Eskom	Report	Nuclear Engineering

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1.0 INTRODUCTION

Long-term operation (LTO) of a nuclear power plant is defined as operation beyond an established time frame set forth by licence terms, design bases, standards, or regulations that have been justified by means of a safety assessment with extensive consideration given to life-limiting processes and features of systems, structures, and components (SSCs). Effective and safe LTO is based on the experience and practices of various countries that have embarked upon ventures such as plant licence renewal, life extension, continued operation, and plant life management. This includes activities relevant to LTO such as, but not limited to, periodic safety review, ageing management, and plant modification.

Eskom intends to operate Koeberg Nuclear Power Station (KNPS) beyond its initial design life of 40 years to an anticipated life of 60 years. This endeavour is to be achieved through several overlapping interventions. One of these interventions is the safety assessment for long-term operation (SALTO) project to assess ageing management. Other LTO initiatives are the third periodic safety review (SRA-III) and certain hardware modifications.

2.0 SUPPORTING CLAUSES

2.1 SCOPE

2.1.1 Purpose

This document is termed the “advance information package” (AIP) and used to convey relevant administrative, operational, and technical information to the IAEA SALTO team members in preparation for a review of the Koeberg Nuclear Power Station.

2.1.2 Applicability

This document shall apply to the IAEA SALTO peer review mission to Koeberg Nuclear Power Station during January 2022.

2.1.3 Effective Date

The document is effective from the authorisation date.

2.2 REFERENCES

Refer to Appendix G.

2.3 DEFINITIONS

Refer to Appendix H.

2.4 ABBREVIATIONS AND ACRONYMS

Refer to Appendix I.

3.0 ADMINISTRATIVE INFORMATION

3.1 ARRIVAL LOGISTICS (AIRPORT TO HOTEL TO PLANT)

All team members should arrive at the Cape Town International Airport on Monday, 17 January 2022, by 17:00 latest. Team members should plan for arrival at the Koeberg plant at 08:00 daily. The itinerary of all team members should be provided to Koeberg in advance.

3.2 TRANSPORTATION (AIRPORT TO HOTEL TO PLANT)

A shuttle will be assigned for the transportation of the team members from the airport to the hotel and from the hotel to the plant for the duration of the SALTO mission. Upon arrival at the Cape Town International Airport, the team members will be met by the Eskom SALTO lead person and the shuttle driver from Boost Shuttles and Tours, who will be displaying a poster with International Atomic Energy Agency (IAEA) signage. Upon completion of the mission on Thursday, 27 January 2022, Boost Shuttles and Tours will be transporting all team members back to Cape Town International Airport. The team members should plan to depart from Cape Town International Airport by 15:00 or later.

3.3 HOTEL ACCOMMODATION INFORMATION

All team members will be accommodated at The Atlantic Beach Hotel located in Melkbosstrand. The hotel provides a complimentary Wi-Fi service. The hotel is situated approximately 30 kilometres from the airport and 5 kilometres from the plant.

The hotel address and contact details are as follows:

The Atlantic Beach Hotel

Corner of Commaille Rd & 13th Ave,
Melkbosstrand,
7437,
South Africa

Phone: +27 21 553 1800

Email: res@AtlanticBeachHotel.co.za

www.AtlanticBeachHotel.co.za

3.4 CONTACT POINTS AT THE PLANT AND LISTS OF THE COUNTERPARTS

3.4.1 Eskom Host Plant Peer

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3.4.2 Contact Person at the Plant

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3.4.3 Eskom SALTO Counterparts

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3.5 LIST OF IAEA TEAM MEMBERS

3.5.1 IAEA Team Leads

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Deputy Team Leader

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3.5.2 IAEA Reviewers

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3.5.3 IAEA Observers

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PAIA 37 Redacted information provides personal information

A summary table of all the mission team members and their respective counterparts is provided in Appendix K.

3.6 TENTATIVE MISSION SCHEDULE

Below is the tentative mission schedule as agreed at the preparatory meeting.

Day/Date	Time	Activity
Day 1, Monday, 17 January	PM	Arrival of team members at the Cape Town International Airport on Monday, 17 January 2022, before 17:00. 17:30: Transportation from the airport to the hotel 19:30: IAEA team briefing at the hotel, preparatory activities
Day 2, Tuesday, 18 January	AM	07:40: Departure from the hotel 08:00 – 09:00: Entrance procedure at the plant 09:00: – 12:30 IAEA team training Lunch at the plant
	PM	14:00 – 15:30: Entrance meeting Opening of the mission – host plant peer – 5 minutes NPP expectations – plant manager – 5 minutes Regulatory authority expectations – 5 minutes Objective and schedule – team leader – 10 minutes Introduction of participants – both sides – 5 minutes Methodology of review – team leader – 30 minutes LTO activities – host plant peer – 30 minutes 16:00 – 18:00: Initial sessions in review areas – general presentations of counterparts, planning with counterparts 18:00: Departure to the hotel 19:00: Official dinner with counterparts
Day 3, Wednesday, 19 January	AM	07:40: Departure from the hotel 08:00 – 12:00: Parallel sessions in review areas – interview and discussion 11:00 – 11:30: Information meeting of PM and TL
	PM	13:00 – 16:00: Parallel sessions in review areas – interview and discussion 16:00 – 16:30: Debrief with counterpart 16:30 – 16:55: Preparation for team meeting 17:00 – 17:50: Team Meeting with host plant peer 18:00: Departure to the hotel
Day 4, Thursday, 20 January	AM	07:40: Departure from the hotel 08:00 – 12:00: Parallel sessions in review areas – interview and discussion 11:00 – 11:30: Information meeting of PM and TL
	PM	13:00 – 16:00: Parallel sessions in review areas – interview and discussion 16:00 – 16:30: Debrief with counterpart 16:30 – 16:55: Preparation for team meeting 17:00 – 17:50: Team Meeting with host plant peer 18:00: Departure to the hotel
Day 5, Friday, 21 January	AM	07:40: Departure from the hotel 08:00 – 12:00: Parallel sessions in review areas – interview and discussion 11:00 – 11:30: Information meeting of PM and TL
	PM	13:00 – 16:00: Parallel sessions in review areas – interview and discussion 16:00 – 16:30: Debrief with counterpart 16:30 – 16:55: Preparation for team meeting 17:00 – 17:50: Team Meeting with host plant peer 18:00: Departure to the hotel 20:00: Team training in the hotel – development of issues and good practices

Day/Date	Time	Activity
Day 6, Saturday, 22 January		Free day – social activity organized by the plant
Day 7, Sunday, 23 January	AM	08:00 – 11:00: Team meeting in the hotel - discussion of potential issues and good practices 11:00 – 12:00: Team training in the hotel – development of an evaluative section of the report
	PM	13:00 – 18:00: Drafting of Working Notes, issues, good practices and evaluative section of the report – bilateral discussions with TL
Day 8, Monday, 24 January	AM	07:40: Departure from the hotel 08:00 – 12:00: Parallel sessions in review areas – interview and discussion 11:00 – 11:30: Information meeting of PM and TL
	PM	13:30 – 16:30: Parallel sessions in review areas – interview and discussion 16:30 – 17:00: Debrief with counterpart 17:00 – 17:25: Preparation for team meeting 17:30 – 18:20: Team Meeting with host plant peer 18:30: Departure to the hotel
Day 9, Tuesday, 25 January	AM	07:40: Departure from the hotel 08:00 – 12:00: Parallel sessions in review areas – interview and discussion 11:00 – 11:30: Information meeting of PM and TL
	PM	13:00 – 16:00: Preparing draft issues and evaluative part of the report 16:00 – 16:30: Debrief with counterpart 16:30 – 16:55: Preparation for team meeting 17:00 – 17:50: Team Meeting with host plant peer 18:00: Departure to the hotel 20:00: Send issues to the IAEA for 'cold body review' 20:00: Team training in the hotel - exit speeches Consultation with TL and DTL in the hotel – development of issues, good practices and evaluative section of the report
Day 10, Wednesday, 26 January	AM	07:40: Departure from the hotel 08:00 – 12:00: Team meeting with host plant peer – issues, good practices and evaluative section of report presentation, discussion and agreement by the team, counterparts review the issues, good practices and evaluative section of report simultaneously
	PM	13:00 Draft press release for comments 13:00 Response from "cold body review" 13:00 – 15:00 Discussion of issues, good practices and evaluative part of the report with counterparts 13:30 – 14:15 Information meeting of PM and TL 14:30 – 15:15 TL Debriefing with regulatory authority 15:00 – 16:00 Revision of the draft issues based on counterpart's comments 16:00 – 17:00 Agree on the issues, good practices and evaluative section of the report with counterparts 17:00 Deadline for any changes in the draft report 17:00 – 18:00 Preparation of exit meeting speeches 18:00 Departure to the hotel 19:00 Official farewell dinner

Day/Date	Time	Activity
Day 11, Thursday, 27 January	AM	08:40 Departure from the hotel 09:00 – 09:45 Rehearsal of exit meeting speeches, “cleaning” of offices 10:00 – 11:00 Exit meeting - (including plant management) Opening by the host plant peer Description of Mission scope - deputy team leader - 4 minutes Detailed findings (each reviewer) – (6x5) 30 minutes Observers remarks and lesson learned: (4x2) 8 minutes Main finding and conclusions - team leader - 5 minutes Regulatory authority speech - 5 minutes Host plant peer’s remark (comparison against initial expectation) - 5 minutes Speech by a plant manager- 5 minutes Closing by the plant manager
	PM	12:00 Transportation of the team to the airport organized by counterpart. Departure of team members from Cape Town International Airport after 15:30

NOTE: Plant walk-downs will be organised as optional for reviewers based on their requests.

3.7 Site Accommodation

3.7.1 Site Access Control

IAEA team members who may require access for the site walk-downs, i.e. beyond access control point 2 (ACP-2), must submit their details to Eskom so that arrangements can be made to ensure access is granted by the time the team arrives on site. Close liaison with the Eskom counterparts will ensure that the required site walk-downs are well planned within the allowable timeframe stipulated in the Eskom site visitor requirements.

For site access, team members will access the plant as fully escorted visitors, i.e. no plant induction training, area access training, or medical examinations are required; only passports are required. The security permit and access application form (KFS-SK-003) will be completed for all team members and submitted to Security at ACP-1. Members will sign the forms on the day of arrival to get their temporary permits for plant access.

For entry into controlled zones, team members will have to apply to enter as an RP special person; a special person controlled zone pass form (KFH-HP-100) must be completed. Passports, medical certificates, and dose records information are required for the completion of this application form.

Authorized SALTO technical team members will be assigned to escort IAEA team members to the required areas. Members will have to comply with security and alcohol/drugs screening before entering the site.

3.7.2 Meeting Rooms

Opening and closing meetings will be held at the Visitors Centre at Koeberg Nuclear Power Station. The rest of the mission meeting and engagement rooms will be at the Conservation Centre.

The meeting rooms are equipped with the following:

- Tables
- Chairs
- Whiteboards
- Paper board
- Projector
- Telephone facilities for team lead officer
- Wifi
- Additional PC screen

The hotel will also have a meeting room for the IAEA team during the evenings with similar facilities.

3.7.3 Office

The SALTO office is equipped with the following:

- Tables
- Chairs
- Whiteboards
- Paper board
- Projector
- Telephone facilities
- Wifi

3.7.4 Clerical Support

The plant will provide clerical support for the SALTO team during the mission.

3.7.5 Lunch Arrangements

Lunch will be provided at the plant.

3.7.6 Plant Access Requirements

To provide an escorted access facility to KNPS, the SALTO team members are required to submit copies of the following documents two weeks before arrival:

- Passport
- Physical address

3.7.7 Summary of Site-Specific Radiological, Industrial and Fire Safety Rules, and Emergency Response Provisions

Koeberg has a fully trained 24-hour standby emergency response team available to respond to various types of emergencies. This team controls the various aspects of an emergency from the Koeberg Emergency Control Centre, situated in the basement of Access Control Point 2 (ACP-2). The following alarm tones are used for the different types of emergencies:

- •The nuclear alarm will only be sounded in the event of a radiological emergency. It sounds like a slow, rising whoop sound.
- The fire alarm sounds like a two-tone, high-low sound and will be sounded in a medical emergency or a fire.
- The all-clear alarm is a repeated gong sound and indicates the termination of the emergency.

It is important to note that, while on site, you are required to be accompanied by the host at all times for the duration of the mission.

4.0 GENERAL INFORMATION

4.1 DESCRIPTION OF THE NUCLEAR POWER PLANT (NPP)

4.1.1 Overall Site, Plant Description and Units to be reviewed

Koeberg Nuclear Power Station (KNPS) is located on the Duynefontein site, approximately 30 km north of Cape Town in the Western Cape (refer to Figure 2). The KNPS site installation measures 1 275 ha in extent, stretching 4,4 km along the coast and 2,5 km inland. The surrounding area, also owned by Eskom, measures 2 820 ha and was proclaimed as the Koeberg Nature Reserve in 1991.

