operation for 40 years at the end of 2013. As it is planned to extend the plant's lifetime until 2034, Elektriciteits Produktiemaatschappij Zuid-Nederland (EPZ) is implementing a Long-Term Operation (LTO) review process in accordance with International Atomic Energy Agency (IAEA) guidelines (Nuclear Safety Guide NS-G-2.12 [4], Safety Report 57 [5]).

This LTO process is being performed to demonstrate that the plant can be safely operated until 2034. For more information, see the Project Conceptual Document [7].

The identification of Systems, Structures and Components (SSCs) that are within the scope of LTO assessment was performed during the Scoping and subsequent Screening processes.

Scoping: This step identifies on a system-level and for major structures and components (SCs) all those SSCs that are important to safety. This process also considers other systems, whose failure may impact those, important to nuclear safety. The results of this effort are reported in NEPS-G/2008/en/0056 [8].

Screening: This step involves the identification of active and passive commodity groups and their intended functions that support the systems identified in the "Scoping" process. The criteria for selection of relevant structures and components, as well as the results of this Screening process (as consolidated into commodity groups), are reported within NTCM-G/2009/en/0144 [9].

Further assessment of SSCs identified to be in scope of LTO during Scoping and Screening is described in the Conceptual Document [7]. The Ageing Management Review (AMR) described herein handles the passive Mechanical, Electrical[1] as well as Structural Structures and Components important to safety, whereas the LTO assessment of active SCs as well as Time-Limited Ageing Analyses (TLAAs) for selected long-lived components are handled separately.

Ageing Management Review: This review involves detailed technical assessment of in-scope passive components (e.g. piping, cables, concrete walls) and passive subcomponents of active SCs (e.g. Pump casing, crane tracks) to demonstrate that the effects of ageing will be adequately managed (i.e. intended function(s) will remain consistent with the NPP licensing basis) during Long-Term Operation.

The AMR process generally consists of two stages.

1. The ageing mechanisms that require management are first identified and evaluated for in-scope SCs. The environmental and operating conditions could cause long-term material degradation of each in-scope SC during the service life of the plant. Therefore, each review considers the environmental and operating conditions to which each SC is subjected, including e.g. ambient air (externally) or pressure, temperature and media (internally). These conditions are then evaluated with respect to their effect on each in-scope structure or component.
2. Once the review of relevant Ageing Mechanisms has been completed, the necessity for relevant Ageing Management Activities is then identified. Effective ageing management may be accomplished by coordinating existing measures or activities, including maintenance, In-Service Inspection (ISI) and surveillance, as well as operations, technical support programs (including analysis of any ageing mechanisms) and external programs, such as research and development.

Ageing Management Activities serve to manage the effects of ageing during operation, such that the intended functions of SCs can be maintained consistent with the current licensing basis. Existing plant programs and documents are reviewed during this step to determine where existing measures or activities are adequate without modification, as well as whether existing measures or activities should

[1] Whenever "Electrical" is stated, it is intended to include I&C SSCs

be augmented during LTO. The existing measures may be adequate to manage ageing mechanisms. However, if an identified measure or activity is not adequate or does not exist at KCB, recommendations will be made regarding the specific areas in which KCB plant practices and policies should be augmented to substantiate LTO.

A detailed review of existing design calculations originally performed by the manufacturer according to the design basis, regulatory requirements, and applicable codes and standards for each component or subcomponent was not performed in the scope of Ageing Management Review for mechanical, electrical and structural SCs. The revalidation of these Time Limited Ageing Analyses falls outside the scope of the Ageing Management Review and is performed in a separate process [7].

As mentioned before, the AMR process covers all three disciplines, mechanical, electrical (including I&C) and structural and will be described in more detail in the following chapters for each single discipline.

4. AMR Methodology Breakdown

Different methodologies are used during the KCB Ageing Management Review process to evaluate different SCs and commodity groups, depending on the discipline.

