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Screening of relevant Structures and Components in the frame of the KCB Long-Term Operation Process

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Summary

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In 2013, the nuclear power plant Borssele will have been in operation for 40 years. It is planned to extend the plant's lifetime until 2034. In this context, EPZ is implementing a Long-Term Operation (LTO) process in accordance with IAEA guidelines. The identification of Systems, Structures and Components (SSCs) that are important to safety and those that are classified as not important to safety but whose failure may impact SSCs important to safety was performed in the separately reported scoping process. This was performed on a system, subsystem, major component and building level and resulted in a list of SSCs in the scope of LTO.

The purpose of this report is to describe the screening process, namely identification of structures and components subject to LTO assessment.

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## 1. Relevant Supporting Information

### 1.1 List of Abbreviations

AC	Alternating Current
AKS	Anlagen Kennzeichen System (Plant Identification Code)
AMR	Ageing Management Review
ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations (United States Nuclear Regulatory Commission)
CG	Commodity Group
CLB	Current Licensing Basis
CT	Current Transformer
DC	Direct Current
ECCS	Emergency Core Cooling System
e.g.	exempli gratia (for example)
EPZ	N.V. Elektriciteits-Produktiemaatschappij Zuid-Nederland
etc.	et cetera
HVAC	Heating Ventilation and Air-Conditioning
I&C	Instrumentation and Control
IAEA	International Atomic Energy Agency
KCB	Nuclear Power Plant Borssele
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
LTO	Long-Term Operation
MCPB	Main Coolant Pressure Boundary
NEI	Nuclear Energy Institute
OEM	Original Equipment Manufacturer
P&ID	Process and Instrumentation Diagram
RTD	Resistance Temperature Detectors
SSC	System, Structure and/or Component
US	United States
VT	Voltage Transformer

## 1.2 List of Symbols and Units

>	Greater Than
≥	Greater Than or Equal To
+	Plus
&	and
bar	Unit of pressure
V	Volt
kV	Kilovolt

## 2. Introduction

In 2013, the nuclear power plant Borssele will have been in operation for 40 years. It is planned to extend the plant's lifetime until 2034. In this context, EPZ is implementing a Long-Term Operation (LTO) process in accordance with IAEA guidelines [1]. This LTO process is being performed to demonstrate, in respect of possible ageing processes affecting Systems, Structures and Components (SSCs), that the plant can be safely operated until 2034.

SSCs that are important to safety and those that are classified as not important to safety but whose failure may impact SSCs important to safety were identified for the KCB in the scoping process in joint co-operation between EPZ and AREVA NP [2]. Scoping was performed on a system, subsystem, major component and building level and resulted in a list of SSCs in scope for the LTO process.

The report herein describes the next step in the LTO process known as the screening. In the screening process structures and components that are within the scope of Long-Term Operation and that are subject to LTO assessment are identified. Screening is performed for active as well as passive structures and components on the level of commodity groups. Passive SCs will be assessed in a so called Ageing Management Review (AMR), whereas active SCs will be addressed separately as part of the overall LTO process [3].

The methodology used to identify structures and components subject to LTO assessment is provided in Chapter 3. The screening results are presented in Chapter 4 for mechanical systems, in Chapter 5 for civil structures and structural components, and in Chapter 6 for electrical and I&C systems. Chapter 7 provides a summary of results and recommendations for the subsequent LTO assessment processes. Chapter 8 includes a list of all references.

It should be noted at this point that, as was the case for the scoping process, EPZ as operator and AREVA NP as original equipment manufacturer (OEM) of KCB collaborated closely in carrying out this work for LTO to assure that all information of relevance was used during preparation of this report.

### 3. Screening Methodology

The screening process identifies the structures and components that are subject to LTO assessment. To perform this screening step on the one hand IAEA guidelines / recommendations (see Chapter 3.1) were followed. On the other hand, most projects in the frame of License Renewal have been performed under US regulation procedures, those procedures have also been taken into account (see Chapter 3.2). From these two methods, the resulting procedure for KCB has been derived as described in sections 3.3 and 3.4.

#### 3.1 Screening Criteria according to IAEA

Safe plant operation is an essential prerequisite for the implementation of LTO. To support safe Long-Term Operation, the IAEA has developed specific guidelines on LTO. Safety report No. 57 (Safe Long Term Operation of Nuclear Power Plants) [1], has been published for this purpose. This report provides general criteria, including "scoping and screening" criteria to identify SSCs relevant for the LTO process. Scoping of SSCs relevant for the LTO process has been completed for KCB and is reported in NEPS-G/2008/en/0056 [2].

According to Safety report No. 57 [1] the next step of the LTO process is the identification of all structures and components which are not subject to replacement based on a qualified life or specified time period (referred to as long-lived structures and components), based on the SSCs determined to be within the scope of evaluation for LTO during the scoping process.

In many countries LTO-assessments focus on passive (parts of) structures and components while the active structures and components are part of maintenance programs and not-functioning of the active structures and components is monitored throughout lifetime independent of the original or extended lifetime.

Passive structures and components include, but are not limited to, the reactor pressure vessel, the reactor coolant system pressure boundary, steam generator, pressurizer, piping, pump casings, valve bodies, the core shroud, component supports, pressure retaining boundaries, heat exchangers, ventilation ducts, the containment, the containment liner, electrical and mechanical penetrations, equipment hatches, seismic category I structures, electrical cables and connections, cable trays and electrical cabinets. Active structures and components excluded from LTO assessment include, but are not limited to, pumps (except casing), valves (except body), motors, diesel generators, air compressors, snubbers, the control rod drives, ventilation dampers, pressure transmitters, pressure indicators, water level indicators, switchgears, cooling fans, transistors, batteries, breaker relay, switches, power inverters, circuit boards, battery chargers and power supplies.