The two units to be reviewed at the power station each consists of a three-loop pressurised water reactor (PWR) system designed to produce 2 775 MWt (megawatt thermal). Each unit is designed for a net output of 921,5 MWe (megawatt electrical). Koeberg is similar to the units of the French CP1 fleet. The reference plant for the nuclear island is Tricastin unit 1.

The two reactors, designed and constructed by Framatome, are located in a containment building with shared nuclear auxiliary and electrical buildings. Directly in front of the reactor building (seawards) is the cooling water pump house. Both turbo-generator sets are in the common turbine hall, situated alongside the electrical building on the landward side of the 56 m high (above terrace level) reactor buildings in Figure 3.

KNPS has the following characteristics:

- a nuclear island consisting of two reactor buildings (each housing an NSSS);
- two fuel buildings;
- a nuclear auxiliary building is shared by both units housing the auxiliaries necessary for unit operation and safety as well as systems common to both units;
- a shared turbine building housing two turbine generators and their auxiliaries;
- five diesel generator buildings, each housing one emergency diesel generator, two are assigned to each unit, and one can be assigned to either unit;
- a shared electrical building for high, medium, and low-voltage supply and control systems;
- one pumping station for the conventional island cooling water;
- one pumping station for the nuclear island cooling water;
- two condensate polishing plants and a water treatment building;
- a separate building that houses two station black-out diesel generator sets;
- miscellaneous buildings for auxiliary equipment and services;
- workshops and service buildings;

- administrative buildings.

4.1.2 Brief Operating History of the Plant

Construction of KNPS began in 1976, and unit 1 was synchronised to the grid on 4 April 1984, with unit 2 following on 25 July 1985. The station's two reactors supply approximately 4,4% of South Africa's electricity needs and ensure a reliable electricity supply to the Western Cape in South Africa. At the end of September 2021, KNPS had produced 447 255,77 GWh (Gigawatt hours) of electricity since 1984. It has safely operated continuously for over 35 years, only suspending operation for refuelling and maintenance outages.

The station was designed to operate for 40 years, and the life extension plans are currently underway to extend Koeberg's operational life by an additional 20 years.

During this period, significant milestones and events include two periodic safety reviews (a third is in progress), a post-Fukushima stress test review, two OSART reviews, regular two- or three-yearly WANO peer reviews, and continued safety improvements and modifications.

4.1.3 Outline of the Operating Licence

Koeberg was designed and built by a French consortium, with the NSSS designed by Framatome under licence from Westinghouse, using the codes, standards, and general requirements applicable in France. Framatome compiled the initial safety analysis report (SAR) for Koeberg, and the operating technical specifications (OTS) were based on EDF practice.

The NNR issued the initial operating licence for Koeberg, which included both a risked-based criterion and many detailed safety-related Eskom documents (for example, specific SAR chapters, OTS, radiation protection, and operating procedures, lists of mandatory maintenance tasks), which were then classified as "licence binding".

Neither the licensing authority nor Eskom prescribed alignment to any particular international set of regulations, codes, and standards. For example, the ISI programme was selected to be based on the ASME XI code and has remained aligned to ASME XI, while many of the plant maintenance and integrity practices have remained closely linked to that of EDF.

The distinguishing feature of the early Koeberg licensing basis was probabilistic safety analysis (PSA) to analyse the plant and demonstrate compliance with nuclear licensing risk criteria.

At the time of the design and construction of the Koeberg power plant, the NSSS and other safety-related equipment were designed to ASME III and built according to French industry standards, referred to as Cahier des Prescriptions de Fabrication et de Contrôle.

4.1.4 Current Organisational Charts of the Utility / Plant

One of Eskom's mandates is to provide electricity in an efficient and sustainable manner, including generation, transmission, and distribution. To fulfil this mandate, Eskom generates electricity from a fleet of operating units (power plants). Koeberg is the only nuclear power plant within the Eskom fleet. Figure 1 depicts the organogram of the Koeberg Nuclear Power Plant and Nuclear Engineering business unit within the Generation Division of Eskom, and Figure 2 shows the distribution of Eskom's power stations.

Nuclear Engineering, as part of the Nuclear Operating Unit, is responsible for the establishment and maintenance of the Eskom nuclear asset design and safety basis, to monitor and support the utilisation of the assets in line with the design and safety basis, and to optimise the nuclear asset design in partnership with the operator. Within Nuclear Engineering, the Koeberg Engineering department leads the Koeberg long-term operation programme and executes the safety aspects of long-term operation (SALTO) assessment project.