- Mechanical A SCs are defined as forming part of the fission product barrier, i.e. the barrier preventing radioactive release to the environment.
- Mechanical B SCs consist of the remaining in-scope mechanical systems.
  (Although the structure and principal procedure to perform each AMR is similar for the Mechanical A and B SCs, the contents of the individual chapters may partly differ)
- Electrical commodity groups, and
- Structural commodity groups.

The AMR methodology for the mechanical SCs is detailed in Chapter 5.
The methodology used to perform a review of Electrical SSCs is outlined in Chapter 6 and for Structural SSCs in Chapter 7.

The identification and handling of relevant interfaces is addressed in each AMR report. Interfaces between disciplines (e.g. supports and hangers between Mechanical and Structural SSCs or cable trays between Electrical and Structural SSCs) may be handled in separate AMR reports.

5. AMR Methodology for Mechanical SSCs

As outlined in Chapter 4 the in-scope [8] mechanical systems are differentiated between Mechanical Cat. A and Cat. B SSCs.

5.1 Scope Definitions Mechanical AMRs

In accordance with NEI 95-10 (Rev. 6) Chapter 4.1 [18] and NUREG-1800 (Rev. 2) Table 2.1-3 [19], as well as ASME Section III Article NB-3540 (Design of Pressure-Retaining Parts) and the requirements of Article NB-2000, certain items are generally considered as non-pressure boundary subcomponents for the purpose of license renewal or life extension. According to this guidance, these items (e.g., gaskets) are not subject to Ageing Management Review.

Subject to AMR are structures or components that perform an intended function without moving parts or without a change in configuration or properties (i.e. passive).

Pump and valve internals (active subcomponents of active components) perform their intended functions with moving parts or with a change in condition, or are subject to replacement based on qualified life or specified period. Therefore, these subcomponents are not subject to an AMR. However, passive subcomponents of active plant components (e.g. pump casing) are included within the scope of review.
An exception are pressure and delta-pressure instruments. In the case these instruments fail the result is only a small leakage due to the small diameters. Secondly, failure of these instruments will be noticed immediately and replacement of these pressure and delta-pressure instruments, which isn't a big effort for the plant, can be initiated. Therefore, even though these instruments have a passive part, which may be part of the pressure boundary, they are considered as active components as a whole and consequently are not subject to AMR.

5.1.1 Boundary Definitions for the Scope of Mechanical Cat. A SC AMRs

Based on the global scope definition from chapter 5 further assumptions have been made for Cat. A SCs for the identification of the boundaries.

Mechanical fasteners (e.g., studs and bolts) support the pressure-retaining capability of certain subcomponents are included within the scope of each single Cat. A Ageing Management Review report.

Supports or support structures directly attached (i.e. welded) to the Cat. A SCs are treated in the respective report. Primary Supports not welded to the MCPB are handled within the generic Cat. B AMR report

Each of the Mechanical Cat. A SCs is handled in an individual AMR Report.

Interfacing Systems attached to the MCPB are generally handled up to and including the second isolable valve within the respective Cat. A AMR report.

As a general guideline, the scope of the seven Cat. A AMRs is defined in accordance with IAEA Safety Guide NS-G-1.9 “Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants” [20]. Detailed instructions for preparation of a Cat. A AMR report are provided in Chapter 5.2.

5.1.2 Boundary Definitions for the Scope of Mechanical Cat. B SC AMRs

The Cat. B systems that are subject to an Ageing Management Review were identified during the KCB-specific Scoping process [8]. Within the Screening process, the results of the Scoping process were evaluated further to identify commodity groups in scope [9].

Each of the above system-groups is handled in an individual AMR Report. The scope for each AMR is outlined in the Screening Report [9], and described in more detail within each individual AMR report.

As a general guideline, the scope of the Cat. B AMRs is defined in accordance with IAEA Safety Guide NS-G-1.9 “Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants” [20]. Detailed instructions for preparation of a Cat. B AMR are provided in Chapter 5.2 below.

5.2 Guidelines for Performing Mechanical AMRs

This sub-chapter describes the process for performing each Mechanical Cat. A and Cat. B Ageing Management Review, as well as the preparation of each corresponding AMR report.

