Basisdocument KCB LTO-2 Safety Demonstration

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Basisdocument KCB LTO-2 Safety Demonstration

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[redacted]

Nederland EPZ

BASIS DOCUMENT OF KCB LTO-2 SAFETY DEMONSTRATION

Subsequent Long Term Operation of the Borssele Nuclear power plant

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1755 ZG Petten
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Utrechtseweg 310 - B50-West
P.O. Box 9034
6800 ES Arnhem
The Netherlands

Management Summary

An essential part of preparations for a possible subsequent Long Term Operation is to demonstrate that KCB can be safely operated for the intended period of LTO-2 by means of an effective management of physical and non-physical ageing. This demonstration will be referred to as the 'KCB LTO-2 Safety Demonstration' (or Safety Demonstration) and is detailed in this document.

This document aims to:

- Describe the methodology for the realization of the Safety Demonstration;
- Identify the Assessment framework used in the LTO-2 Assessment of the Safety Demonstration;
- Identify the current situation (at cut-off date) and the assessment and reference criteria for each aspect of the Safety Demonstration;
- Describe the activities that will be performed in order to demonstrate that KCB can maintain the actual safety level for the intended period of long term operation by means of an effective management of physical and non-physical ageing;
- Act as a basis document for the Safety Demonstration. By approving this document, the ANVS agrees on the scope, methodology and deliverables proposed for the Safety Demonstration.

The Safety Demonstration is based on current versions of IAEA Safety Standards.

The Safety Demonstration will result in documents showing conformance to current IAEA Safety Standards and in measures that are required to maintain the current level of safety of the installation during LTO-2. These results are input to the PSR for LTO-2 and to the license change procedure required to allow KCB to enter LTO-2.

How the documents from the Safety Demonstration are used in preparation of, or as part of, the license application is outlined in the overall 'Plan van Aanpak (voorbereiding) aanvraag LTO-2 vergunning'.

The license change procedure will also be prepared with an environmental impact assessment and a PSR to identify opportunities for safety improvements in LTO-2. These other deliverables including the strategy to obtain regulatory approval are also detailed in the overall Plan van Aanpak (voorbereiding) aanvraag LTO-2 vergunning.

Glossary

Ageing Management: engineering, operations, inspection, testing, chemical and maintenance activities to control within acceptable limits the ageing degradation of structures, systems and components.

Ageing Management Programme: The ageing management programme shall determine the consequences of ageing and the activities necessary to maintain the operability and reliability of structures, systems and components.

Aspect of Safety Demonstration: is a delimited process, programme or documentation which is considered to be relevant for demonstrating adequate management of physical and non-physical ageing.

Non-conformance: deviation from a specification, a standard, or an expectation which is not part of the current license basis.

Deliverable: a document issued by the operating organization to support the request for license change or a document issued by the operating organization to demonstrate how requirements are met.

Equipment Reliability: Equipment Reliability is the result of all activities aimed at designing, installing, maintaining, and managing equipment, so that it continues to correctly perform its safety and operational functions under normal and exceptional operating conditions, within specified performance requirements, and without unexpected failure.

Guideline: is intended as documentation presenting an approach that is generally considered valid.

KeW license (or operating license): is intended as the most recent issue of the operating license of KCB.

LTO-1: the period between 01-01-2014 and 31-12-2033.

LTO-2: intended as the period between 01-01-2034 and 31-12-2053.

Mandatory action plan: intended as the set of commitments to be realized in order to ensure that the currently licensed safety level is maintained during the LTO-2 period. In the 'Plan van aanpak (voorbereiding) aanvraag LTO 2-vergunning is referred to as 'Implementatieplan verplichte maatregelen'.

LTO-2 Justification Project: is intended as the set of activities, managed according to a project management approach, that lead to the obtainment of a modified operating license.

LTO-2 Programme: is intended as all planned activities that lead to and continue during LTO-2 period. The LTO-2 Programme includes among others the LTO-2 Justification Project and LTO-2 Implementation Plans.

Regulatory Framework: is the set of legal and regulatory requirements that must be fulfilled.

Legal requirements ('wettelijk kader'): is intended as obligations laid down in Dutch regulation that must be fulfilled.

Regulatory requirement(s): is intended as (an) obligation(s) set forth in a license that must be fulfilled.

Assessment framework ('toetsingskader'): is the set of requirements against which the licensee effectively performs the assessment.

Reference framework ('referentiekader'): is the set of codes and standards not containing requirements but guidelines and/or examples of good practices which can be used to fulfil requirements.

Assessment / reference criteria: are the clauses of the assessment/reference framework relevant for the clause-by-clause assessment of a particular aspect of the Safety Demonstration.

LTO-2 Safety Demonstration: is intended as the set of activities that are carried out to demonstrate that KCB can be safely operate for the intended period of LTO-2 by means of an effective management of physical and non-physical ageing.

Periodic Safety Review for LTO-2 (PSR(LTO-2)): PSR(LTO-2) is intended to support the justification of LTO-2 and identify opportunities for safety improvements.

Safety Improvements Implementation Plan: intended as the set of commitments to be realized in order to improve the plant safety according to the feasible opportunities arising by the PSR for LTO-2. In the 'Plan van aanpak (voorbereiding) aanvraag LTO 2-vergunning referred to as 'Implementatieplan veiligheidsverhogende maatregelen'.

List of abbreviations

Abbr.	Meaning
10EVA	10 jaarlijkse evaluatie (Periodic Safety Review)
AKI	Aangewezen Keuring Instelling - Designated Inspection Body
AMP	Ageing Management Programme
AMR	Ageing Management Review
ANVS	Autoriteit Nucleaire Veiligheid en Stralingsbescherming (National Regulatory Body)
ASME	American Society of Mechanical Engineers
AUREST	Automated Residual Life Estimation
CAP	Corrective Action Programme
COMSY	Condition Oriented Ageing Management System
CUF	Cumulative Usage Factor
DBA	Design Basis Accident
DEC	Design Extension Condition
EI&C	Electrical, Instrumentation and Control
EFPD	Effective Full Power Days
EFPY	Effective Full Power Years
ENIQ	European Network for Inspection Qualification
EPZ	Elektriciteits-Produktiemaatschappij Zuid-Nederland
EQ	Equipment Qualification
EQDBA	Qualification of Design Base Accident resistant electrical Equipment
ERI	Equipment Reliability Index
FAMOS	Fatigue Monitoring System
FROG	Framatome Owners Group
GRS	Gesellschaft für Anlagen-und Reaktor Sicherheit
GSR	General Safety Requirements (IAEA)
HABOG	Hoogradioactief Afval Behandelings Gebouw (High Radioactive Waste Handling and Storage Facility)
HAZ	Heat Affected Zone
HR	Human Resources
IAEA	International Atomic Energy Agency
IGALL	International Generic Ageing Lessons Learned (IAEA)
IMS	Integrated Management System
IRS	Incident Reporting System (IAEA/NEA)
ISI	In-Service Inspection
KCB	Kernenergie Centrale Borssele (Borssele NPP)
KeW	KernEnergieWet (Dutch Law on use of nuclear energy)
KTA	Kerntechnischer Ausschusses (German nuclear code)
LBB	Leak Before Break
LCO	Limiting Conditions for Operation
LOCA	Loss Of Coolant Accident
LTO	Long Term Operation
LTO-1	Initial Long Term Operation (between 01.01.2014 and 31.12.2033)
LTO-2	Subsequent Long Term Operation (between 01.01.2034 and 31.12.2053)
MOX	Mixed Oxide Fuel
MTSI	Maintenance, Testing, Surveillance and Inspections
NDT	Non-destructive testing

NEA	Nuclear Energy Agency
NPP	Nuclear Power Plant
NVR	Nucleaire Veiligheids Regels – Nuclear Safety Requirements
OECD	Organisation for Economic Co-operation and Development
PDCA	Plan-Do-Check-Act
PSA	Probabilistic Safety Assessment or Analysis
PSR	Periodic Safety Review
PTS	Pressurized Thermal Shock
PWROG	Pressurized Water Reactor Owner Group
RCP	Reactor Coolant Pump
RDM	Rotterdam Dockyard Company
RPV	Reactor Pressure Vessel
SALTO	Safety Aspects for Long Term Operation
SAR	Safety Analysis Report
SOER	Significant Operating Event Report
SOP	Staal Onderzoek Programma – Surveillance irradiation programme
SRS	Safety Report Series (IAEA)
SSC(s)	Structure(s), System(s) or(and) Component(s)
SSG	Safety Guide (IAEA)
STRAT	EPZ Strategy report
SVS	Services Series (IAEA)
TECDOC	Technical Document (IAEA)
TIP	Technical Information Package
TLAA	Time Limited Ageing Analysis
VGB	Vereinigung der Großkesselbesitzer
WANO	World Association of Nuclear Operators

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1. Introduction

1.1. Context

The Borssele Nuclear Power Plant (Kernenergie Centrale Borssele, KCB) was built between 1969 and 1973 and started commercial operation in October 1973. The original design life of 40 years for KCB expired on 31 December 2013.

In 2006 KCB operating organization and the Dutch Government agreed on a covenant that intended to extend the operating life time of KCB to 1 January 2034. KCB performed a LTO-1 Justification project to extend the design life to 60 years and to update the safety report.

Regulatory approval for the request of the license change was granted by the regulatory body in September 2012 allowing KCB to enter the Long Term Operation (LTO-1) phase on 1 January 2014.

Part of the covenant was to stop operation with KCB by 1 January 2034. As there was no legal opportunity to limit the operating life of a nuclear power plant, in 2010 a change in the Dutch Nuclear Energy Act (KeW) [3] became effective. This change legally limits the operating life time (period for production of nuclear energy) of KCB to 31 December 2033. Furthermore, it stipulates that license applications that aim at extending the operating life time of KCB beyond this date have to be rejected.

In 2020, the Minister of Economic Affairs and Climate decided to aim at extending the operating life time of KCB beyond 31 December 2033 citing the preservation of critical knowledge and the role of nuclear energy in the country's energy mix as strategic elements.

Extended operating life time beyond 31 December 2033 will be indicated as LTO-2 phase. A procedure has been started to modify the Nuclear Energy Act.

In order to obtain a license modification allowing Long Term Operation beyond 31 December 2033, a modification of the KeW in accordance with [3] article 15a has been proposed. In the proposed article 15a, the justification for prolonging the design life time and operation beyond 31 December 2033 is supported by an actualized Safety Report ('veiligheidsrapport').

Articles B6 and C of KCB operating license [46] reference NVR NS R-2 for safety requirements during operations, including requirements for Long Term Operation. The IAEA guidelines on which NVR NS R-2 is based has been replaced by the IAEA Safety Standard SSR 2/2 Rev.1 [5]. The ANVS has indicated that reference to SSR 2/2 Rev.1 will be included in the KCB operating license this year and that references to NVRs will be removed.

The preparatory work to the justification of KCB LTO-2 is therefore based on the satisfaction of Requirement 16 of SSR 2/2 Rev.1 [5].

Requirements 16 foresees that the justification of Long Term Operation is based on the results of a safety assessment, with due consideration of the ageing of

structures, systems and components (SSCs) and using the results of the periodic safety review.

The Safety Demonstration contributes to the safety assessment by demonstrating that KCB can maintain the actual safety level for the intended period of long term operation by means of an effective management of physical and non-physical ageing.

The results of the Safety Demonstration are deliverables demonstrating conformance with the IAEA Safety Standards, demonstrating that ageing management is effective in retaining the safety function of SSCs during LTO-2, and mandatory measures to maintain the actual level of safety for LTO-2. These results are also used as input to the periodic safety review for LTO-2.

How the documents from the Safety Demonstration are used in preparation of, or as part of, the permit application is outlined in the overall 'Plan van Aanpak (voorbereiding) aanvraag LTO-2 vergunning'.

1.2. Long Term Operation beyond 60 (LTO-2) at KCB

According to OECD/NEA and IAEA definitions, there is no difference between the concepts of a first and a subsequent Long Term Operation.

OECD/NEA defines Long Term Operation in [1] as:

"*Long-term operation can be defined as operation, justified by a comprehensive safety assessment, that goes beyond a previously established time frame corresponding to initial design assumptions (typically referred to as "original design lifetime" and usually 30-40 years depending on the design). These initial assumptions, however, do not represent a technical constraint inhibiting longer operating time frames and should not be confounded with the remaining, useful life of the facility, which is periodically re-evaluated taking into account the actual plant conditions and the latest available knowledge*."

IAEA SSG-48 [2] defines Long Term Operation as:

"*Long term operation of a nuclear power plant is operation beyond an established time frame defined by the licence term, the original plant design, relevant standards or national regulations. Long term operation should be justified by safety assessment and, depending on the State, this justification may take place within a broader regulatory process, such as licence renewal or a PSR*."

Therefore, prevailing requirements and guidelines for LTO are applicable to LTO-2. The IAEA Safety Standards will form the basis for the Assessment framework that will be applied for the LTO-2 Safety Demonstration.

1.3. Role and structure of the ‘Basis Document of KCB LTO-2 Safety Demonstration’ document

1.3.1. Role of this document

The Basis Document of KCB LTO-2 Safety Demonstration document intends to reach the following goals:

- Describe the methodology for the realization of the Safety Demonstration;
- Identify the assessment framework used in the Safety Demonstration;
- Identify the current situation (at cut-off date) and the assessment and reference criteria for each aspect of the Safety Demonstration;
- Describe the activities that will be performed in order to demonstrate that KCB can maintain the actual safety level for the intended period of long term operation by means of an effective management of physical and non-physical ageing;
- Act as a basis document for the Safety Demonstration. By approving the basis document, the ANVS agrees on the scope, methodology and deliverables proposed for the Safety Demonstration.

1.3.2. Structure of this document

This current document is composed of five chapters and one appendix.

Chapter 1 gives an introduction to LTO-2 at KCB and describes the context within which preparation for possible LTO-2 takes place. Furthermore, it defines the contents and the role of the 'Basis Document of KCB LTO-2 Safety Demonstration’’.

Chapter 2 describes the methodology of the Safety Demonstration specifying the objectives, the aspects that will be assessed, the assessment process and the expected deliverables.

Chapter 3 defines the assessment framework used for the LTO-2 Assessment of the Safety Demonstration based on IAEA Safety Standards.

Chapter 4 describes per aspect of the Safety Demonstration:

- the assessment and reference criteria: IAEA requirements to be satisfied and the relevant guidance;
- the current situation at KCB: based on the available documentation at cut-off date.
- the assessment activities that will be performed during the Safety Demonstration and the related deliverables.

Chapter 5 summarises the key conclusions of the document.

Appendix A gives a complete overview on the Assessment framework for the Safety Demonstration indicating for each requirement the related field of application.

2. KCB LTO-2 Safety Demonstration Methodology

2.1. Regulatory requirement

Performance of the Safety Demonstration is based on the satisfaction of the upcoming regulatory requirement 16 of SSR 2/2 Rev.1 [5]:

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

Requirement 16, further elaborates in 4.53 that:

"The **justification for long term operation** shall be **prepared on the basis of the results of a safety assessment**, with **due consideration of the ageing of structures**, systems and components. The justification for long term operation shall utilize the results of periodic safety review and shall be submitted to the regulatory body, as required, for approval **on the basis of an analysis of the ageing management programme, to ensure the safety of the plant throughout its extended operating lifetime**."

And in 4.54 that:

"The comprehensive programme for long term operation shall address:

a) **Preconditions** (including the current licensing basis, safety upgrading and verification, and operational programmes);
b) Setting the **scope** for all structures, systems and components important to safety;
c) Categorization of structures, systems and components with regard to degradation and ageing processes;
d) **Revalidation of safety analyses** made on the basis of time limited assumptions;
e) Review of **ageing management programmes** in accordance with national regulations;
f) The **implementation programme for long term operation**.

2.2. Reference framework

To satisfy Requirement 16 of SSR 2/2 [5], SSG-48 [2] Chapter 7 is used as guidance for the performance of the Safety Demonstration.

SSG-48 (7.5) identifies the major steps in a programme for Long Term Operation. Figure 1 shows how the Safety Demonstration is part of the Long Term Operation Programme.

Furthermore, the internationally accepted SALTO review approach described in IAEA SVS-26 [18] is used to ensure completeness of the assessment of preparedness to Long Term Operation and the conformance of the ageing related programmes, processes and documentation to the IAEA Safety Standards (particularly SSR 2/2 Rev.1 [5] and SSG-48 [2]).

The following paragraphs describe the objective, process, and interfaces of the Safety Demonstration, highlighting how it satisfies the relevant requirements and guidance.

2.3. Objective of the Safety Demonstration

Consistent with the guidance given in SSG-48 [2] (7.13 and 7.14), the objective of the Safety Demonstration is to demonstrate that KCB can maintain the actual safety level for the intended period of long term operation by means of an effective management of physical and non-physical ageing.

The Safety Demonstration contributes to satisfying Req. 16 par. 4.53 [5]. It contributes to the safety assessment on the basis of which LTO-2 shall be justified for what concerns the ‘due consideration of the ageing of structures, systems and components’ and ‘analysis of the ageing management programme, to ensure the safety of the plant throughout its extended operating lifetime’.

The Safety Demonstration produces deliverables demonstrating that the plant can be safely operated during the intended period of Long Term Operation by managing physical and non-physical ageing.

As outlined in paragraph 4.1.2. of the Plan van aanpak (voorbereiding) aanvraag LTO 2-vergunning, the Safety Demonstration covers most of the elements of a Long Term Operation programme mentioned in 4.54 (see Table 1).

The deliverables of the Safety Demonstration are part of the LTO documentation and are used as a basis for (preparation of) the regulatory approval and the LTO programme implementation.

2.4. Process of Safety Demonstration

The process for the performance of the Safety Demonstration follows the steps highlighted in Figure 1. In the following paragraphs it is explained how each of the highlighted steps is addressed in the safety demonstration.

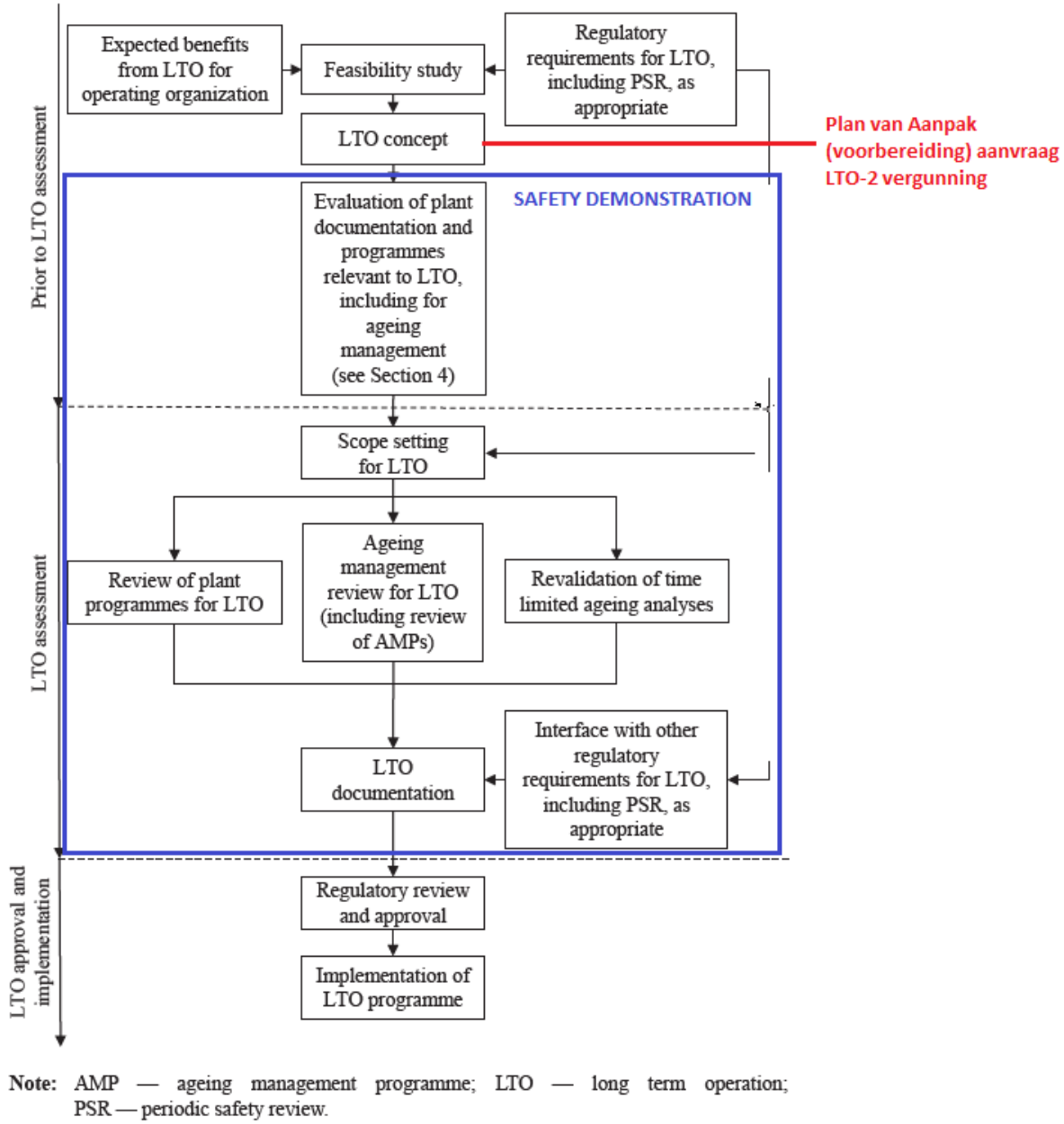

Figure 1 Major steps in a programme for long term operation

2.4.1. Evaluation of relevant plant documentation and programmes for LTO-2

SSG-48 establishes in Chapter 4 that relevant programmes and documentation should be in place at a plant aiming to extend its operating life. For LTO-1 it has already been demonstrated that these programmes and documentation were in place and complied with then established requirements. Since then however, safety standards and insights on relevant programmes and documentation have evolved and the EPZ organization and installation have changed. To provide a complete safety demonstration it is therefore necessary to demonstrate that all the relevant programmes and documentation conform to requirements from current safety standards.

The process for the evaluation of plant documentation and programmes for LTO-2 is shown in Figure 2.

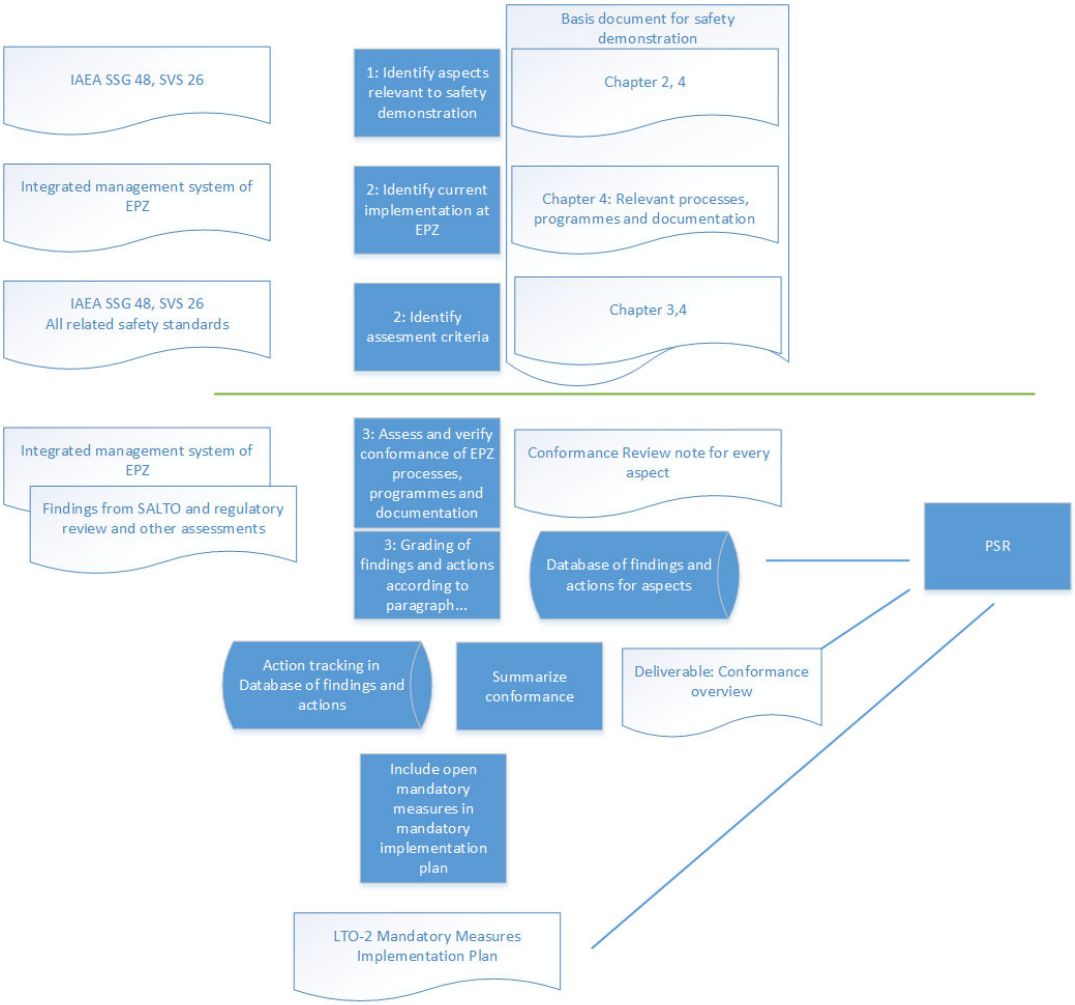

Figure 2 Process for the evaluation of plant documentation and programmes for LTO-2

The first step is to identify the relevant aspects of the Safety Demonstration. As shown in Figure 3, the identification of the aspects of the Safety Demonstration is based on obtaining a full coverage of:

- The SALTO scope according to SVS-26 [18];
- The SSG-48 [2] chapter 4 scope (relevant plant documentation and programmes);
- The SSG-48 [2] chapter 5 scope (ageing management);
- The SSG-48 [2] chapter 6 scope (obsolescence);
- The SSG-48 [2] chapter 7 scope (programme for long term operation).