#### 3.2 Screening Criteria according to 10 CFR Part 54-License Renewal Rule-for US Plants

The IAEA guidance for screening summarized in Section 3.1 above is similar to the requirements for the integrated plant assessment used in the license renewal process for plants in the United States, i.e., 10 CFR Part 54--Requirements for Renewal of Operating Licenses for Nuclear Power Plants [4].

The focus of 10 CFR Part 54 is on providing reasonable assurance that the effects of ageing on the functionality of passive long-lived structures and components are adequately managed in accordance with the plant-specific current licensing basis (CLB) design basis conditions such that the safety functions are maintained for long term plant operation. The basis for limiting screening to passive long-lived structures and components is that the effects of ageing on the functionality of long-lived active components are adequately managed by current plant performance based programs, which are required by the mandatory Maintenance Rule (10 CFR 50.65 [5]). This requires monitoring and



establishment of performance goals for SSCs important to safety and power production, root cause evaluation of components when SSC performance criteria are not met, trending of component performance, use of risk-based methods to establish maintenance activities, and evaluation of performance and monitoring every refueling outage or not less than every 2 years.

Relevant requirements of 10 CFR 54.21(a) pertaining to screening include the identification of structures and components that perform a safety function without moving parts or without a change in configuration or properties. These passive structures and components comprise the same structures and components as defined in the IAEA screening criteria in Chapter 3.1. Structures and components that are subject to replacement based on a qualified life or specified time period are not subject to further AMR.

US Nuclear Industry guidance for screening (the identification of passive and long-lived components subject to AMR for LTO), is provided in Section 4.1 of NEI-95-10, Revision 6 (Reference [6]). This guidance recommends the establishment of commodity groups of like structures or components to disposition the entire group with a single AMR. The basis to group structures or components can be such characteristics as similar design, similar materials of construction, similar ageing management practices and similar environments. If the environment in which the structure or component operates suggests potential different environmental stressors, then the commodity group determination also could consider service time, operational transients, previous failures and any other conditions that would suggest different results. Appendix B of NEI 95-10 includes a listing, although not all-inclusive, of typical plant components, structures and commodity groups, along with a determination of whether the group is active or passive. The majority of US plants use Appendix B to NEI 95-10 in determining structures and components subject to an AMR.

### **3.3 Principles for Identification of Structures and Components subject to further LTO Assessment for Long-Term Plant Operation of KCB**

The next step is to identify structures and components within these SSCs that are subject to further LTO assessment. The SSCs important to safety identified in Reference [2] contain both active and passive structures and components. Active structures and components are structures, components or subcomponents that perform or support a safety function in support of the Systems, Structures or Component/Commodity Group function(s) with moving parts or with an intentional change in configuration or state.

The identification of structures and components that are subject to further LTO assessment will focus on the identification of both active and passive components and subcomponents. For the purpose of this screening report, passive structures and components are structures, components or subcomponents that perform or support an intended safety function in support of the Structures or Component / Commodity Group function(s) without moving parts or without an intended change in configuration or state (referred to as passive) e.g., piping or vessels. Further examples of passive components or subcomponents include valve bodies and pump casings. For the purpose of this screening report, active structures and components are structures, components or subcomponents that perform or support an intended safety function in support of the Structures or Component / Commodity Group function(s) with moving parts or with an intended change in configuration or state (referred to as active). These active structures and components comprise the same structures and components as defined in the IAEA screening criteria in Chapter 3.1.

### 3.4 Procedure for Identification of Structures and Components subject to further LTO Assessment for Long-Term Plant Operation of KCB

The first step of the screening process is to constitute a general KCB specific list of active and passive commodity groups using the commodity groups listed in Attachment B to NEI 95-10. This KCB specific list is included as Appendix 1. Note: for the passive commodity groups listed in Appendix 1, consumables such as O-rings, structural sealants, oil, grease and component filters, system filters, fire extinguishers, fire hoses and air packs are not listed. These items are considered part of the component and are typically not evaluated during the latter LTO assessment since most are short-lived subcomponents.

The further steps used to perform screening for KCB are described in terms of mechanical systems, civil structures and structural components, and electrical and I&C systems. In this context, mechanical system indicates the mechanical parts of the particular KCB designated system (e.g., RA), whereas electrical and I&C system indicates in the same manner the electrical and I&C parts of the particular KCB designated system (e.g., RA).

A system level review is conducted to identify appropriate component commodity groups in order to facilitate the further LTO assessment.

System descriptions are used as basis for the review of the system safety function(s) mentioned in the scoping report [2], and are applied within the screening process to identify all structures and components that support these system safety function(s). If the system boundary could not be easily determined from the system safety function(s), it was conservatively assumed that the entire system was required to fulfill the safety function(s). Additional commodity groups identified using this process could be removed during the further LTO process when more detailed system boundaries will be developed.

#### Screening of Mechanical Systems

For each applicable mechanical system, process and instrumentation diagrams (P&ID) that describe the system were identified.

Mechanical active and passive component commodity groups and their functions were identified by using the generic NEI list [6] of active and passive components supplemented by KCB specific components as listed on the system P&IDs (see Appendix 1).

Component supports and hangers were identified, where applicable during the mechanical review and will in detail be identified during the further LTO assessment. Component supports and hangers will be evaluated as part of the mechanical AMR process by the application of commodity groups.

The screening results for the mechanical systems are presented in Chapter 4

### Screening of Structures and Structural Components from Reference [2]

It is assumed that the entire building structure is screened in. As buildings are passive, they will be assessed in the Ageing Management Review.

As these structures are all passive, they will be assessed in the AMR process. All applicable internal structures will be identified using building drawings in the AMR.