As described in Chapter 5.1 above, individual AMR reports are prepared for each Cat. A SCs.

Each Mechanical AMR starts with a listing of references in the specific AMR (chapter 1). Chapter 2 contains specific report related supporting information, such as abbreviations, symbols or definitions. A short introduction (chapter 3) embeds the individual report in the whole AMR process. Within chapter 4 a description of the scope of the AMR report at hand is given.

5.2.1 Current physical Status of the SSC (Chapter 5)

An engineering assessment of the current status of the SCs is performed for Mechanical SCs as recommended by IAEA Guidelines [5]. Understanding the ageing of a structure or component is the key to effective ageing review and management [4]

5.2.1.1 SSC specific information

Component specific information for Mechanical Cat A AMR reports

System group / SSC specific information for Mechanical Cat B AMR reports

Identification of Component Materials

During the original KCB design phase, a primary material of construction was specified for each system.

Common materials used in the fabrication of mechanical system components include steel (e.g. carbon steel, low-alloy steel, chrome-molybdenum steel), cast iron, stainless steel, nickel-based alloys, copper alloys, aluminum, and non-metallics such as elastomers, polymers, and glass.

5.2.1.2 Identification of Environmental and Operating Conditions

for each component and component type subject to Ageing Management Review are described in the body of each AMR report and outlined in tabular form in the Attachment of each AMR report.

5.2.1.3 Review of Operating and Maintenance History

To confirm that all relevant ageing mechanisms are identified for KCB, a review of plant operating and

This review serves to identify any plant-specific ageing mechanisms that may not have been identified through use of other nuclear guidance and operating experience.

5.2.1.4 Review of Generic Nuclear Industry Experience

Relevant nuclear industry operating experience is used

However, as stated above in Chapter 5.2.1.3, an independent review of nuclear operating experience or relevant research results is also required in the AMR reports to ensure that no new ageing mechanisms have been identified since the publication of certain generic nuclear guidance documents (e.g. IAEA Guidance documents). If no additional ageing mechanisms are identified, the generic experience review simply confirms that the appropriate ageing mechanisms are considered in the Ageing Management Review.

All applicable ageing mechanisms, including any additional ageing mechanisms identified through the operating or generic experience review, are listed in each AMR report as described in the Chapter 5.2.2.

5.2.2 Identification of Relevant Ageing Mechanisms (Chapter 6)

All

potential ageing mechanisms are listed in each AMR report.

The results of this ageing mechanisms review are explained in the body of the AMR report, as well as in tabular form therein.

5.2.3 Identification of Existing Ageing Management Activities (Chapter 7)

Program descriptions for Ageing Management Activities existing at KCB are reported in documents on the verification of preconditions and additional notes on further Ageing Management Activities which are identified and referenced within the individual AMR reports in detail.

Time-Limited Ageing Analyses (TLAA) are reported separately, and as a general rule have little impact on system Ageing Management Reviews

5.2.4 Evaluation of Ageing Mitigation Practices during Long-Term Operation (Chapter 8)

Appropriate Ageing Management needs to be in place for relevant ageing mechanisms such that component-intended functions continue to be maintained consistent with the current licensing basis during the period of long-term operation. The Ageing Management Activity / Activities applicable for each relevant ageing mechanism are identified in each AMR report.

Following IAEA guidance on the assessment in Safety Report 57 (Chapter 5.4 in [5], a comparison of relevant ageing mechanisms and existing activities is performed to demonstrate that ageing / degradation mechanisms are either properly managed or to identify gaps where adapted or new Ageing Management Activities should be implemented within KCB policies and/or procedures. When demonstrating whether the effects of ageing are being managed adequately, either a single activity or a combination of activities may be cited.

The results of this ageing mechanism review are explained in the body of each AMR report, as well as in tabular form therein.

5.2.5 Conclusion (Chapter 9)

Each Mechanical AMR report ends with a concluding chapter. Therein the recommendations as identified within the assessment are summarized.