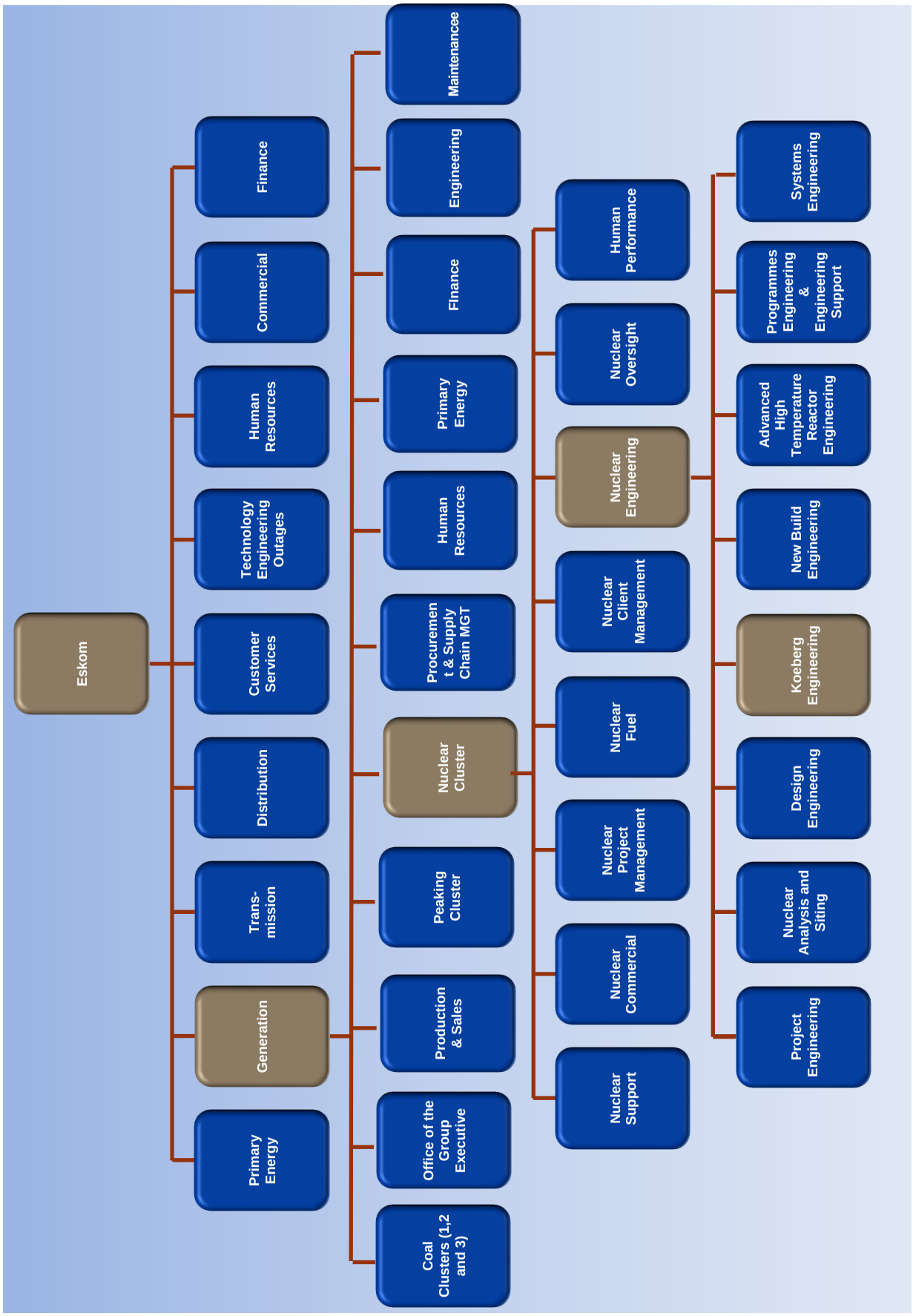

Figure 1: Eskom structure

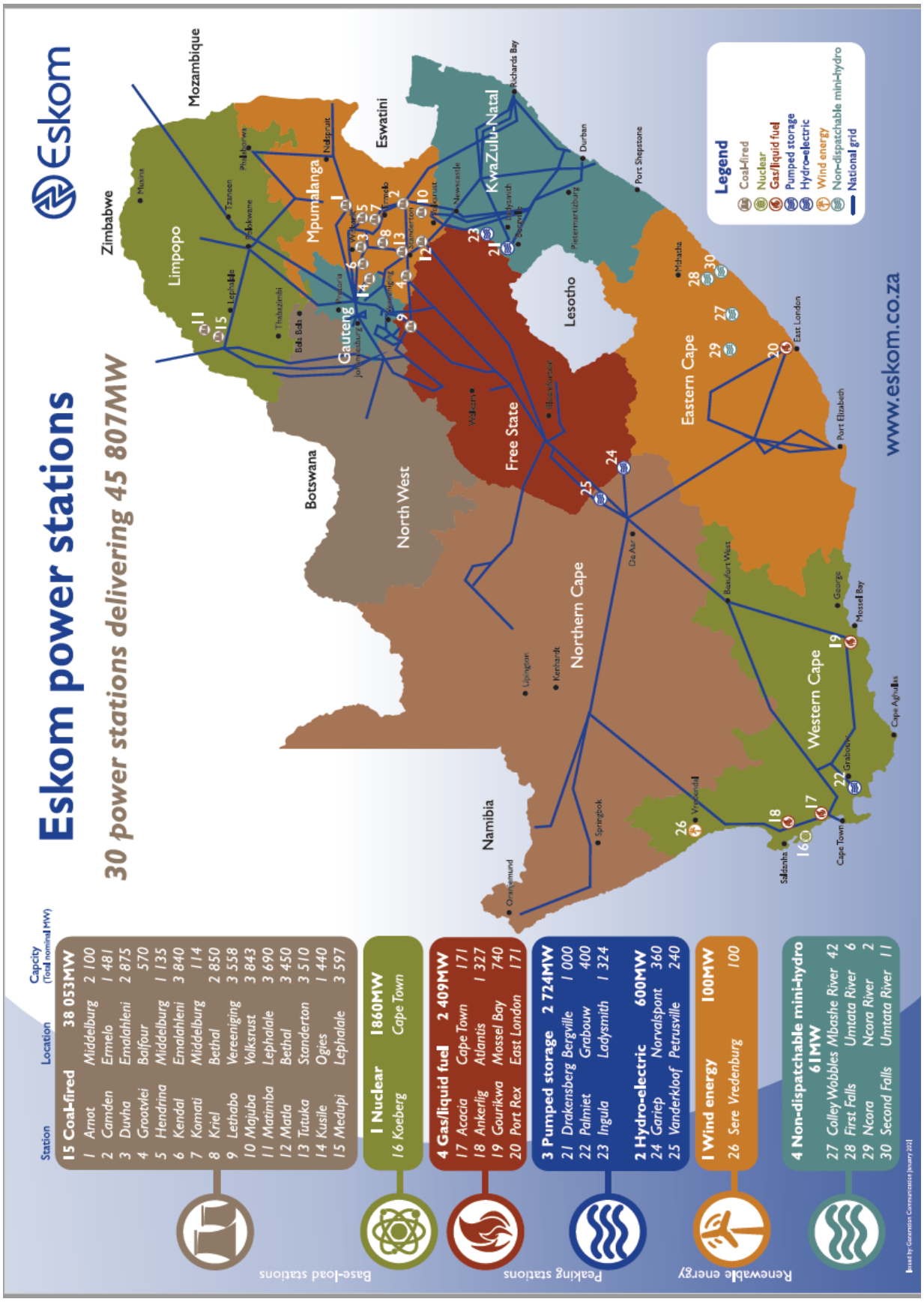

Figure 2: Eskom power stations

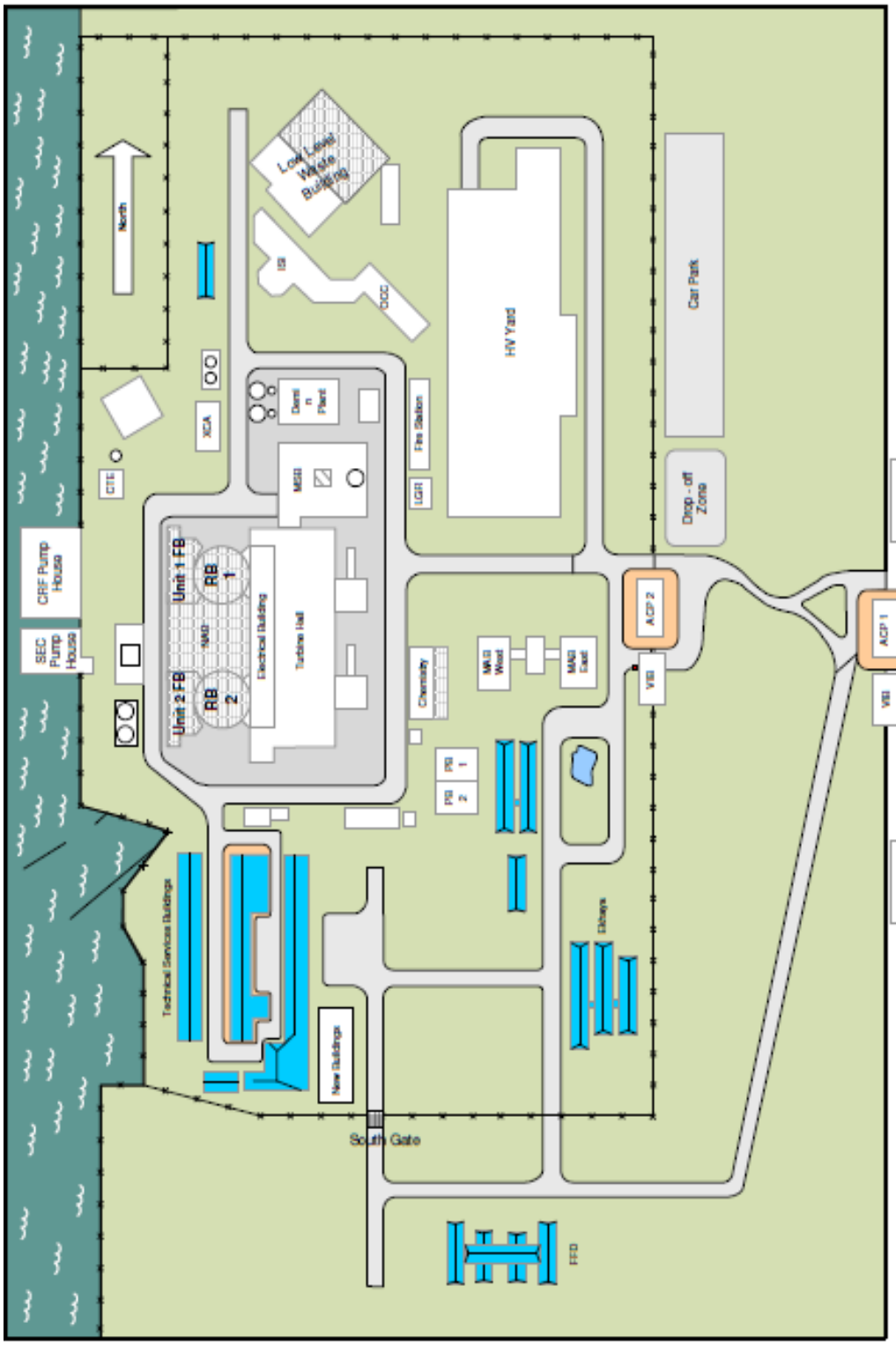

Figure 3: Koeberg plant layout schematic

Figure 4: Koeberg Power Station aerial view

4.1.5 List of Abbreviations and Acronyms Used in the Plant

See Appendix I.

4.1.6 Plant Colour Coding System Identification and Labelling System

Each component identification code has five groups of characters as follows:

- The second and third groups are sufficient for the identification of a main system. The main plant and system groups together form a trigram, in the example below being “RCV”. The last two letters are combined to form a bigram, which identifies a specific plant component, in the example below being “MN”. The five groups together identify a unique item of equipment within the main system.
- Components are always identified by their trigrams and bigrams. A complete list of all the trigrams can be found in KBA 00 00 G00 032 (List of Systems) and the bigrams in KBA 00 00 G00 036 (Equipment Identification System).

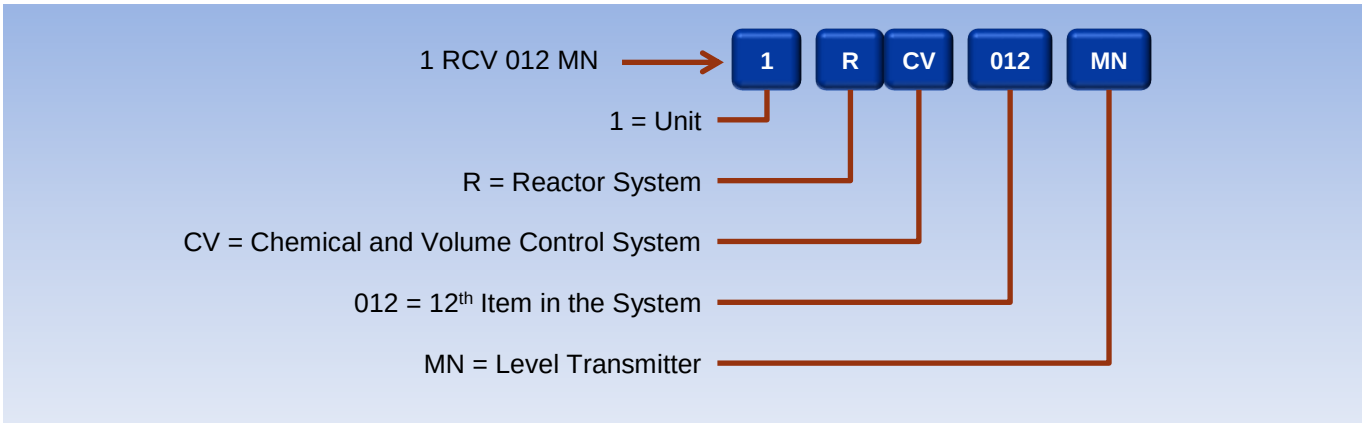

Figure 5: Plant labelling system

Specific colours denote the content of the pipes at Koeberg.

Pipe Contents	Colour	
Acids and alkalis	Violet	
Air	Light blue	
Gases other than air	Yellow ochre	
Fire	Red	
Oils and combustible liquids	Brown	
Steam	Silver-grey	
Waste effluents	Black	
Water	Green	

Radiation	*Colour*	*General Area (GA)*	*Actions*
	Green	Less than 25 µSv/h	Areas are open for Radiation Workers. If intrusive work to be done. Contact RP.
	Yellow	Equal to or greater than 25 µSv/h and is less than 1000 µSv/h	
	Orange	Equal to or greater than 1000 µSv/h and is less than 10000 µSv/h.	Any work performed inside on orange zone will be supervised by RP.
	Red	Equal to or greater than 10 000 µSv/h	Red zones are always kept locked. An RP Monitor MUST accompany you at all times.
	RP Locked Zone Red and Yellow stripes	Dose rates can vary rapidly.	These areas are also kept locked. RP must survey the area prior to any work being performed.

Figure 6: Radiation zones and signposting

4.2 DESIGN INFORMATION

4.2.1 Major Process and Safety Systems

4.2.1.1 Auxiliary feedwater system

The auxiliary feedwater system (ASG) has one steam-driven and two electrically driven pumps.

4.2.1.2 Containment spray system

In addition to the normal containment spray system (EAS) (dual independent train injection pumps, sumps, heat exchangers), an external connection point to enable emergency water supply is fitted to the system.

4.2.1.3 Safety injection system

The safety injection system has three high-head pumps (RCV), one per train, one spare linked to train A, and two low-head safety injection pumps (RIS). There are also accumulators attached to each primary loop, which discharge if the primary system depressurises.

Inside the reactor building, the residual heat removal system (RRA) is independent of the low-head safety injection pumps.

4.2.2 Key Design Parameters

KNPS has two pressurised water reactors (PWR) with three steam generators per reactor. The reactor core contains 157 fuel assemblies, each assembly containing 4,4% enriched uranium dioxide ceramic pellets. KNPS procures fuel assemblies both from Westinghouse and Framatome. Approximately one third of the fuel assemblies are changed out every 18 months.

The current steam generators will be replaced with larger steam generators before LTO. Five of the current tube bundles are manufactured from a thermally treated nickel-based alloy, Inconel 600 MA and one from 600 TT. The new steam generators will be manufactured from Inconel 690 TT and enlarged to allow a 10% power uprate later.

4.2.2.1 Spent fuel pool and storage

The storage capacity of the spent fuel pool was increased from 728 to 1 536 storage positions by modifying the racking. KNPS currently has eight dry storage casks loaded, and ten unloaded for future long-term dry storage of spent nuclear fuel.

4.2.2.2 Turbines

The turbine sets have one high-pressure turbine and three low-pressure turbines. The LP turbines have been retrofitted and cater for the intended power uprate; no additional modifications are needed for the HP turbines.

4.2.2.3 Electrical power system

The generator is connected to the Eskom national grid through the generator 24 kV circuit breaker, the 24 kV to 400 kV step-up main generator transformer, and the 400 kV breaker.

The 24 kV to 6,6 kV step-down unit transformer supplies the unit boards, which supply the following switchboards:

- 6,6 kV / 380 V transformers, which supply low-power system auxiliaries;
- 220 V ac;
- 125 V dc;
- 48 V dc;

- 30 V dc.

Koeberg can also connect to the Eskom 132 kV system through the auxiliary transformers from the 132 kV busbars. On the 132 kV busbars, there is also a dedicated emergency off-site power supply line from the remotely situated Acacia gas turbines.

4.2.2.4 Emergency power supply

The emergency power supply system consists of two emergency trains, A and B.

Back-up is provided by two emergency diesel generator sets per unit, namely LHP and LHQ (one for each emergency train). There is an additional diesel generator set, 9 LHS.

There is also a standby diesel generating system consisting of two 1 MW containerised generator sets. This system is fully automated, and in the event of a station black-out (SBO) incident, it will start up to protect the primary pump seals and provide essential battery back-up.

In addition, Koeberg has ten 500 kW mobile diesel generators which can be manually connected to a hardened electrical system to supply the essential switchboards during a beyond-design-basis accident.

4.2.2.5 Reactor building

The containment building with internal and outer diameters of 37,9 m and 38,8 m respectively consists of a 900 mm thick post-tensioned concrete shell with an airtight 6 mm steel liner. Steel cables in the concrete shell are permanently grouted to provide comprehensive corrosion protection. The capacity of the polar crane is 380 t. Equipment access is sufficiently large to enable steam generator replacement without enlargement of the equipment hatch.

4.2.2.6 Marine works

An intake basin was created by constructing two breakwaters, one 922 m and the other 580 m long to minimise the effects of wave action and allow for sand settlement before cooling water suction entry.

The secondary pump house, located adjacent to the main pump house (built on a separate soil-cement sub-foundation, constructed on bedrock), provides essential cooling water for the safety-related systems.

Both the circulating and essential service water system takes suction from the same intake basin. The outflows of both systems are joined in an outflow channel and discharged adjacent to the 922 m breakwater arm.

4.2.3 Unique Design Features

Koeberg has some notable unique safety features:

- **Containment sump screens:** Increased containment sump screens were installed to enlarge the surface area and ensure filtration of containment debris during LOCA conditions without clogging and affecting the sump supplies.

- **Firefighting/fire monitoring:** All parts of the plant (and many other buildings) have dedicated and diverse fire detection with control room alarms. The on-site fire station with a fire-fighting team on each operating shift serves as the first response upon fire identification.
- **Operation at reduced temperature (ORT):** Koeberg is currently operated at reduced primary circuit temperature to improve the resistance of the steam generator 600 MA tubes (and other Inconel parts) from primary water stress corrosion cracking (PWSCC) by lowering the primary temperature by 10°C. This reduces Koeberg's power output, but the core remains to be operated at 2 775 MWt. Koeberg is scheduled to replace all six steam generators in 2022/3 with SGs that employ Alloy 690 tubing. This will allow Koeberg to increase its operating temperature.
- **Passive autocatalytic hydrogen recombiners (H_2 PARs):** The same type, size, quantity, and location as EDF CP1 hydrogen passive recombiners were fitted in the Koeberg reactor buildings.
- **Seismic raft/seismic design:** Similar to the EDF Cruas plant, Koeberg was fitted with a seismic isolation system. The design comprises foundations excavated to bedrock, a soil-cement foundation layer (6 m deep), a lower reinforced concrete raft, more than 1 800 seismic pillars with neoprene, barium, and stainless steel plates to accommodate elastic and lateral sliding movement under seismic conditions, a 6,7 m thick upper raft upon which the containment, fuel, electrical, and two diesel generator buildings are built. The plant seismic design ignored the raft, and all seismic plant equipment was designed to a value of 0,3 g horizontal ground acceleration.
- **Simulator:** Two full-scope training simulators (with a second PC-based platform) are on site.
- Sodium hydroxide addition: This function was removed from the EAS (containment spray) system, and installed meshed baskets containing granular trisodium phosphate within the containment building.
- **Spent fuel pool make-up:** Pipework is installed to enable make-up from external (to the fuel buildings) water sources such as firefighting and mobile systems.
- **Technical support centre:** There is an on-site technical support centre for the Emergency Plan and severe accident management with strong links to the EDF and Framatome support centres.
- **Tsunami:** The tsunami design basis was calculated as 7 m above average sea level. The terrace level is at 8 m, with the station black-out diesel generators (LLS) situated at a level of 14 m.