Cranes are active and will be assessed according to [3] whereas crane tracks and lifting equipment are passive and will be assessed in the AMR.

A listing of relevant buildings, pipe and cable ducts as well as lifting equipment of concern is given.

### Screening of Electrical and I&C Systems

System descriptions are included in the document management system of the plant and are not included in this report.

2. The entire electrical system related to safety is assumed to be in scope and subject to further LTO assessment, i.e., the functional chain beginning from a specific component to e.g., the process computer or reactor safety system.
3. Electrical active and passive component commodity groups and their functions, specific for KCB, were identified within this screening process by using the generic NEI list [6] of active and passive components supplemented by KCB specific components (see Appendix 1). Cable trays are assumed to be an electrical passive component commodity group. In general wires and terminations inside of active cabinets (e. g. switchgear, rectifier, I&C, etc.) belong to that active component; this is valid for outgoing terminations also; the interfacing passive component is the outgoing cable. But to benefit from the material investigation which is performed in the AMR, the wires/terminations inside of active components as well as the enclosures of cabinets are examined with the passive commodity groups because of their passive function.
4. The screening results and applicable KCB-specific electrical component commodity groups for electrical and I&C systems within scope are presented in Chapter 6.

#### 4. Screening Results of KCB Mechanical Structures and Components

As discussed in Section 3.4, each mechanical system within the scope of LTO [2] was reviewed by identifying applicable system P&IDs, reviewing the system safety functions to identify all structures and components listed on the P&IDs that support the system safety function(s), and finally the identification of active and passive component commodity groups within each system boundary using Appendix 1 as a guideline. Screening is performed for each mechanical system to facilitate the subsequent LTO assessment process where active structures and components are handled further according to the conceptual document [3] and passive commodity groups within similar operating environments and operating conditions are evaluated collectively in the subsequent ageing management review.

The full set of KCB passive mechanical commodity groups is provided in the following table. This list is the result of screening KCB systems within the scope of LTO using Appendix 1 as a guideline. In general the typical intended function(s) of passive mechanical components important to nuclear safety is to maintain the pressure boundary integrity and/or structural integrity. However selected commodity groups might have deviating or additional intended function(s) which will be identified in the further LTO assessment.

**Table 1: KCB passive Commodity Groups based on Review of LTO Systems from Reference 2 and Commodity Groups from Appendix 1**

KCB passive Commodity Groups based on Review of LTO Systems from Reference 2 and Commodity Groups from Appendix 1	
Piping / Fittings	Penetrations
Restricting Orifices	Pump Housings
Valve Bodies	Fan Housings
Thermowells	Filter / Strainer Housings
Bolts / Fasteners	Sightglasses
Vessels (P>0.5 bar)	Turbine Housing
Tanks (P≤0.5 bar)	Pulsation Damper Housings
Heat Exchanger Internals	Ducting and Components
Flow-Meter Bodies	Damper Housings
Manways	Flex Connections
Expansion Bellows / Joints	Rupture Discs
Instrumentation Tubing	Hydrogen Detector Bodies
Supports / Hangers	

The full set of KCB active mechanical commodity groups is provided in the following table. This list is the result of screening KCB systems within the scope of LTO using Appendix 1 as a guideline.

**Table 2: KCB active Commodity Groups based on Review of LTO Systems from Reference 2 and Commodity Groups from Appendix 1**

<b>KCB active Commodity Groups based on Review of LTO Systems from Reference 2 and Commodity Groups from Appendix 1</b>	
Valve	Turbine
Flow-meter	Emergency Diesel Generator
Pump / Compressor	Recombiner
Fan	Damper
Control Rod Drive	

The mechanical systems are presented in alphabetical order consistent with the scoping report [2].

For the majority of mechanical systems the entire scope of the system was considered to be within the scope of LTO and the components that were identified represent a conservative bounding set of component commodity groups. This set of component commodity groups may be reduced during the further LTO assessment when detailed system boundaries will be established.

## 5. Screening Results of KCB Civil Structures and Components

Hangers and supports subject to AMR were identified through the mechanical system review summarized in Chapter 4. Detailed review of structural subcomponents and identification of their intended functions will be performed as part of the AMR process. Within the AMR, plant walk downs will be performed to identify and list relevant structures and components, which will subsequently be summed up to adequate KCB specific commodity groups, based on the generic list of passive long-lived components in Appendix 1.

Typical civil passive long-lived commodity groups are concrete elements, fire rated doors, masonry walls, seals, personal airlock, et cetera.

The only active structural commodity group – snubbers – is subject to LTO assessment in a separate process [3].

In general, the civil AMR will include buildings, building internal structures, hangers, supports, pipe and cable ducts, and lifting equipment. The KCB buildings, pipe and cable ducts, and lifting equipment subject to AMR assessment are listed below.

**Table 3: KCB Buildings**

KCB Buildings	
Nr.	Building
01	Reactor building, containment, including systems XA, XB, XC, XD, XE, XF, XG, XH, XT
02	Reactor building, annulus
03	Auxiliary reactor building
03	Secondary pressure relief station
04	Turbine building
05	Switchgear building
10	Emergency diesel generator building
13	Ventilation chimney
33	Building for auxiliary water supply systems
35	Emergency control building
72	Emergency diesel generator building
21/23	Cooling water inlet building Cooling water outlet building

The primary intended functions of below mentioned Pipe and Cable ducts are shelter / protection and structural support.