By using both SSG-48 and SVS-26, it is ensured that all aspects relevant for the safety demonstration are part of the assessment phase and that all relevant programmes and documentation are evaluated.

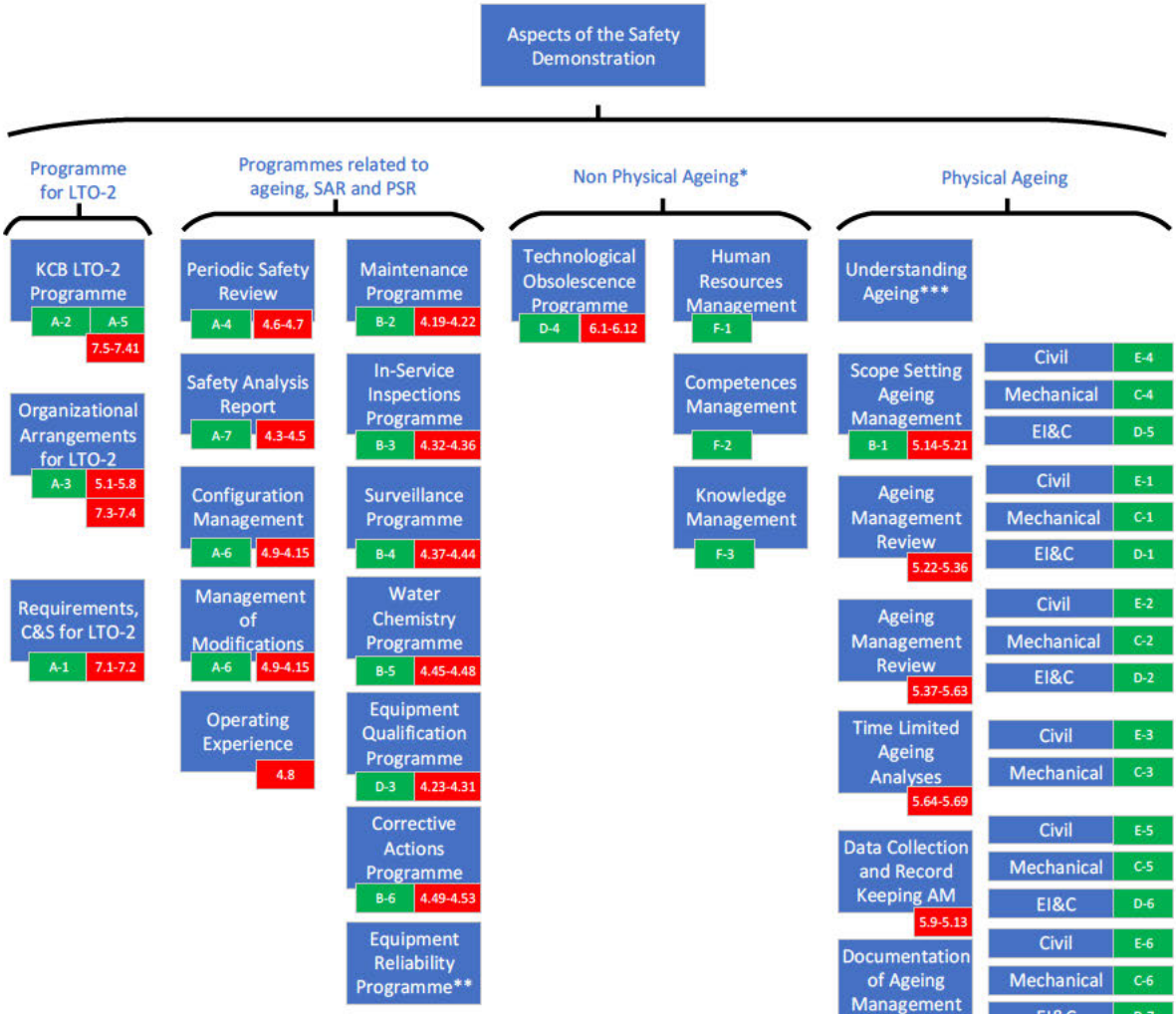

Figure 3 Aspects of the Safety Demonstration, per each aspect the relevant SALTO areas (green) and SSG-48 paragraphs (red).

The second step is to determine, for each identified aspect of the Safety Demonstration:

- implementation at EPZ (at cut-off date 22 May 2025) of relevant documentation and programmes.
- the assessment criteria and reference criteria that will be used for the conformance review.

The implementation at EPZ and the assessment and reference criteria derived from the Assessment framework “toetsingskader” and Reference framework

“referentiekader”) are specified in this document for each aspect of the Safety Demonstration in Chapter 4.

The third step is the actual evaluation. The implementation at EPZ of relevant processes, documentation and programmes is assessed for each aspect of the safety demonstration against the specified assessment criteria in a clause by clause Conformance Review in order to verify that EPZ processes, programmes and documentation are in conformance with the identified assessment criteria. Deviations are documented and graded to determine the required actions.

The results of the pre-SALTO mission of November 2024 and the outcomes of regulatory review are also taken into account. This Conformance Review functions as an independent assessment performed by a third party (see 2.4.6) of EPZ processes, programmes and documentation relevant to the Safety Demonstration.

Following the performance of the Conformance Review, the evaluation of plant documentation and programmes for LTO-2 results in the **deliverable**:

- Conformance Overview.

The results of the conformance review and the documented deviations are input to the PSR for LTO-2 and available for auditing by the ANVS at any time.

Any deviations that were graded as needing mandatory action and that were not resolved before the license application will be input in the **deliverable:**

- LTO-2 Mandatory Measures Implementation Plan.

2.4.2. Scope Setting for SSCs for LTO-2

An important part of the safety demonstration is a proper selection of SSCs important to safety for which ageing management needs to be implemented.

Scope setting was already performed and approved for LTO-1, but since then guidance on scope setting has changed in the referenced Safety Standard.

The scope setting of SSCs for LTO -2 is based on the SSG-48 guidance given in 5.14-5.21. The SSCs in scope are:

- Mechanical;
- Electrical, Instrumentation and Control (EI&C);
- Civil.

The scope setting methodology is prepared by EPZ, based on the three criteria of SSG-48 [2] par. 5.16 and results in a list of SSCs that shall retain their capability to perform their intended function during the LTO-2 period and for which the adequate management of ageing processes shall be demonstrated. The scope setting is independently assessed by a third party (see 2.4.6) and results in the following **deliverable**:

- Scope setting methodology based on SSG-48 including the scope setting results at system level.

The full scope on a component level is available for auditing by ANVS.

Findings are documented and are input to the PSR for LTO-2 and available for auditing by the ANVS at any time.

Any deviations that were graded as needing mandatory action and that were not resolved before the license application will be input in the **deliverable:**

- LTO-2 Mandatory Measures Implementation Plan.

More details on scope setting can be found in 4.4.3.

2.4.3. Ageing Management Review for LTO-2

An Ageing Management Review (AMR) was performed for the justification of LTO-1. On the basis of this Ageing Management Review, EPZ developed the concept of a living AMR, according to which operating experience is incorporated in the AMR during the operating lifetime of the reactor.

The ageing management review for LTO-2 consists of the following steps.

- A methodology for the AMR is developed by EPZ based on SSG-48, experience of LTO-1 and good practices from the industry. The methodology is independently assessed by a third party (see 2.4.6)
- For LTO-2 the existing AMRs (i.e. for the SSCs in scope for LTO-1) are reviewed and, when necessary, updated to be consistent with the defined methodology. For those SSCs which are added to the scope of SSCs for LTO-2 and have not been reviewed in an AMR, new AMRs are realized.

The AMR for LTO-2 results in the following **deliverables**:

- Methodology for living AMR based on input from SSG-48;
- Ageing Management Reviews results for the in-scope SSCs of LTO-2.

Findings from the reviews are documented and are input to the PSR for LTO-2 and available for auditing by the ANVS at any time.

Any actions like inspections or replacements that were graded as mandatory actions and that are not resolved before the license application will be input in the **deliverable:**

- LTO-2 Mandatory Measures Implementation Plan.

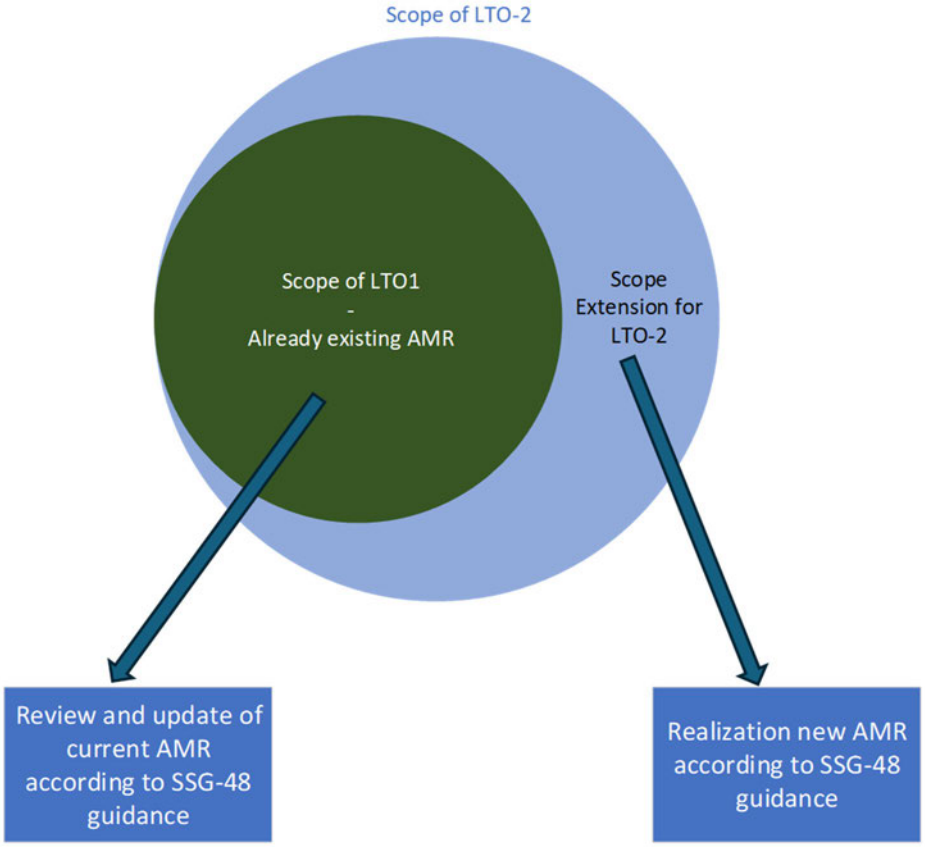

Figure 4 Ageing Management Review for LTO-2.

More details on the ageing management review can be found in 4.4.4.

2.4.4. Review of Plant Programmes and Ageing Management Programmes

During LTO-1 all relevant plant programmes and dedicated ageing management programmes were identified and implemented in procedures PU-N12-50-4** describing the application of these programmes according to the 9 attributes of an effective ageing management programme (see Table 2 of SSG-48 [2]) in the integrated management system of EPZ.

These Plant Programmes and Ageing Management Programmes (AMPs) will be reviewed in order to ensure that they are complete and remain effective – according to the nine attributes of an effective AMP - in managing the ageing effects during LTO-2. Where necessary, modifications to existing programmes or new programmes are identified to ensure that the in-scope SSCs will retain their ability to perform their intended functions during LTO-2.

The review is performed as an independent assessment by a third party (see 2.4.6) and consists of the following steps.

- Verification that all SSCs in scope have AMPs based on plant specific degradation assessment results and a comparison with IGALL AMPs. This step allows the identification of any missing AMPs.

- Assessment of the plant programmes and AMPs according to the nine attributes of an effective ageing management programme.

The review of Plant Programmes and Ageing Management Programmes results in the following **deliverable:**

- Documented consistency with the 9 attributes of effective ageing management programmes.

The plant programmes and AMPs themselves are auditable for the ANVS.

Findings are documented and are used as input to the PSR for LTO-2 and available for auditing by the ANVS at any time.

Any actions that were graded as needing mandatory action and that were not resolved before the license application will be input in the **deliverable:**

- LTO-2 Mandatory Measures Implementation Plan.

2.4.5. Identification and Revalidation of Time Limited Ageing Analyses for LTO-2

For the justification of LTO-1 the following TLAAs were revalidated:

- Reactor Pressure Vessel (RPV) Neutron Embrittlement;
- Low-Cycle Fatigue Usage;
- Leak Before Break;
- Qualification of Design Base Accident resistant electrical Equipment (EQDBA).

One additional TLAA has been credited in the period since the LTO justification project:

- Strength of RCP Flywheel.

The identification and (re)validation of TLAAs for LTO-2 consists of the following steps

- A methodology for the selection of (additional) TLAAs for LTO-2 is developed by an expert third party based on the guidance of SSG-48 par. 5.64-5.69, IGALL, GALL-SLR, and operating experience. This methodology will be assessed by EPZ.
- Selection of relevant TLAAs for KCB LTO-2 and the justification of the exclusion of non-relevant TLAAs.
- Preliminary studies on the selected scope of TLAAs for identifying the steps to be taken for revalidation.
- (Re)validation of identified TLAAs for LTO-2.

The identification and (re)validation of TLAAs for LTO-2 results in the following **deliverables:**

- Methodology for selection of TLAA scope for LTO-2 including the list of TLAAs in-scope for LTO-2 and the justification for exclusion of TLAAs out-of-scope;
- Preliminary studies for the revalidation of the TLAAs in-scope for LTO-2.
- Summary of the revalidation of the TLAAs in-scope for LTO-2.

Findings from the TLAA (re)validation are documented and are input to the PSR for LTO-2 and available for auditing by the ANVS at any time.

Any actions, like replacements that were graded as needing mandatory action and that were not resolved before the license application, will be input in the **deliverable:**

- LTO-2 Mandatory Measures Implementation Plan

More details on TLAA revalidation can be found in 4.4.6.

2.4.6. LTO-2 Documentation (from Safety Demonstration)

The deliverables mentioned in the previous paragraphs form part of the LTO documentation are shown in Table 1.

Furthermore, the results of the Safety Demonstration contribute to the realization of the deliverables that are mentioned in the Plan van Aanpak (voorbereiding) aanvraag LTO-2 vergunning**.**

SSG-48 par. 7.30 advises that the documentation for LTO provides detailed information on each element mentioned in par. 7.18-7.19. Par. 7.19 refers to safety improvements. For KCB LTO-2 justification, the safety improvements are part of the PSR(LTO-2) and are therefore out of the scope of the Safety Demonstration.

Table 1 demonstrates how each deliverable fulfils the element of Requirement 16 par. 4.54 of SSR 2/2 [5] and what Guidance is used from SSG-48 par. 7.18 and par. 7.31-7.36.

Table 1 Deliverable of Safety Demonstration and related requirements and guidance

Deliverable	Relevant SSR 2/2 Req.16	Relevant guidance SSG-48	Indicative delivery date
Conformance Overview	4.54 a)		Q4 2025
Scope setting methodology based on SSG-48 including the results of the scope setting at system level.	4.54 b)	7.18 a); 7.33 a); 7.33 b) & 7.33 c)	June 2025
Methodology for living AMR based on input from SSG-48	4.54 c)	7.18 c); 7.32	June 2025
Ageing Management Reviews results for the scope of LTO-2	4.54 c)	7.18 c); 7.34; 7.35 a)	Q3 2026
Documented consistency with the 9 attributes of effective ageing management programme for: ○ Maintenance Programme; ○ In-Service Inspection Programme; ○ Surveillance Programme; ○ Water Chemistry Programme; ○ Equipment Qualification Programme ○ Technological Obsolescence Management Programme; ○ Equipment Reliability Programme; ○ Specific AMPs (PU-N12-4xx series);	4.54 e)	7.18 b); 7.31 a); 7.35 b); 7.35 c)	Q4 2025
Methodology for selection of TLAAs scope for LTO-2 including list of TLAAs in-scope for LTO-2 and justification for exclusion of TLAAs not in-scope.	4.54 d)	7.18 d)	May 2025
Summary of the revalidation of the TLAAs in-scope for LTO-2	4.54 d)	7.18 d); 7.36	2026/2027
LTO-2 Implementation Plans	4.54 f)	7.18 e); 7.31 b)	2027
Updated Safety Report	4.53	7.36*	2027
Summary of the results of the Safety Demonstration	4.53		2027

*Par. 7.36 of SSG-48 [2] guidance is related to changes in the Safety Analysis Report. The Safety Report is a summarized version of the Safety Analysis Report used for licensing purpose. Changes in the Safety Report reflect changes in the Safety Analysis Report. Further explanation is given in **Chapter 4.2.1.**

2.4.7. Interactions with Periodic Safety Review for LTO-2

As specified in the Plan van Aanpak (voorbereiding) aanvraag LTO-2 vergunning [4], the Safety assessment for KCB LTO-2 justification consists of:

- The Safety Demonstration: aimed to demonstrate that EPZ is able to maintain the current level of safety during the period of LTO-2 by an adequate management of physical and non-physical ageing.
- The PSR(LTO-2): aimed to identify and consider safety improvements to the installation that are beneficial during the period of LTO-2.

Both elements of the safety assessment produce findings. The findings from the Safety Demonstration are introduced in the PSR(LTO-2) process in order to verify interfaces with other Safety Factors and be considered in the Global Assessment.

The interaction process is shown in Figure 5.

The performance of the Safety Demonstration partially covers the content of the review of the following Safety Factors of the PSR(LTO-2):

- Safety Factor 2: Actual condition of structures, systems and components (SSCs) important to safety;
- Safety Factor 3: Equipment Qualification;
- Safety Factor 4: Ageing;
- Safety Factor 10: Organization, the management system and safety culture;
- Safety Factor 12: Human factors.

Further detail on how the Safety Demonstration (partly) covers these Safety Factors are given in the Basis Document of the PSR(LTO-2) [90].

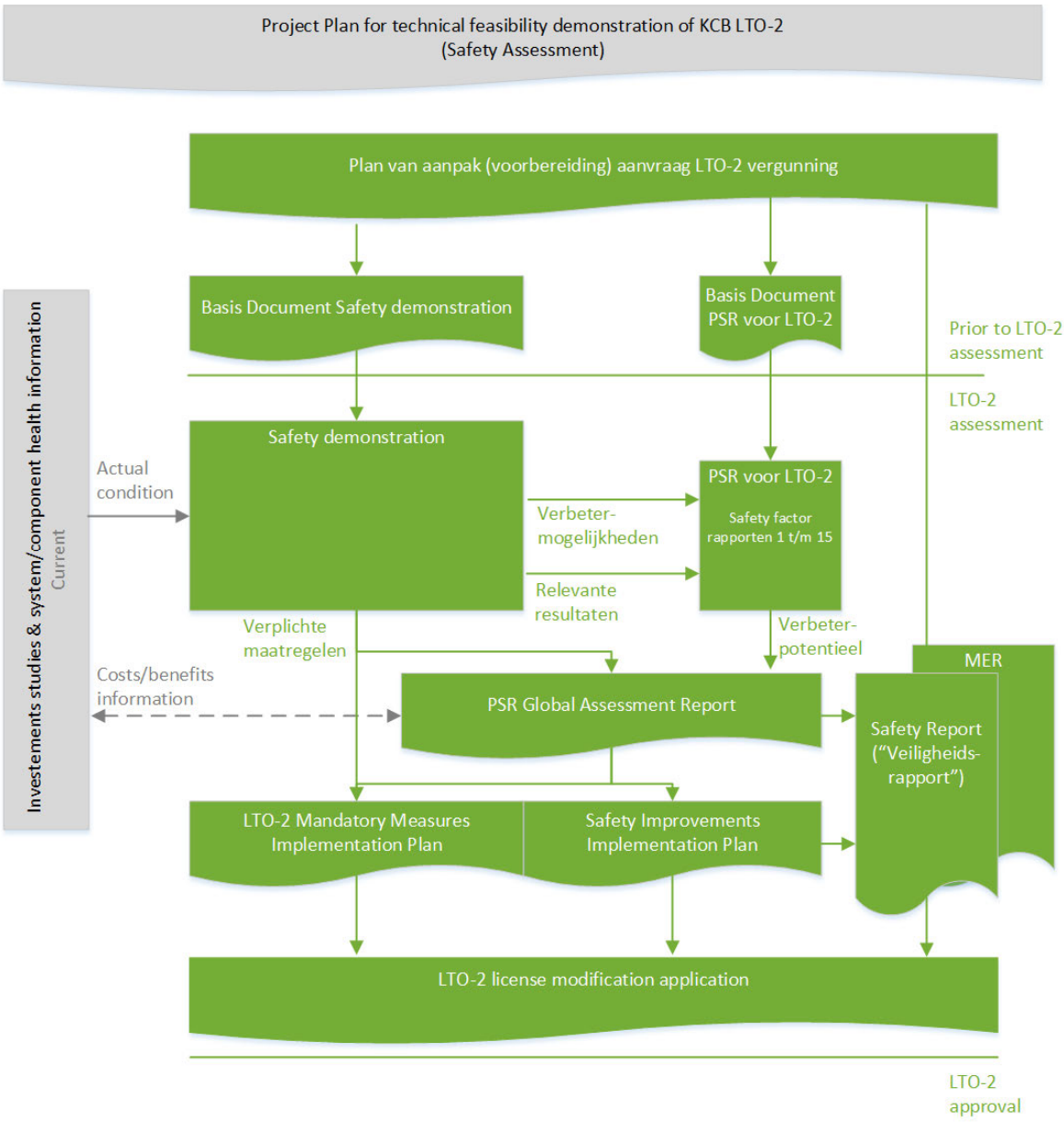

Figure 5 Interaction between PSR(LTO-2) and Safety Demonstration and with other assessments

2.5. Deliverables of KCB LTO-2 Safety Demonstration

2.5.1. Deliverables send in for review

The deliverables that will be sent for review to the regulatory body are identified in Table 1, for each relevant aspect of the Safety Demonstration, in line with the guidance of SSG-48 [2] par. 7.29-7.38.

The documentation supporting the deliverables remains auditable upon request by the national regulatory body (ANVS).

2.5.2. Grading of findings

The assessment activities of the Safety Demonstration will result in findings.

With a positive finding, it is intended that the operating organization exceeds the requirements.