4.3 EXTERNAL ORGANISATIONS

4.3.1 Utility Headquarters

KNPS is owned and operated by the South African national electricity supplier, Eskom. Eskom is a state-owned utility with the South African government as the sole shareholder. Eskom's headquarters are based at:

Physical Address: Megawatt Park, 2 Maxwell Drive, Sunninghill, Sandton, Gauteng, RSA

Postal Address:	PO Box 1091, Johannesburg, 2001
Web Address:	www.eskom.co.za
Tel No:	+27 118 00 8111
Fax No:	+27 11 800 4299

4.3.2 Industry Organisations

The nuclear industry has established an international network of monitoring and safety assurance controls, communication, and information sharing, unique in world industrial history. The Eskom strategy has been to consider and adopt (where practical) best international practices to improve nuclear safety, plant performance, and to maintain plant reliability. To achieve world-class performance, Koeberg has used the services of the following organisations:

- EDF (Électricité de France)

  KNPS has established and continues a partnering contract with EDF for information sharing, benchmarking, and technical support since the KNPS design is similar to the EDF CPY fleet.

- EPRI (Electrical Power Research Institute)

  EPRI is an organization that conducts research and development related to the generation, delivery, and use of electricity to help address challenges in electricity, including reliability, efficiency, affordability, health, safety, and the environment.

- FROG (Framatome Owners Group)

  FROG members are all Framatome reactor owners and combine efforts to improve plant performance through forums dedicated to research, knowledge, and feedback exchanges.

- PWROG (Pressurized Water Reactor Owners Group)

  PWROG works to address plant efficiencies, seeking ways to improve operations and safety while providing cost-effective solutions.

- WANO (World Association of Nuclear Operators)

  Eskom is a member of WANO-Atlanta, an organisation whose aim is to maximise the safety and reliability of nuclear power plants worldwide by working together to assess, benchmark and improve performance through mutual support, exchange of information, and emulation of best practices.

4.3.3 Regulatory Authorities

Koeberg is regulated, licensed, and governed by the National Nuclear Regulator (NNR). The National Nuclear Regulatory Act, 1999 (Act No. 47 of 1999, also referred to as the NNR Act) establishes the NNR as an independent regulator and the competent authority for nuclear regulation in South Africa to provide for the protection of persons (the public and workers), property, and the environment against nuclear damage. The act grants the NNR the power to exercise regulatory control over the safety of siting, design,

construction, operation, manufacture of component parts, decontamination, decommissioning, and closure of nuclear installations by issuing nuclear authorisations. The NNR is responsible for issuing Eskom with the nuclear installation licences (NIL) in terms of the NNR Act, which specifies various conditions that, as a collective, define the current licensing basis for the KNPS. The current nuclear installation licence is referred to as NIL-01, Variation 19.

Figure 7 illustrates the relationship the South African regulator has with other local and international organisations.

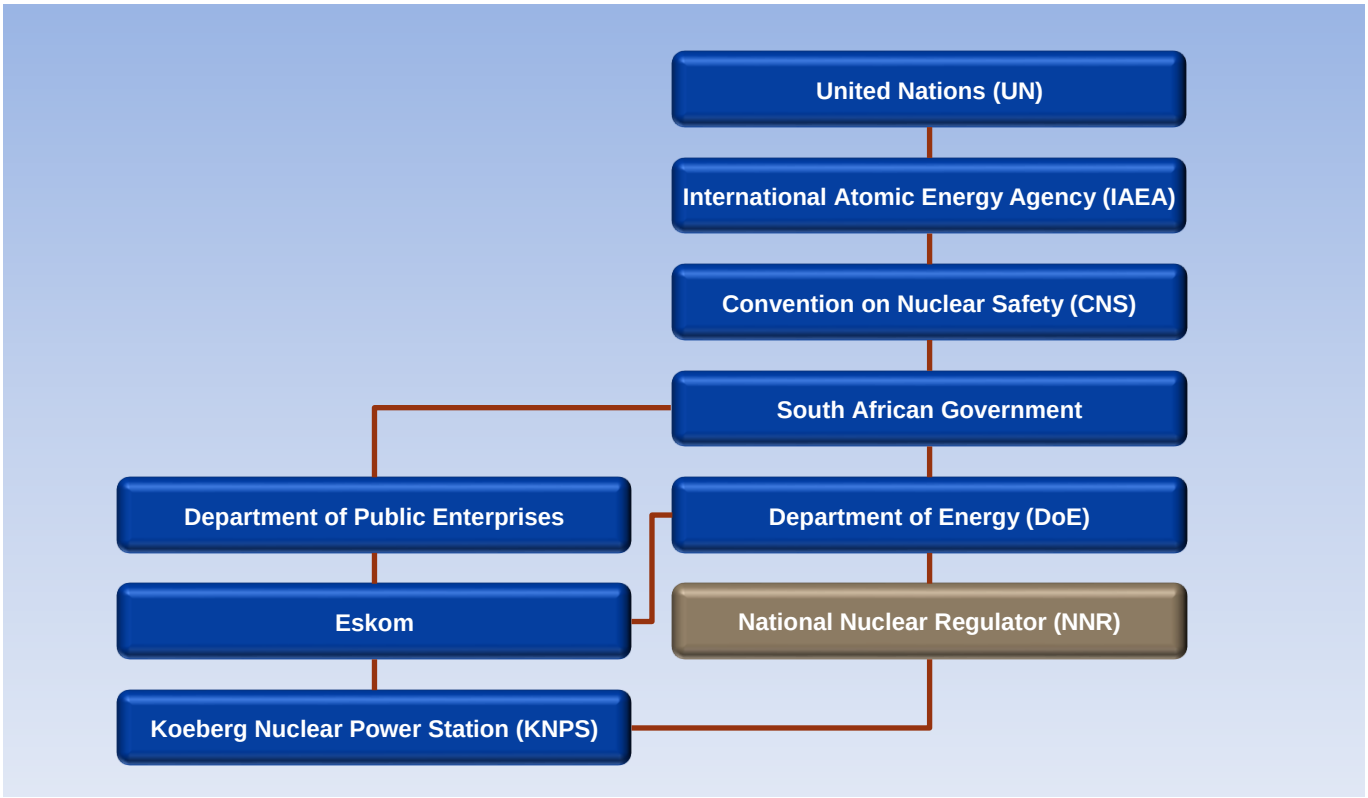

Figure 7: NNR relationship with other organisations

4.3.4 Main Suppliers and Sub-Contractors

The KNPS was built under a turnkey contract, which covered the major installations on the site except for the cooling water pump houses (civil works) and the high-voltage switchyard. The turnkey contractor was a consortium of the organisations Framatome, Alsthom Atlantique, Spie-Batignolles, and Frameteg. Fragema/Framatome manufactured the initial batches of fuel. Subsequent batches of fuel were manufactured by the South African Atomic Energy Corporation and Westinghouse.

Since the original installation, KNPS has relied on the OEM to supply the required fuel, system and component spares, and assistance with required preventive maintenance and services.

4.3.5 Contractors supporting Plant Maintenance

Through the years of operation, Eskom has compiled a list of approved suppliers/contractors that can be used for various services, including system or component designs and maintenance (preventive, corrective, and predictive). Once an activity is identified, a work package is compiled, and a tender process is used to contract a supplier to provide the services (design or maintenance). These suppliers comprise local and overseas business entities that comply with Eskom quality assurance, site access and technical requirements.

The KNPS personnel review the scope of activities, the implementation plan and supervise work implementation.

5.0 INFORMATION FOR AREA REVIEWERS' PREPARATION

To aid the area reviewers' preparation, the areas have been separated into independent appendices to this document. For each review area, refer to the following:

Appendix	Area	Discipline(s)
A	A	Organization of Ageing Management and LTO Activities
B	B	Scope Setting, Plant Programmes, and Corrective Action Programme
C	C	Ageing Management of Mechanical SSCs
D	D	Ageing Management of Electrical and I&C SSCs
E	E	Ageing Management of Civil SSCs
F	F	Human Resources, Competence, and Knowledge Management for LTO

6.0 REVISIONS

Date	Rev.	Compiler	Remarks
Sept 2021	0	A Oosthuizen	To compile a new advance information package for the SALTO IAEA mission in January 2022.
Nov 2021	1	A Oosthuizen	To issue the authorised advance information package.

7.0 DEVELOPMENT TEAM

The following people were involved in the development of this document:

- Agape Sinankwa
- Alan Nambiar
- Anton Kotze
- Ashley Oosthuizen
- Ditsietsi Malale
- Garetshose Mdluli
- Kabelo Moroka
- Linda Lukwe
- Magrieta Koopman
- Mashudu Rulu
- Megan Schlebusch-Kemp
- Raymond Maapola

8.0 ATTACHMENTS

Appendix A: Area A Reviewer's Information:
Organisation of Ageing Management and LTO Activities

Appendix B: Area B Reviewer's Information:
Scope Setting, Plant Programmes and Corrective Action Programme

Appendix C: Area C Reviewer's Information:
Ageing Management of Mechanical SSCs

Appendix D: Area D Reviewer's Information:
Ageing Management of Electrical and I&C SSCs

Appendix E: Area E Reviewer's Information:
Ageing Management of Civil SSCs

Appendix F: Area F Reviewer's Information
Human Resources, Competence and Knowledge Management for LTO

Appendix G: References

Appendix H: Definitions

Appendix I: Abbreviations and Acronyms

Appendix J: Updated Issue Sheets from Pre-Salto 2 Mission (2019)

Appendix K: Mission Team Member Summary Sheet

APPENDIX A
AREA A REVIEWER'S INFORMATION:
ORGANISATION OF AGEING MANAGEMENT AND LTO ACTIVITIES

Background to the Koeberg Current Licensing Basis

Koeberg was designed and built by a French consortium, with the NSSS designed by Framatome under licence from Westinghouse, using the codes, standards, and general requirements applicable in France. Framatome compiled the initial safety analysis report (SAR) for Koeberg, and the operating technical specifications (OTS) were based on EDF practice.

The NNR issued the initial operating licence for Koeberg, which included both a risked-based criterion and many detailed, safety-related Eskom documents (for example, specific SAR chapters, OTS, Radiation Protection, and operating procedures, lists of mandatory maintenance tasks), which were then classified as "licence binding".

Neither the licensing authority nor Eskom prescribed alignment to any particular international set of regulations, codes, and standards. For example, the ISI programme was selected to be based on the ASME XI code and has remained aligned to ASME XI, while many of the plant maintenance and integrity practices have remained closely linked to that of EDF and WANO practices.

The distinguishing feature of the early Koeberg licensing basis was the use of probabilistic safety analysis (PSA) to analyse the plant and demonstrate compliance with nuclear licensing risk criteria.

At the time of the design and construction of the Koeberg power plant, the NSSS and many other safety-related equipment were designed to ASME III and built according to French industry standards, referred to as Cahier des Prescriptions de Fabrication et de Contrôle.

Alignment of Licensing Basis

Periodic safety review: After the first fifteen years of operation, during the 1990s, Eskom decided to benchmark the Koeberg plant and related practices to the French reference plant and technical practices, while aligning operating and management practices to that of INPO (achieving full INPO accreditation for operator training). The SAR was updated in close co-operation with EDF and Framatome. Eskom committed to the NNR to adopt the IAEA practice of 10-yearly periodic safety reviews (PSR). The first PSR was performed and the report issued in 1998. This report identified significant gaps in the safety level of EDF. This was followed by a series of plant modifications to improve the basic safety level of plant design.

The second PSR was started in 2008 and finalised in 2011. This report concluded a comparable level of safety with the EDF reference and identified five significant initiatives to match the EDF safety level. During the finalisation stages of this report, the Fukushima accident occurred, and an ad hoc PSR was requested by the NNR. This (essentially) external event review was completed in 2015 and confirmed design basis accident preparedness and identified numerous improvements to mitigate potential beyond design incidents.

The third PSR is currently ongoing and scheduled to be completed in 2022. The PSR is being performed to comply with NNR RG0028 (*Periodic Safety Review of Nuclear Power Plants*). This document is closely aligned with IAEA SSG 025.