**Table 4: KCB Pipe and Cable Ducts**

KCB Pipe and Cable Ducts			
Building No.	From Building	Building No.	To Building
01	Reactor Building	05	Switchgear building
04	Turbine building VC/VF pipelines	21/23	Cooling water inlet building/ Cooling water outlet building
05	Switchgear building	72	Emergency diesel generator building 72.101/72.103
05	Switchgear building	21	in direction cooling water inlet building
21	Cooling water intake building		Buildings on the dike with vacuum breakers
33,401	Redundancy 1	02	Redundancy 1 (from building No. 33)
33,402	Redundancy 3	02	Redundancy 3 (from building No. 33)
33,403	Redundancy 2	02	Redundancy 2 (from building No. 33)
35,115	Redundancy 2 35.114	06.702	Redundancy 2 (from building No. 35)
35,116	Redundancy 3 35.113	06.703	Redundancy 3 (from building No. 35)
35,117	Redundancy 1 35.112	06.704	Redundancy 1 (from building No. 35)
35,504	Redundancy 1 (building No. 35)	35,504	Redundancy 1 (building No. 33)
35,507	Redundancy 2 (building No. 35)	35,507	Redundancy 2 (building No. 33)
35,509	Redundancy 3 (building No. 35)	35,509	Redundancy 3 (building No. 33)
69,101	Redundancy 1 + Redundancy 2 (Building for auxiliary water supply systems 69.101 to 69.102)	05/06	Redundancy 1/2 (From Building for auxiliary water supply systems No. 33)
69,102	Redundancy 2 (Building for auxiliary water supply systems 69.102)	69,101	Redundancy 1 (Building for auxiliary water supply systems 69.101 Emergency control building 35.115/116/117)
72,101	Emergency diesel generator building	04	Turbine building 5.2/5.3
72,101	Emergency diesel generator building	72,101	Emergency diesel generator building
72,103	Emergency diesel generator building	04	Turbine building 5.2/5.3
72,103	Emergency diesel generator building	72,103	Emergency diesel generator building
72,103	Emergency diesel generator building	10	Emergency diesel generator building No. 10

The primary intended function of the following lifting devices is structural support. As stated before the cranes and hoists are active, whereas crane tracks and lifting equipment is passive and subject to AMR assessment.

**Table 5: Lifting Equipment with specific Requirements**

AKS	Description
UQ10	Reactor hoist in building 01; lifts radioactive load, for this hoist additional requirements are considered
UQ16	Hoist outside building 01; lifts radioactive load (among others waste container), for this hoist additional requirements are considered
UQ17	Round rotation hoist in building 01; lifts radioactive load, for this hoist additional requirements are considered
UQ18	Hoist outside near dry fuel element storage (part of workshop in building 01)
UQ29	Not named as hoist with special requirements but it also lifts radioactive loads in building 02 and 03

## 6. Screening Results of KCB Electrical and I&C Structures and Components

Electrical active and passive commodity groups applicable to KCB were identified on the basis of the generic list given by NEI 95-10 (*Reference [6]* therein Attachment B) and adapted to the relevance for KCB; the outcome is listed in Appendix 1. This resulted for electrical and I&C in the definition of 7 passive and 14 active KCB-specific commodity groups. The passive commodity groups are separated on the one hand to those covering electrical and I&C components and on the other hand to those dealing with structural parts for electrical and I&C. Passive and active commodity groups are defined in the following Chapter 6.1.

The intended functions of the passive commodity groups subject to AMR are presented in Chapter 6.2. These commodity groups define the electrical components subject to AMR. Active components are required to maintain functional for LTO, the further LTO assessment of active commodity groups will be performed as outlined in [3].

The detailed selection of components or structural parts for each commodity group will also be part of the further LTO assessment.

Every commodity group is allocated at least to one of the systems. The connection from the switchgear breaker via cables/etc. to the electrical consumer is allocated to the respective process system

Accordingly the signal connection from a sensor / transducer to an I&C cabinet is allocated to the process system . Connections between I&C cabinets and control panels are allocated to the panels .



## **6.1 Definition of Commodity Groups for Electrical and I&C Structures and Components**

### **6.1.1 Passive Electrical and I&C Commodity Groups**

#### **6.1.1.1 Cables**

Power, as well as I&C cables and splices used in atmospheric conditions as well as buried ones (e.g., cooling water inlet building as well as conduits between buildings, e.g., from building 10 to 72), etc. are handled within this issue for all voltage levels. The insulation materials are subject to AMR for LTO.

Splices are used to connect cable conductors to penetration pigtails or to motor leads, and also to connect sections of cables due to repair or replacement. The electrical splices (insulation) review includes heat shrink tubing and insulation tape used for the insulation materials in electrical splices.

#### **6.1.1.2 Wires**

Wires can be outside or inside of components/cabinets. Examples are the wires on the cable spreaders in the spreader rooms (outside) or wires in I&C cabinets (inside). They are handled within this issue for all voltage levels. The insulation materials are subject to AMR for LTO.

Within the scope of screening a wire is defined as a single conductor with a single insulation.

#### **6.1.1.3 Connectors and Terminals**

Electrical connectors are used to connect the cable conductors to other cables or electrical devices or to the grounding system. Those connectors contain also terminal blocks, which consist of an insulation base with fixed metallic points for landing wires and cables (conductors). The insulating material portions as well as their electrical conductivity are under review for ageing management in this electrical commodity group.

Terminal Blocks are installed in enclosures (i.e., panels, control boards, motor control centers, terminal boxes, and junction boxes). Terminal blocks in passive enclosures are in scope of AMR. Within the Screening Process the three main types of connectors as compression, fusion, and plug-in (mated) connectors are identified. A brief description of each is provided below:

- **Compression Connectors: Fittings** (e.g., ring lugs or barrels) that are bolted, physically crimped or mechanically swaged to connect cable conductors. The bolted connections are used in metal enclosed bus, large fuses, and internal equipment connections.
- **Fusion Connectors:** Cable connections made by welding, brazing or soldering where permanence of the conductor connection is desired.
- **Plug-in (Mated) Connectors:** Connectors with one or more electrical contacts that plug or screw into a mating receptacle; useful where ease and frequency of separation of an electrical connection is desired, for ease of mating specific types of equipment and where multiple simultaneous electrical connections need to be made.