5.3 Generic Report Structure for Mechanical Cat A and Cat B AMRs

Based on the guidelines for performing Mechanical AMRs a generic report structure is defined. The generic report structure is based on IAEA Safety Guide NS-G 2.12 “Ageing Management for Nuclear Power Plants” [4] and IAEA Safety Report No. 57 “Safe Long Term Operation of Nuclear Power Plants” [5]. A general Table of Contents for Cat. A AMRs is provided to guide the formulation of each Cat. A AMR report. However, an AMR may vary slightly from this example as appropriate, depending on the set of system(s), components, environments, and materials encountered during the preparation of each AMR.

A general Table of Contents for Cat. B AMRs is provided to guide the formulation of each Cat. B AMR report. However, an AMR may vary slightly from this example as appropriate depending on the set of system(s), components, environments, and materials encountered during the preparation of each AMR.

6. AMR Methodology for Electrical SSCs

6.1 Scope and Reporting of Electrical SSC AMRs

This chapter presents the goals and the processes involved in performing an Ageing Management Review of Electrical SCs, as well as the format stipulated for the ”Electrical AMR Report“. The purpose of the Electrical AMR is to evaluate whether existing Ageing Management Activities for in-scop

The following sub-chapters describe the approach used within the AMR project to perform this assessment.

Within the framework of the Electrical AMR, all passive SSCs important to safety located in certain environmental areas are considered and assessed with respect to Long-Term Operation for KCB.

6.2 Guidelines for Performing the Electrical SC AMR

This sub-chapter describes the process for performing an AMR for Electrical SCs, as well as the preparation of the corresponding AMR report

6.2.1 Detailing of Commodity Groups

6.2.1.1 Identification of Component Types

KCB-specific commodity groups were defined during the Screening Process [9]. Electrical SCs that are subject to Ageing Management Review based on the results of the Screening process can be grouped into component types or groups with similar characteristics.

All passive SSCs important to safety are covered by these commodity groups that are subject to AMR.

6.2.1.2 Identification of Component Materials

As stated above, relevant materials for each commodity group are presented in the section “Definition of Component Types and Materials” of the AMR.

6.2.1.3 Identification of Environmental Conditions

6.2.2 Review of Operating and Maintenance History / Experience

To confirm that all relevant ageing mechanisms are identified for KCB, a review of plant operating and maintenance history is performed, the intent of which is to search for indications of additional ageing mechanisms. This review serves to identify any plant-specific ageing mechanisms that may not have been identified through use of nuclear guidance and operating experience

6.2.3 Identification of Relevant Ageing Mechanisms

6.2.4 Identification of Existing Ageing Management Activities

In this step, each existing Ageing Management Activity is identified based on information provided by KCB in the frame of this project.

6.2.5 Evaluation of Ageing Management Activities during Long-Term Operation

The purpose of this final step of the AMR assessment is to investigate whether the technical design of relevant materials and the scope of existing Ageing Management Activities are adequate under normal operating conditions to ensure reliability for in-scope SCs during Long-Term Operation. The results of this comparison of conditions and technical design are reported

6.2.6 Conclusion

The Electrical AMR report ends with a concluding chapter. Therein the recommendations as identified within the assessment are summarized.

7. Methodology for Structural SCs

7.1 Scope of Structural SSCs

The relevant structural SSCs subject to ageing management review for Long-Term Operation for KCB have been identified in the Scoping and Screening processes ([8] & [9]) that were performed at an earlier stage.

The exact scope of the AMR for the above listed structural commodity groups is defined in the Ageing Management Review report

7.2 Guidelines for Performing AMR for Structural SCs

The process of performing the AMR for the structural SCs consists of several individual steps, which are described hereafter

7.2.1 Evaluation of the Current Physical Status of the Systems

Within this sub-chapter of the report the physical status for each building or commodity group is described.

7.2.1.1 Description of the Building or Commodity Group

Based on the available material a detailed description of the individual building or commodity group is given in this part.

7.2.1.2 Identification of Structural Components and their Intended Functions

Subjected to structural AMR, structural components within the individual building or commodity group are identified.