Safety evaluation: In 1998, Eskom adopted the US approach to assessing changes to the safety basis by establishing the safety evaluation process (KAA-709) for Koeberg, closely following US NRC regulation 10 CFR 50.59 (evaluation requirements).

In the early 2000s, Eskom and the NNR resolved to improve the Koeberg licensing process and established the Koeberg licensing basis manual (KLBM) (36-197). The manual reflected the agreement with the licensing authority to group the licensing processes into five domains and include all important safety-related requirements and commitments. The safety evaluation process was modified to control any changes to the KLBM.

The nuclear licence for Koeberg was then updated to comply with the KLBM and the safety evaluation process (along with specific NNR requirements), allowing the direct reference to the many other Eskom licence binding documents in the licence to be excluded. This was then termed a “process-based licence”, although it was agreed that the basis itself needed improvements in certain areas to allow process-based licensing to be fully realised.

The KLBM has been updated (expanded and now aligned to the licence conditions) following the issue of NIL01 version 19 and submitted to the NNR for acceptance.

Recent Improvements

Further improvements to the licensing basis followed, including upgrading KBA-0022-OTS-000-0001 (*Operating Technical Specifications*) and KBA-0022-SRSM-000-00 (*Safety Related Surveillance Manual*).

To improve plant condition and integrity management, the maintenance bases have been centred on reliability principles, and the AP-913 equipment reliability process has been partially adopted. The materials reliability and ageing management effort was made more systematic by establishing a plant ageing matrix, utilising EDF expertise and reference plant experience. This element, in particular, was considered to be critical in preparing Koeberg for long-term operation.

A.1 RELATED REGULATORY REQUIREMENTS, CODES, AND STANDARDS FOR AGEING MANAGEMENT AND LTO AND REGULATORY REVIEW

A.1.1 Complete and consistent set of regulatory requirements, codes and standards related to LTO and ageing management

The regulatory requirements cover those elements necessary for the safe operation of the plant, including safety assessment and continually applying good engineering and quality practices. This practice also takes into consideration the decommissioning requirements. The South African regulations generally provide only high-level requirements, with more specific requirements in the form of licensee commitments.

In March 2019, the Regulator provided Eskom with interim regulatory guides related to LTO and PSR, i.e. RG-0027 Ageing Management and Long-Term Operation of Nuclear Power Plants and RG-0028 Periodic Safety Reviews of Nuclear Power Plants. In March 2021, the government promulgated the regulations on The Long-Term Operation of Nuclear Installations R.266.

A.1.2 Consistency of regulatory requirements, codes, and standards with the IAEA requirements and recommendations

The NNR has issued interim regulatory guide RG-0027 (Ageing Management and Long-Term Operations of Nuclear Power Plants). This guide aligns closely with the IAEA's SSG-48 (*Ageing Management and Development of a Programme for Long-Term Operation of Nuclear Power Plants*).

The NNR has also issued interim regulatory guide RG-0028 (*Periodic Safety Review of Nuclear Power Plants*). This guide aligns closely with the IAEA's SSG-25 (*Periodic Safety Review for Nuclear Power Plants*).

The Koeberg nuclear licence refers directly to the KLBM requirements for the safe operation of the plant. The KLBM includes a complete set of radiation protection, nuclear safety processes, programmes, and practices that demonstrate compliance with the regulatory licence requirements.

A.1.3 Regulatory requirements, codes and standards, industry practices related to the LTO programme

The higher-level requirements in the KLBM cover safe practice requirements for ongoing plant operation.

In 2019, the NNR issued a variation to Koeberg's nuclear installation licence (NIL-01). The variation (no 19) included, among other requirements, the limitation of the operating licence to 40 years of operation and the inclusion of provisions for ageing management and long-term operation. The NNR interim regulations on ageing management and long-term operation and the interim regulations on periodic safety reviews give further guidance on the expectations of the NNR for long-term operation.

A.1.4 LTO Liaison with the regulatory body

To facilitate common understanding and oversight of the AM and LTO requirements of the nuclear power plant, Koeberg, through the licensing department, has established a liaison with the NNR. The single point contact with the regulator is the LTO senior manager. Arrangements for discussions with the regulator are undertaken by the Licensing department.

A.1.5 Interfaces between regulatory requirements, codes and standards for LTO and PSR

In RG-0027, the regulator requires that Eskom utilise the results of the PSR to justify LTO. Figure 8 below illustrates the interfaces in regulatory requirements in the NNR's RG-0027 and RG-0028.

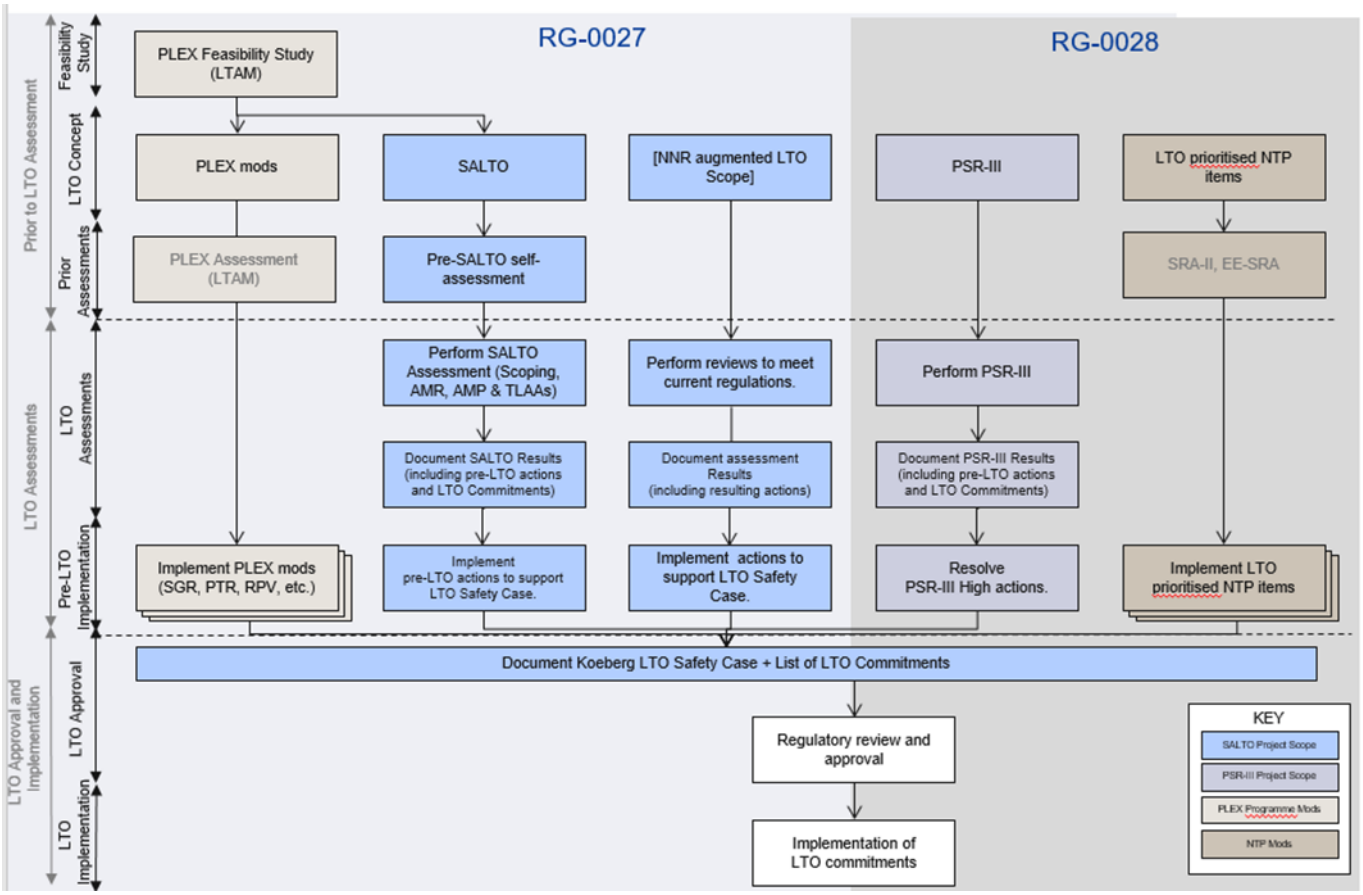

Figure 8: Regulatory requirements and interfaces

A.2 PRINCIPLES AND APPROACH TO AGEING MANAGEMENT AND LTO

A.2.1 Policy for ageing management AM and LTO consistent with IAEA Safety Standards

The core policy principle of 32-83 (*The Nuclear Management Policy*) is that Eskom manages its nuclear assets, people, the safety of the public and workers, and the impact on the environment in a responsible and sustainable manner, in alignment with Eskom's policies.

Eskom has endorsed the achievement of long-term operation at all levels of the organisation, and the completion of the assessment and resultant actions needed to ensure safe long-term operation (beyond 2024) has been documented in 240-108035478 (*The Eskom Nuclear Objectives*).

32-83 (*The Eskom Nuclear Policy*) makes provision for emulating international benchmarked good practice throughout all life cycle stages of the plant (this includes ageing management and LTO). 238-8 (*The Nuclear Safety and Quality Manual*) provides the integrated management system and incorporated in it is a clear policy for ageing management and long-term operation.

A.2.2 Plant-level documents covering the principles and concepts for AM and LTO

240-149139512 (*The Ageing Management Standard*) provides the requirements for ageing management and LTO. The standard contains the plant level processes relating to ageing management, roles and responsibilities of various plant departments as required.

A.2.3 Use of PSR adequately to support decision making for LTO

The third PSR is currently underway and will also be used to determine the extent to which the plant is safe and adequate for LTO. The PSR is undertaken in accordance with 240-134382460 (*Koeberg PSR Basis Document*). The PSR will be completed in June 2022.

A.2.4 Plant personnel familiarity with the LTO, its principles and concepts

LTO is one of the focus areas in the NOU operational plan (238-89). LTO is often discussed at various engagement forums across the plant as a station priority. It ensures that the principles and concepts of LTO are well understood, as this is a station priority.

A.3 ORGANISATIONAL ARRANGEMENTS FOR AGEING MANAGEMENT AND LTO

A.3.1 Roles and responsibilities of all organisations that participate in AM and LTO preparation

240-160692514 (*LTO Programme Organisation*) provides clear reporting structures, roles and responsibilities, reporting relationships that govern AM and LTO preparatory work

240-149139512 (*Koeberg Ageing Management Standard*) was developed to conform to the IAEA Safety Report Series No. SSG-48 (*Ageing Management and Development of a Programme for Long-Term Operation of Nuclear Power Plants*) and the NNR RG-0027 (*Ageing Management and Long-Term Operations of Nuclear Power Plants*). The requirements, roles, and responsibilities related to ageing management and long-term operation are documented in this standard.

The process and responsibilities for the various activities related to the ageing management matrix are documented in 331-275 (*Process for the Development and Control of Ageing Management Matrix at Koeberg Operating Unit*).

The responsibility for the long-term nuclear technical plan resides with Nuclear Engineering and is coordinated by the Integrated Plant Design – Koeberg (IPD-K) department. Data to populate this plan is extracted from the System Engineering Life of Plant Plan documents (LOPPs), which provide detailed information about each system (or major component) as well as from periodic safety reviews.

The nuclear technical plan, used to identify large financial expenditures, contains the large modifications and major refurbishment projects for the remainder of the plant life. This plan directs upgrading/replacing plant equipment at the appropriate time to ensure the long-term sustainability of the asset. Furthermore, the NTP contains projects required for Koeberg to remain on par with acceptable industry practices from periodic safety reviews and operational experience evaluations; refer to 240-84975495 (Engineering Change Management). Since the LTO objectives and programme are incorporated into normal plant processes, future projects during LTO will form part of this technical plan.

240-160692496 (*Long-Term Operation Programme Management Manual*) provides the approach to LTO at Koeberg, programme organisation, roles and responsibilities, licensing interfaces, and schedule, resources, and deliverables in accordance with RG-0027. This document details the approach to prepare for LTO, including the SALTO assessment, the PLEX programme initiative, and the PSR requirements. In summary, the responsibility of LTO resides with Nuclear Engineering to lead the required changes in existing or new processes and management of the LTO programme, including the Koeberg SALTO assessment project

At a high level, 32-83 (*Nuclear Management Policy*) has as a core policy principle that Eskom manages its nuclear assets, people, the safety of the public and workers, and the impact on the environment in a responsible and sustainable manner, in alignment with Eskom's policies.

The achievement of long-term operation beyond 40 years has been endorsed by Eskom at all levels within the organisation, and the completion of the assessment and resultant actions needed to ensure safe long-term operation (beyond 2024) has been documented in the directive 240-108035478 (*Eskom Nuclear Objectives*).