Fuse holders outside the Metal Enclosed Busses (battery fuse holders) in the scope of the screening process require also an AMR and are located in passive assemblies/enclosures. Those are considered as connectors and therefore handled within this scope.

The connector insulation material portions are various organic polymers subject to an AMR in this electrical commodity group as well as their electrical conductivity behavior.

#### **6.1.1.4 Electrical Penetrations (Containment/Annulus)**

Electrical penetration assemblies are provided as a means of passing electrical circuits through the containment building wall (while maintaining the integrity of the containment pressure barrier as a structural requirement).

### 6.1.1.5 Passive Structural Parts for Electrical and I&C

- Cable penetrations (through floors and walls) belong to this commodity group insofar as those needs to cover the function of "fire protection" or "tightness against ingress" (e.g., water, steam, etc.).

Further commodity groups relevant as structural parts for Electrical and I&C are:

- Cabinets, Racks, other Enclosures, and
- Cable Trays and tubes for cable routing / protection.

### 6.1.2 Active Electrical and I&C Commodity Groups

The following active commodity groups were identified, which are subject to LTO assessment according to the conceptual document [3]:

- **Power transformers**  
Including protection equipment, measuring devices, isolators, CTs, VTs, et cetera.
- **Power supply distribution systems**  
6 kV AC, 380 V AC, 220 V DC, 24V DC systems, including isolators, breakers, measuring transformers and transmitters, relays, protection relays, fuses, indication meters and lights, power supply decoupling, et cetera.
- **Battery chargers, static converters**  
220 V DC, 24 V DC.
- **Batteries**  
220 V DC, 24 V DC including isolators, fuses.
- **Rotating converters**  
Including controllers, measurement, indication, et cetera.
- **Generators/Motors**  
Emergency diesel generators, 6 kV AC-, 380 V AC-, 220 V AC-, 220 V DC motors.  
Electrical motors of actuators are part of CG "actuators".
- **Actuators**  
Including motor operated valves, solenoid drives.
- **Control circuits**  
Loop controllers including solid state devices, indicators, meters, et cetera.

- **Emergency diesel equipment**  
Including control circuits, protection relays, indicators, et cetera, and Pressure/Temperature/Frequency/Speed/Voltage sensors and transmitters are part of CG "instrumentation".
- **Instrumentation**  
Including process instrumentation (pressure, temperature, flow) sensors and transducers/transmitters, analyzers and monitors (e. g. radiation).
- **Panel assemblies**  
Main and emergency control room panels and emergency diesel panels including switches, indicating lights and meters, alarm equipment, recorders, et cetera.
- **Electrical heaters**  
Electrical heaters, heat tracing.
- **Electronic cabinets**  
Mainly cabinets in buildings 5, 10, 33, 35, 72 including fuses, surge arresters, solid state devices, power supply decoupling, et cetera.
- **Safety-relevant (class 1A) non-process systems**  
Communication systems, fire detection, lightning protection & earthing, et cetera.

## 6.2 Intended Functions of passive Commodity Groups for Electrical and I&C Structures and Components

The following table states the intended function(s) of the particular commodity group:

**Table 6: Intended Function(s) of Particular Commodity Group**

Commodity Group	Intended Function(s)
Cables	Insulation
Wires	Insulation
Electrical Connectors	Insulation, Conductivity
Electrical Containment Cable Penetrations	Insulation, Conductivity
Cable Penetration (floors, walls)	Protection, Support
Cabinets, Racks	Protection, Support
Cable Trays	Protection, Support

## 7. Summary and Recommendations

In 2013, the nuclear power plant Borssele will have been in operation for 40 years. It is planned to extend the plant's lifetime until 2034. In this context, EPZ is implementing a Long-Term Operation process in accordance with IAEA guidelines. The goal of this process is to demonstrate, in respect of possible physical ageing processes affecting Systems, Structures and Components (SSCs), that the plant can be safely operated until 2034. Among others, three essential steps required to perform the LTO assessment include:

- Step 1 - Scoping:

Identification of Systems, Structures and Components that are important to safety and that are classified as not important to safety but whose failure may impact SSCs important to safety. This step is referred to as scoping and the list of SSCs within the scope of LTO for KCB is reported in Reference [2].

- Step 2 - Screening:

Identification of active and passive structures and components and their intended functions that support the SSCs identified in Step 1. These structures and components are subject to further LTO assessment. Active and passive component commodity groups are defined in this document in terms of three disciplines:

- (1) Mechanical components,
- (2) Civil structures and components, and
- (3) Electrical and I&C components.

Active and passive structures and component commodity groups subject to further LTO assessment were identified for KCB by reviewing the SSCs within the scope of LTO from Reference [2]. The results of this screening review are contained in Chapters 4 through 6 of this document.

- Step 3 – LTO assessment:

The next step of the process is the performance of a detailed AMR with respect to LTO (i.e., identification as well as assessment of ageing effects and check/proposal for adaptation of ageing management programs) for the passive structures and components identified in Step 2 above and an assessment of active structures and components according to the conceptual document [3].

### **Mechanical**

Regarding passive structures and components an AMR will be performed for each mechanical system within the scope of LTO since the entire system contains passive long-lived commodity groups that are exposed to the same environment, operating conditions, testing, and in-service inspection requirements. Grouping of mechanical systems with similar operating environments is possible but needs to be studied in detail within the detailed AMR process. In general, AMR of passive components for the reactor coolant system is at a subcomponent level, for all other mechanical systems is typically at the component level. A review of plant and industry operating experience is used to confirm that all applicable ageing effects have been identified.