Negative findings identified during the assessment activities of the Safety Demonstration are graded following the process shown in Figure 6 which makes use of the safety relevance matrix shown in Table 2. The safety relevance matrix is consistent with the risk matrixes used in 10EVA13 and 10EVA23.

All identified findings are used in the Global Assessment of the PSR(LTO-2) to assess the combined effect of all findings on nuclear safety. However, as described in the Plan van Aanpak [4], negative findings require mandatory measures (not subject to costs/benefits analysis) when they constitute:

- A direct non-conformance with IAEA Requirements that form part of the assessment framework that may lead to deterioration of the safety during LTO-2 (Grading: *Recommendations*);
- Major deviations from IAEA Guidance that form part of the reference framework, which may lead to deterioration of safety during LTO-2 if no alternative is given (Grading: *Recommendations*);
- A non-compliance with the current licensing basis (Grading: *Recommendations*);
- A identification, based on the results of the Safety Demonstration, that changes to ageing management programs or the replacement of SSCs are necessary to control ageing (Grading: *Technical Recommendations*).

All other findings and the related safety improvements undergo cost-benefit considerations during the Global Assessment process of the PSR(LTO-2) [90].

The grades used for conformance related findings are:

1. **Recommendations**: the findings graded as recommendations identify proven non-conformances with the IAEA Safety Requirements or major deviations from the guidance from IAEA SSGs, or the prescription of the IMS,

with an expected impact on the nuclear safety (e.g. failing of one or more defense lines). In the framework of the Safety Demonstration, non-conformances with the IAEA Safety Requirements related to ageing are brought to the level of non-compliance with the operating license prescriptions.

2. **Suggestions**: the findings graded as suggestions identify deviations from the guidance given in IAEA SSGs, or the prescription of the IMS, that can credibly lead to detrimental effects on the nuclear safety (e.g. degradation of the capability of SSCs to perform their intended safety functions due to ageing) or that represent major deviations from the guidance leading to unreliable processes, lack of necessary knowledge and information.
3. **Encouragements**: the findings graded as encouragements identify deviations from the guidance given in IAEA SSGs that can be addressed alternatively (e.g. a process is not properly documented but its results are present), or the prescription of the IMS, that have low to very low impact on nuclear safety, and differences from the guidance given in IAEA SRS/TECDOCs that, if addressed, would help the operating organization to address deviations from guidance given in IAEA SSGs.
4. **Improvements**: the findings graded as improvements identify opportunities based on proven practices (e.g. differences from guidance given in IAEA SRS/TECDOCs) that if addressed will improve the effectiveness/efficiency of the processes (or their results) under assessment. Improvements that are related to the quality of the assessed documentation or process (e.g. traceability, inconsistencies) are marked as Improvement (Quality). Improvements will be addressed in the Global Assessment of the PSR (LTO-2). Improvements (Quality) will be addressed by EPZ Corrective Action Programme.

The grades used for findings that result from ageing management activities are:

1. **Technical Recommendations**: the findings graded as technical recommendations are related to outcomes of the ageing management related activities which imply a proven impact on nuclear safety during the LTO-2 period (e.g. a TLAA cannot be revalidated) or that lead to the necessity of preventive replacement or the modification of ageing management related programmes (including one-time inspections).
2. **Technical Suggestions**: the findings graded as technical suggestions are related to proven (partially) ineffective/incorrect/insufficient ageing management with potential safety consequences (e.g. the actual condition information of some in-scope components needs to be developed/updated). Findings implying the ageing management is not effective at a programmatic level (e.g. a plant programme does not fulfil one or more of the 9 attributes

for effective ageing management) are also categorized as technical suggestions.

3. **Technical Encouragements**: the findings graded as technical encouragements are related to partially ineffective ageing management (e.g. some procedures of a plant programme credited for ageing management do not report acceptance criteria conform to the 9 attributes of effective ageing management).
4. **Technical Improvements**: the findings graded as technical improvements identify opportunities based on proven practices for the improvement of ageing management effectiveness (e.g. use on-line monitoring instead on sampling-based monitoring).

2.5.3. Quality assurance of deliverables.

As detailed in the Plan van Aanpak (voorbereiding) aanvraag LTO-2 vergunning, quality of deliverables is ensured by applying the quality requirements of the integrated management system of EPZ, current IAEA requirements and guidance. This leads to the general requirement that all deliverables are developed by a competent person/group and receive independent assessment/verification ("onafhankelijke controle") by a competent person/group that did not take part in the development of the deliverable.

Where necessary (for example, because sufficient independent expertise is not available at EPZ) or required (e.g. by national regulations, such as in art. 21 of Bkse concerning nuclear pressure equipment), quality control is performed by an independent third party.

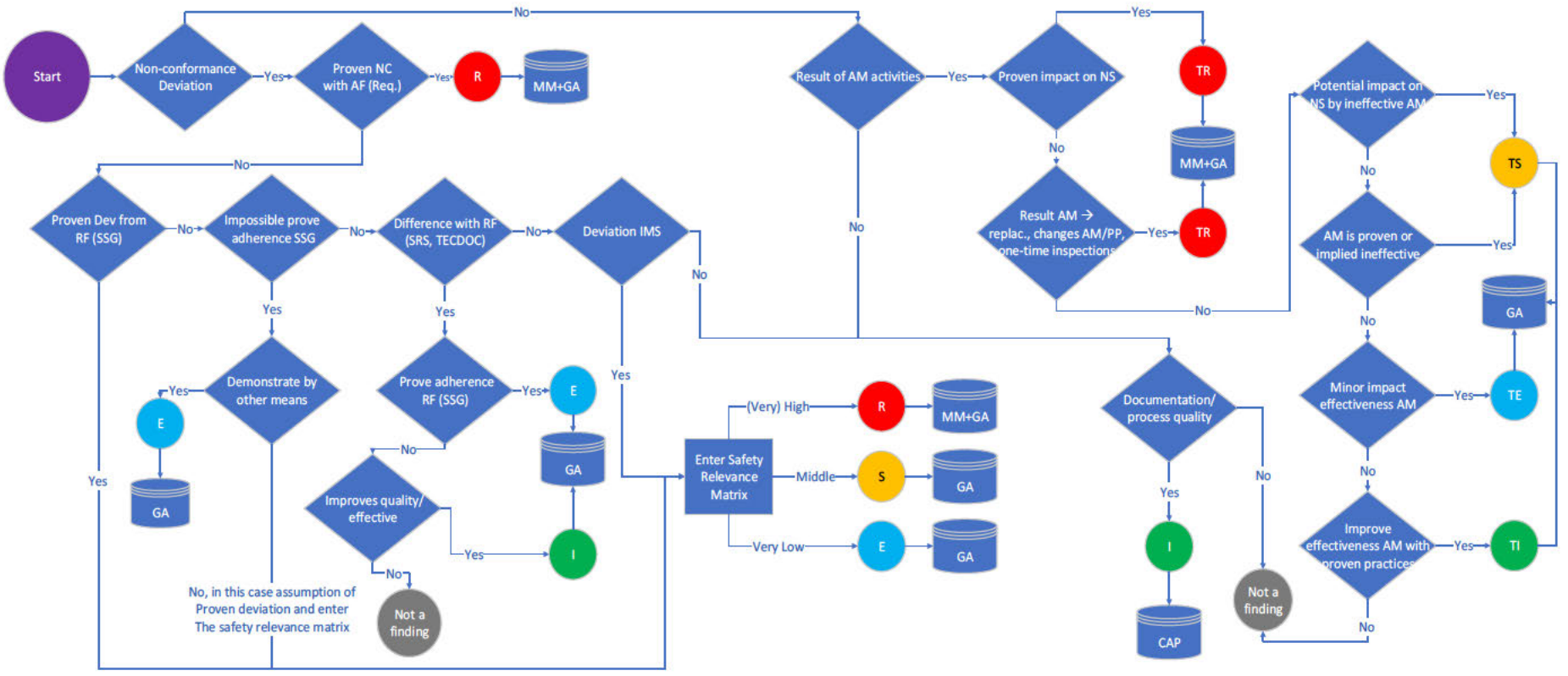

Figure 6 Categorization of findings

NC = Non-Conform
AF = Assessment framework
RF = Reference framework
IMS = Integrated Management System
MM = Mandatory Measure
GA = Global Assessment
AM = Ageing Management
PP = Plant Programme
NS = Nuclear Safety
CAP = Corrective Actions Programme
(T)R = (Technical) Recommendation
(T)S = (Technical) Suggestion
(T)E = (Technical) Encouragement
(T)I = (Technical) Improvement

Table 2 Safety Relevance Matrix for findings of the Safety Demonstration. Applicable to the Conformance Review.

The finding is expected to have the realistic potential to lead to the failure of more DiD lines or multiple barriers due to failure of safety measures or SSCs, wrong process, or human error. The finding proves an unsafe situation at the plant.	**Very high safety relevance**
The finding is expected to have the realistic potential to lead to the failure of one DiD lines or one barrier, or to the loss of one of the three main safety functions due to failure of safety measures or SSCs, wrong process, or human error. The finding implies that the plant is unable demonstrate safety of a particular situation.	**High Safety Relevance**
The finding implies a non-conformance to law, decrees (inc. future license requirements e.g. SSRs), regulations, license or technical specifications. The finding implies a limitation to the presence of adequate knowledge. The finding implies that the documentation cannot be reliable in assolving to its intents. The findining is expected to lead to realistic degradation of the safety-related functions of SSCs in-scope for LTO-2	**Medium Safety Relevance**
The finding is a deviation from external regulations and guidelines without expected impact on the safe operation of the plant (i.e. non of the above applies)	**Low Safety Relevance**
The finding is a deviation from internal rules or inconsistence in process/documentation without credible impact on safety	**Very Low Safety Relevance**

3. Assessment and Reference frameworks for the Safety Demonstration

This chapter selects from the latest IAEA Safety Standards the Assessment and Reference framework to be used for the assessments performed in the Safety Demonstration.

- *Assessment framework or 'toetsingskader' (Chapter 3.1)*: is the set of codes and standards against which the licensee effectively performs the assessment. For the Safety Demonstration, it is defined by the IAEA safety requirements that need to be fulfilled in order to meet objectives and principles of the IAEA Safety Standards. In the context of the safety demonstration, conformance is considered as mandatory. Corrective actions are also regarded as mandatory.
- *Reference framework or 'referentiekader' (Chapter 3.2)*: is the set of codes and standards not containing requirements but guidelines and/or examples of good practices which can be used to fulfil the requirements of the assessment framework. For the Safety Demonstration, it is defined by guidelines at SSG level. Guidelines with a lower hierarchical level might be considered in the assessment phase (e.g. Safety Reports), where appropriate, to identify good practices.

3.1. Assessment framework (Safety Requirements)

The Requirements are composed by the following IAEA Safety Standards:

- IAEA Specific Safety Requirements (SSR – 2/1) Rev.1: Safety of Nuclear Power Plants: Design [6];
- IAEA Specific Safety Requirements (SSR – 2/2) Rev.1: Safety of Nuclear Power Plants: Commissioning and Operation [5];
- IAEA General Safety Requirements GSR – Part 2: Leadership and Management for Safety [7];

According to the IAEA definition of Safety Requirements:

> *The format and style of the requirements facilitate their use for the establishment, in a harmonized manner, of a national regulatory framework. Requirements, including numbered 'overarching' requirements, are expressed as 'shall' statements. Many requirements are not addressed to a specific party, the implication being that the appropriate parties are responsible for fulfilling them.*

The relevant general and specific safety requirements are defined in the following chapters for each aspect of the Safety Demonstration. A complete list of the used requirements forming the LTO requirements is given in Appendix A.

3.2. Reference Framework (Guidance)

The guidance is composed by the relevant Specific Safety Guides (or Nuclear Safety Guides) issued by the IAEA in support of the IAEA General and Specific Safety Requirements:

- IAEA Specific Safety Guide No. SSG-48 - Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants [2];
- IAEA Specific Safety Guide No. SSG-25 - Periodic Safety Review for Nuclear Power Plants [8];
- IAEA Specific Safety Guide No. SSG-72 – The Operating Organization for Nuclear Power Plants [9];
- IAEA Specific Safety Guide No. SSG-61 – Format and Content of the Safety Analysis Report for Nuclear Power Plants [10];
- IAEA Specific Safety Guide No. SSG-74 – Maintenance, Testing, Surveillance and Inspection in Nuclear Power Plants [11];
- IAEA Specific Safety Guide No. SSG-13 – Chemistry Programme for Water Cooled Nuclear Power Plants [12];
- IAEA Specific Safety Guide No. SSG-69 – Equipment Qualification for Nuclear Installations [13];
- IAEA Specific Safety Guide No. SSG-89 – Seismic Hazards in Site Evaluation for Nuclear Installations [14];
- IAEA Specific Safety Guide No. SSG-75 – Recruitment, Qualification and Training of Personnel for Nuclear Power Plants [15];
- IAEA Specific Safety Guide No. SSG-50 – Operating Experience Feedback for Nuclear Installations [16];
- IAEA Safety Guide No. GS-G-3.1 - Application of the Management System for Facilities and Activities General Safety Guide [17];
- IAEA Specific Safety Guide No. SSG-71 – Modifications to Nuclear Installations [19].
- IAEA Safety Guide No. GS-G-3.5 - The Management System for Nuclear Installations General Safety Guide [83];

As per the IAEA definition of (specific) Safety Guide:

Safety Guides provide recommendations and guidance on how to comply with the safety requirements, indicating an international consensus that it is necessary to take the measures recommended (or equivalent alternative measures). The Safety Guides present international good practices, and increasingly they reflect best practices, to help users striving to achieve high levels of safety. The recommendations provided in Safety Guides are expressed as 'should' statements.

The relevant guidance is defined in the following chapters for each Aspect of the Safety Demonstration.

3.3. Selection of assessment and reference criteria

From the Assessment framework and Reference framework, relevant clauses need to be selected that can be used to evaluate the processes, procedures and activities of each aspect of the Safety Demonstration.

The selection of assessment and reference criteria is based on the guidance given in SVS-26 [18] and the SALTO Working Notes Outline.

A specified objective of the SVS-26 [18] is to review the preparedness of NPPs for Long Term Operation by determining the alignment (conformance) with the IAEA Safety Standards in the relevant technical areas, managerial aspects of policy implementation, control and coordination of related activities, continuous review and improvement activities, document control and human resources.

The assessment and reference criteria for each aspect of the Safety Demonstration are defined in Chapter 4.

3.4. Cut-off date

The cut-off date for the standards used as reference for the Safety Demonstration is set to the date of official submission of the present document to the regulatory body for approval (namely: 22-05-2025).

4. Aspects of Safety Demonstration

This chapter describes the following for each aspect of safety demonstration:

- A short introduction explaining the relevance of the aspect for LTO-2;
- Assessment and reference criteria based on guidance from SVS-26 [18] and SALTO Working Notes Outline;
- A summary of the requirements. The summary will not be used in the assessment phase but is intended to explain briefly to the reader what is required;
- Current situation description explaining how the aspect is implemented at EPZ, referring to relevant processes, programmes and documentation, and, if applicable, formal agreements with the regulator[1];
- Planned assessment activities during Safety Demonstration;
- Deliverables for the regulator.

The aspects are grouped in four main categories in line with Figure 3:

- Programme for LTO-2 (4.1);
- Other relevant plant documentation and programmes (4.2);
- Non-Physical Ageing Management (4.3);
- Physical Ageing Management (4.4).

[1] The situation described in this document represents the most recent status at the time of publication and is meant as a reference to describe the starting situation of the plant and describe the relevant processes, programmes and documentation. The assessment (e.g. conformance review) will occur on the actual situation at the time of the assessment and will take into account possible evolution in EPZ processes and documentation occurred between publication and assessment.

4.1. Programme for LTO-2

4.1.1. Requirements, codes and standards for KCB LTO-2

A complete and clear regulatory framework is essential for safe LTO-2.

Assessment and reference criteria

Table 3 Assessment and reference criteria for requirements, codes and standards for KCB LTO-2

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	1 (3.3)
SSR 2/2 Rev. 1 [5]	16 (4.53)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	1.10, 3.2, 3.6, 3.18, 7.2, 7.8, 7.39-7.40

Summary of requirements: EPZ shall establish liaison with the regulatory body and with relevant authorities to ensure a common understanding of, and to ensure compliance with, safety requirements and their interface with other requirements (e.g. PSR, environmental impact assessment). The justification of KCB LTO-2 shall utilize the results of the PSR.

Current situation at KCB

As explained in the introduction, there are no clear legal and regulatory requirements yet for a license application for LTO in the Netherlands. Therefore, the upcoming regulatory requirements for LTO-2 have been detailed in the Plan van Aanpak [4].

The assessment framework for the safety assessment of LTO-2 justification is based on the most recent IAEA Safety Standards. The assessment framework is detailed for the Safety Demonstration and for the PSR(LTO-2) in the respective basis documents (i.e. the current document for the Safety Demonstration). The regulatory body is involved in the definition of requirements, their interfaces and expectations during preliminary consultation.

Assessment activities during the Safety Demonstration

The regulatory body will assess the Plan van Aanpak [4] and basis documents. By approving the Plan van Aanpak [4] and the basis documents for the Safety Demonstration and PSR(LTO-2) the regulatory body agrees to the proposed regulatory and assessment frameworks. Any findings from other instances (e.g. ANVS) will be included in the conformance review as described in section 2.4.1.

4.1.2. KCB LTO-2 Programme

The establishment of a comprehensive Programme for LTO ensures that all necessary activities for achieving safe LTO will be conducted.

Assessment and reference criteria

Table 4 Assessment and reference criteria for KCB LTO-2 Programme

Assessment criteria	
Source	**Requirement**
GSR Part 2 [7]	9 (4.26)
SSR 2/2 Rev. 1 [5]	1 (3.2a-3.2b)
SSR 2/2 Rev. 1 [5]	12 (4.47)
SSR 2/2 Rev. 1 [5]	16 (4.53-4.54)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	2.21, 2.31, 3.3, 3.31-3.35, 4.1-4.8, 5.70, 7.5-7.19, 7.26-7.41
SSG-25 [8]	3.7, 3.10, 9.1-9.5
SSG-72 [9]	7.1-7.4, 7.108
GS-G-3.1 [17]	3.1-3.12, 5.10

Summary of requirements: EPZ shall establish clear policies for ageing management and LTO-2 shall allocate the necessary responsibilities and resources for (i.e.) retaining the necessary competences, providing the appropriate HR and developing processes and procedures. EPZ shall establish and implement a comprehensive programme for ensuring safe LTO-2. The LTO-2 justification shall be based on the results of a safety assessment making use of different review means, such as PSR, which shall result in (safety retaining or improving) measures ensuring the safe LTO-2.The programme for LTO-2 shall address preconditions, scope of SSCs important to safety, categorization of SSCs with regard to ageing, revalidation of safety analyses based on time limited assumptions, review of AMPs and implementation programme for the LTO. EPZ shall train the relevant personnel to ensure that individuals are knowledgeable of the LTO-2 principles and concepts.

Current situation at KCB

For LTO-1 EPZ established a comprehensive programme. Lessons learned have been incorporated into the establishment of a programme for LTO-2. An LTO-2

policy has been developed. And the overall KCB LTO-2 Programme is described at a conceptual level in the Plan van Aanpak [4] which is submitted to the regulator.

Assessment activities during the Safety Demonstration

The regulatory body will assess the Plan van Aanpak [4] and basis documents. By approving the Plan van Aanpak [4] and the basis documents for the Safety Demonstration and PSR(LTO-2) the regulatory body agrees to the proposed Programme for KCB LTO-2 justification. Any findings from other instances (e.g. ANVS) will be included in the conformance review as described in section 2.4.1.

4.1.3. Organizational Arrangements for KCB LTO-2

LTO presents organizational challenges during all its phases which need to be addressed.

Assessment and reference criteria

Table 5 Assessment and reference criteria for Organizational Arrangements for KCB LTO-2

Assessment criteria	
Source	**Requirement**
GSR Part 2 [7]	6 (4.11)
GSR Part 2 [7]	9 (4.26)
SSR 2/2 Rev. 1 [5]	3 (3.8-3.9)
SSR 2/2 Rev. 1 [5]	4 (3.10-3.11)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	3.5, 3.31, 5.1-5.8, 6.9, 7.3, 7.4
SSG-72 [9]	3.2, 3.3, 3.7, 7.8-7.15
GS-G-3.1 [17]	2.28-2.31, 2.61, 2.62, 3.5, 4.1, 4.2

Summary of requirements: EPZ shall ensure that organizational structures, roles and responsibilities are clearly specified and documented for processes relevant to ageing management and the preparation and implementation of LTO-2. The necessary competences shall be determined and provided, and the necessary training conducted, to enable the performance of the required activities for LTO-2. Senior management shall provide the necessary resources to ensure safety.

Current situation at KCB

The processes for organizational arrangements and personnel management are described in the handbooks HB-A00 (‘Handboek Integraal Managementsysteem) [55] and HB-A11 (‘Personeelsmanagement’) [59]. EPZ has established task, role and function descriptions in dedicated procedures present in the IMS. The outcome of LTO-1 has been integrated into the organizational arrangements of EPZ. The general Organizational Arrangements of KCB are part of the IMS and were reviewed during 10EVA23.

The organizational arrangements for the KCB LTO-2 justification project are shown in Figure 7.

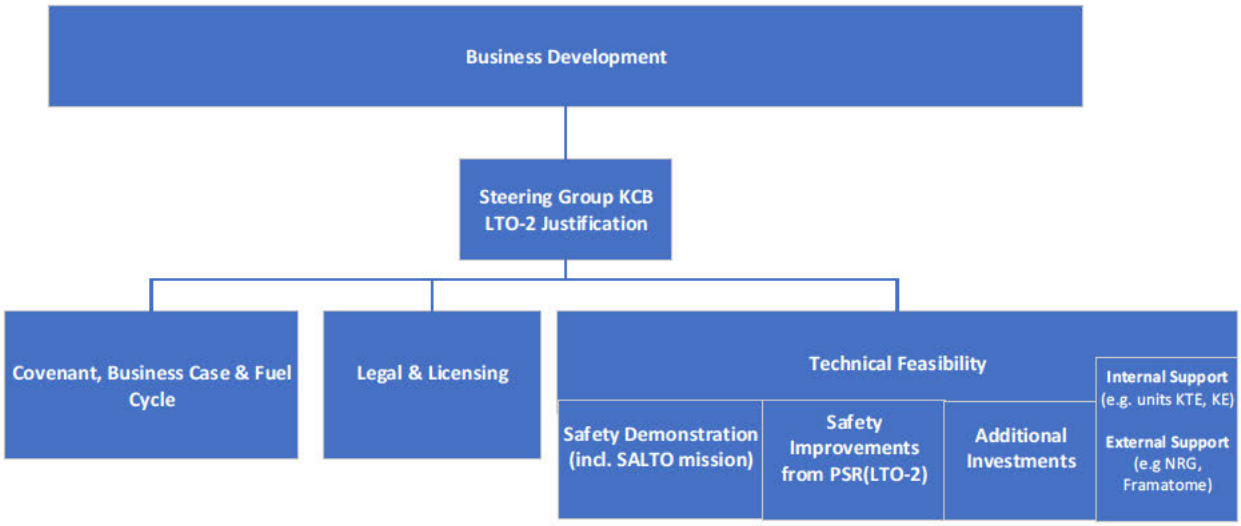

Figure 7 Organizational arrangements for KCB LTO-2 Justification project

The KCB LTO-2 Justification project is led, on mandate of the organization's senior management, by a steering group which includes the participants of the 3 branches of the project:

- Covenant, Business Case & Fuel Cycle: the main goals of this branch are to investigate the possibility of a covenant between EPZ, the shareholders and the authority. Moreover, the business case justifying KCB LTO-2 is developed in this framework. Inter-organizational considerations regarding the fuel cycle (e.g. waste management, HABOG expansion) are also investigated;
- Legal & Licensing: the main goal is to provide the necessary legal support to the operating organization to face the potential legal challenges (e.g. modification of article 15a of the KeW) and fulfil the licensing obligations that will result in a modification of the operating license;
- Technical feasibility: the main goal is to demonstrate that KCB can safely operate for the period of LTO-2. This branch is further subdivided in:
    - Safety Demonstration: the scope of this document.
    - Safety Improvements deriving from the PSR for LTO-2.
    - Additional investment as identified during the project.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the KCB organizational arrangements for KCB LTO-2 conforms to the assessment and reference criteria listed in Table 5. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*

4.2. Other relevant plant documentation and programmes

SSG-48 [2] identifies programmes and documentation that should be in place at the plant for evaluation for long term operation. This paragraph addresses other relevant plant documentation and programmes. Documentation and programmes related directly to non-physical and physical ageing management are described separately in paragraphs 4.3 and 4.4.