At the plant level, procedures have been developed to govern and control the assessment for LTO. Now that the assessments have been completed, actions to manage the implementation of actions to achieve LTO have been formulated and managed via a project management process and/or the plant's corrective action process.

A.3.2 Organisational structure for the preparation and implementation of Ageing Management and LTO programme

240-160692514 (*Long-Term Operations Programme Organisation*) defines, amongst others, the programme organisation and roles and responsibilities for all the employees involved in the LTO preparatory activities.

The Nuclear Engineering organisational structure was changed in 2021 to streamline and optimise the organisation for LTO. A new organisation termed Project Engineering was created. The Project Engineering department is structured in a manner to best support AM and LTO projects. The existing Engineering Programmes Department was assigned the responsibility of controlling AM requirements. See Nuclear Engineering FOS 40-88257644.

A matrix organisation has been adopted to plan, manage, and execute all activities towards LTO:

- The organisational matrix is represented by functional line groups or departments within the Nuclear Operating Unit (NOU), responsible for LTO related activities within their domain of functional responsibility.
- The project portion will be represented by dedicated project management and team members assigned to the Koeberg SALTO project.

The organisational structure for the programme is contained in 240-160692496 (*LTO Programme Management Manual*) and is shown in Figure 9 . The various line group functions are detailed in 240-64602879 (*Nuclear Operating Unit Structure and Mandates*).

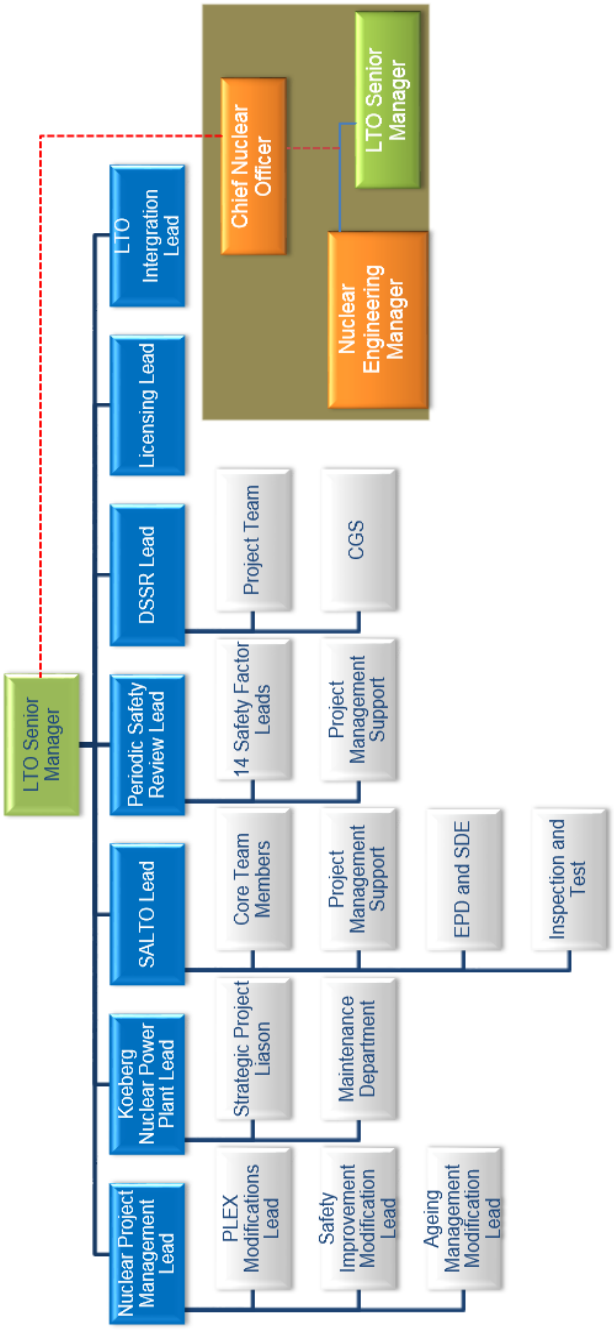

Figure 9: High-level organogram for the LTO programme

A.3.3 A suitable organisational structure for preparation for LTO

The establishment of a special LTO-oriented project started with the initial pre-SALTO assessment in 2015. Since 2015, as regulatory expectations and requirements were communicated to Koeberg, these were incorporated into the overall Koeberg LTO programme.

The Koeberg SALTO assessment project team was formally established to ensure that all the necessary preparatory work for LTO is performed and the preparation and performance of the SALTO peer review

missions to Koeberg. The project is established in accordance with the Eskom project life cycle model (PLCM) governance processes.

The scope of the assessment project was initially collected from three sources:

- The gaps identified through the Materials Reliability group (previously EPG) AMP IGALL self-assessment (SE 85540);
- The gaps identified through the Koeberg pre-SALTO self-assessment (SE 35244); and
- The recommendations and suggestions identified through the IAEA Koeberg pre-SALTO peer review mission performed in November 2015.

The project has completed the Definition phase, for which the consortium supplied the deliverables as per the Eskom technical requirement specification. All consortium governance documents, procedures, and output deliverables were technically reviewed and accepted by Eskom. The documents retain the consortium numbering which will form part of the project QADP, and will also be listed in the SALTO Ageing Management Assessment Report (Final).

The project is currently in the Execution phase of its life cycle and has procured the services of a consortium comprising Lesedi and Framatome Germany (with support from Framatome France) to execute the scope of work identified during the definition phase of the project, i.e.:

- new ageing management programmes required and updates to existing programmes,
- correction of identified anomalies,
- revalidation of outstanding TLAAs,
- creation of additional required TLAAs.

The scope of work will be completed by 2024, before entry into LTO.

The LTO programme consists of the SALTO assessment and implementation of the resulting actions, the completion of Koeberg's third periodic safety review (PSR III) to support LTO, and the implementation of the various modifications to enable entering the LTO period.

The NNR has stipulated the request for life extension into LTO is to be supported by a safety case. The safety case will document arguments, which substantiate the safety of the plant, demonstrate compliance to regulatory requirements and criteria, and provide the overall justification for continued safe operation. The safety case will be compiled by the LTO team.

A.3.4 Adequate staff and required qualifications for the scope of the ageing management and LTO work

The Koeberg SALTO assessment project has established a team to perform the preparation activities for LTO as described in Figure 9. A consortium comprising Lesedi and Framatome Germany (with support from Framatome France) supports the project team. Team members are suitably qualified, and the required skills and qualifications of the consortium team members were confirmed during contract

placement. The plant subject matter experts assist with the assessment results and implementation activities.

LTO and AM activities are fully funded. The strategy used to resource AM and LTO activities at Koeberg includes utilising permanent Koeberg employees, supplemental employees and outsourcing some scope. Eskom has provided financial resourcing for the various projects to complete all activities to achieve an LTO licence, whereafter normal business practice will prevail.

A.3.5 Interfaces with the corporate organization

238-8 (*Nuclear Safety and Quality Manual*) details the support of the corporate organisation and the interface between the chief executive to the chief nuclear officer.

A.3.6 Qualification and training for personnel working on AM and LTO activities

For preparation activities, all employees engaged in LTO assessments (permanent and supplementary) have the required level of experience and those with less experience work under supervision.

For the period of LTO, all ongoing activities are enveloped by the task grade job descriptions and requirements (qualifications). Specifically for ageing management, the Engineering Programmes department responsible engineers are appointed and trained in accordance with the relevant requirement in the programme engineer's guide.

A.3.7 Job descriptions and task responsibilities

240-160692514 (*Long-Term Operations Programme Organisation*) defines, amongst others, the programme organisation and roles and responsibilities for all the employees involved in the LTO preparatory activities. For SALTO specific project activities, job descriptions/task responsibilities have been identified and documented in the project management plan and the stakeholder management plan. Key team members have been assigned to the project through agreements with department management and issued appointment letters defining their duties and responsibilities.

Document 240-88257644 provides the organisational structure for Nuclear Engineering and a description of the mandate for each department in Nuclear Engineering. This structure has been developed to provide appropriate capabilities for LTO functions.

A.4 PERIODIC SAFETY REVIEW

A.4.1 Comprehensive information in the PSR on AM, equipment qualification and LTO

The third periodic safety assessment is currently underway. The scope of the assessment is documented in 240-134382460 (*PSR Basis Document*). One of the objectives of the PSR is to determine the extent to which the licensing basis will remain valid until the end of LTO, therefore covering the entire duration of LTO instead of the usual ten years.

Safety factor 4 assesses ageing to determine whether ageing aspects affecting SSCs important to safety are being effectively managed and whether an effective ageing management programme is in place so

that all required safety functions will be delivered for the anticipated lifetime of the plant. The review methodology is contained in 240-153546869 (*PSR Safety Factor 4 Requirements and Methodology*).

Safety factor 3 assesses equipment qualification to determine the following:

- Whether plant equipment important to safety has been properly identified and qualified (for both seismic and environmental conditions) throughout specified plant states;
- Whether the equipment environmental and seismic qualification is being maintained to provide adequate confidence in the delivery of its safety functions, for the duration of LTO;
- Whether a formal process is in place to maintain qualification during the installed life of the equipment which takes into account significant changes from relevant EQ standards, operating experience, plant modifications, failures, and qualified conditions;
- Whether the existing EQ temperature and pressure profiles are appropriate; and
- Whether the results of the SALTO assessment (i.e. the result of the ageing management review (AMR) and revalidation of EQ time-limited ageing analyses (TLAAs)) are incorporated into the EQ programme.

The review methodology for the equipment qualification safety factor is contained in 240-153546180 (*PSR Safety Factor 3 Requirement and Methodology*).

A.4.2 PSR as a licensing tool

The third periodic safety assessment is currently underway. The scope of the assessment is documented in 240-134382460 (*PSR Basis Document*). An objective of the PSR is to determine the extent to which the licensing basis will remain valid until the end of LTO, therefore covering the entire duration of LTO instead of the usual ten years. The PSR report will be submitted to the regulator, with the LTO safety case, as mandated by the NNR regulatory guidance RG-0027.

A.4.3 Life limiting features identified in the PSR

The PSR safety factor 1 includes assessing design limitations such as specifications, design limits, operating limits, safety limits, failure or fitness for service criteria. These limitations will be treated in accordance with the criteria outlined in the PSR safety factor 1 Requirements and Review Methodology document, 240-153546074. Note that life-limiting features were specifically searched and identified as part of the LTO feasibility stage and during the SALTO assessment of TLAAs.

Furthermore, the PSR assesses issues related to obsolescence, deemed important for successful justification of LTO, i.e. technological obsolescence, codes, and standard obsolescence, and knowledge obsolescence.

A.4.4 Scope of national and international requirements, codes and standards, as well as practices in the PSR in PSR basis document

The applicable national and international requirements, codes and standards are detailed in the PSR basis document, 240-134382460. These cover national regulations as well as international safety standards (IAEA and WENRA).

A.4.5 PSR aimed at justifying the adequacy of AM for the planned period of LTO focus on safety factors 1 – 4 and adequately considers other safety factors

The periodic safety review is performed in accordance with regulatory guidance in the NNR's RG-0028 and aligned with IAEA SSG-25. The review methodology considers those LTO aspects described in the NNR's RG-0027 and RG-0028, as PSR will be used to support the decision to enter LTO. Particular attention is being paid to safety-related programmes and associated documents considered of significant importance to LTO. Particular attention will therefore be paid to the following safety factors or topical areas:

1. Plant Design;
2. Actual condition of SSCs important to safety;
3. Equipment qualification;
4. Ageing;
5. Deterministic analysis, specifically the safety analysis involving time-limiting assumptions relating to the proposed lifetime;
6. Programmes for promoting safety culture focused on the pursuit of excellence in all aspects of safety management and human factors;
7. The process to ensure key technical competencies are sufficient for future operation; and
8. The management system addresses quality management and configuration management.

A.4.6 PSR identification of trends and possible connection with degradation of SSC

The results of the previous PSRs are part of the safety factor reviews and specifically examined in SF-4 and SF-8 to detect any long-term trends in deteriorating safety performance.

A.4.7 PSR preparation

The PSR was prepared in compliance with the issued regulations RG-0028. The PSR basis document was reviewed and accepted by the regulator in letter k26875N. Feedback on the ongoing assessments is provided to the regulator quarterly. The review and methodology documents were submitted to the regulator for acceptance. The next milestone, as committed to in the basis document, is submitting the safety factor review reports to the NNR for review and comment, followed by submitting the final PSR report to the NNR for acceptance in June 2022.

A.4.8 Periodic safety review LTO-related results

The last PSR (SRA II), concluded in 2011, identified only five issues rated with a medium safety significance and several with a low safety significance. While the SRA II report contained several areas for improvement in sections that are key to long-term operation (e.g. maintenance bases, the scope of EQ), there were no urgent safety concerns noted compared to the benchmark used for the re-assessment. The areas for improvements were taken up in normal business processes.