Examples for these categories are given hereafter:
- Steel (Steel frames, structural steel members, connections etc.
- Concrete (Columns, beams, interior and exterior walls slabs, etc.)
- etc.

The criteria for being relevant to AMR is that a structural component has an intended function, which is important to safety, without moving parts (i.e. passive). As structural components are mostly passive, the main criterion is the intended function.
The typical intended functions important to safety for passive structural components are summarized in the following table:

Intended Function	Description
Decontamination	Provides a protection layer which is invulnerable for contaminants and uncomplicated to decontaminate.
Direct Flow	Provides spray shield or curbs for directing flow (e.g. safety injection flow to containment sump)
Dilatation	Provides for thermal expansion and/or seismic separation
Fire Barrier	Provides rated fire barrier to confine or retard a fire from spreading to or from adjacent areas of the plant
Flood Barrier	Provides flood protection barrier (internal and external flooding event)
HELB Shielding	Provides shielding against high energy line breaks
Missile Barrier	Provides missile barrier (internally or externally generated)
Pipe Whip Restraint	Provides pipe whip restraint
Pressure Distribution	Avoids pressure build-up during LOCA and the possible spalling of concrete and coating during depressuisation after LOCA and subsequent generation of large quantities of debris.

Intended Function	Description
Shelter/Protection	Provides shelter/protection to safety related components
Shielding	Provides shielding against radiation
Shutdown Cooling Water	Provides source of cooling water for plant shutdown
Structural Pressure Barrier	Provides pressure boundary or essentially leak tight barrier to protect public health and safety in the event of any postulated design basis events
Structural Support	Provides structural and/or functional support to safety related and/or non-safety related components
Surface Protection	Surface coating which protects SSC's from the environment and its possible corrosion promoting contaminants by debarment of supporting substances. Specific composites may be resistant against influence of radiation or temperature.
Thermal Insulation	Provides thermal insulation

7.2.1.3 Identification of the Environments

Besides the material of the structural components, the environmental conditions are of high importance for structural ageing as well.

Consequently, all environmental conditions during normal operation for the buildings and commodity groups are identified and documented in this sub-chapter. Abnormal or emergency conditions are not considered in the frame of this project, as these conditions are not contributing to structural ageing.

Typical operating and environmental conditions for structural components can be:

Environment	
Air - Indoor	
Air - Outdoor	

Environment	Description
Air - With Borated Water Leakage	
Embedded in Concrete	
Raw Water - Stagnant	
Raw Water - Flowing	
Soil Buried	
Soil/Groundwater Buried	

7.2.1.4 Review of the Plant Specific Experience and History

To confirm that all relevant ageing mechanisms for KCB have been identified a review of the plant operating and maintenance history is performed,

This review will serve to identify any plant-specific ageing mechanisms not identified through use of nuclear guidance and operating experience.

7.2.1.5 Review of Generic Nuclear Industry Experience

Relevant nuclear industry operating experience is used during

Nevertheless, an independent review of nuclear operating experience or relevant research results is also required in the AMR reports to ensure that no new ageing mechanisms have been identified.

If no additional ageing mechanisms are identified, the generic experience review simply confirms that the appropriate ageing mechanisms are considered in the Ageing Management Review.

7.2.2 Identification of Relevant Ageing Mechanisms and Effects

On the basis of the identified materials and environments, the relevant ageing mechanisms and effects that require management during the designated period of extended operation are identified.

7.3 Generic Report Structure for Structural AMR

Based on IAEA safety Guide NS-G 2.12 [4] and IAEA Safety Report No. 57 [5] a generic report structure for the Structural AMR is defined

8. Summary

In the context of the LTO project Ageing Management Review reports are elaborated, that need to be submitted to the regulator as supporting documents for the license application process. These reports consider the identification as well as the KCB specific management of physical ageing mechanism, which could affect systems, structures and components important to safety.

AMR reports are elaborated for all three disciplines, Mechanical, Electrical and I&C as well as Structural SSCs.

The general scope and methodology applied to perform each Ageing Management Review as well as the differences in the assessment approach between the individual reports is outlined in the document at hand for generic overview and guidance.