4.2.1. Safety Analysis Report

The Safety Analysis Report (SAR) is used for assessing the plant safety in all stages of the lifetime of a NPP and determine the suitability of the licensing basis.

As such, the SAR needs to be kept constantly up to date with changes in design, other safety relevant aspects (e.g. technical, organizational and human) and their interactions.

Assessment and reference criteria

Table 6 Assessment and reference criteria for the Safety Analysis Report

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	1 (3.2e)
SSR 2/2 Rev. 1 [5]	4 (3.10-3.11)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	3.11, 4.1-4.5, 4.10, 7.36
SSG-25 [8]	3.9
SSG-61 [10]	2.17-2.20, 3.3.30-3.3.32, 3.3.67, 3.3.71-3.3.76, 3.4.10(e), 3.5.7-3.5.8, 3.5.22, 3.7.5, 3.8.17, 3.13.10-3.13.13, 3.13.16-3.13.16, 3.15.2-3.15.31, 3.15.67-3.15.68

Summary of requirements: EPZ shall ensure that the plant is operated according to the SAR and therefore shall keep up to date the SAR to reflect design changes, and activities and results of the KCB LTO-2 safety assessment, including possible safety improvements.

Current situation at KCB

The role of the SAR is assumed at KCB by the Technisch Informatie Pakket ('Technical Information Package' - TIP).

Conditions B18 of the KeW License BS30 [46] prescribe that EPZ shall maintain the TIP available. The scope and content of the TIP is prescribed by PO-N13-28 and was agreed with the regulator.

The TIP contains a very detailed description of the installation, the technical specifications and the features guaranteeing safety.

The TIP is the basis on which the Veiligheidsrapport VR15 ('Safety Report') [66] is realized, as described in Figure 8.

According to condition 2.3 of the KeW License BS30 [46], the Safety Report (VR15) is part of the license basis, except for chapters 2.1 and 15.

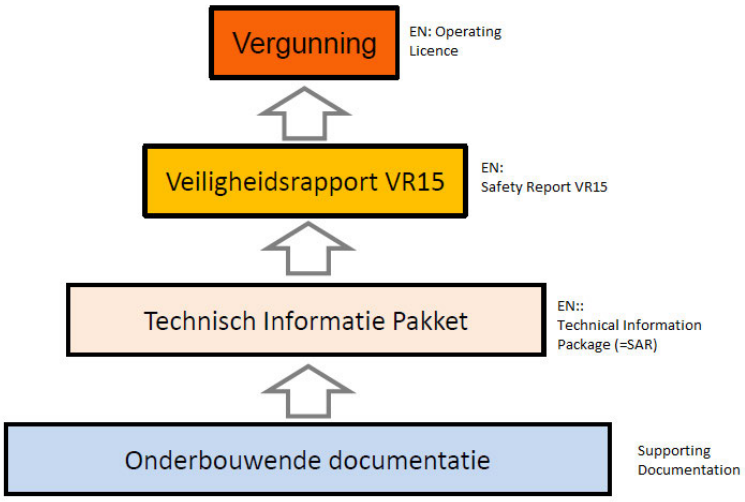

Figure 8 Relation between Technisch Informatie Pakket, Safety Report and Operating License

A change in the operating license allowing for LTO-2 is supported by changes in the Safety Report (VR15) reflecting the results of the KCB LTO-2 Justification project.

The operating license prescribes that the TIP remains auditable.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the TIP and the VR15 are realized conform to the assessment and reference criteria listed in Table 6. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

The Safety Report (VR15) will be updated to reflect the results of the KCB LTO-2 justification project (including the Safety Demonstration). The updated Safety Report

will be delivered as a part of the operating license modification request (deliverable: *updated Safety Report*).

According to the operating license [46] the information on which the Safety Report is based must be kept available. To address this obligation, the TIP will be actualized according to the results of the KCB LTO-2 justification project (including the Safety Demonstration) including the modifications to be carried out in the period after the license modification approval. The timeframe for the TIP actualization will therefore extend beyond the license modification approval. If changes of the scope of the TIP are considered PO-N13-28 will be submitted to the ANVS.

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan).*

4.2.2. Periodic Safety Review

As described in the Plan van Aanpak [4], the PSR for LTO-2 justification support is performed according to the Basis Document for PSR(LTO-2) [90]. The PSR(LTO-2) will not be further addressed in this document.

4.2.3. Configuration Management

Configuration management is used to ensure consistency among elements of design requirements, facility configuration documentation and the physical plant. Plant configuration ensures that changes to the plant and systems are properly identified, screened, designed, evaluated implemented and recorded, so that the imbalance can be restored.

Assessment and reference criteria

Table 7 Assessment and reference criteria for the configuration management

Assessment criteria	
Source	**Requirement**
SSR 2/1 Rev. 1 [6]	3 (3.6d)
SSR 2/1 Rev. 1 [6]	14 (5.3)
SSR 2/2 Rev. 1 [5]	1 (3.2f)
SSR 2/2 Rev. 1 [5]	10 (4.38)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	4.1 (b), 4.2
SSG-25 [8]	5.25-5.26
SSG-61 [10]	2.19, 3.3.8 (design basis)

Summary of requirements: EPZ shall maintain the configuration of the plant during LTO-2 by means of a Configuration Management system. Such a system shall ensure consistency between design requirements, physical configuration and plant documentation when changes to the plant configuration are made (e.g. during LTO-2 implementation). EPZ shall ensure that the responsibilities for maintaining the configuration of the plant during LTO-2 are assigned.

Current situation at KCB

Conditions A1, B6, B9, B18 of the KEW License BS30 [46] prescribe configuration management as a plant process.

Configuration Management at KCB is contained in main process HB-N13 “Configuratiemanagement” [54]. The process monitors and manages the configuration and provides unput to other relevant processes.

Within the framework of the process ““Configuratiemanagement” a set of procedures is established in the IMS for ensuring that modifications to the plant or to design

limits are processed in the relevant documentation so that the configuration equilibrium is preserved.

The Configuration Management process is built around the PDCA cycle, incorporating all the steps of plan, do, check and act and it is self-evaluated annually. Audits are periodically carried out to assess the application and effectiveness of the process.

The Configuration Management is part of the IMS and was reviewed during the 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the configuration management conforms to the assessment and reference criteria listed in Table 7. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan).*

4.2.4. Management of Modifications

The Management of Modifications ensures control over the modifications that during the plant lifetime are conducted on the plant to ensure that the modified plant meets the design requirements and remains consistent with the SAR.

A Management of Modifications ensures that the modification process interfaces with the relevant plant programmes (e.g., maintenance, AMP), projects (e.g., LTO) and documentation (e.g., SAR, AMPs).

Assessment and reference criteria

Table 8 Assessment and reference criteria for the management of modifications

Assessment criteria	
Source	**Requirement**
SSR 2/1 Rev. 1 [6]	14 (5.3)
SSR 2/2 Rev. 1 [5]	1 (3.2f)
SSR 2/2 Rev. 1 [5]	11 (4.39-4.43)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	4.1, 4.2, 4.9-4.15
SSG-25 [8]	5.24
SSG-61 [10]	2.10, 2.15-2.16, 2.18-2.20, 2.27-2.28
SSG-71 [19]	1.2, 2.2 - 2.7, 2.10, 2.13-2.15, 3.3, 3.8, 3.10, 4.9 (g, l), 4.13, 4.14(l), 4.18, 4.32, 5.5, 7.17, 7.21, 7.23, 10.1, 10.5, 10.7
SSG-72 [9]	7.42, 7.97

Summary of requirements: EPZ shall ensure the control of design changes during the LTO-2 period by means of Management of Modifications. This shall ensure that all modifications are properly identified, specified, screened, designed, evaluated, authorized, implemented and recorded. EPZ shall ensure that the responsibilities for managing plants modification during LTO-2 are assigned.

Current situation at KCB

According to condition A1 stipulated in the KeW License BS30 [46], EPZ shall have in place a modification procedure for the modification of safety-relevant structures, systems and components.

The Management of Modifications process is handled as a sub-process within the main Configuration Management process manual HB-N13 [54].

The process is suitable for all types of modifications which have an impact on nuclear safety. Procedures exist within the IMS for technical modification, changes in operation management, modification to operational limits and conditions, changes in the organizational structure and changes to safety analyses (e.g. PSA) and changes of design requirements.

A graded approach is applied to Management of Modifications. Changes are categorized according to their potential impact or risk to safety. 3 categories are distinguished as follows:

- Category 1 is for nuclear safety significant changes, that require amendment to the Safety (Analysis) Report.
- Category 2 is for nuclear safety relevant changes whose impact is minor to nuclear safety.
- Category 3 is reserved for changes that have no relevance to nuclear safety.

This categorization was approved by the regulator and documented in PU-N13-05 [91].

The Management of Modifications is structured on a set of procedures guaranteeing that the changes are considered into the relevant documentation and processes, including ageing management.

Relevant modifications are transferred to the knowledge management process HB-A31 [56], providing resource for training and education.

The Management of Modifications is part of the IMS and was reviewed during the 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the management of modifications conforms to the assessment and reference criteria listed in Table 8. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan).*

4.2.5. MTSI Programmes

General introduction.

Maintenance, testing, surveillance and ISI activities are necessary to ensure that SSCs are available to perform their functions in accordance with the assumptions and intent of the design.

SSR-2/2 § 8.1: "Maintenance, testing, surveillance and inspection programmes shall be established that include predictive, preventive and corrective maintenance activities. These maintenance activities shall be conducted to maintain availability during the service life of structures, systems, and components by controlling degradation and preventing failures. In the event that failures do occur, maintenance activities shall be conducted to restore the capability of failed structures, systems and components to function within acceptance criteria."

SSG-74 § 2.26: 'Maintenance, testing, surveillance and inspection have the common objective of ensuring that the plant is operated in accordance with the design assumptions and intent, and in compliance with the operational limits and conditions. Results of surveillance or inspection should be compared with acceptance criteria. If the results fall outside the acceptance criteria, corrective actions should be initiated. Such actions should include corrective maintenance measures such as adjustment, repair, or replacement of defective items to prevent recurrence. Maintenance should always be followed by testing."

At KCB, the surveillance programme is conducted to test the availability of SSCs that are required from the technical specifications. Unavailability leads to entrance of a STATUS in the technical specifications and must be solved by performing corrective maintenance activities.

The preventive maintenance programme includes a range of activities that ranges from preventive exchange of (parts of) SSC's and preventive overhaul of SSCs to capacity testing of SSCs. To perform maintenance activities on SSCs that have lost part of their capacity (but that are still available according to the surveillance test), it is allowed to enter a STATUS in the technical specifications. This type of maintenance is called 'deficient maintenance'.

At KCB, the entrance of a STATUS in the technical specification for performing preventive maintenance activities is only allowed if this is explicitly mentioned in the section of the Technical Specifications that identifies the lowest functional capability or performance level of equipment (Limiting Conditions for Operation - LCO). At KCB all maintenance, surveillance and ISI activities are grouped under the process ‘instandhouding’ (HB-N12 [21]) with the objective to preserve the SSCs in such a condition that they are able to fulfill the design specification and maintain the availability requirements. In the document STRAT-ISH [79] the preventive activities of the project are considered and categorized as shown in

Table 9.

Table 9 Subdivision of activities in the preventive programmes of instandhouding

	Mandatory		Not Mandatory
	Nuclear Safety Relevant SSC	**Non-Nuclear Safety Relevant SSC**	
Preventive Maintenance and capability testing	From condition C.5 of V-Kern Mandatory preventive maintenance activities for nuclear safety relevant SSCs according to codes and standards (e.g. KTA, ASME)	Mandatory preventive maintenance activities for non-nuclear safety relevant SSCs (ASME, environment, fire protection)	Preventive maintenance to non-nuclear safety relevant SSCs related to reliability management
Surveillance (availability testing)	From condition C.6 of V-Kern Mandatory surveillance activities for nuclear safety relevant SSCs according to technical specifications	Mandatory surveillance to non-nuclear safety relevant SSCs	Surveillance activities on basis of operating experience or ageing management
ISI (Non-destructive testing, NDT, for pressure retaining components)	From condition C.7 of V-Kern Mandatory NDT based on ASME XI [49]	Mandatory NDT to pressure retaining SSCs based on the national law on pressure retaining components	NDT activity to pressure retaining systems based on perceived need or ageing management

Maintenance

The process of maintenance aims to ensure that SSCs can perform their design functions. Activities typically performed in the maintenance programme are preventive, deficient or corrective in nature.

Assessment and reference criteria

Table 10 Assessment and reference criteria for the maintenance programme

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	9 (4.34)
SSR 2/2 Rev. 1 [5]	16 (4.54)
SSR 2/2 Rev. 1 [5]	31 (8.1, 8.3-8.6, 8.14-8.17)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	3.3, 3.21, 3.25, 3.28, 3.30, 3.33, 3.35, 4.16-4.22, 5.9-5.13, 5.70-5.73, 7.26-7.27

SSG-74 [11]	2.9-2.17, 2.27, 4.3-4.5, 4.24, 5.57-5.62, 6.12-6.15, 7.4-7.8, 8.1-8.6, 8.41.

Summary of requirements: EPZ shall establish a maintenance programme, including for non-permanent equipment dealing with mitigation of severe accidents, to maintain the level of safety and availability of the SSCs. EPZ shall demonstrate that the maintenance programme is and will remain effective for the intended period of LTO-2. EPZ shall ensure that the necessary maintenance procedures are prepared, reviewed, distributed and modified when required. EPZ shall ensure that the data from maintenance procedures are recorded and analysed. EPZ shall ensure that the AMP can take credit for the maintenance activities on SSCs. EPZ shall ensure that the results of the AMP will be reflected in the maintenance programme. EPZ shall ensure that the spare parts shall be available and stored in conditions such that spare will be in proper condition for use. EPZ shall establish arrangements for the procurement, control and storage in adequate conditions of spare parts and components.

Current situation at KCB

According to KCB's KeW operating license BS30 [46] conditions B.4, C.4 and C.5, KCB shall operate in a good state of maintenance and it shall have a documented preventive maintenance programme in order to ensure that the availability, reliability and functionality of safety functions remains consistent with its design. The operating license further prescribes that the results of the maintenance activities performed at KCB are stored and analysed and that the results of these analyses form the input for corrective actions, and modifications to the preventive maintenance programme.

The maintenance programme at KCB is part of the 'instandhouding' process as described in HB-N12 [21].

From the perspective of the maintenance programme, two types of maintenance are recognized: corrective maintenance and preventive maintenance.

However, from the perspective of the technical specifications, 3 types of maintenance are recognized:

- Corrective maintenance: maintenance activities aimed to recover the availability of an SSC's function after failure/unavailability;
- Deficient maintenance: maintenance activities performed in response to a not-foreseen degradation (but not yet unavailability) of an SSC's function. The deficient maintenance actions prevent the SSC's unavailability;
- Preventive maintenance: intended as the maintenance actions and functional tests performed routinely to ensure the SSC's functionality over the longer term, minimize the chances of failure and detect non-foreseen degradation.

The preventive maintenance programme, its objectives and the principles and norms upon which it is based and criteria for return of operating experience, is further described in STRAT-OHD [62]. The preventive maintenance programme is based on IAEA guidelines for maintenance at nuclear power plants.

A procedure exists to deal with changes to the preventive maintenance programme based on the findings from the MTSI programmes.

The technical background for civil, EI&C and mechanical maintenance is given respectively in N12-77-ONDC [63], N12-77-ONDE [64] and N12-77-ONDW [65].

For the LTO-1, the maintenance programme was verified against the then current attributes of an effective AMP [85].

The Maintenance Programme is part of the IMS and was reviewed during the 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the maintenance programme conforms to the assessment and reference criteria listed in Table 10. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

The preventive maintenance programme as credited in the ageing management programme will be independently assessed by a third party according to paragraph 2.4.4 and 2.5.3 for completeness and to verify consistency with the nine attributes of an effective AMP: (deliverable: *Documented consistency with the 9 attributes*).

The AMR for LTO-2 will be performed according to 2.4.3 to verify that the activities of the preventive maintenance programme for managing ageing effects are effective. (deliverable: *Ageing Management review*)

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*.

Surveillance

The surveillance programme is implemented for demonstrating compliance with established operational limits and conditions.

The surveillance programme should verify that SSCs important to safety are ready to operate and able to perform their safety functions as intended in the design.

Assessment and reference criteria

Table 11 Assessment and reference criteria for the surveillance programme

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	9 (4.34)
SSR 2/2 Rev. 1 [5]	16 (4.54)
SSR 2/2 Rev. 1 [5]	31 (8.1-8.5)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	3.3, 3.21, 3.30, 3.33, 3.35, 4.16-4.18, 5.8, 4.37-4.44, 7.26-7.27
SSG-74 [11]	2.19-2.21, 2.27, 4.3, 4.5, 4.24, 5.57-5.62, 6.11-6.15, 7.4-7.8, 7.9, 9.1-9.3, 9.5-9.6, 9.9, 9.11-9.32, 9.36-9.40

Summary of requirements: EPZ shall establish a surveillance programme and shall demonstrate that it is and will remain effective for the intended period of LTO-2. EPZ shall identify a clear relation with the AMP. EPZ shall periodically review the surveillance programme to ensure its effectiveness.

Current situation at KCB

According to conditions C4 and C6 of the KeW License BS30 [46], EPZ is required to establish, implement and maintain a documented programme for surveillance activities (regular availability tests) of safety relevant SSCs. As per condition B6, EPZ is required to comply with the provisions of NVR NS-G-2.6 [53] for surveillance activities.

The document STRAT-SURV [53] describes the interpretation of NVR NS-G-2.6 [53] for KCB and methods on the basis of which the surveillance programme should be developed, tested and adjusted, if required.

Systems/components are identified for inclusion in the surveillance programme based on their safety function in accordance with the criteria mentioned in NVR NS-G-2.6 [53].

The surveillance programme at KCB has been developed based on the following aspects:

- Functional testing and inspections of SSCs;
- Monitoring of operating parameters;
- Checking and calibrating instrumentation.

KCB has established its own system with regards to surveillance of civil structures (due to absence of specific national or international standards) with details in the substantiation report of the civil maintenance N12-77-ONDC [63].

In accordance with the KEW License BS30 [46], systems and components that are part of the fire prevention, fire detection and fire suppression facilities shall be examined once a year by an expert for availability and usability.

For the LTO-1, the surveillance programme was verified against the current 9 attributes of an effective ageing management programme [88].

The Surveillance Programme is part of the IMS and was reviewed during the 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the surveillance programme conforms to the assessment and reference criteria listed in Table 11. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

The surveillance programme as credited in the ageing management programme will be independently assessed by a third party according to paragraph 2.4.4 and 2.5.3 for completeness and to verify consistency with the nine attributes of an effective ageing management programme: (deliverable: *Documented consistency with the 9 attributes*).

The ageing management review for LTO-2 will be performed according to 2.4.3 to verify that the activities of the surveillance programme for managing ageing effects are effective. (deliverable: *Ageing Management review*)

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*

In-Service Inspection

ISI is performed by the plant over the operating lifetime for detecting possible degradation of the relevant SSCs. The goal of ISI is to determine whether the condition of the SSCs with respect to the investigated degradation is acceptable for continued safe operation or whether corrective actions should be taken.

Assessment and reference criteria

Table 12 Assessment and reference criteria for the In-Service Inspection programme

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	9 (4.34)
SSR 2/2 Rev. 1 [5]	15 (4.52)
SSR 2/2 Rev. 1 [5]	16 (4.54)
SSR 2/2 Rev. 1 [5]	31 (8.1, 8.3-8.5)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	3.3, 3.21, 3.24, 3.30, 3.33, 3.35, 4.16-4.18, 4.32-4.36, 5.9-5.13, 5.70-5.73, 7.26-7.27.
SSG-74 [11]	2.22-2.24, 2.27, 4.3-4.5, 4.24, 5.57-5.62, 6.11-6.15, 7.4-7.8, 7.9, 10.1-10.4, 10.6, 10.8-10.15, 10.23-10.30, 10.37-10.38.

Summary of requirements: EPZ shall establish an ISI programme and shall demonstrate that it is and will remain effective for the intended period of LTO-2. EPZ shall ensure that methodology, equipment and personnel have been qualified according to the regulatory requirements. EPZ shall identify for the scope of ISI a clear relation with the Ageing Management Programme. EPZ shall review periodically the ISI programme to ensure its effectiveness.

Current situation at KCB

As per conditions C.4 and C.7 of the KEW License BS30 [46], a new ISI programme shall be drawn up every 10 years and provided with an assessment by the designated inspection body, submitted to the ANVS for approval. Presently, the 6th interval of the ISI programme is being implemented which is valid from 1 January 2020 to 31 December 2029 and is based on the Nuclear Pressure Equipment Regulation [47] and the Pressure Equipment Commodities Act Decree 2016 [48]. As per condition B6, EPZ is required to comply with the provisions of NVR NS-G-2.6 [53] for ISI activities.

ISI programme is a part of the ‘instandhouding’ process (N12) at KCB. The document STRAT-ISI [45] outlines the ISI programme at KCB which includes description of the components to be inspected, the methods of inspection and the frequency of inspection.

The applicability of the chosen NDT method is demonstrated using the current inspection code. Qualification of the chosen method is to be demonstrated using ENIQ guideline Report no. 3 [50]. The decision to qualify an NDT methodology is taken in mutual consultation between the owner (customer), NDT company and the notified inspection body. The qualification and testing of the NDT personnel is performed based on NEN-EN-ISO 9712 [51].

A formal evaluation of ISI activities is carried out on an annual basis.

For the LTO-1, the ISI programme was verified against the then current attributes of an effective AMP [86].

The ISI Programme is part of the IMS and was reviewed during the 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the in-service inspection programme conforms to the assessment and reference criteria listed in Table 12. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

The ISI programme as credited in the AMP will be independently assessed by a third party according to paragraph 2.4.4 and 2.5.3 for completeness and to verify consistency with the nine attributes of an effective AMP: (deliverable: *Documented consistency with the 9 attributes*).

The AMR for LTO-2 will be performed according to 2.4.3 to verify that the activities of the ISI programme for managing ageing effects are effective. (deliverable: *Ageing Management review*)

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan).*

4.2.6. Equipment Qualification

An Equipment Qualification (EQ) Programme is implemented to verify that items important to safety at a NPP can perform their intended functions when necessary, and in the prevailing environmental conditions, throughout their design life including accidents, with due account taken of plant conditions during maintenance and testing. Qualified life is the period, prior to the start of a design basis event, for which an SSC has been demonstrated, through testing, analysis or experience, to be capable of functioning within acceptance criteria during specific operating conditions.

Assessment and reference criteria

Table 13 Assessment and reference criteria for the Equipment Qualification programme

Assessment criteria	
Source	**Requirement**
SSR 2/1 Rev. 1 [6]	30 (5.48-5.50)
SSR 2/2 Rev. 1 [5]	13 (4.48-4.49)
SSR 2/2 Rev. 1 [5]	16 (4.54)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	3.3, 3.21, 3.24, 3.30, 3.33, 3.35, 4.16-4.18, 4.32-4.36, 5.9-5.13, 5.70-5.73, 7.26-7.27
SSG-74 [11]	7.2, 7.3
SSG-69 [13]	2.6, 2.14, 2.21, 2.26-2.33, 3.1, 3.12, 3.24, 3.27-3.30, 4.18, 4.23-4.33, 4.34, 4.57-4.59 5.1, 5.2, 5.7, 5.9, 5.10, 5.11, 5.14, 5.15, 5.23, 5.31, 5.43-5.48, 6.1, 6.4, 6.5, 7.1, 7.2
SSG-89 [14]	2.26, 4.6-4.9, 4.17, 4.1-4.8, 5.10, 5.20, 6.5, 7.5, A.10-A.17, A.24-A.25

Summary of requirements: EPZ shall ensure that an auditable EQ Programme for qualified equipment, including evaluation reports and test reports is implemented during the intended LTO-2 period. EPZ shall demonstrate that the EQ programme is and will remain effective for the intended period of LTO-2. EPZ shall ensure that each component relevant for LTO-2 can perform its safety function under all specified operating and accident conditions for the intended period of operation. EPZ

shall ensure that the status of qualified equipment is preserved by using controls on installation, maintenance, modifications, and condition monitoring.