The assessment of active mechanical structures and components in scope of LTO should be performed separately from the AMR.

## **Civil**

Civil AMR for passive structures and components may be performed by evaluation of each building structure within the scope of LTO. The containment building assessment should typically be the most detailed. Building internal structures may be evaluated with the building or evaluated in a separate ageing management report. AMR commodity groups may be prepared for structural components such as supports for piping and components, instrument tubing, miscellaneous mechanical equipment, and masonry walls. A review of plant and industry operating experience will be used to confirm that all applicable ageing effects have been identified.

Active structures and components are limited to an assessment of snubbers, which should be performed separately from the AMR.

## **Electrical and I&C**

All in-scope passive electrical and I&C components require an assessment in the context of the AMR. The handling of commodity groups, on system level or by other criteria (e.g., for cables, cable trays, etc.) will be defined within this AMR after a detailed survey has been performed. Thereafter criteria should be established to identify ageing effects for these commodity groups. The materials of construction for the commodity groups may be available from plant data bases, plant environments should be identified as well as applicable ageing effects and ageing management programs. A review of plant and industry operating experience will be used to confirm that all applicable ageing effects have been identified. The commodity group evaluations may be contained in one or more reports.

Also for active electrical and I&C commodity groups identified in this report, an adequate LTO assessment should be performed.

## 8. References

- [1] Safety Reports Series No. 57, Safe Long Term Operation of Nuclear Power Plants, International Atomic Energy Agency, Oct 2008.
- [2] NEPS-G/2008/en/0056, Rev. B, Definition of the Scope of KCB Systems, Structures and Components to be taken into Consideration for the Long-Term Operation Process, AREVA NP, 27 Jul 2011.
- [3] NRG-22701/10.103460, Conceptual Document LTO “Bewijsvoering” KCB, Nuclear Research & Consultancy Group, Sep 2011.
- [4] 10 CFR Part 54, Requirements for Renewal of Operating Licenses for Nuclear Power Plants, U.S. Nuclear Regulatory Commission, Dec 2010
- [5] 10 CFR 50.65, Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants, U.S. Nuclear Regulatory Commission, Jul 2011
- [6] NEI 95-10, Rev. 6, Industry Guidelines for Implementing the Requirements of 10 CFR Part 54 – The License Renewal Rule, Nuclear Energy Institute, Jun 2005.

### Appendix 1: List of Commodity Groups

List of Commodity Groups (CGs) using NEI-95-10, Attachment B as a guideline.

Note: Items in italics are changes to NEI-95-10 Attachment B made for the KCB.

Miscellaneous process components can be either mechanical or structural commodity groups.

For electrical and I&C SSCs an additional column is inserted, if and how commodity groups have been combined for the screening tables in Appendix 2.

**Table 7: List of Electrical and I&C passive / active Commodity Groups using NEI-95-10, Attachment B as a Guideline**

Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity is Active / Passive	Further processed in Commodity Group
Electrical and I&C	Penetration Seals	Passive	Cable Penetration (floors, walls)
Electrical and I&C	Electrical and Instrumentation and Control Penetration Assemblies	Passive	Electrical Penetrations (Containment)
Electrical and I&C	Instrumentation Racks, Frames, Panels, and Enclosures	Passive	Racks, Cabinets
Electrical and I&C	Electrical Panels, Racks, Cabinets, and Other Enclosures	Passive	Racks, Cabinets
Electrical and I&C	Cable Trays and Supports	Passive	Cable Trays
Electrical and I&C	Tube Track	Passive	Cable Protections
Electrical and I&C	Alarm Unit (e.g., fire detection devices)	Active	Safety-relevant (class 1A) non-process systems
Electrical and I&C	Analyzers (e.g., gas analyzers, conductivity analyzers)	Active	Instrumentation
Electrical and I&C	Annunciators (e.g., lights, buzzers, alarms)	Active	included in diverse other CGs
Electrical and I&C	Batteries	Active	Batteries

Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity is Active / Passive	Further processed in Commodity Group
Electrical and I&C	Cables and Connections, Bus, electrical portions of Electrical and I&C Penetration Assemblies, Includes fuse holders outside of cabinets of active electrical structures and components (e.g., electrical penetration assembly cables and connections, connectors, electrical splices, terminal blocks, power cables, control cables, instrument cables, insulated cables, communication cables, un-insulated ground conductors, transmission conductors, isolated-phase bus, non segregated-phase bus, segregated-phase bus, switchyard bus)	Passive	Cables and Wires Electrical Connectors
Electrical and I&C	Chargers, Converters, Inverters (e.g., converters-voltage/current, converters voltage/pneumatic, battery chargers/inverters, motor-generator sets)	Active	Battery chargers, static converters Rotating converters
Electrical and I&C	Circuit Breakers (e.g., air circuit breakers, molded case circuit breakers, oil-filled circuit breakers)	Active	Power supply distribution systems
Electrical and I&C	Communication Equipment (e.g., telephones, video or audio recording or playback equipment, intercoms, computer terminals, electronic messaging, radios, transmission line traps and other power-line carrier equipment)	Active	Safety-relevant (class 1A) non-process systems
Electrical and I&C	Electric Heaters	Active, Passive (for Pressure Boundary if applicable)	Electric Heaters



Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity is Active / Passive	Further processed in Commodity Group
Electrical and I&C	Heat Tracing	Active	Electric Heaters
Electrical and I&C	Electrical Controls and Panel Internal Component Assemblies (may include internal devices such as, but not limited to, switches, breakers, indicating lights, fuse holders, etc.) (e.g., main control board, HVAC control board)	Active	Panel Assemblies Electronic cabinets
Electrical and I&C	Elements, RTDs, Sensors, Thermocouples, Transducers (e.g., conductivity elements, flow elements, temperature sensors, radiation sensors, watt transducers, thermocouples, RTDs, vibration probes, amp transducers, frequency transducers, power factor transducers, speed transducers, var. transducers, vibration transducers, voltage transducers)	Active Passive (for pressure Boundary if applicable)	Instrumentation
Electrical and I&C	Fuses	Active	included in diverse other CGs
Electrical and I&C	Generators, Motors (e.g., emergency diesel generators, ECCS and emergency service water pump motors, small motors, motor-generator sets, steam turbine generators, combustion turbine generators, fan motors, pump motors, valve motors, air compressor motors)	Active	Generators/Motors Actuators
Electrical and I&C	High-voltage Insulators (e.g., porcelain switchyard insulators, transmission line insulators)	Active	<i>non-safety</i>
Electrical and I&C	Surge Arresters (e.g., switchyard surge arresters, lightning arresters, surge	Active	Safety-relevant (class 1A) non-process systems

Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity is Active / Passive	Further processed in Commodity Group
	suppressers, surge capacitors, protective capacitors)		
Electrical and I&C	Indicators (e.g., differential pressure indicators, pressure indicators, flow indicators, level indicators, speed indicators, temperature indicators, analog indicators, digital indicators, LED bar graph indicators, LCD indicators)	Active	included in diverse other CGs
Electrical and I&C	Isolators (e.g., transformer isolators, optical isolators, isolation relays, isolating transfer diodes)	Active	included in diverse other CGs
Electrical and I&C	Light Bulbs (e.g., indicating lights, emergency lighting, incandescent light bulbs, fluorescent light bulbs)	Active	Safety-relevant (class 1A) non-process systems
Electrical and I&C	Loop Controllers (e.g., differential pressure indicating controllers, flow indicating controllers, temperature controllers, controllers, speed controllers, programmable logic controller, single loop digital controller, process controllers, manual loader, selector station, hand/auto station, auto/manual station)	Active	Control circuits
Electrical and I&C	Meters (e.g., ammeters, volt meters, frequency meters, var. meters, watt meters, power factor meters, watt-hour meters)	Active	included in diverse other CGs
Electrical and I&C	Power Supplies	Active	Power supply distribution systems
Electrical and I&C	Radiation Monitors (e.g., area radiation monitors, process radiation monitors)	Active	included in diverse other CGs
Electrical and I&C	Recorders (e.g., chart recorders, digital recorders, events recorders)	Active	non-safety

Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity is Active / Passive	Further processed in Commodity Group
Electrical and I&C	Regulators (e.g., voltage regulators)	Active	Control circuits
Electrical and I&C	Relays (e.g., protective relays, control/logic relays, auxiliary relays)	Active	included in diverse other CGs
Electrical and I&C	Signal Conditioners	Active	Instrumentation
Electrical and I&C	Solenoid Operators	Active	Actuators
Electrical and I&C	Solid-State Devices (e.g., transistors, circuit boards, computers)	Active	included in diverse other CGs
Electrical and I&C	Switches (e.g., differential pressure indicating switches, differential pressure switches, pressure indicator switches, pressure switches, flow switches, conductivity switches, level indicating switches, temperature indicating switches, temperature switches, moisture switches, position switches, vibration switches, level switches, control switches, automatic transfer switches, manual transfer switches, manual disconnect switches, current switches, limit switches, knife switches)	Active	included in diverse other CGs
Electrical and I&C	Switchgear, Load Centers, Motor Control Centers, Distribution Panel Internal Component Assemblies (may include internal devices such as, but not limited to switches, breakers, indicating lights, etc.)(e.g., 4.16 kV switchgear, 480V load centers, 480V motor control centers, 250 VDC motor control centers, 6.9 kV switchgear units, 240/125V power distribution panels)	Active	Power supply distribution systems
Electrical and I&C	Transformers (e.g., instrument transformers,	Active	Power transformers / included in diverse

Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity is Active / Passive	Further processed in Commodity Group
	load center transformers, small distribution transformers, large power transformers, isolation transformers, coupling capacitor voltage transformers)		other CGs
Electrical and I&C	Transmitters (e.g., differential pressure transmitters, pressure transmitters, flow transmitters, level transmitters, radiation transmitters, static pressure transmitters)	Active	Instrumentation
Emergency Diesel Generators	Emergency Diesel Generators	Active	Generators/Motors
			Emergency diesel equipment

**Table 8: List of Mechanical and Structural passive / active Commodity Groups using NEI-95-10, Attachment B as a Guideline**

Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity is Active / Passive	Further processed in Commodity Group
Fans	Ventilation Fans (includes intake fans, exhaust fans, and purge fans)	Active / Passive (Housings)	Fans
Fans	Other Fans	Active / Passive (Housings)	Fans
Heat Exchangers	Condensers	Passive	Heat Exchangers
Heat Exchangers	HVAC Coolers (including housings)	Passive	Heat Exchangers
Heat Exchangers	Primary Water System Heat Exchangers	Passive	Heat Exchangers
Heat Exchangers	Treated Water System Heat Exchangers	Passive	Heat Exchangers
Heat Exchangers	Closed Cooling Water System Heat Exchangers	Passive	Heat Exchangers
Heat Exchangers	Lubricating Oil System Heat Exchangers	Passive	Heat Exchangers
Heat Exchangers	Raw Water System Heat Exchangers	Passive	Heat Exchangers
Heat Exchangers	Containment Atmospheric System Heat Exchangers	Passive	Heat Exchangers
<i>Miscellaneous Process Components</i>	Structural Bellows	Passive	Expansion Bellows / Joints
<i>Miscellaneous Process Components</i>	Reactor Vessel Internals	Passive	handled as system
<i>Miscellaneous Process Components</i>	ASME Class 1 Hangers and Supports	Passive	Hangers and Supports
<i>Miscellaneous Process Components</i>	Non-ASME Class 1 Hangers and Supports	Passive	Hangers and Supports
Miscellaneous Process Components	Recombiners	Passive	Tanks
Miscellaneous Process Components	Flexible Connectors	Passive	Flexible Connections
Miscellaneous Process	Strainers	Passive	Filters / Strainers

Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity is Active / Passive	Further processed in Commodity Group
Components			
Miscellaneous Process Components	Rupture Disks	Passive	Rupture Disks
Miscellaneous Process Components	Steam Traps	Passive	Valves
Miscellaneous Process Components	Restricting Orifices	Passive	Restricting Orifices
Miscellaneous Process Components	Air Compressor	Active	Fans
Non-Class I Piping Components	Underground Piping	Passive	Piping
Non-Class I Piping Components	<i>Piping</i>	Passive	Piping
Non-Class I Piping Components	Instrument Tubing	Passive	Instrumentation Tubing
Non-Class I Piping Components	Expansion Joints	Passive	Expansion Bellows / Joints
Non-Class I Piping Components	Ductwork	Passive	Ductwork
Non-Class I Piping Components	Sprinklers Heads	Passive	Piping
Non-Class I Piping Components	Miscellaneous Appurtenances (Includes fittings, couplings, reducers, elbows, thermowells, flanges, fasteners, welded attachments, etc.)	Passive	Piping
Pumps	ECCS Pumps	Active / Passive (Casing)	Pumps
Pumps	Service Water and Fire Pumps	Active / Passive (Casing)	Pumps
Pumps	Lube Oil and Closed Cooling Water Pumps	Active / Passive (Casing)	Pumps
Pumps	Condensate Pumps	Active / Passive (Casing)	Pumps
Pumps	Borated Water Pumps	Active / Passive (Casing)	Pumps
Pumps	Emergency Service Water Pumps	Active / Passive (Casing)	Pumps

Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity is Active / Passive	Further processed in Commodity Group
Pumps	Submersible Pumps	Active / Passive (Casing)	Pumps
Reactor Coolant Pressure Boundary Components	Steam Generators	Passive	Separately addressed
Reactor Coolant Pressure Boundary Components	Reactor Vessel	Passive	Separately addressed
Reactor Coolant Pressure Boundary Components	Reactor Coolant Pumps	Active / Passive (Casing)	Separately addressed
Reactor Coolant Pressure Boundary Components	Control Rod Drives	Active	Control Rod Drives
Reactor Coolant Pressure Boundary Components	Control Rod Drive Housing	Passive	Separately addressed
Reactor Coolant Pressure Boundary Components	Pressurizer	Passive	Separately addressed
Reactor Coolant Pressure Boundary Components (Note: the components of the MCPB are defined by each plant's CLB and site specific documentation.	ASME Class 1 Piping	Passive	Separately addressed
Structures	Category I Structures	Passive	Buildings
Structures	Primary Containment Structure	Passive	Separately addressed
Structures	Intake Structures	Passive	Buildings
Structures	Intake Canal	Passive	Buildings
Structures	Other Non-Category I Structures Within the Scope	Passive	Buildings

Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity is Active / Passive	Further processed in Commodity Group
	of LTO		
Structures	Equipment Supports and Foundations	Passive	Supports and Hangers
Structures	Compressible Joints and Seals	Passive	Buildings
Structures	Fuel Pool and Sump Liners	Passive	Tank (mechanical)
Structures	Concrete Curbs	Passive	Building
Structures	Offgas Stack and Flue	Passive	Building
Structures	Fire Barriers	Passive	Fire Barriers
Structures	Pipe Whip Restraints	Passive	Supports and Hangers
Structures	Conduit	Passive	Pipe and Cable ducts
Structures	Snubbers	Active	Snubbers
Tanks	Air Accumulators	Passive	Tanks
Tanks	Discharge Accumulators (Dampers)	Passive	Tanks
Tanks	Boron Acid Storage Tanks	Passive	Tanks
Tanks	Above Ground Oil Tanks	Passive	Tanks
Tanks	Demineralized Water Tanks	Passive	Tanks
Tanks	Neutron Shield Tank	Passive	Tanks
Turbines	Turbine Pump Drives (excluding pumps)	Active / Passive (Casing)	Turbines
Turbines	Controls (Actuator and Overspeed Trip)	Active	Turbines
Valves	Hydraulic Operated Valves	Active / Passive (Bodies)	Valves
Valves	Explosive Valves	Active / Passive (Bodies)	Valves
Valves	Manual Valves	Active / Passive (Bodies)	Valves
Valves	Small Valves	Active / Passive (Bodies)	Valves
Valves	Motor-Operated Valves	Active / Passive (Bodies)	Valves
Valves	Air-Operated Valves	Active / Passive (Bodies)	Valves
Valves	Main Steam Isolation Valves	Active / Passive (Bodies)	Valves
Valves	Small Relief Valves	Active / Passive (Bodies)	Valves
Valves	Check Valves	Active / Passive	Valves



Category	Structure, Component, or Commodity Grouping	Structure, Component, or Commodity is Active / Passive	Further processed in Commodity Group
		(Bodies)	
Valves	Safety Relief Valves	Active / Passive (Bodies)	Valves
Valves	Dampers, louvers, and gravity dampers	Active / Passive (Housings)	Dampers





