Since then, progress has been made in establishing an ageing management matrix, and a procedure 331-275 (*Process for the Development and Control of Ageing Management Matrix at KOU*) has been compiled. From the SALTO assessment and the new regulatory requirements that stipulate requirements for ageing management, there are some updates to ageing management processes and requirements at Koeberg currently ongoing.

The third PSR is currently in progress, where the safety factor review has been completed, and the global assessment is in progress. The compiled 14 safety factor reports are to be sent to the IAEA for review. The PSR identified 113 deviations; these were graded, and only one deviation was graded as high (a known pre-existing issue). There were 17 medium deviations. Most deviations were graded low. The final PSR report will be submitted to the regulator in June 2022.

A.5 PROGRAMME FOR LTO

A.5.1 LTO programme

240-160692496 (*The LTO Programme Management Manual*) provides the details of the Koeberg LTO programme in accordance with the regulatory guidance NNR RG-0027, which is consistent with the IAEA safety standards.

A.5.2 LTO programme activities

The LTO programme is a set of activities, including evaluations, assessments, maintenance, inspections and testing, aimed at justifying and demonstrating plant safety for the planned period of long-term operation. The LTO programme includes scope setting, AMR, review of plant programmes and AMPs, identification and revalidation of TLAAs, and the development of an implementation programme. The LTO programme is based on national regulatory requirements (contained in NNR RG-0027), and the PSR, which is synchronised with the licence application, considers international best practice, operating experience, and research findings.

A.5.3 LTO programme documentation

The LTO programme is documented in 240-160692496 (*Programme Management Manual*) and adequately identifies assumptions, activities, evaluations, and assessments. The result of the ageing management safety assessment for LTO is documented in 240-156945472 (*Interim SALTO Ageing Management Assessment Report*).

A.5.4 LTO programme and safety improvements

The LTO programme addresses safety improvements. In accordance with the regulatory guidance, a list of commitments and an implementation plan will be provided to the regulator as part of the LTO safety case. 240-157754316 (*The Structure and Content of the LTO Safety Case*) provides the framework agreed with the regulator for the anticipated submission of the safety case.

A.5.5 Action plan for the resolution of issues identified during the review of AMPs, EQ and TLAAs

The actions resulting from gaps identified through the SALTO assessment project are managed (actioned/tracked) as output deliverables. The actions are captured on Devonway for traceability. See 240-106374366 (*SALTO Project Scope and Work Breakdown Structure (WBS*) Report) and 08016-S-PMP.

A.5.6 Existing NPP programmes and documentation

The existing Koeberg programmes were evaluated against the IAEA IGALL AMPs (SRS-082) requirements. The results were documented in a consortium report L1124-GN-RPT-030 (*Comparison Report of the Existing KNPS Plant Programs with IGALL-AMP Requirements*). Eskom also evaluated the existing programmes against the requirements of the NNR's RG-0027, where the self-evaluation report SE 38545 was compiled, and corrective actions were raised to close identified gaps.

These assessments were performed to ensure that the proper ageing management will be performed throughout the intended plant life.

A.5.7 Plant activities

Activities resulting from the LTO assessments are incorporated into normal processes as business-as-usual activities. Line groups or departments within the Nuclear Operating Unit (NOU) are responsible for LTO related activities within their domain of functional responsibility.

A.6 CONFIGURATION / MODIFICATION MANAGEMENT AND DESIGN BASIS DOCUMENTS

A.6.1 Management system processes, configuration management programme and the modification management programme

238-8 (*The Nuclear Safety and Quality Manual*) defines the integrated management system requirements to ensure that nuclear safety is appropriately taken into account in all activities and decisions that have a bearing on safety throughout the life cycle of a nuclear installation and contains activities related to configuration management and modification management.

Configuration Management:

240-99837788 (*KOU Configuration Management Process Manual*) describes configuration management processes and requirements applicable to the Nuclear Operating Unit.

Modification Management:

KAA-501 and KAA-502 describe the modification process, roles, and responsibilities and ensure that all modification-related configuration and quality requirements are met.

331-86 (*Design Changes to Plant, Plant Structures, or Operating Parameters*) is the design engineering document that describes responsibilities and processes for design changes and ensures that quality requirements are met.

A.6.2 Modification documentation

The third PSR has reviewed configuration management of the plant w.r.t modifications. It was found that the processes are robust; however, some instances were found where documents were not updated within the 90-day requirement of processing documents (due to backlog), and this was identified as a gap in the PSR.

Changes to the design of the plant are screened using the KAA-709 safety evaluation process. Safety significant modifications which require a SAR update follow the KAA-696 (240-119744497) process. Modifications that have an impact on safety are documented in the SAR.

A.6.3 Design authority – configuration and modification management

Design Engineering is the delegated design authority for the maintenance and control of the design bases, and has the responsibility to establish and maintain the Configuration Management standards for nuclear asset management, and provides a design engineering service and support (for new plant, plant modifications, temporary alterations, minor design changes, etc.)

A.6.4 Access to design basis documentation

Various design basis documents exist at Koeberg, and these can be accessed via multiple platforms. The nuclear engineering guide 240-89284686 (*Locating Technical Information in the KOU*) lists all the available documents and where they can be retrieved. The SALTO assessment has also considered the comprehensiveness of these documents to ensure that the appropriate documents for the LTO and decommissioning periods remain available and accessible. The standard 238-6 (*Nuclear Document and Records Management Requirements*) lists the requirements for all documents and records at Koeberg.

Koeberg has always maintained close links with its OEMs. Where OEMs retain specific design basis information (normally OEM intellectual property) through their agreements with OEMs, Koeberg can request the detailed information when required. In addition, with OEM and/or other technical support, reconstitution of design basis information can be performed should the information be required that has become outdated.

The plant has access to design basis documentation through contractual agreements with OEM. The strategy is documented in 240-164729849 (*Original Designer Document Control Strategy*). Significant design reconstitution has not yet been required at the plant.

A.6.5 Location of design basis information

Design basis information is contained in the SAR, DSEs, 240-132364298 (*Initial list of Koeberg TLAAs*) and other documents. The SALTO assessment project consortium assessed the design basis information required for TLAAs, documented in L1124-GN-RPT-022 Rev. 1.

A.7 SAFETY ANALYSIS REPORT

A.7.1 Plant programmes and analyses relevant to AM and evaluation for LTO documented in the SAR

The Koeberg safety analysis report (SAR) documents the justification for design basis and plant safety. The current revision of the SAR (revision 5b) was authorised in July 2018 and reflects the current plant configuration. The SAR is periodically revised to include changes that result from modifications to the plant, operational experience feedback, the correction of errata, and the results of new safety analyses. The updating of the SAR is performed in a controlled manner. The process in KAA-697 (240-119744497 (*Control of the Safety Analysis Report*) is aligned to the NRC document US NRC RG 1.181 and NEI-98-03 and meets the requirements of the NNR stipulated in LD-1091 Rev 3. The current SAR does not yet contain a description of the planned period of LTO or the ageing management process. There is a formal action tracking the required update of the SAR and will include provisions for ageing management and revalidated (and new) TLAAs generated during the LTO preparation phase.

The SAR will be marked-up appropriately by the time Koeberg submits the Safety Case. All SAR updates will be completed before entry into LTO, in accordance with regulatory guidance and as agreed with the regulator in the programme management manual.

A.7.2 Justification for plant safety during the planned period of LTO in the Safety Analysis Report

As stated in § A.7.1, Eskom will submit a marked-up SAR with the LTO safety case in July 2022, as agreed with the regulator. The completed and updated SAR will then be provided to the regulator when Koeberg enters LTO in July 2024.

APPENDIX B
AREA B REVIEWER'S INFORMATION: SCOPE SETTING, PLANT PROGRAMMES AND CORRECTIVE ACTION PROGRAMME

B.1 METHODOLOGY AND CRITERIA FOR SCOPE SETTING OF SSCS FOR AGEING MANAGEMENT AND LTO

B.1.1 Methodology for scoping and commodity grouping of SSCs for LTO

B.1.1.1 Koeberg's classification system overview

The Koeberg classification system forms the basis for SALTO scoping. The classification standard, documented in 240-89294359 (KSA-010) (*Nuclear Safety, Seismic, Environmental, Quality and Importance and Management System Level Classification Standard*), establishes the safety classifications used at KNPS.

For the Koeberg SALTO scoping process, the following classifications are relevant:

- Design safety class;
- Importance category;
- Seismic class.

The following classification categories are not used for scoping:

- Environmental category;
- Quality levels.

Design Safety Class

The design safety classification is in accordance with ANSI 18.2 (American National Standard Nuclear Safety Criteria for the Design of Stationary Pressurised Water Reactor Plants). The following safety classes are applicable at Koeberg:

- Mechanical classes 1, 2, 3, LS (Linked to Safety), and NSF (No Safety Function);
- Electrical classes 1E and NSF (No Safety Function).

Importance Category

In addition to the standard design safety classifications stemming from design standards, the Koeberg importance category is a classification that defines the nuclear safety importance of functions, systems, processes, components, structures, services, and software. It also provides for boundaries between interfaces of important-to-safety and not-important-to-safety functions. The importance classifications stem from deterministic and probabilistic considerations. A listing 331-94 (KLA-001) (*Importance Category Classification Listing*) records importance categories.

Importance categories assigned to SSCs are:

- Critical Safety Related (CSR);
- Safety-Related (SR);
- Design Extension Related (DER);
- Availability Related (AR);
- Not Safety or Availability Related (NSA).

Seismic Classes

Seismic classes are defined as follows:

- 1 Active (1A);
- 1 Passive (1P);
- Seismic 1 (1);
- Non-Destruct (ND);
- Non-Classified (NC).

B.1.1.2 Methodology and criteria for scoping SSCs for LTO

The scope setting procedure was written in line with the National Nuclear Regulator (NNR) regulatory guide on ageing management and LTO of NPPs (RG-0027) and IAEA Specific Safety Guide No.SSG-48. The scoping methodology is documented in procedure 240-125839632 (*Koeberg Safety Aspects of Long-Term Operation (SALTO) Scoping Methodology*). It defines the scoping criteria performed by the consortium contracted for the SALTO assessment. In addition, the ageing management interim report 240-156945472 (*SALTO Ageing Management Assessment Report (Interim)*) covers the process for scoping.

For Koeberg, SSCs required to fulfil the fundamental safety functions described in RG-0027 and SSG-48 are design basis SSCs. They are assigned design safety classes either 1, 2, 3, or LS (for mechanical SSCs) and 1E (for electrical SSCs).

For the SALTO project, other SSCs whose failure may induce failure upon SSCs important to safety are treated as follows:

- SSCs assigned seismic class ND (Non-Destruct) are included in the SALTO scope.
- Non-safety related SSCs or equipment identified in the fire, flooding, and seismic studies pose a risk of inducing failure upon design safety function.
- Lifting equipment such as cranes and hoists are included in the SALTO scope.
- Protection against missiles from rotating equipment was taken into account during the design stages of the plant. Rotating equipment is excluded from the scope; however, protection barriers, such as structural walls, are included in the SALTO scope.

- Non-safety related high-energy piping adjacent to SSCs that perform a safety function must be identified and included in the SALTO scope.

The requirement for other SSCs that are credited in the safety analyses (deterministic and probabilistic) as performing the function of coping with certain types of events consistent with national regulatory requirements is interpreted, for Koeberg, as equipment identified by:

- Importance categories SR and CSR based on deterministic considerations;
- Importance category SR based on probabilistic considerations;
- Importance category DER.

B.1.1.3 Plant divisions and interfaces between SSCs

Boundary conditions and interfaces between various disciplines (mechanical, civil, electrical, and control and instrumentation) have been defined as part of the scoping activities to facilitate commodity grouping and ultimately AME. The boundary definition defines the extent of each component bigramme (including that of civil structures) and is documented in L1124-GN-RPT-004. The components within the boundary of civil discipline are refined further and allocated unique trigrams in document L1124-CV-RPT-001.

B.1.1.4 Information sources and scoping results

International guidelines recommend a list or database of all SSCs (a master equipment list) be available before scope setting commences. However, due to the lack of an integrated, consolidated and verified list of SSCs, the Koeberg SALTO Assessment Project had to identify all the SSCs information sources available to be used for scoping. As a result, document 240-128716554 (*Koeberg Safety Aspect of Long-Term Operation Input Sources*), which lists multiple input SSCs information sources available, was developed before the scope setting activity. The input information sources collated for the scoping process fall under one or more of the following:

- Digital SSC sources: 331-94 (*Importance Category Classification Listing*), Design Engineering classifications catalogue, SAP equipment listing, IQReview (preventative maintenance equipment listing), etc.
- Digital cable sources: Pericles database (originally installed electrical cables database); cable number allocation database and cable list of electrical cables installed through modifications; electrical cables have since been consolidated into a list of cables both in the scope and those excluded from the SALTO scope LIS L1124-EL-LIS-003 and have been actioned for migration into an electrical cable database.
- Plant documents – scoping sources: system designs files (DSEs); plant drawings such as P&IDs (process & instrumentation drawings) and isometric drawings; the Koeberg Safety Analysis Report (SAR), etc.
- Plant documents – ageing management sources: working procedures; operating procedures; operator training manuals; Devonway; SAP history; IQReview strategies; etc.