Current situation at KCB

STRAT-KWAL [84], “Strategie voor kwalificatie van veilgheidsrelevante componenten” (‘Strategy for qualification of safety-relevant components’) establishes the processes that KCB follows for the qualification of components. This strategy document describes the implementation of the qualification requirements specific to KCB. Qualification covers the spectrum of design requirements, purchasing, installation, storage, maintenance, and testing of components.

The EQ process and scope is described in procedures on the IMS.

When the qualified residual life of a component is limited or cannot be sufficiently substantiated, measures are taken. The possible measures to take are replacement of the component with new equipment, requalification or maintenance actions for the component.

During operating cycle from SW22 to SW23, a new environmental condition monitoring programme was implemented that provides data on temperature and radiation. The results of this monitoring programme have been introduced in the calculation of the qualified service life of the components in the Automated Residual Life Estimation (AUREST)-database. The calculated qualified life of each component using the monitored parameters is updated annually and reported to the regulator.

For the LTO-1, the EQ programme was verified against the 9 attributes of an effective AMP [89]. EQ was reviewed during the 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the EQ programme conforms to the assessment and reference criteria listed in Table 13. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

The EQ programme as credited in the AMP will be independently assessed by a third party according to paragraph 2.4.4 and 2.5.3 for completeness and to verify consistency with the nine attributes of an effective AMP: (deliverable: *Documented consistency with the 9 attributes*).

The AMR for LTO-2 will be performed according to 2.4.3 to verify that the activities of the EQ programme for managing ageing effects are effective. (deliverable: *Ageing Management review*).

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan).*

4.2.7. Equipment Reliability

AP-913 [57] by Institute of Nuclear Power Operations defines that the equipment reliability process enables plant personnel to assess important station equipment, develop and implement long term equipment health plans, monitor equipment performance, and make continuing adjustments to preventive maintenance tasks and frequencies based on equipment operating experience.

Assessment and reference criteria

Table 14 Assessment and reference criteria for the equipment reliability programme

Assessment criteria	
Source	**Requirement**
SSR 2/1 Rev. 1 [6]	23 (5.37)
SSR 2/1 Rev. 1 [6]	29 (5.46)
SSR 2/2 Rev. 1 [5]	14 (4.50-4.51)
SSR 2/2 Rev. 1 [5]	31 (8.4, 8.5, 8.14A)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	2.25, 6.1, 6.8
SSG-74 [11]	2.4, 2.7 (b), 2.9 (c), 2.17, 3.2-3.3, 3.14, 5.13, 6.12-6.13, 7.5, 8.2, 9.28 (a), 9.28 (b), 9.30 (a), 9.30 (b), 9.47

Summary of requirement: EPZ shall ensure that the design of equipment important to safety ensures sufficient reliability and shall determine the activities necessary to maintain the reliability of SSCs and shall evaluate and assess long term effects arising from degradations in the plant that may affect the long term reliability of plant equipment or structures. EPZ shall ensure that the Equipment Reliability Programme can be credited as an AMP.

Current situation at KCB

As per condition C.4 of the KeW License BS30 [46], the ‘Instandhouding’ process for safety-relevant SSCs should ensure that their reliability remain in line with the design throughout the life of the plant. Inherent reliability of the safety-relevant SSCs should be considered while determining the extent and frequency of the preventive maintenance, surveillance and ISI activities. Also, as per regulation C.8 [46], EPZ implements Equipment reliability as part of the ‘Instandhouding’ (N12) process. The document PU-N12-60 [58] describes the equipment reliability at EPZ. It comprises of six main steps:

- Determination of component class;
- Determination and improvement of preventive programme;
- Performance of preventive tasks;
- Monitoring;
- Corrective actions;
- Long term plan.

The description of each step is given in procedures on the IMS.

The ageing management takes credit on the equipment reliability mostly for the active components.

The 'EPZ Equipment Reliability Index' (ERI) is the main process indicator.

Equipment reliability delivers ‘health’ reports on the current condition of the installation. These reports are an important input to the living ageing management review.

Because the current equipment reliability process focuses on monitoring of the current condition of the installation and associated risks for the coming years, EPZ performs an additional extensive risk assessment (investment study) of the installation to anticipate necessary investments for LTO-2 to ensure reliability of the power plant. This includes identifying all SSCs for which it is anticipated that:

- the SSC will reach end of life;
- technological obsolescence cannot be managed;
- maintenance will become too costly or impossible.

This is graphically shown in Figure 5. See also paragraph 4.4.4 on the interaction with the AMR.

When issues are identified, corrective actions are determined and prioritized based on the associated risks; both for nuclear safety and plant reliability. Corrective actions are tracked trough to resolution through portfolio systems, the CAP system and/or work management.

Equipment reliability was reviewed during the 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the equipment reliability conforms to the assessment and reference criteria listed in Table 14. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

The equipment reliability programme as credited in the AMP will be independently assessed by a third party according to paragraph 2.4.4 and 2.5.3 for completeness and to verify consistency with the nine attributes of an AMP: (deliverable: *Documented consistency with the 9 attributes*).

The AMR for LTO-2 will be performed according to 2.4.3 to verify that the activities of the equipment reliability programme credited for managing ageing effects are effective. This includes the verification that information on the current condition of the SSCs in scope is available. And considers ageing issues identified in the investment study. (deliverable: *Ageing Management review*)

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*.

4.2.8. Water Chemistry

A chemistry programme minimizes the harmful effects of chemical impurities and corrosion on plant structures, systems and components. It supports the minimization of buildup of radioactive material and occupational radiation exposure as well as limiting of the release of chemicals and radioactive material to the environment.

Assessment and reference criteria

Table 15 Assessment and reference criteria for the water chemistry programme

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	9 (4.34)
SSR 2/2 Rev. 1 [5]	15 (4.52)
SSR 2/2 Rev. 1 [5]	16 (4.54)
SSR 2/2 Rev. 1 [5]	29 (7.13-7.17)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	3.3, 3.21-3.23, 3.30, 3.33, 3.35, 4.16-4.18, 4.45-4.48, 5.8, 5.9-5.11, 5.70-5.73, 7.26-7.27
SSG-13 [12]	2.4, 2.6, 2.9-2.11, 2.21-2.23, 3.1, 3.3, 3.4, 4.1, 4.4, 4.12, 4.27, 4.29, 4.31, 4.43-4.44, 4.46-4.47, 4.49, 5.23-5.24, 6.5-6.7, 7.6-7.9

Summary of requirements: EPZ shall establish a water chemistry programme and shall demonstrate that it is and will remain effective for the intended period of LTO-2. EPZ shall verity that the water chemistry programme can be credited as an AMP. EPZ shall monitor, record and use the data from the water chemistry programme for determining and preventing ageing degradation. EPZ shall review the water chemistry programme periodically to ensure its effectiveness.

Current situation at KCB

Water chemistry management is part of the (radio) chemical management (N04) process at KCB. The main objectives of the water chemistry programme concerning ageing management at KCB are:

- Minimizing corrosion and erosion in primary and secondary systems to maintain the integrity of systems and components throughout the life of the plant;

- Preventing corrosion on the fuel elements, to maintain the integrity of the fuel cladding;
- Minimizing the occurrence of deposits in the primary and secondary systems, to prevent heat transfer or corrosion problems.

The water chemistry specifications are based on the Vereinigung der Großkesselbesitzer (VGB) standard [52].

Water chemistry activities including monitoring are conducted based on procedures auditable on the IMS. The programme is evaluated every 2-years.

For the LTO-1, the water chemistry programme was verified against the nine attributes of an effective AMP [87].

The Water Chemistry Programme is part of the IMS and was lastly reviewed during the 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the water chemistry programme conforms to the assessment and reference criteria listed in Table 15. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

The water chemistry programme as credited in the AMP will be independently assessed by a third party according to paragraph 2.4.4 and 2.5.3 for completeness and to verify consistency with the nine attributes of an effective AMP: (deliverable: *Documented consistency with the 9 attributes*).

The AMR for LTO-2 will be performed according to 2.4.3 to verify that the activities of the water chemistry programme for managing ageing effects are effective. (deliverable: *Ageing Management review*)

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*.

4.2.9. Corrective Actions Programme

The effectiveness of the organization, management system and culture of a nuclear power plant is subject to continuous monitoring to identify weaknesses and opportunities for improvement. In these activities, the area of corrective actions is one of the most significant because it represents the final step to ensure that the situation is improved, and subsequent satisfactory performance is obtained.

Assessment and reference criteria

Table 16 Assessment and reference criteria for the Corrective Actions Programme

Assessment criteria	
Source	**Requirement**
GSR Part 2 [7]	8 (4.20)
GSR Part 2 [7]	13 (6.1-6.8)
SSR 2/2 Rev. 1 [5]	1 (3.2e, 3.2f)
SSR 2/2 Rev. 1 [5]	9 (4.37)
SSR 2/2 Rev. 1 [5]	24 (5.29-5.30)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	3.3, 3.25, 3.30, 3.35, 4.49–4.53

Summary of requirements: EPZ shall establish a Corrective Action Programme (CAP) and shall demonstrate that it is and will remain effective for the intended period of LTO-2. EPZ shall ensure that the CAP documents ageing related events for effective return of operational experience. EPZ shall ensure that the results from the CAP are used by ageing management for improvement based on operational experience. EPZ shall ensure that the responsibilities for the CAP of the plant during LTO-2 are assigned.

Current situation at KCB

The KCB CAP is used to track correction of issues, and actions to prevent recurrence of issues, where appropriate. The IMS specifies that a graded approach is applied (HB-A00 [55]). Furthermore, each of the processes within EPZ is equipped with a PDCA cycle to ensure continuous improvement. For example, based on maintenance feedback, the maintenance programme is continuously updated (HB-N12 [22]).

To ensure corrective actions and continuous improvement of ageing management are properly addressed, additional provisions have been put in place in the IMS during LTO-1 to ensures that relevant internal and external ageing related events

are investigated for their ageing related effects and the ageing management programs are modified accordingly.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the CAP conforms to the assessment and reference criteria listed in Table 16. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*.

4.2.10. Operating Experience Feedback

Operating experience includes all events that have challenged or might challenge the safe operation of the plant. Operating experience is a process of learning that organizations use for avoiding the repetition of consequential events.

Operating experience is intended both as internally accumulated by the operating organization and externally acquired by importing the operational experience of other installations.

Assessment and reference criteria

Table 17 Assessment and reference criteria for the operating experience feedback

Assessment criteria	
Source	**Requirement**
GSR Part 2 [7]	12 (5.2d, 5.2e)
GSR Part 2 [7]	13 (6.7)
SSR 2/2 Rev. 1 [5]	1 (3.2e)
SSR 2/2 Rev. 1 [5]	24 (5.27-5.33)
SSR 2/2 Rev. 1 [5]	31 (8.4)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	2.7h, 3.3b, 3.30, 3.35, 4.50, 4.53, 5.8, 5.28c, 5.28e, 5.28f, 6.10, 7.18c, 7.23c
SSG-25 [8]	5.103-5.110
SSG-50 [16]	2.3-2.4, 2.6, 2.70, 2.71, 2.79-2.80

Summary of requirements: EPZ shall establish and implement a programme to report, collect, screen, analyse, trend, document and communicate operating experience, including from other plants and industries, in a systematic way**.** EPZ shall ensure that operating experience review and feedback is used in LTO-2 and Ageing Management. EPZ shall foster a positive environment for the promotion and maintenance of such a practice throughout the LTO-2 period.

Current situation at KCB

According to condition B6 of the KEW License BS30 [46], EPZ is required to comply with the provisions of NVR NS-G-2.11, A System for the Feedback of Experience from Events in Nuclear Installations (now superseded by SSG-50 [16]).

The handbook HB-A27 [82] describes the continuous improvement cycle at KCB with the goal to ensure that improvement activities are effective, and that recurrence of undesirable events is prevented. The handbook also monitors and stimulates prevention, correction and continuous improvement in the organization.

Sources of external operating experience include SOER and SER reports by WANO, VGB database, incident reports from IRS and GRS, and information from suppliers. EPZ also participates in several external knowledge groups, such as VGB-working groups, FROG, and PWROG. External reviews and inspections provide a valuable source of knowledge and experience that are fed to the continuous improvement cycle.

As outlined in the EPZ's ageing management process handbook HB-N12-2 the analysis and evaluation of internal and external operating experiences in the field of ageing management are systematically addressed.

The effectiveness of Operating Experience Feedback was reviewed during 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the operating experience feedback conforms to the assessment and reference criteria listed in Table 17. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*.

4.3. Non-Physical Ageing Management

4.3.1. HR, competences and knowledge management for KCB LTO-2

Human Resource (HR) management, knowledge management and competence management are critical for the LTO of nuclear power plants to ensure safety, reliability, and efficiency.

Together, these management areas contribute to maintaining operational excellence, mitigating risks, and fostering a culture of safety and continuous learning in nuclear power plants.

Human Resources Management

HR management ensures the availability of qualified personnel through effective recruitment, retention, and continuous training, promoting a strong safety culture and regular performance management.

Assessment and reference criteria

Table 18 Assessment and reference criteria for the Human Resources management

Assessment criteria	
Source	**Requirement**
GSR Part 2 [7]	7 (4.15)
GSR Part 2 [7]	8 (4.16)
GSR Part 2 [7]	9 (4.21-4.27)
GSR Part 2 [7]	10 (4.29)
SSR 2/2 Rev. 1 [5]	3 (3.8)
SSR 2/2 Rev. 1 [5]	4 (3.10-3.11)
Reference criteria	
Source	**Guidance**
GS-G-3.1 [17]	2.23, 2.31, 2.36, 2.53-2.54, 3.2, 3.11-3.12, 4.1-4.12, 4.29, 5.11, 5.21, 5.59-5.60, 6.3, 6.32
SSG-72 [9]	2.11, 2.14, 3.2, 3.12, 3.14, 4.3-4.9, 5.9, 7.7, 7.9-7.15, 7.77
SSG-75 [15]	2.3, 2.4, 2.8, 4.1, 4.4, 4.11-4.12

Summary of requirements: EPZ shall ensure that the adequate HR will be available for the intended LTO-2 period. EPZ shall ensure that knowledgeable and

experienced staff are retained and implement succession plans. EPZ shall ensure that the adequate resources are assigned and coordinated to perform LTO-2 and ageing management activities and that personnel involved have authorities, duties and responsibilities specified and documented.

Current situation at KCB

According to article B6 stipulated in the KeW License BS30 [46], EPZ shall comply with the provisions of relevant IAEA standards NS-G-2.4 [77] for the operating organization and NS-G-2.8 [78] for the recruitment, qualification and training of personnel. HR Management is a recognised process in the IMS (HB-A00) [121] and contained process manual 'Personeelsmanagement' (HB-A11) [59]. The goal of the process is to provide EPZ with sufficient, qualified, motivated and healthy employees capable of ensuring the plant's safe and compliant operation, including during LTO. This is achieved by determining the personnel needs for the short and medium to long term.

Key performance indicators are used to monitor the effectiveness of the process.

The HR Management is part of the IMS and was reviewed during the 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the HR management conforms to the assessment and reference criteria listed in Table 18. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*.

Competences Management

Competence Management focuses on maintaining and enhancing employee skills and qualifications, ensuring that personnel are competent in their roles, particularly in safety-critical functions.

Assessment and reference criteria

Table 19 Assessment and reference criteria for the competences management

Assessment criteria	
Source	**Requirement**
GSR Part 2 [7]	9 (4.21, 4.23-4.24)
GSR Part 2 [7]	10 (4.28)
GSR Part 2 [7]	13 (6.1-6.5, 6.7)
SSR 2/2 Rev. 1 [5]	1 (3.2)
SSR 2/2 Rev. 1 [5]	2 (3.4-3.7)
SSR 2/2 Rev. 1 [5]	3 (3.8-3.9)
SSR 2/2 Rev. 1 [5]	4 (3.10-3.11)
SSR 2/2 Rev. 1 [5]	5 (4.1-4.3)
SSR 2/2 Rev. 1 [5]	7 (4.18, 4.21-4.22)
Reference criteria	
Source	**Guidance**
GS-G-3.1 [17]	3.4, 4.6-4.9, 4.18, 4.20, 4.21, 6.8, 6.16
GS-G-3.5 [83]	3.30, 4.12, 6.23
SSG-72 [9]	2.14, 2.15, 3.6, 7.5, 7.15
SSG-75 [15]	2.4, 2.7, 2.11, 2.14-2.18, 2.19, 3.1, 3.2, 3.26, 4.2, 4.9, 4.4, 4.11, 4.14-4.16, 4.30, 4.46, 5.8, 5.27, 5.41, 5.42-5.45, 5.51, Appendix-I
SSG-50 [16]	2.18-2.19, 2.71

Summary of requirements: EPZ shall establish the competence requirements for safe LTO-2 and shall ensure a process for assessing the current competence level and gaps. EPZ shall ensure systematically that competent HR (including external) will be available during LTO-2. EPZ shall establish trainings to guarantee that the

gaps in competence are addressed. EPZ shall ensure that changes in the installation related to LTO-2 are considered within competences management.

Current situation at KCB

For the licensing basis Technical Information Package TIP-09-06-01 [61] describes the qualification and training of personnel and gives references to the main personnel management HB-A11 [59] process and the related implementation procedure for determining qualifications and competences and (re)training of staff.

Competences management is strongly interlinked with knowledge management and human resources management. Thus, aspects of in-house competence management are covered by the knowledge management handbook HB-A31 [56]. For the competence management of third parties and suppliers, procurement process HB-A05 [60] also provide requirements.

Process for the Continuous Improvement HB-A27 [82] gives directions for the required competences of the workforce. Fostering a 'culture of improvement' is present from the top-down and emphasized not only on the organizational but on individual levels as well.

A competency matrix, which is designed to record the required competencies and qualifications for each department, is developed.

The Competences Management is part of the IMS and was reviewed during the 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the competences management conforms to the assessment and reference criteria listed in Table 19. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*.

Knowledge Management

Knowledge management preserves institutional knowledge by documenting procedures and best practices, facilitating knowledge transfer, and supporting continuous improvement through research and sharing industry experiences.

Assessment and reference criteria

Table 20 Assessment and reference criteria for the knowledge management

Assessment criteria	
Source	**Requirement**
GSR Part 2 [7]	4 (4.3)
GSR Part 2 [7]	8 (4.16-4.17, 4.20)
GSR Part 2 [7]	9 (4.21-4.27)
GSR Part 2 [7]	13 (6.1-6.2)
SSR 2/1 Rev. 1 [6]	2.17
SSR 2/2 Rev. 1 [5]	3 (3.8)
SSR 2/2 Rev. 1 [5]	7 (4.21)
SSR 2/2 Rev. 1 [5]	24 (5.28-5.32)
SSR 2/2 Rev. 1 [5]	31 (8.4)
Reference criteria	
Source	**Guidance**
GS-G-3.1 [17]	2.4-2.5, 2.28-2.31, 3.1, 3.11, 3.16, 4.1-4.2, 4.4, 4.6-4.7, 4.20, 5.6, 5.14.
SSG-71 [19]	10.7.
SSG-72 [9]	3.2, 3.3, 3.14.
SSG-74 [11]	2.26, 3.6, 3.13-3.14, 6.2, 9.55, 10.37.
SSG-75 [15]	4.49, 5.42-5.45.
SSG-25 [8]	5.7, 5.103-110, 8.13, 9.5
SSG-48 [2]	2.21, 2.26, 2.29, 2.31, 2.7, 3.3-3.5, 3.10, 3.13-3.14, 3.16-3.18, 3.20, 3.30, 4.1-4.2, 4.8-4.10, 4.13-4.14, 5.8, 6.1-6.3, 7.16, 7.18

Summary of requirements: EPZ shall establish knowledge management policies and programmes to ensure that knowledge is being maintained and transferred especially concerning ageing management and LTO-2. EPZ shall ensure that knowledge management practices are part of the culture of the organization. EPZ shall ensure via the adequate processes and organizational arrangements that internal and external knowledge are effectively transferred within the organization.

Current situation at KCB

According to article B6 stipulated in the KEW License BS30 [46], EPZ shall comply with the provisions of relevant IAEA standards NS-G-2.4 [77] for the operating organization and NS-G-2.8 [78] for the recruitment, qualification and training of personnel. Knowledge management has a dedicated process manual 'Opleiden en Kennismanagement' (HB-A31) [56].

The process of knowledge management at KCB incorporates developing and implementing training courses, recording, sharing and applying company-specific knowledge throughout the organization, in accordance with its strategy whilst assuring that nuclear safety remains the overriding priority.

Knowledge transfer and competencies management is applicable to entities outside of the EPZ organization and is regulated through the procurement process HB-A05 [60].

In process HB-A27 [82] for the Continuous Improvement the objective for EPZ is to actively participate in (international) knowledge exchange and benchmarking to apply the best standards and to continuously increase knowledge.

Accessibility to the amassed knowledge is available through information systems (e.g. Lotus Notes, E-soms, Asset Suite) and electronic learning environment. Control room personnel and personnel enrolled in maintenance of the plant have access to simulators and work practice training models, so that on-field activities can be performed right first time.

Monitoring the effectiveness of knowledge management is ensured through process indicators. Besides this, the effectiveness of the training is measured with evaluation forms, lesson observations and workplace visits.

The risk of loss of knowledge due to inadequate retention, failure of transfer or any other mechanism is recognised in the process. The impact of change on the retention of knowledge is assessed and new knowledge transfer and the compensation for loss of knowledge are also considered within the procedures and the IMS [55].

The Knowledge Management is part of the IMS and was reviewed during the 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to

verify that the knowledge management conforms to the assessment and reference criteria listed in Table 20. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*

4.3.2. Technological Obsolescence Management

Ageing management for nuclear power plants requires addressing both the effects of physical and non-physical ageing (obsolescence) of SSCs. Obsolescence is the process of SSCs becoming out of date (i.e. obsolete) due to their availability, evolution of knowledge and technology and the associated changes in requirements, codes and standards.

Technological obsolescence may be caused due to lack of spare parts and technical support, lack of suppliers and lack of technical capabilities.

Assessment and reference criteria

Table 21 Assessment and reference criteria for the technological obsolescence management

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	10 (4.38)
SSR 2/2 Rev. 1 [5]	16 (4.54)
Reference criteria	
Source	**Guidance**
SSG-74 [11]	8.34 (c).
SSG-48 [2]	3.20–3.21, 3.27–3.28, 3.33, 6.1–6.12

Summary of requirements: EPZ LTO programme shall address the ageing processes (including non-physical) and shall review the ageing management related programmes (including technological obsolescence management). EPZ shall maintain the configuration control following changes due to technological obsolescence.

Current situation at KCB

According to condition B.6 of the KEW License BS30 [46], EPZ is required to comply with the provisions of NVR NS-G-2.12 for Ageing Management for NPPs (now superseded by SSG-48 [2]) which requires an obsolescence programme.

The management of technological obsolescence is implemented as part of the spare parts management and equipment reliability processes.

Stock levels are determined and recorded in Asset Suite. When the stock reaches a low level, it is determined whether the components have been withdrawn from the original equipment manufacturer's / supplier's assortment (no longer available).

EPZ uses specific criteria to determine/calculate the priority of obsolete SSCs.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the technological obsolescence management conforms to the assessment and reference criteria listed in Table 21. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

The technological obsolescence management programme will be independently assessed by a third party according to paragraph 2.4.4 and 2.5.3 to verify consistency with the nine attributes of an effective ageing management programme: (deliverable: *Documented consistency with the 9 attributes*).

As part of preparations for LTO-2, EPZ performs an extensive assessment to identify necessary investments (investment study shown in Figure 5). Part of this assessment Is to identify anticipated technological obsolescence issues. If a technological obsolescence issue is graded as mandatory action and not resolved before the license application, it will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*.

4.4. Physical Ageing Management

4.4.1. KCB Ageing Management Programme

The operating KEW License BS30 ('V-Kern') [46]prescribes at condition 8 that:

"EPZ shall prepare, implement and maintain a documented ageing management process wherein all ageing mechanisms are identified for the SSCs that form the scope of the ageing management. In the ageing management process the consequences of the ageing mechanisms shall be identified and the activities necessary to guarantee the reliability and operability of the SSCs that form the scope of the ageing management process shall be determined. Ageing is a process due to which the physical properties of SSCs change because of time or use."

This chapter investigates all relevant aspects of ageing management at KCB for the Safety Demonstration.

Assessment and reference criteria

Table 22 Assessment and reference criteria for the plant level ageing management programme policy

Assessment criteria	
Source	**Requirement**
SSR 2/1 Rev. 1 [6]	31 (5.51-5.52)
SSR 2/2 Rev. 1 [5]	14 (4.50-4.51)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	2.6-2.24, 5.1, 5.70

Summary of requirements: EPZ shall maintain a systematic Ageing Management Programme, considering the safety relevance of SSCs, which shall be coordinated and consistent with other relevant programmes. The ageing management of component shall be addressed in the design stage where necessary (e.g. for modifications).

Current situation at KCB

According to KCB's KEW license BS30 [46] condition C.8, a documented ageing management programme shall be implemented at KCB. The ageing management programme shall identify all ageing mechanisms, their consequences and the strategy to manage these for all safety relevant SSCs.

Ageing management is governed by handbook HB-N12-2 [22] wherein the basis for the development of an ageing management programme for KCB are reported. The plant level ageing management programme is documented in PU-N12-50 [23].

The Ageing Management Programme is part of the IMS and was lastly reviewed during 10EVA23.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the ageing management programme policy conforms to the assessment and reference criteria listed in Table 22. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

4.4.2. Understanding Ageing

Understanding ageing is key in the development of ageing management strategies. The understanding of ageing allows to identify all possible degradation mechanisms that may occur and to identify the susceptible locations in the installation and in the equipment.

Without a proper understanding of ageing the planning of ageing management activities will be ineffective.

Assessment and reference criteria

Table 23 Assessment and reference criteria for the understanding of ageing

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	14 (4.50-4.51)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	2.7, 3.24, 3.30, 5.27-5.29, 5.63.

Summary of requirements: EPZ shall develop an Ageing Management Programme determining the consequences of ageing and evaluating long term effects arising by operational and environmental conditions. EPZ shall develop the necessary knowledge of ageing mechanisms for understanding the occurrence of ageing effects.

Current situation at KCB

During the first LTO-1 Justification project a major effort was launched to understand ageing mechanisms that (might) play a role during KCB lifetime. The current knowledge about these ageing mechanisms is reported in the 'Catalogues of Ageing Mechanisms'. Three catalogues are currently present at KCB:

- Catalogue for Ageing Mechanisms of Mechanical Components [67];
- Catalogue for Ageing Mechanisms of EI&C Components [68];
- Catalogue for Ageing Mechanisms of Structural Components [69].

The catalogues provide the operating organization with a description of any possible ageing mechanisms and with quantitative and qualitative criteria for assessing the relevance of each mechanism to individual components within the plant.

The catalogues provide also the means to understand the relations between ageing mechanisms and ageing effects.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that understanding of ageing conforms to the assessment and reference criteria listed in Table 23. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

The catalogues of ageing mechanisms will be independently reviewed by a third party and updated as necessary to reflect the latest insights in research and knowledge. The (new) reviewed information will be used as input in the Ageing Management Review (deliverable: *Ageing Management Review*).

4.4.3. Scope setting

Scope setting is the process of selecting the relevant systems, structures and components that are part of ageing management. The scope setting methodology is defined by the operating organization and it is to be aimed to identify those SSCs that are directly or indirectly relevant to the plant nuclear safety.

Assessment and reference criteria

Table 24 Assessment and reference criteria for the scope setting

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	15 (4.52)
SSR 2/2 Rev. 1 [5]	16 (4.54)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	5.14-5.21, 5.70, 7.18a, 7.20, 7.29-7.30, 7.33.

Summary of requirements: EPZ shall set the scope for all structures, systems and components important to safety and the scope shall be documented and properly stored.

Current situation at KCB

A procedure for the scope setting of the Ageing Management Programme is required by policy documents: Handbook of Ageing Management (HB-N12-2) [22] and Handbook Instandhouding (HB-N12) [21].

The scope at KCB is set in procedure PU-N12-50-201 [20]. This procedure refers to the scope setting at a system (or part of system) level and at component level. Commodity groups are identified.

As specified in HB-N12-2 [22], the scope of the Ageing Management Programme was limited to passive functions of components while the active functions of components are part of the scope of the Equipment Reliability Programme. The identification of components with an active safety function is made during the scope setting at structures and components level.

The current scope at structure and component level is recorded in the scope setting document under configuration control (PU-N12-50-201), and in the commercial ageing management software COMSY (Condition Oriented Ageing Management System) [24]. The master list is retrieved from the asset management software Asset Suite.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the scope setting conforms to the assessment and reference criteria listed in Table 24. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

The methodology for scope setting and the scope of SSCs for LTO-2 are developed by EPZ according to SSG-48 and independently assessed by a third party according to 2.4.2. The methodology for scope setting including the results of scope setting at systems level will be delivered to the regulatory body after integrating the feedback from the independent assessment (deliverable: *Scope setting methodology including results of scope setting at system level*).

4.4.4. Ageing Management Review

An Ageing Management Review is a process according to which each (group of) component, structure or equipment is assessed to determine their status with respect to occurring or potential ageing degradation and their susceptibility to identified ageing mechanisms.

Results of the AMR are used to determine the necessary ageing management actions for the (group of) SSCs.

Assessment and reference criteria

Table 25 Assessment and reference criteria for the ageing management review

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	14 (4.50-4.51)
SSR 2/2 Rev. 1 [5]	16 (4.53-4.54)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	3.3, 3.4, 3.20, 3.24, 3.26, 3.30, 3.32, 3.33, 3.40, 5.22-5.36, 5.48, 5.49, 5.69, 7.21-7.26, 7.30, 7.32-7.35.
SSG-74 [11]	2.20, 6.13, 7.4-7.8

Summary of requirements: EPZ shall determine the consequences of ageing and the activities necessary to maintain safety, operability and reliability of SSCs. EPZ shall define and implement programmes for ageing management and long term operation. Part of these programmes is the performance of an Ageing Management Review (i.e. identification of relevant ageing mechanisms for in-scope equipment, condition assessment of in-scope equipment, definition or effectiveness evaluation of ageing management strategies for the relevant ageing mechanisms of in-scope equipment).

Current situation at KCB

A comprehensive Ageing Management Review (AMR) has been performed in the framework of the first operating lifetime extension (LTO-1).

Currently KCB applies the concept of 'living' Ageing Management Review. The AMR conclusions drawn from the LTO-1 Justification project are kept up to date by means of including operational experience to the existing AMR procedures.

Newly discovered ageing mechanisms (e.g. communicated through an ageing management issue report) are analysed according to the same procedure to assess their applicability for the rest of the scope of ageing management.

The 'living' AMR makes use of the knowledge captured in the Catalogues of Ageing Mechanisms [67] [68] [69], documented internal and external operating experience and the AMR reports from the LTO-1 Justification project. The AMR includes the necessary information on the current condition of the SSC in scope from 'health' reports produced by the equipment reliability process. The commercial software COMSY [24] is used for organizing and facilitating the data keeping and reporting. The outputs of the 'living' AMR can result in new (or modified) ageing management programmes, modification to MTSI or other plant programmes, replacements of SSC and input for the Corrective Action Programme.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the ageing management review conforms to the assessment and reference criteria listed in Table 25. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

As described in 2.4.3 an AMR methodology will be developed by EPZ to formalize the process of living AMR and to guarantee the quality and completeness of the information in the AMR documentation. The methodology will be independently assessed by a third party. The AMR methodology will be delivered to the regulatory body after integrating the feedback from the independent assessment (deliverable: *Ageing Management Review methodology).*

The AMRs developed by EPZ will be independently assessed by a third party to address possible scope, process-, and technical gaps. New AMRs will be identified and developed for those SSCs not (effectively) covered by the existing AMRs. The current condition of the SSC in scope of the AMR will be verified by including results of the health reports of equipment reliability, results of the obsolescence programme (4.3.2) and results of the investment study performed for LTO-2 (4.2.7). The Ageing Management Reviews will be delivered to the regulatory body after integrating the feedback from the independent assessment (deliverable: *Ageing Management Reviews)*.

4.4.5. Ageing Management Programmes

Ageing Management Programmes (AMPs) are sets of processes, procedures and activities that aim to manage ageing effectively. Effective management of ageing is achieved via understanding, prevention, minimization, detection, monitoring and/or mitigation of a specific ageing effect on a (group of) SSCs.

AMPs might be made component or degradation mechanisms specific or a combination of these two. In any case, the AMPs need to consider the nine attributes of effective AMPs to adhere to IAEA guidelines.

AMPs may introduce new activities that need to be performed to manage the ageing effects effectively, modify existing activities and/or coordinate existing activities from existing Plant Programmes.

Assessment and reference criteria

Table 26 Assessment and reference criteria for the ageing management programmes

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	14 (4.50-4.51)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	3.33, 3.35, 3.37–3.39, 5.37-5.63, 7.26-7. 27..
SSG-74 [11]	7.4-7.8

Summary of requirements: EPZ shall determine the consequences of ageing and the activities necessary to maintain safety, operability and reliability of SSCs. EPZ shall coordinate the Ageing Management Programme with existing Plant Programmes. EPZ shall develop, implement and continuously improve the relevant Ageing Management Programmes.

Current situation at KCB

According to condition C.8 of the KEW License BS30 [46], EPZ is required to establish, implement and maintain a documented ageing management process. According to condition B.6 of the KEW License BS30 [46], EPZ is required to comply with the provisions of NVR NS-G-2.12 for Ageing Management for NPPs (now superseded by SSG-48 [2]).

The Ageing Management Programmes (AMPs) are part of the plant level Ageing Management Programme at KCB and integrated into the management system under PU-N12-50-4**.

The development of the AMPs at KCB follows the following steps:

- determining the SSC scope in relation to ageing management;
- identifying and describing the ageing mechanisms;
- gather relevant component information; storing this information in the ageing database COMSY [24];
- determining how ageing is managed per SSC or SSC group;
- linking the ageing mechanisms to each SSC in COMSY through an ageing mechanism matrix;
- using the ageing mechanism matrix, a management programme is developed according to SSG-48 [2].

Figure 9 illustrates an example of an ageing mechanism matrix, detailing the relevant degradation mechanisms based on the component's materials, operating temperature range, and medium. For each identified degradation mechanism, the corresponding ageing management programme is specified.

Material	Temperature (middle of range)	Medium	Commodity code	Corrosion by dissolved oxygen	Pitting corrosion	Intergranular corrosion	Selective corrosion, Dezincification	Graphitic corrosion of cast iron	Crevice corrosion	Transgranular stress corrosion cracking (TGSCC)
Copper alloy	30°C<T≤50°C	Deminwater	VOB_CUA-205y-zz		442		442, 462		442, 403, 483	
Copper alloy	50°C<T≤100°C	Lubricating oil	VOB_CUA-311y-zz		401		401		401	
Forged austenitic stainless steel	50°C<T≤100°C	Lubricating oil	VOB_FAS-311y-zz		401	401			401	401
Forged carbon steel	30°C<T≤50°C	Compressed air	VOB_FCS-210y-zz	442, 483						
Forged carbon steel	50°C<T≤100°C	Compressed air	VOB_FCS-310y-zz	442, 483						
Forged carbon steel	50°C<T≤100°C	Lubricating oil	VOB_FCS-311y-zz	401	401				401	
Cast iron	50°C<T≤100°C	Deminwater	VOB_GCI-305y-zz	442, 403	442, 403			442, 462	442, 403	
Cast austenitic stainess steel	T≤30°C	Diesel	VOB_CAS-115y-zz		401	401			401	
Copper alloy	T≤30°C	Diesel	VOB_CUA-115y-zz		401		401		401	
Forged austenitic stainless steel	T≤30°C	Diesel	VOB_FAS-115y-zz		401	401			401	401
Forged austenitic stainless steel	30°C<T≤50°C	Diesel	VOB_FAS-215y-zz		401	401			401	401
Forged carbon steel	T≤30°C	Diesel	VOB_FCS-115y-zz	401	401				401	
Forged carbon steel	30°C<T≤50°C	Diesel	VOB_FCS-215y-zz	401	401				401	
Cast iron	30°C<T≤50°C	Diesel	VOB_GCI-215y-zz	401	401			401	401	

Figure 9 Ageing Mechanism Matrix of the steam-water cycle

The AMPs highlight the link between ageing management and EPZ plant programmes. The AMPs are structured according to IGALL, fulfilling the nine attributes of an effective ageing management programme as defined in SSG-48 [2].

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the ageing management programmes conform to the assessment and reference criteria listed in Table 26. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

The ageing management programmes will be independently assessed by a third party according to paragraph 2.4.4 and 2.5.3 for completeness and to verify

consistency with the nine attributes of an effective ageing management programme: (deliverable: *Documented consistency with the 9 attributes*).

The ageing management review for LTO-2 will be performed according to 2.4.3 to verify that the credited AMP's for managing ageing effects are effective. (deliverable: *Ageing Management review*)

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measure Implementation Plan).*

4.4.6. Time Limited Ageing Analyses

Time Limited Ageing Analyses (TLAAs) are safety analyses that meet at least the first five of the following criteria [2]:

- TLAAs should involve SSCs within the scope for ageing management;
- TLAAs should consider ageing effects;
- TLAAs should involve time limited assumptions defined by the current operating term. The specified operating term should be explicit in the analysis;
- TLAAs should have been determined to be relevant by the operating organization in making a safety determination as required by national regulations;
- TLAAs should involve conclusions or provide the basis for conclusions relating to the capability of SSCs to perform their intended functions;
- TLAAs should be contained or incorporated by reference in the current licensing basis.

Assessment and reference criteria

Table 27 Assessment and reference criteria for the Time Limited Ageing Analyses

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	16 (4.54)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	3.34, 5.64–5.69, 5.70-5.72, 7.14, 7.17, 7.18, 7.28, 7.30, 7.36.

Summary of requirements: EPZ shall develop a procedure for systematically identify the TLAAs that are relevant for the installation. EPZ shall develop or revalidated the TLAAs identified as relevant for LTO-2. EPZ shall include the results

from TLAAs in the relevant documentation (inclusive license basis) and EPZ shall ensure that corrective actions will be taken if TLAAs cannot be revalidated.

Scope

Current situation at KCB

Some TLAAs were identified in the conceptual document for the LTO-1 Justification project in 2011 [74]. The selection was made based on the criteria that analyses were to be selected among those original safety analyses which:

- Involved SSCs within the scope of LTO;
- Considered the effects of ageing degradation;
- Involved time limited assumptions defined by the current operating term;
- Were determined to be relevant in making safety determinations as required by national regulations;
- Involved conclusions or provide the basis for conclusions related to the capability of the SSC to perform its intended functions;
- Were contained or incorporated by reference in the Current Licensing Basis (CLB).

Based on this criterion three analyses were identified:

- Reactor Pressure Vessel (RPV) Neutron Embrittlement;
- Low-Cycle Fatigue Usage;
- Leak Before Break;

Furthermore, the following TLAA was identified based on its strong relation with the time factor:

- Qualification of Design Base Accident resistant electrical Equipment (EQDBA).

One additional TLAA has been credited in the period since the LTO study in 2011:

- Fatigue crack initiation and growth of reactor coolant pump (RCP) flywheel.

A detailed programme for the revalidation of the TLAA RPV Neutron Embrittlement has been defined. Due to this the documentation for the TLAA RPV are specified in detail in the related paragraph.

RPV Neutron Embrittlement

KCB reactor pressure vessel (RPV) was manufactured by RDM - Rotterdam Dockyard Co. (casted by Krupp and forged by RDM) and has been in operation since 1973. KCB RPV is made of base material 22NiMoCr3-7 (comparable to ASTM A-508 Cl. 2) and weld material S3Mo/Grau L0. The main ageing mechanism acting on the RPV is neutron embrittlement. This ageing mechanism has the main effect of progressively reducing the fracture toughness of the RPV base and weld materials due to the caused changes in their microstructure.

The reduction of the RPV fracture toughness is particularly critical during accidental situation (e.g. LOCA) during which cold water is injected into the RPV to ensure cooling of the core. In this transient, called Pressurized Thermal Shock (PTS), the

injection of cold water causes high thermal stresses which may initiate a catastrophic rupture of the RPV at relevant locations (high loaded locations like welds or nozzles) in case that the material residual fracture toughness is not sufficient to meet the arising stress intensity factor for a postulated flaw at relevant locations.

The time dependent parameter in this TLAA is the total high energy (>1 MeV) neutron fluence (n/cm^2) at critical locations of the RPV. This parameter becomes higher during LTO periods than foreseen during the RPV design due to a longer period of irradiation. The RPV exposure to high-energy neutrons can be influenced by several factors (e.g. power uprates, modification of the use of MOX). When applicable, these factors should be considered during the TLAA revalidation.

Current situation at KCB

Currently a TLAA exists at KCB for the safety assessment of RPV against neutron embrittlement.

The TLAA is currently revalidated until 2034 and consists of:

- Fluence calculations for determining the fluence until 2034;
- A neutron embrittlement surveillance programme;
- A PTS analysis and Pressure-Temperature Curves check;
- A safety assessment for KCB RPV until 2034.

The leading document for the revalidation of the TLAA for KCB RPV neutron embrittlement is the KCB RPV safety assessment assuming 60 years of operation [25]. The safety assessment is supported by a neutron embrittlement surveillance programme (Staal Onderzoeks Programma – SOP).

KCB has run two surveillance irradiation programmes for a total of six specimen sets:

- 1st surveillance irradiation programme [26]: the objective of the first irradiation surveillance programme was to proof safe operation for 40 years (until 31-12-2013). The programme consisted of 3 SOPs:
    - SOP 0: unirradiated base and weld materials from rings 03 and 04 and weld 03 (W03) and its HAZ as reference set.
    - SOP 1: irradiated base and weld materials, withdrawn after 663 effective full power days (EFPD).
    - SOP 2: irradiated base and weld materials, withdrawn after 1514 EFPD.

  The materials were tested by tensile tests Charpy V tests and fracture toughness test [27], [28].
- 2nd surveillance irradiation programme [31]: the objective of the second irradiation surveillance programme was to proof safe operation for 60 years (until 2034). The programme consisted of 3 SOPs manufactured according to KTA 3203 [30] with transversal specimens for the base material:
    - SOP 0a: unirradiated base and weld materials made as transverse specimens from rings 03 and 04 and weld 03 (W03). The use of

transverse specimens is foreseen by KTA 3203 [39] for use in the Master Curve analysis [29].
    - SOP 3: irradiated base and weld materials, withdrawn after 1980 EFPD.
    - SOP 4: irradiated base and weld materials, withdrawn after 3411 EFPD.

  The materials were tested by tensile tests, Charpy V tests and fracture toughness tests [32], [33], [34].

The irradiation surveillance programmes are supported by fluence calculations (validated by radiochemical analyses of KCB RPV scraping samples [40] and by neutron fluence detectors included in the irradiation capsules). These are made to calculate the necessary time of irradiation of the specimens at their irradiation locations. Particularly, for the safety assessment of KCB RPV up to 60 years operation the fluence calculation are described in [36].

The reference temperature for brittle and ductile fracture initiation obtained in the various SOPs are compared with the maximum allowable values obtained by PTS analysis. PTS analysis was initially developed for operation up to 40 years and later updated in the framework of the first LTO (up to 60 years) [35]. Moreover, the reference temperatures are used for determination of Pressure-Temperature Curve (P-T curve).

Currently a pre-study for possibilities of TLAA revalidation up to 2054 has been developed [37] and assessed [62]. The following conclusions are drawn:

- The SOP 4 irradiation programme has reached an average fluence of 3.79E+19 n/cm^2. This represents the irradiation behaviour of the RPV core beltline for 77 operating years (66.90 EFPY).
- An option for revalidating the TLAA of RPV embrittlement at the core beltline is to select and test those SOP 4 specimens which have exceeded the extrapolated average RPV fluence for 80 operating years (69.53 EFPY) of 3.92E+19 n/cm^2. From broken specimen halves Charpy-V, fracture toughness or smaller tensile specimens will be re-manufactured and tested without further irradiation.
- It is not possible to manufacture L-oriented small tensile specimens for the weld material of W03, as required by KTA 3203 [39] from the SOP 4 brokens specimens. However, the average fluence reached by welding material specimens of SOP 4 has already reached 3.96E+19 n/cm^2, exceeding the extrapolated average fluence at 80 operating years. Therefore, no further test campaign of weld material tests is required for the weld material of W03.
- For the core beltline other options are to further irradiate SOP 4 material for 2 cycles or to use remaining unirradiated material for a longer irradiation (13 cycles). Both options are costlier in terms of time, resources and cumulative dose received by personnel than the proposed option to re-manufacture and

re-test those specimen of SOP 4 which have already exceeded 3.92E+19n/cm^2.

- The re-testing of SOP 4 specimens which have already reached 80 years equivalent of neutron irradiation is the only options which guarantees the proof for TLAA revalidation up to 2054 before the license actualization request.
- KTA 3203 [39] foresees the necessity of investigation of behaviour under irradiation for regions that exceed 1.0E+17n/cm^2. Due to foreseen longer irradiation during LTO-2, the welding material of W04 and the base material of Ring 05 will exceed this value and need to be investigated.
- W04 has the same material and manufacturing characteristics of W03, and it is therefore reasonable to assume that its behaviour is comparable to the already investigated W03. It is therefore assumed that W03 can be used as an enveloping case.
- An investigation according to KTA 3203 [39] for Ring 05 material involves the irradiation of base material for 1 cycle to achieve the fluence of 1.93E+18n/cm^2 covering 80 operating years.
- Other areas of the RPV which are currently predicted to be below the KTA 3203 [39] investigation threshold might exceed this threshold due to the influence of neutron backscattering from the biological shield (albedo effect). State of the art fluence calculation can give precise indications on the relevance of this phenomena.
- The assessment fluence of 3.5E+19n/cm^2 used during the safety assessment against brittle fracture (PTS) will be exceeded during LTO-2.
- An adjustment of the limiting reference temperatures with respect to neutron irradiation behaviour for 80 years is necessary for revalidating the RPV brittle failure assessment.

In the current situation KCB fulfils the requirements established for LTO-1 (2034). However the TLAA needs to be revalidated according to the conclusions drawn in [37] and [38] in order to be valid for the period of LTO-2 (until 2054).

Documentation for revalidation TLAA RPV Embrittlement

The Safety Demonstration for the TLAA RPV Embrittlement will be based on the current version of KTA standards 3201 [41][42][43], 3203 [39] and 3206 [44] and their reference codes. This choice is made because the KTA standards:

- are best suited to the design of KCB, the KCB RPV and materials used
- form a consistent framework
- were – in their previous iteration – already used for the safety assessment of the RPV in the license application for LTO-1
- reflect the state of art in their current iteration

The deliverables for the revalidation of the RPV embrittlement TLAA until 2054 are graphically rendered in Figure 10. And will consist of:

- A pre-study and plan for the realization of irradiation programmes SOP 5, SOP 5a and 0b.
- A 3rd surveillance irradiation programme proving safe operation for 80 years operation according to requirements from the latest version KTA 3203 [39] and based on the conclusions and identified steps from [37], a second opinion [38] and consent from the ANVS before September 2024. For this surveillance programme the following choices were made:
    - SOP 5: Reconstitution and testing of material specimen from rings 03 and 04 and weld 03 (W03) from SOP 4 that have already reached the target fluence at 80 years of operation.
    - SOP 5a: Manufacturing, irradiating for one cycle and testing one irradiation set of material of flange Ring 05
    - SOP 0b: Manufacturing and testing one reference set of material from flange Ring 05.
- The manufacturing and testing procedures and results documentation according to [37] and quality assurance by AKI for SOP 5, 5a and 0b.
- A plan for the realization of the safety assessment: as was done for the earlier SOP programme, a plan of approach will be developed detailing the way in which the safety assessment will be performed. Independent quality assurance will be performed by an AKI.
- An update of safety analyses (fluence calculations including Albedo effects and connecting areas between RPV and MCL, PTS analysis, P-T Curve, thermal hydraulic analysis for Level A/B transients covering whole RPV) according to current KTA requirements necessary to update the RPV safety assessment to cover 80 years of operation. Independent quality assurance by TÜV.
- Update of relevant design documentation will be performed as part of the license application
- A RPV safety assessment for 80 operating years based on the structure and contents of the existing RPV safety assessment for 60 operating years.

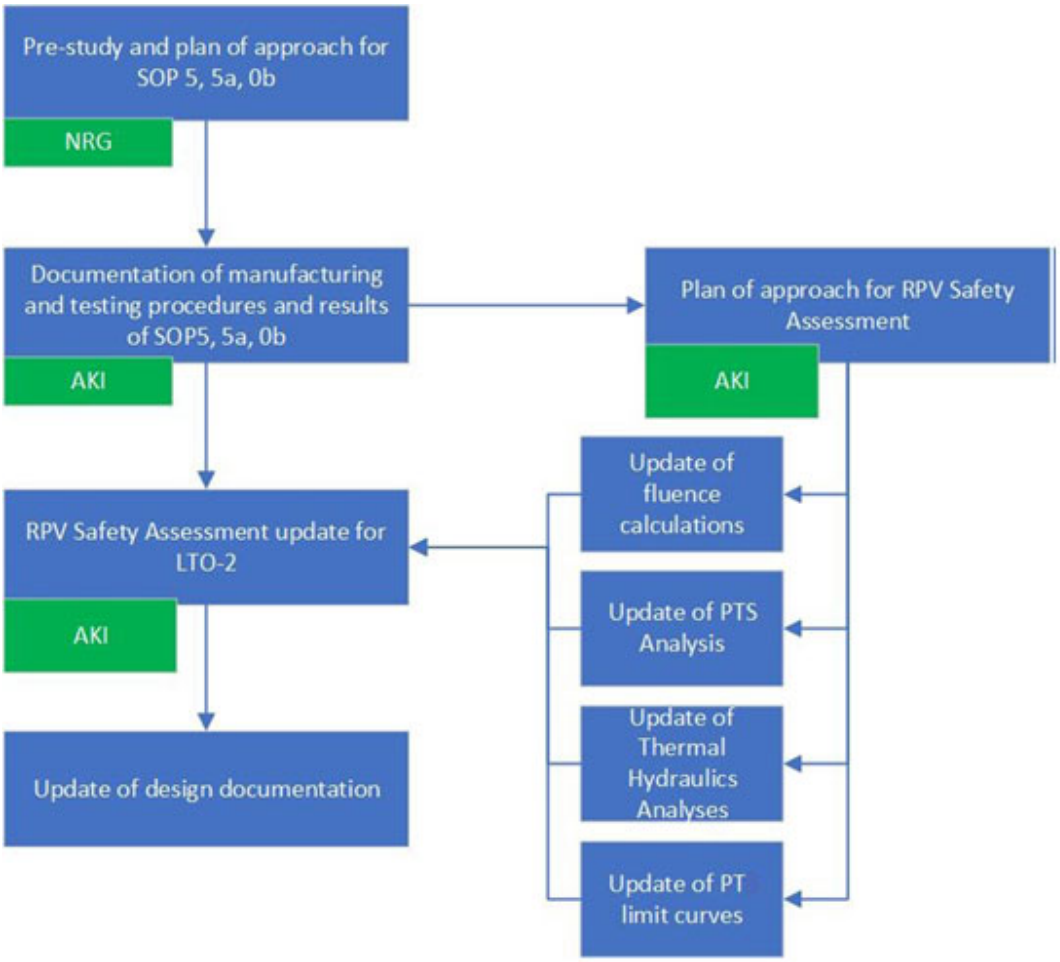

Figure 10: Deliverables for revalidation of RPV Embrittlement TLAA

Quality assurance of each deliverable will be guaranteed by the assigned independent AKI.

Low-Cycle Fatigue Usage

Fatigue might affect a multitude of locations of a NPP, and its analysis is required to demonstrate that for all components important to safety adequate safety margins against crack initiation by fatigue are in place. Time limited assumptions are considered when designing high stress regions of certain components. The total number of pressure and thermal transient cycles is an initial assumption of the designer, and as the life of the plant is extended then the expected cyclic transients count increases accordingly. Therefore, for this TLAA, the time-dependent parameter is the number of transient cycles, and the analysis parameter is the cumulative usage factor (CUF).

Current situation at KCB

The scope of fatigue TLAAs has previously been identified to support LTO-1 in 2011 [71]. Following components were considered for this TLAA:

- Reactor pressure vessel;

- Steam generators;
- Pressurizer;
- Main coolant pumps (pressure boundary);
- Main coolant piping;
- Surge line;
- Spray lines and auxiliary spray lines;
- Feedwater piping;
- Main steam piping;
- Recuperative heat exchanger (added due to existing fatigue analysis);
- Pressure release tank (added due to existing fatigue analysis).

A total of 45 locations were identified for this TLAA. These locations were selected based on a survey performed of the existing fatigue analysis in the design documentation of KCB along with international good practices and engineering judgement.

Thermal loads were determined using the relevant fatigue monitoring system (FAMOS) readings of the temperature transients. Mechanical loads were determined from the relevant pipe stress analyses. Fatigue assessment was performed according to KTA 3201.2. International experience was incorporated through the investigation of environmental fatigue, high cycle thermal fatigue and fatigue design curves.

For each location a screening assessment [72] was undertaken to determine CUF up to 2034 by taking into account the actual number of transient cycles up to the point of assessment. Where the CUF > 1 or where there were unknowns for the assessment, these were identified as requiring further analysis. The locations requiring further assessment were assessed [73] and updated CUF were provided.

All relevant locations are continuously monitored by using FAMOS. For all locations in the scope a yearly update of the CUF is performed.

Leak Before Break

Leak Before Break (LBB) analyses aim at demonstrating that in any location of a component, the through wall crack size that would generate, under normal service conditions, a leak that can be easily detected by the existing leak monitoring system, is much smaller than the maximum flaw size that may be tolerated at the same location under the most severe faulted conditions.

Current situation at KCB

At KCB, LBB is part of the break preclusion concept (Bruchausschluss) [75], this refers to the concept that mitigation measures due to pipe break need not be considered if it can be shown that leak occurs before break under the conditions experienced. The following piping is considered for LBB [75]:

- Main coolant lines;
- Surge line;
- Main steam lines within secondary containment;
- Main feedwater lines within secondary containment;

- Parts of emergency feedwater lines;
- Lines of the secondary reserve feedwater system between the first NRV at the steam generator and main feedwater line;

A crack growth analysis for a reference postulated defect is performed. The time necessary to grow the reference defect into a through wall defect. The time limited assumption in the LBB analyses was the time for growth of surface defect to through wall defect. The TLAA was revalidated for the period of LTO-1.

Qualification of Design Base Accident resistant electrical equipment

Temperature and radiation are the main stressors causing ageing degradation of component materials during normal operation of the plant regarding the functional requirements and the harsh environmental conditions during design basis accidents (DBAs). Environmental qualification of electrical equipment ensures the availability of each component to perform their safety functions during DBAs. Based on the component test data and the actual environmental conditions in the plant, the qualified life can be determined for each component and location.

Current situation at KCB

"Qualification of Design Base Accident resistant electrical Equipment (EQDBA)" was developed as a TLAA in the framework of LTO-1 Justification project [70]. Electrical components with harsh environment accident and post-accident requirements were considered. The scope of EQDBA subproject was the determination of the thermal and radiological qualified life of each component. The year in which the qualified life ends was regarded as the period of revalidation.

AUREST is used as a calculation and presentation tool for the qualified life of components. The qualified life (thermal and radiological) calculations were performed in AUREST until 2024 and checked against qualification requirements. The use of accurate measured local temperatures and dose rates leads to a refined and more accurate calculated qualified life of the components with harsh environment requirements.

The annual "Qualified Life Cycle Report" shows the remaining lifespan for each component. Components in the EQ programme identified as having a qualified life equal to, or greater than, the intended period of operation are considered satisfying the TLAA requirements for LTO-2.

Fatigue crack initiation and growth of reactor coolant pump (RCP)

The strength and integrity analysis of the reactor coolant pumps flywheel meets the criteria in SSG-48 for the definition of a TLAA. The flywheel is a critical component for maintaining a flow of coolant to the reactor in certain conditions. The flywheel is subject to ageing and undergoes cyclic action during start-up and shutdown, hence meeting the criteria for time limited assumptions.

Current situation at KCB

A strength analysis of the flywheel was conducted in 2019 by Siemens [80]. This considered the four different load cases the flywheel is subject to:

- Standstill during downtime;

- Rated speed during normal operation;
- Maximum torque rate due to maximum speed;
- Short circuit scenario.

Material tests to determine the fracture toughness of the flywheel material were conducted in support of the linear elastic fracture mechanics calculations.

An input of 3500 cycles for start-up over a 40-year lifespan were assumed, noting that the flywheel is not the original flywheel from KCB commissioning. New RCP flywheels have been installed as part of the electric motor replacements in 2021 and 2024 respectively. The result showed negligible damage for a postulated defect of 6.35mm. This postulated defect is more than the size of a defect which should be documented during inspection; greater than 2.5mm to be documented during inspection and greater than 5.0mm to not be accepted. Furthermore, the critical speed was calculated and is more than the maximum speed of the flywheel by a factor of 1.8.

US-NRC Regulatory Guide 1.14 [81] provides guidance on the inspection frequency of reactor coolant pump flywheels. Ultrasonic volumetric inspection at 3-year intervals for areas of high stress concentration, unless it is demonstrated in a TLAA that intervals up to 10 years can safely be applied and 10-year intervals for all exposed surfaces.

By using the above-mentioned calculation as well as, operating experience and pre-service inspection it is possible to justify adapting the frequency of ISI on the flywheel to perform this at the same time of the revision of the electrical motor of the RCPs. The latter occurs every 6 to 7 years and it allows access to the flywheel [45].

Assessment activities during the Safety Demonstration

As described in section 2.4.5 a set of TLAAs applicable for LTO-2 will be identified according to the developed methodology (deliverable: *Methodology for scope setting TLAAs and list of in-scope TLAAs).* For each identified TLAA a preliminary study will be developed. For TLAAs that were already revalidated for the LTO-1 period the preliminary study will include a detailed revalidation methodology. For newly identified TLAA the preliminary study will be limited to feasibility consideration and revalidation option analysis, including the data that would be needed in order to develop a numerical TLAA (deliverable: *Preliminary studies for in-scope TLAAs revalidation*). The selected TLAAs will be addressed using one of the methods allowed by SSG-48 [2]. The revalidation of the TLAAs will be captured in the relevant documentation and a summary of the revalidations will be delivered to the regulatory body (deliverable: *Summary of the revalidation of the TLAAs in-scope for LTO-2*).

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*

4.4.7. Data collection & record keeping

A data collection and record keeping system supports the development and implementation of effective ageing management and LTO. Such a system for ageing management contains plant related information which is systematically collected and managed through the lifetime of the plant. This includes the rules to define the information collected, storage requirements and correlations that exist within the data.

Assessment and reference criteria

Table 28 Assessment and reference criteria for the data collection and record keeping

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	15 (4.52)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	3.23, 5.9–5.13.
SSG-74 [11]	7.8 (d)

Summary of requirements: EPZ shall implement the necessary record-keeping and documentation managing systems in order to ensure the availability of the necessary ageing related documentation and operational data.

Current situation at KCB

Documents relating to original design data, drawings and technical articles are stored. Other specific documents relating to ageing management are stored in separate systems (see Section 4.4.8). TIP-09-09-01 [76] describes that documents within KCB can be split into four distinct categories:

- AVS (Algemeen Voorschriften Systeem) documents relating to policy and instructions;
- Documents that describe, demonstrate or substantiate the configuration of KCB;
- Master files with KCB installation-related software;
- Operational data collected during the lifetime of the plant.

Quality of new documents, including their inputs and outputs, is ensured through a review process which follows a rigorous procedure with different relevant personnel required to approve the document.

Ageing Management related data are included in the ageing management database, COMSY.

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the data collection & record keeping conforms to the assessment and reference criteria listed in Table 28. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*

4.4.8. Documentation of Ageing Management

Documentation relevant to ageing management include mainly the SAR, PSR, catalogues of Ageing Mechanisms, AMR, AMPs, plant programmes, TLAAs and the associated plant procedures related to these programmes. It includes the documents related to assessments such as scoping process, condition assessments. All the documents should be maintained in an auditable and retrievable form.

Assessment and reference criteria

Table 29 Assessment and reference criteria for the documentation of ageing management

Assessment criteria	
Source	**Requirement**
SSR 2/2 Rev. 1 [5]	16 (4.53)
Reference criteria	
Source	**Guidance**
SSG-48 [2]	5.70-5.74, 7.29-7.38.

Summary of requirements: EPZ shall document the ageing management and LTO-2 processes (e.g. activities, results, assessments) in an auditable and retrievable form. EPZ shall document the methodologies followed and the demonstration that ageing effects shall be managed for the intended period of LTO-2. EPZ shall ensure that ageing management and LTO-2 processes are considered within the license basis documentation and the periodic safety evaluation.

Current situation at KCB

The procedure PU-N12-50 [23] outlines the documentation of ageing management activities alongside the responsibilities of documentation. Major documentation related to ageing management is described below:

- Scoping data along with substantiation is recorded in the ageing management database, COMSY;
- Catalogues of Ageing Management Mechanisms;
- Living AMR reports;
- Ageing-related data registered in COMSY;
- Ageing Management Programmes (VBPs) documenting the ageing management activities;
- Records and findings from plant programmes;
- Evaluation reports.

Original design data that is required for ageing management should be contained within the DMS, as per TIP-09-09-01 [76].

Assessment activities during the Safety Demonstration

As part of the Safety Demonstration, a Conformance Review is performed as an independent assessment by a third party (according to sections 2.4.1 and 2.5.3) to verify that the documentation of ageing management conforms to the assessment and reference criteria listed in Table 29. The summary of the results of the Conformance Review will be delivered to the regulatory body (deliverable: *Conformance Overview*).

Any actions that were graded as mandatory actions and that are not resolved before the license application will be input in the Mandatory action plan (deliverable: *LTO-2 Mandatory Measures Implementation Plan)*

5. Conclusions

This document described the scope, objective, assessment framework and methodology for the realization of the Safety Demonstration and will function as the Basis Document for the performance of the activities to be performed in the Safety Demonstration. These activities and the related deliverables were described for each identified aspect of the Safety Demonstration. For each aspect of the Safety Demonstration the current situation and the relevant assessment and reference criteria (clauses) were identified.

On the basis of the information contained in this document it is possible to move to the assessment phase of the Safety Demonstration. In this phase the deliverables that demonstrate the safe long term operation are produced and the mandatory measures for maintaining the currently licensed safety level are identified.

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Appendix-A Assessment framework for Safety Demonstration KCB LTO-2

A.1 GSR Part 2

Requirement 4: Goals, strategies, plans and objectives

Senior management shall establish goals, strategies, plans and objectives for the organization that are consistent with the organization's safety policy.

4.3 Goals, strategies, plans and objectives for the organization shall be developed in such a manner that safety is not compromised by other priorities. (*Knowledge Management)*

Requirement 6: Integration of the management system

The management system shall integrate its elements, including safety, health, environmental, security, quality, human-and-organizational-factor, societal and economic elements, so that safety is not compromised

4.11 The organizational structures, processes, responsibilities, accountabilities, levels of authority and interfaces within the organization and with external organizations shall be clearly specified in the management system. *(Organizational Arrangements)*

Requirement 7: Application of the graded approach to the management system

The management system shall be developed and applied using a graded approach.

4.15. The criteria used to grade the development and application of the management system shall be documented in the management system. The following shall be taken into account:

(a) The safety significance and complexity of the organization, operation of the facility or conduct of the activity;

(b) The hazards and the magnitude of the potential impacts (risks) associated with the safety, health, environmental, security, quality and economic elements of each facility or activity;

(c) The possible consequences for safety if a failure or an unanticipated event occurs or if an activity is inadequately planned or improperly carried out.

(Human Resources Management)

Requirement 8: Documentation of the management system

The management system shall be documented. The documentation of the management system shall be controlled, usable, readable, clearly identified and readily available at the point of use.

4.16. The documentation of the management system shall include as a minimum: policy statements of the organization on values and behavioural expectations; the fundamental safety objective; a description of the organization and its structure; a description of the responsibilities and accountabilities; the levels of authority, including all interactions of those managing, performing and assessing work and including all processes; a description of how the management system complies with regulatory requirements that apply to the organization; and a description of the interactions with

external organizations and with interested parties. *(Human Resources Management, Knowledge management)*

4.17. Documents shall be controlled. All individuals responsible for preparing, reviewing, revising and approving documents shall be competent to perform the tasks and shall be given access to appropriate information on which to base their input or decisions. *(Knowledge management)*

4.20. Retention times of records and associated test materials and specimens shall be established to be consistent with the statutory requirements and with the obligations for knowledge management of the organization. The media used for records shall be such as to ensure that the records are readable for the duration of the retention times specified for each record. *(Corrective action programme, Knowledge management)*

Requirement 9: Provision of resources

Senior management shall determine the competences and resources necessary to carry out the activities of the organization safely and shall provide them.

4.21 Senior management shall make arrangements to ensure that the organization has in-house, or maintains access to, the full range of competences and the resources necessary to conduct its activities and to discharge its responsibilities for ensuring safety at each stage in the lifetime of the facility or activity, and during an emergency response. *(Organizational Arrangements, Human Resources Management, Knowledge management, Competence management)*

4.22 Senior management shall determine which competences and resources the organization has to retain or has to develop internally, and which competences and resources may be obtained externally, for ensuring safety. *(Organizational Arrangements, Human Resources Management, Knowledge management)*

4.23 Senior management shall ensure that competence requirements for individuals at all levels are specified and shall ensure that training is conducted, or other actions are taken, to achieve and to sustain the required levels of competence. An evaluation shall be conducted of the effectiveness of the training and of the actions taken. *(Organizational Arrangements, Human Resources Management, Knowledge management, Competence management)*

4.24 Competences to be sustained in-house by the organization shall include: competences for leadership at all management levels; competences for fostering and sustaining a strong safety culture; and expertise to understand technical, human and organizational aspects relating to the facility or the activity in order to ensure safety *(Organizational Arrangements, Human Resources Management, Knowledge management, Competence management)*

4.26 All individuals in the organization shall be trained in the relevant requirements of the management system. Such training shall be conducted to ensure that individuals are knowledgeable of the relevance and the importance of their activities and of how their activities contribute to ensuring safety in the achievement of the organization's goals (*LTO-2 Programme, Human Resources Management, Knowledge management)*

4.27. The knowledge and the information of the organization shall be managed as a resource. (*Human Resources Management, Knowledge management)*

Requirement 10: Management of processes and activities

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

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

process have been achieved shall be specified in the process documentation. *(Competence management)*

4.29. The sequencing of a process and the interactions between processes shall be specified so that safety is not compromised. Effective interaction between interfacing processes shall be ensured. Particular consideration shall be given to interactions between processes within the organization, and to interactions between processes conducted by the organization and processes conducted by external service providers. (*Human Resources Management)*

Requirement 12: Fostering a culture for safety

Individuals in the organization, from senior managers downwards, shall foster a strong safety culture. The management system and leadership for safety shall be such as to foster and sustain a strong safety culture.

5.2 Senior managers and all other managers shall advocate and support the following:

[…]

(d) The reporting of problems relating to technical, human and organizational factors and reporting of any deficiencies in structures, systems and components to avoid degradation of safety, including the timely acknowledgement of, and reporting back of, actions taken;

(e) Measures to encourage a questioning and learning attitude at all levels in the organization and to discourage complacency with regard to safety;

(Operational experience feedback)

[…]

Requirement 13: Measurement, assessment and improvement of the management system

The effectiveness of the management system shall be measured, assessed and improved to enhance safety performance, including minimizing the occurrence of problems relating to safety.

6.1. The effectiveness of the management system shall be monitored and measured to confirm the ability of the organization to achieve the results intended and to identify opportunities for improvement of the management system. *(Knowledge management, Competence management, Corrective action programme)*

6.2. All processes shall be regularly evaluated for their effectiveness and for their ability to ensure safety. *(Knowledge management, Competence management, Corrective action programme)*

6.3. The causes of non-conformances of processes and the causes of safety related events that could give rise to radiation risks shall be evaluated and any consequences shall be managed and shall be mitigated. The corrective actions necessary for eliminating the causes of non-conformances, and for preventing the occurrence of, or mitigating the consequences of, similar safety related events, shall be determined, and corrective actions shall be taken in a timely manner. The status and effectiveness of all corrective actions and preventive actions taken shall be monitored and shall be reported to the management at an appropriate level in the organization. *(Competence management, Corrective action programme)*

6.4. Independent assessments and self-assessments of the management system shall be regularly conducted to evaluate its effectiveness and to identify opportunities for its improvement. Lessons and any resulting significant changes shall be analysed for their implications for safety. *(Competence management, Corrective action programme)*

6.5. Responsibility shall be assigned for conducting independent assessments of the management system. The organizations, entities (in-house or external) and individuals assigned such responsibilities shall be given sufficient authority to discharge their responsibilities and shall have direct access to senior management. In addition, individuals conducting independent assessments of the management system shall not be assigned responsibility to assess areas under the responsibility of their own line management. *(Competence management, Corrective action programme)*

6.6. Senior management shall conduct a review of the management system at planned intervals to confirm its suitability and effectiveness, and its ability to enable the objectives of the organization to be accomplished, with account taken of new requirements and changes in the organization. *(Corrective action programme)*

6.7 The management system shall include evaluation and timely use of the following:

(a) Lessons from experience gained and from events that have occurred, both within the organization and outside the organization, and lessons from identifying the causes of events;

(b) Technical advances and results of research and development;

(c) Lessons from identifying good practices.

(Operational experience feedback, Competence management, Corrective action programme)

6.8. Organizations shall make arrangements to learn from successes and from strengths for their organizational development and continuous improvement. *(Corrective action programme)*

A.2 SSR 2/1

Paragraph 2.17

In practice, the design of a nuclear power plant is complete only when the full plant specification (including site details) is produced for its procurement and licensing. IAEA INSAG-19 emphasizes the need for a formally designated entity that has overall responsibility for the design process and is responsible for approving design changes and for ensuring that the requisite knowledge is maintained. IAEA INSAG-19 also introduces the concept of 'responsible designers', to whom this formally designated entity could assign specific responsibilities for the design of parts of the plant. Prior to an application for authorization of a plant, the responsibility for the design will rest with the design organization (e.g. the vendor). Once an application for authorization of a plant has been made, the prime responsibility for safety will lie with the applicant, although detailed knowledge of the design will rest with the responsible designers. This balance will change as the plant is put into operation, since much of this detailed knowledge, such as the knowledge embodied in the safety analysis report, design manuals and other design documentation, will be transferred to the operating organization. To facilitate this transfer of knowledge, the structure of the formally designated entity that has overall responsibility for the design process would be established at an early stage. (*Knowledge management)*

Requirement 3: Safety of the plant design throughout the lifetime of the plant

The operating organization shall establish a formal system for ensuring the continuing safety of the plant design throughout the lifetime of the nuclear power plant.

(d) That management of design requirements and configuration control are maintained;

[…]. *(Configuration Management)*

Requirement 14: Design basis for items important to safety

The design basis for items important to safety shall specify the necessary capability, reliability and functionality for the relevant operational states, for

accident conditions and for conditions arising from internal and external hazards, to meet the specific acceptance criteria over the lifetime of the nuclear power plant.

5.3. The design basis for each item important to safety shall be systematically justified and documented. The documentation shall provide the necessary information for the operating organization to operate the plant safely. *(Management of Modifications)*

Requirement 20: Design extension conditions

A set of design extension conditions shall be derived on the basis of engineering judgement, deterministic assessments and probabilistic assessments for the purpose of further improving the safety of the nuclear power plant by enhancing the plant's capabilities to withstand, without unacceptable radiological consequences, accidents that are either more severe than design basis accidents or that involve additional failures. These design extension conditions shall be used to identify the additional accident scenarios to be addressed in the design and to plan practicable provisions for the prevention of such accidents or mitigation of their consequences.

5.29. The analysis undertaken shall include identification of the features that are designed for use in, or that are capable15 of preventing or mitigating, events considered in the design extension conditions. These features:

(a) Shall be independent, to the extent practicable, of those used in more frequent accidents;

(b) Shall be capable of performing in the environmental conditions pertaining to these design extension conditions, including design extension conditions in severe accidents, where appropriate;

(c) Shall have reliability commensurate with the function that they are required to fulfil.

(Equipment qualification)

Requirement 23: Reliability of items important to safety

The reliability of items important to safety shall be commensurate with their safety significance.

5.37. The design of items important to safety shall be such as to ensure that the equipment can be qualified, procured, installed, commissioned, operated and maintained to be capable of withstanding, with sufficient reliability and effectiveness, all conditions specified in the design basis for the items.

(Equipment Reliability)

Requirement 29: Calibration, testing, maintenance, repair, replacement, inspection and monitoring of items important to safety

Items important to safety for a nuclear power plant shall be designed to be calibrated, tested, maintained, repaired or replaced, inspected and monitored as required to ensure their capability of performing their functions and to maintain their integrity in all conditions specified in their design basis.

5.46. Where items important to safety are planned to be calibrated, tested or maintained during power operation, the respective systems shall be designed for performing such tasks with no significant reduction in the reliability of performance of the safety functions. Provisions for calibration, testing, maintenance, repair, replacement or inspection of items important to safety during shutdown shall be included in the design so that such tasks can be performed with no significant reduction in the reliability of performance of the safety functions.

(Equipment Reliability)

Requirement 30: Qualification of items important to safety

A qualification programme for items important to safety shall be implemented to verify that items important to safety at a nuclear power plant are capable of performing their intended functions when necessary, and in the prevailing environmental conditions, throughout their design life, with due account taken of plant conditions during maintenance and testing.

5.48. The environmental conditions considered in the qualification programme for items important to safety at a nuclear power plant shall include the variations in ambient environmental conditions that are anticipated in the design basis for the plant. *(Equipment qualification)*

5.49. The qualification programme for items important to safety shall include the consideration of ageing effects caused by environmental factors (such as conditions of vibration, irradiation, humidity or temperature) over the expected service life of the items important to safety. When the items important to safety are subject to natural external events and are required to perform a safety function during or following such an event, the qualification programme shall replicate as far as is practicable the conditions imposed on the items important to safety by the natural external event, either by test or analysis, or by a combination of both. *(Equipment qualification)*

5.50. Any environmental conditions that could reasonably be anticipated and that could arise in specific operational states, such as in periodic testing of the containment leak rate, shall be included in the qualification programme. *(Equipment qualification)*

Requirement 31: Ageing management

The design life of items important to safety at a nuclear power plant shall be determined. Appropriate margins shall be provided in the design to take due account of relevant mechanisms of ageing, neutron embrittlement and wear out and of the potential for age related degradation, to ensure the capability of items important to safety to perform their necessary safety functions throughout their design life.

5.51 The design for a nuclear power plant shall take due account of ageing and wear out effects in all operational states for which a component is credited, including testing, maintenance, maintenance outages, plant states during a postulated initiating event and plant states following a postulated initiating event. *(KCB Ageing Management)*

5.52 Provision shall be made for monitoring, testing, sampling and inspection to assess ageing mechanisms predicted at the design stage and to help to identify unanticipated behavior of the plant or degradation that might occur in service. *(KCB Ageing Management)*

A.3 SSR 2/2

Requirement 1: Responsibilities of the operating organizations

The operating organization shall have the prime responsibility for safety in the operation of a nuclear power plan.

3.2 The management system, as an integrated set of interrelated or interacting components for establishing policies and objectives and enabling the objectives to be achieved in an efficient and effective manner, shall include the following activities. *(Competence management)*

(a) Policy making for all areas of safety, which includes:

- Setting management objectives;

- Establishing the policy for safety;
- Developing management and staff who value learning, have skills in creating, acquiring and transferring knowledge, and can adapt the organization on the basis of new knowledge and insights;
- Promoting a strong safety culture.
- Strategies and management objectives shall be developed in accordance with the policy in order to put the policy into effect.

(b) Allocation of responsibilities with corresponding lines of authority and communication, for:

- Allocating resources;
- Providing human resources with the appropriate level of education and training and material resources;
- Retaining the necessary competences;
- Approving the contents of management programmes;
- Developing procedures and instructions, and having a strict policy of adherence to these procedures and instructions;
- Setting policies on fitness for duty;
- Establishing a programme to make the necessary changes to any of these functions on the basis of the performance in achieving objectives

(LTO-2 Programme)

(e) Review activities, which include monitoring and assessing the performance of the operating functions and supporting functions on a regular basis. The purpose of monitoring is: to verify compliance with the objectives for safe operation of the plant; to reveal deviations, deficiencies and equipment failures; and to provide information for the purpose of taking timely corrective actions and making improvements. Reviewing functions shall also include review of the overall safety performance of the organization to assess the effectiveness of management for safety and to identify opportunities for improvement. In addition, a safety review of the plant shall be performed periodically, including design aspects, to ensure that the plant is operated in conformance with the approved design and safety analysis report, and to identify possible safety improvements *(Safety Analysis Report, Deterministic Safety Analysis, Probabilistic Safety Analysis, Operational Experience Feedback, Corrective action programme)*

(f) Design integrity, which includes maintaining a formally designated entity that has overall responsibility for the continuing integrity of the plant design throughout its lifetime, and managing the interfaces and lines of communication with the responsible designers and equipment suppliers contributing to this continuing integrity. *(Corrective action programme)*

3.3. The operating organization shall establish liaison with the regulatory body and with relevant authorities to ensure a common understanding of, and to ensure compliance with, safety requirements and their interface with other requirements, such as those for security, protection of health or protection of the environment. (*Regulatory requirements, codes and standards requirements for KCB LTO-2*)

Requirement 2: Management system

The operating organization shall establish, implement, assess and continually improve an integrated management system.

3.4. The operating organization shall ensure through the establishment and use of a management system that the plant is operated in a safe manner and within the limits and conditions that are specified in the safety assessment and established in the authorization. *(Competence management)*

3.5. The management system shall integrate all the elements of management so that processes and activities that may affect safety are established and conducted coherently with other requirements, including requirements in respect of leadership, protection of health, human performance, protection

of the environment, security and quality, and so that safety is not compromised by other requirements or demands. *(Competence management)*

3.6. The management system of the operating organization shall provide for arrangements to ensure safety in activities performed by external support organizations. Responsibility for activities performed by external support organizations, and for their overall control and supervision, rests with the operating organization. The operating organization shall establish a system for the supervision of work performed by support organizations. It shall be the responsibility of the operating organization to ensure that the personnel of external support organizations who perform activities on structures, systems or components important to safety or activities affecting safety are qualified to perform their assigned tasks. The overall contracted activity shall be clearly specified in writing and shall be approved by the operating organization prior to its commencement. The operating organization shall ensure long term access to knowledge of the plant design and manufacturing and construction throughout the lifetime of the plant. *(Competence management)*

3.7. The operational safety of a plant is subject to oversight by a regulatory body independent of the operating organization. The operating organization, in accordance with the regulatory requirements, shall submit or make available to the regulatory body all necessary documents and information. The operating organization shall develop and implement a procedure for reporting events to the regulatory body in accordance with the established criteria and the State's regulations. The operating organization shall provide the regulatory body with all necessary assistance to enable it to perform its duties, including enabling unhindered access to the plant and providing documentation. *(Competence management)*

Requirement 3: Structure and functions of the operating organization

The structure of the operating organization and the functions, roles and responsibilities of its personnel shall be established and documented.

3.8 Functional responsibilities, lines of authority, and lines of internal and external communication for the safe operation of a plant in all operational states and in accident conditions shall be clearly specified in writing. Authority for the safe operation of the plant may be delegated to the plant management. In this case, the necessary resources and support shall be provided. *(Organizational Arrangements, Knowledge management, Competence management, Human Resources Management)*

3.9 Documentation of the plant's organizational structure and of the arrangements for discharging responsibilities shall be made available to the plant staff and, if required, to the regulatory body. The structure of the operating organization shall be specified so that all roles that are critical for safe operation are specified and described. Proposed organizational changes to the structure and associated arrangements, which might be of importance to safety, shall be analyzed in advance by the operating organization. Where so required by the State's regulations, proposals for such organizational changes shall be submitted to the regulatory body for approval. *(Organizational Arrangements, Competence management)*

Requirement 4: Staffing of the operating organization

The operating organization shall be staffed with competent managers and sufficient qualified personnel for the safe operation of the plant

3.10 The operating organization shall be responsible for ensuring that the necessary knowledge, skills, attitudes and safety expertise are sustained at the plant, and that long term objectives for human resources policy are developed and are met. *(Organizational Arrangements, Human Resources Management, Competence management)*

3.11 The organization, qualifications and number of operating personnel shall be adequate for the safe and reliable operation of the plant in all operational states and in accident conditions. Succession planning shall be an established practice for the operating personnel. The recruitment and selection policy of the operating organization shall be directed at retaining competent personnel to cover all

aspects of safe operation. A long term staffing plan aligned to the long term objectives of the operating organization shall be developed in anticipation of the future needs of the operating organization for personnel and skills. *(Organizational Arrangements, Human Resources Management, Competence management)*

Requirement 5: Safety policy

The operating organization shall establish and implement operational policies that give safety the highest priority.

4.1. The operational policy established and implemented by the operating organization shall give safety the utmost priority, overriding the demands of production and project schedules. The safety policy shall promote a strong safety culture, including a questioning attitude and a commitment to excellent performance in all activities important to safety. Managers shall promote an attitude of safety consciousness among plant staff. *(Competence management)*

4.2. The safety policy shall stipulate clearly the leadership role of the highest level of management in safety matters. Senior management shall communicate the provisions of the safety policy throughout the organization. Safety performance standards shall be developed for all operational activities and shall be applied by all site personnel. All personnel in the organization shall be made aware of the safety policy and of their responsibilities for ensuring safety. The safety performance standards and the expectations of the management for safety performance shall be clearly communicated to all personnel, and it shall be ensured that they are understood by all those involved in their implementation. *(Competence management)*

4.3. Key aspects of the safety policy shall be communicated to external support organizations, including contractors, so that the operating organization's requirements and expectations for the safety related activities of external support organizations, including contractors, will be understood and met. *(Competence management)*

Requirement 7: Qualification and training of personnel

The operating organization shall ensure that all activities that may affect safety are performed by suitably qualified and competent persons.

4.18. The management of the operating organization shall be responsible for the qualification and the competence of plant staff. Managers shall participate in determining the needs for training and in ensuring that operating experience is taken into account in the training. Managers and supervisors shall ensure that production needs do not unduly interfere with the conduct of the training programme. *(Competence management)*

4.21. The training programmes shall be assessed and improved by means of periodic review. In addition, a system shall be put in place for the timely modification and updating of the training facilities, computer models, simulators and materials to ensure that they adequately reflect current plant conditions and operating policy, and that any differences are justified. *(Knowledge management, Competence management)*

4.22. Operating experience at the plant, as well as relevant experience at other plants, shall be appropriately incorporated into the training programme. It shall be ensured that training is conducted on the root cause(s) of the events and on the determination and implementation of corrective actions to make their recurrence less likely. *(Competence management)*

Requirement 9: Monitoring and review of safety performance

The operating organization shall establish a system for continuous monitoring and periodic review of the safety of the plant and of the performance of the operating organization.

4.34 Self-assessment by the operating organization shall be an integral part of the monitoring and review system. The operating organization shall perform systematic self-assessments to identify achievements and to address any degradation in safety performance. Where practicable, suitable objective performance indicators shall be developed and used to enable senior managers to detect and to react to shortcomings and deterioration in the management of safety *(Maintenance, In-Service Inspections, Surveillance, Water chemistry)*

4.37. The appropriate corrective actions shall be determined and implemented as a result of the monitoring and review of safety performance. Progress in taking the corrective actions shall be monitored to ensure that actions are completed within the appropriate timescales. The completed corrective actions shall be reviewed to assess whether they have adequately addressed the issues identified in audits and reviews. *(Corrective action programme)*

Requirement 10: Control of plant configuration

The operating organization shall establish and implement a system for plant configuration management to ensure consistency between design requirements, physical configuration and plant documentation.

4.38 Controls on plant configuration shall ensure that changes to the plant and its safety related systems are properly identified, screened, designed, evaluated, implemented and recorded. Proper controls shall be implemented to handle changes in plant configuration that result: from maintenance work, testing, repair, operational limits and conditions, and plant refurbishment; and from modifications due to ageing of components, obsolescence of technology, operating experience, technical developments and results of safety research. *(Configuration Management, Technological Obsolescence Management)*

Requirement 11: Management of modifications

The operating organization shall establish and implement a programme to manage modifications.

4.39 A modification programme shall be established and implemented to ensure that all modifications are properly identified, specified, screened, designed, evaluated, authorized, implemented and recorded. Modification programmes shall cover: structures, systems and components; operational limits and conditions; procedures; documents; and the structure of the operating organization. Modifications shall be characterized on the basis of their safety significance. Modifications shall be subject to the approval of the regulatory body, in accordance with their safety significance, and in line with national arrangements. *(Management of Modifications, Configuration Management)*

4.40 Modification control, in compliance with the requirements set out in SSR-2/1, shall ensure the proper design, safety assessment and review, control, implementation and testing of all permanent and temporary modifications. Consequences of the modification for human tasks and performance shall be systematically analysed. For all plant modifications, human and organizational factors shall be adequately considered. *(Management of Modifications, Configuration Management)*

4.41 Temporary modifications shall be limited in time and number to minimize the cumulative safety significance. Temporary modifications shall be clearly identified at their location and at any relevant control position. The operating organization shall establish a formal system for informing relevant personnel in good time of temporary modifications and of their consequences for the operation and safety of the plant. *(Management of Modifications, Configuration Management)*

4.42 The plant management shall establish a system for modification control to ensure that plans, documents and computer programmes are revised in accordance with modifications. *(Management of Modifications, Configuration Management)*

4.43 Before commissioning a modified plant or putting the plant back into operation after modifications, personnel shall be trained, as appropriate, and all relevant documents necessary for plant operation shall be updated. *(Management of Modifications, Configuration Management)*

Requirement 12: Periodic Safety Review

Systematic safety assessments of the plant, in accordance with the regulatory requirements, shall be performed by the operating organization throughout the plant's operating lifetime, with due account taken of operating experience and significant new safety related information from all relevant sources.

4.44 Safety reviews such as periodic safety reviews or safety assessments under alternative arrangements shall be carried out throughout the lifetime of the plant, at regular intervals and as frequently as necessary (typically no less frequently than once in ten years). Safety reviews shall address, in an appropriate manner: the consequences of the cumulative effects of plant ageing and plant modification; equipment requalification; operating experience, including national and international operating experience; current national and international standards; technical developments; organizational and management issues; and site related aspects. Safety reviews shall be aimed at ensuring a high level of safety throughout the operating lifetime of the plant. *(Periodic Safety Review, Condition Assessment)*

4.45 The operating organization shall report to the regulatory body as required, in a timely manner, the confirmed findings of the safety review that have implications for safety. *(Periodic Safety Review)*

4.46 The scope of the safety review shall include all safety related aspects of an operating plant. To complement deterministic safety assessment, probabilistic safety assessment (PSA) can be used for input to the safety review to provide insight into the contributions to safety of different safety related aspects of the plant. *(Periodic Safety Review, Deterministic Safety Analysis, Probabilistic Safety Analysis)*

4.47 On the basis of the results of the systematic safety assessment, the operating organization shall implement any necessary corrective actions and reasonably practicable modifications for compliance with applicable standards with the aim of enhancing the safety of the plant by further reducing the likelihood and the potential consequences of accidents. *(LTO-2 Programme, Periodic Safety Review)*

Requirement 13: Equipment qualification

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

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

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

Requirement 14: Ageing Management

The operating organization shall ensure that an effective ageing management programme is implemented to ensure that required safety functions of systems,

structures and components are fulfilled over the entire operating lifetime of the plant

4.50 The ageing management programme shall determine the consequences of ageing and the activities necessary to maintain the operability and reliability of structures, systems and components. The ageing management programme shall be coordinated with, and be consistent with, other relevant programmes, including the programme for periodic safety review. A systematic approach shall be taken to provide for the development, implementation and continuous improvement of ageing management programmes. *(Periodic Safety Review, Ageing Management Review, KCB Ageing Management, Understanding ageing, Ageing Management Programmes, Corrective action programme, Equipment Reliability)*

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

Requirement 15: Records and reports

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

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

Requirement 16: Programme for Long Term Operation

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

4.53 The justification for long term operation shall be prepared on the basis of the results of a safety assessment, with due consideration of the ageing of structures, systems and components. The justification for long term operation shall utilize the results of periodic safety review and shall be submitted to the regulatory body, as required, for approval on the basis of an analysis of the ageing management programme, to ensure the safety of the plant throughout its extended operating lifetime. *(Regulatory requirements, codes and standards requirements for KCB LTO-2, LTO-2 Programme, Periodic Safety Review, Ageing Management Review, Documentation of ageing management)*

4.54 The comprehensive programme for long term operation shall address:

a) Preconditions (including the current licensing basis, safety upgrading and verification, and operational programmes);
b) Setting the scope for all structures, systems and components important to safety;
c) Categorization of structures, systems and components with regard to degradation and ageing processes;

d) Revalidation of safety analyses made on the basis of time limited assumptions;
e) Review of ageing management programmes in accordance with national regulations;
f) The implementation programme for long term operation.

(LTO-2 Programme, Scope Setting, Ageing Management Review, In-service inspection, Technological Obsolescence Management, Maintenance, Surveillance, Water chemistry, Equipment qualification, Time limited ageing analysis)

Requirement 24: Feedback of operating experience

The operating organization shall establish an operating experience programme to learn from events at the plant and events in the nuclear industry and other industries worldwide.

5.27 The operating organization shall establish and implement a programme to report, collect, screen, analyze, trend, document and communicate operating experience at the plant in a systematic way. It shall obtain and evaluate available information on relevant operating experience at other nuclear installations to draw and incorporate lessons for its own operations, including its emergency arrangements. It shall also encourage the exchange of experience within national and international systems for the feedback of operating experience. Relevant lessons from other industries shall also be taken into consideration, as necessary. *(Operational Experience Feedback)*

5.28 Events with safety implications shall be investigated in accordance with their actual or potential significance. Events with significant implications for safety shall be investigated to identify their direct and root causes, including causes relating to equipment design, operation and maintenance, or to human and organizational factors. The results of such analyses shall be included, as appropriate, in relevant training programmes and shall be used in reviewing procedures and instructions. Plant event reports and non-radiation-related accident reports shall identify tasks for which inadequate training may be contributing to equipment damage, excessive unavailability of equipment, the need for unscheduled maintenance work, the need for repetition of work, unsafe practices or lack of adherence to approved procedures. *(Operational Experience Feedback, Knowledge management)*

5.29 Information on operating experience shall be examined by competent persons for any precursors to, or trends in, adverse conditions for safety, so that any necessary corrective actions can be taken before serious conditions arise. *(Operational Experience Feedback, Corrective action programme, Knowledge management)*

5.30 As a result of the investigation of events, clear recommendations shall be developed for the responsible managers, who shall take appropriate corrective actions in due time to avoid any recurrence of the events. Corrective actions shall be prioritized, scheduled and effectively implemented and shall be reviewed for their effectiveness. Operating personnel shall be briefed on events of relevance and shall take the necessary corrective actions to make their recurrence less likely. *(Operational Experience Feedback, Corrective action programme, Knowledge management)*

5.31 The operating organization shall be responsible for instilling an attitude among plant personnel that encourages the reporting of all events, including low level events and near misses, potential problems relating to equipment failures, shortcomings in human performance, procedural deficiencies or inconsistencies in documentation that are relevant to safety. *(Operational Experience Feedback, Knowledge management)*

5.32 The operating organization shall maintain liaison, as appropriate, with support organizations (e.g. manufacturers, research organizations and designers) involved in the design, construction, commissioning and operation of the plant in order to feedback information on operating experience and to obtain advice, if necessary, in the event of equipment failure or in other events. *(Operational Experience Feedback, Knowledge management)*

5.33 The operating experience programme shall be periodically evaluated to determine its effectiveness and to identify any necessary improvements. *(Operational Experience Feedback)*

Requirement 29: Chemistry programme

The operating organization shall establish and implement a chemistry programme to provide the necessary support for chemistry and radiochemistry.

7.13. The chemistry programme shall be developed prior to normal operation and shall be in place during the commissioning programme. The chemistry programme shall provide the necessary information and assistance for chemistry and radiochemistry for ensuring safe operation, long term integrity of structures, systems and components, and minimization of radiation levels. *(Water chemistry)*

7.14. Chemistry surveillance shall be conducted at the plant to verify the effectiveness of chemistry control in plant systems and to verify that structures, systems and components important to safety are operated within the specified chemical limit values. *(Water chemistry)*

7.15. The chemistry programme shall include chemistry monitoring and data acquisition systems. These systems, together with laboratory analyses, shall provide accurate measuring and recording of chemistry data and shall provide alarms for relevant chemistry parameters. Records shall be kept available and shall be easily retrievable. *(Water chemistry)*

7.16. Laboratory monitoring shall involve the sampling and analysis of plant systems for specific chemical parameters, concentrations of dissolved and suspended impurities, and radionuclide concentrations. *(Water chemistry)*

7.17. The use of chemicals in the plant, including chemicals brought in by contractors, shall be kept under close control. The appropriate control measures shall be put in place to ensure that the use of chemical substances and reagents does not adversely affect equipment or lead to its degradation. *(Water chemistry)*

Requirement 31: Maintenance, testing, surveillance and inspection programmes

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

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

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

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

8.4 Data on maintenance, testing, surveillance and inspection shall be recorded, stored and analyzed for the purpose of confirming that the operating performance is in accordance with the design intent and with requirements for the reliability and availability of equipment. *(Operational Experience Feedback, Surveillance, Maintenance, In-service inspection, Knowledge management, Equipment Reliability)*

8.5 The frequency of maintenance, testing, surveillance and inspection of individual structures, systems and components shall be determined on the basis of:

a) The importance to safety of the structures, systems and components, with insights from probabilistic safety assessment taken into account;
b) Their reliability in, and availability for, operation;
c) Their assessed potential for degradation in operation and their ageing characteristics;
d) Operating experience;
e) Recommendations of vendors.

(Probabilistic Safety Analysis, Surveillance, Maintenance, In-service inspection, Equipment Reliability)

8.6 A comprehensive and structured approach to identifying failure scenarios shall be taken to ensure the proper management of maintenance activities, using methods of probabilistic safety analysis as appropriate. (*Maintenance)*

8.7 New approaches that could result in significant changes to current strategies for maintenance, testing, surveillance and inspection shall be taken only after careful consideration of the implications for safety and after appropriate authorization, as required. (*Maintenance)*

8.14 Corrective maintenance of structures, systems and components shall be performed as promptly as practicable and in compliance with operational limits and conditions. Priorities shall be established, with account taken first of the relative importance to safety of the defective structures, systems and components. (*Maintenance)*

8.14A The operating organization shall establish maintenance programmes for non-permanent equipment to be used for accidents more severe than design basis accidents, in order to maintain high reliability of this equipment. The operating organization shall carry out periodic training and exercises in handling the equipment and connecting it to the nuclear power plant. (*Maintenance, Equipment Reliability)*

8.15 The operating organization shall establish suitable arrangements to procure, receive, control, store and issue materials (including supplies), spare parts and components. (*Maintenance)*

8.16 The operating organization shall be responsible for using these arrangements for the procurement of materials (including supplies), spare parts and components and for ensuring that their characteristics are consistent with applicable safety standards and with the plant design. (*Maintenance)*

8.17 The operating organization shall ensure that storage conditions are adequate and that materials (including supplies), spare parts and components are available and are in proper condition for use. (*Maintenance)*