The interim report 240-156945472 (*SALTO Ageing Management Assessment Report*) provides the process used for scoping using various input sources.

B.1.1.5 Scope setting results

The number of items evaluated and considered for the SALTO scope totals 209 774. These items include components, structures, and parts. The result of the establishment of a consolidated AM scoping list can be found in Consortium document L1124-GN-LIS-018. In addition, the full SALTO electrical cables scope list is documented in list L1124-EL-LIS-003, (*Cable List*). A total of 36 965 electrical cables are included in the SALTO scope for ageing management, and 84 097 SSCs are included in the SALTO scope for ageing management.

These lists were provided to Eskom Design Engineering to incorporate into formal Eskom documents as tracked by the SALTO project (OD_3.8 and 3_10B (CR 121535-006 CA)).

B.1.1.6 Plant Walkdowns

Plant walkdowns were undertaken to confirm the completeness of the list of SSCs, whose failure may prevent SSCs important to nuclear safety from performing their intended functions, already included in the SALTO scope list. The scope of the plant walk-downs was limited to the most risk-significant components based on the current Koeberg PSA Risk Spectrum. The walk-downs confirmed that most of the non-safety items that pose a hazard to SSCs important to safety are structural items with fall-down/seismic hazards (and are located in Safety Related (SR) buildings such as diesel generator buildings, fuel building and electrical building); these items have typically been scoped into the civil structure scope. Two issues were identified during the plant walkdowns (and actions have been raised to track resolution of these), namely:

- A steel pipe, without trigram labelling, runs through room L441. The pipe is a potential source of a leak spray or localised flooding.
- Barrier door separating rooms L441 and L442 in the electrical building was found to be non-compliant with the requirement for fire barrier.

Result of the plant walkdowns are covered in 240-160675265 (*Plant-Walk-downs for SALTO Scope Confirmation Report).*

B.1.1.7 Commodity grouping of SSCs for LTO

To ensure that the ageing management evaluation is performed effectively in accordance with procedure 240-125122792 (*Koeberg Safety Aspects of Long-Term Operation (SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*), in-scope SSCs were arranged into commodity groups, where applicable. Commodity groups are a group of structures or components with characteristics such as similar design, similar materials of construction, similar ageing management practices, and operating under similar environments. Some components (for example, component supports, cable trays, cable tray supports, impulse lines, hangers, etc.) are not uniquely identified by plant trigrams. In-scope SCs that cannot be grouped into commodity groups are evaluated as stand-alone structures and components. A list of applicable commodity groups was developed and linked to associated SSCs.

A list of applicable commodity groups was developed and provided in L1124-GN-LIS-006A, (*IGALL Commodity Group Linking Table*).

B.2 MAINTENANCE PROGRAMME

B.2.1 Preventive maintenance programme

The plant process for determining the maintenance programme requirements forms part of the Koeberg integrated equipment reliability process. This process has been based on the recommendations contained in INPO AP-913 *(Equipment Reliability Process Description*) and aligned with the methodology employed by Electricite de France (EDF).

The top tier document governing the maintenance process is KSM-LIC-001 (*Requirements for the Control of Maintenance*). The purpose of this document is to define the requirements for the maintenance process and the controls to be in existence to comply with the requirements of the nuclear licence.

The requirements for the preventive maintenance basis are expanded on in KSA-913 (*Integrated Equipment Reliability Standard: Preventive Maintenance Basis*). This standard establishes the approach to preventive maintenance (PM) and defines the requirements and controls for managing the PM basis.

The process and responsibilities for the Koeberg Integrated Equipment Reliability Process are described in KAA-913 (*Integrated Equipment Reliability Process*).

The methodology used to identify the scope and determine the component ER classifications is described in the guide KGU-035 (*Integrated Equipment Reliability Process: Scoping and Classification of Components*). This methodology provides a structured approach to classify components in terms of their functional importance, duty cycle, and service conditions.

The methodology used to develop and maintain PM templates is described in the guide KGU 037 (*Integrated Equipment Reliability Process: Developing PM Templates*). A PM template is a pre-defined maintenance approach for a particular component type (or family of components) that lists significant failure modes, failure causes, and recommended PM tasks and task intervals.

The methodology used to develop and maintain PM strategies is described in the guide KGU 039 (*Integrated Equipment Reliability Process: Developing PM Strategies*). A PM strategy identifies and justifies the PM programme on a component level. It includes the required PM tasks and details, their respective task intervals, implementation recommendations, a justification for PM template deviations and selected tasks, and PM basis supporting information (the association of the component ER classification with the relevant PM template, influenced by the component-specific OE, results in the PM strategy and collectively forms the PM basis).

All mandatory PM task requirements resulting from the above process are documented in the list KLM-005 (*Mandatory Preventive Maintenance Listing*).

B.2.1.1 Preventive and predictive maintenance for the ageing mechanism of safety-related SCCs

The integrated equipment reliability process is described in KSA-913 and KAA-913.

Following the guides mentioned above, the PM templates define the proposed PM tasks and periodicities for families of components. They are developed based upon established EDF PM templates or using a failure mode analysis (FMA) approach with input from the EPRI PM templates or pre-existing maintenance bases. Post-maintenance history, operating experience, and vendor recommendations are required to be considered when developing PM templates. Actual and potential ageing mechanisms taken into account are reflected in the FMA. Most of the recently developed Koeberg PM templates are based on the associated EDF PM template, and the EDF PM template forms the basis for the recommended PM tasks and task intervals. For this reason, not all Koeberg PM templates identify the relevant failure modes and causes.

B.2.1.2 The plant approach to maintenance

The Koeberg maintenance programme comprises 12 elements (refer to KSM-LIC-001), which can essentially be grouped into the following four areas:

- Programme bases (development);
- PM task planning and scheduling (implementation);
- Perform preventive maintenance (execution);
- Feedback on PM implementation (control).

Programme Bases

The approach to developing the programme bases is based on AP-913 methodology, including determining the scope, the tasks, task frequencies, and developing a technical basis.

PM Task Planning and Scheduling

Once the PM strategy has been developed, it is implemented into the computer work management system (SAP). Then the service note is developed, including working procedures/instructions, bills of materials, and permit requirements. One technical aspect of the PM task planning and scheduling is the development and determination of acceptance criteria. Extensive acceptance criteria have been developed for condition monitoring tasks and are covered under the specific technology. A few examples are documented in the thermography guide KGM-005 (*Infrared Thermographic Inspections*) and procedure 36-53 (*In-Service Monitoring of Lubricating Oils and Hydraulic Fluids*).

Spare Parts

Spare parts are one of the technical aspects of preventive maintenance execution, although it is not part of the maintenance programme as detailed in KSM-LIC-001. Having the correct spare of the correct quality level is vital to fulfilling the objectives of the maintenance programme.

Spares assessment is defined in KAA-614 (*Control of Spares Assessments and New Stock Applications*).

Post-Maintenance Testing

The second technical aspect of executing the maintenance programme is post-maintenance testing.

KSM-LIC-001 prescribes that a process shall exist whereby equipment post-maintenance integrity is verified. Furthermore, post-maintenance requalification testing requirements and acceptance criteria shall be determined during the preparation phase of working documents.

Post-maintenance testing is governed by the following procedures:

- KSA-147 (*Investigating, Compiling, and Issuing of Work Packages including Post Maintenance Requalification Identification*)
- KAA-648 (*Administration and Responsibilities for Requalification Testing*)

Maintenance History

Maintenance history is governed by the standard KSM-015 (*Maintenance History Records*), which sets out the requirements for the generation of maintenance history records. The standard applies to both working procedure equipment history records (EHR) and history summaries.

B.2.1.3 Maintenance history and knowledge management feedback for maintenance programmes

Periodic reviews of the maintenance programme are performed through feedback loops based on component performance, history, and industry operating experience. The requirements for feedback on PM implementation are captured in KSM-LIC-001 (*Requirements for the Control of Maintenance*).

Maintenance history includes equipment history records (EHR), as-found condition codes, failures, craft feedback, performance monitoring, trending, and corrective action programme items.

Maintenance history capture starts with the standard KSM-015, which sets out the requirements for the generation of maintenance history records. The standard applies to both working procedure equipment history records (EHR) and history summaries.

New knowledge and research include sources such as EDF, INPO OE and reports, EPRI, benchmarking, self-assessments, and vendor and Eskom events. All these elements of operating experience are captured and tracked through the CAP programme software (DevonWay, previously EPMS).

B.2.1.4 Maintenance programme identification and links with ageing management programme for SSCs in the LTO scope

The preventive maintenance and equipment reliability is part of the plant programmes used, at Koeberg, for ageing management of important to safety SSCs. As documented in 240-149139512 (*Standard: Ageing Management Requirements for KNPS*), in the process of ageing management evaluation commodity groups and the associated degradation and ageing effects are identified, constituting ageing couples. The ageing couple is then linked to one or more management methods. The ageing management methods could be diverse, inclusive of preventive maintenance tasks, justifications (inclusive of acceptance of risk of failure), mitigation, monitoring, surveillances, or any other acceptable method.

B.3 IN-SERVICE INSPECTION PROGRAMME

B.3.1 Programme Description

The in-service inspection (ISI) programme at Koeberg is governed by ASME Section XI requirements for the examination and testing of ASME Class 1, 2, 3, MC, and CC components and component supports. The programme has a ten-year inspection interval. Every ten years, the programme is updated to the latest ASME Section XI code edition and addendum in 10 CFR 50.55a. Koeberg entered the fourth ISI interval at the end of outages 122/222 for units 1 and 2, respectively.

To this end, Eskom selected the ASME Section XI edition 2007 to 2008 addenda as the base code for the fourth ISI interval. In addition to the ASME Section XI base code as limited by 10 CFR 50.55a, other internal and external requirements were considered during the compilation of this ISIPRM, as is also normal practice in the USA. In particular, the requirements of the South African Pressure Equipment Regulations were addressed by obtaining an exemption for nuclear safety-related equipment on the basis that the in-service inspection and test requirements for this equipment are covered by the ISI programme. Furthermore, the programme also serves to control inspections that are necessary for treating key integrity issues.

In terms of the configuration and structure of this document, historically, the required in-service inspections comprised two main categories, each consisting of several modules, (i) the basic scope modules based on ASME Section XI requirements, and (ii) the augmented scope modules based on Koeberg-specific integrity concerns and/or international operating experience. Each module addressed a specific theme; however, together, they form the in-service inspection programme requirements manual (ISIPRM) for Koeberg Nuclear Power Station. For the fourth interval ISIPRM, this approach has changed in that all the basic and augmented modules were combined into one single document.

B.3.2 Evaluation of the ISI programme

Since the start of the 4th ISI interval, the ISIPRM (240-119362012) had undergone a full review. During the review of the ISIPRM, extensive research and benchmarking were performed to establish whether any new inspection requirements were required to be implemented in the 4th interval or for existing requirements to be removed from the 4th interval. This benchmarking and investigation were mainly attributed to EDF OE, as well as some insights from US in-service engineering consultants. All the relevant industry changes were summarised, and their applicability to Koeberg was highlighted. The results and feedback of the benchmarking/investigations have been evaluated, and the necessary actions raised. Additionally, the ISI programme engineers have established links with industry experts (EDF counterparts, ISI programme owners group etc.), as well as regulatory-related subscriptions to, e.g. the NRC Federal Register, the NNR, and others to ensure that industry experience, developments, or prescriptions are timely reviewed for programme impact.

The existing ISI programme was evaluated against the IGALL AMP 102, and there were no gaps identified. The programme has been evaluated against the nine IAEA attributes of an effective programme and was found to be consistent even though it is not structured in that manner.

Procedure 240-110745414 (KSA-021), which provides the requirements for ISI records generation and maintenance, states that records of ISI / IST examinations and tests, applicable procedures applied, and reports shall be retained as permanent records for the life of the plant. Such records shall be retained in a manner that allows access by the regulatory authority and shall be stored under conditions that will preserve their quality for the life of the plant.

Implementation of this requirement is the responsibility of the Inspection and Test (I&T) line group. Procedures that control the implementation of this requirement, including processes for measuring the retrievability and quality of records generated, are in place. These records are stored in the ISI vault.

The qualification process for the methodology, equipment, and personnel that are part of the ISI process are documented in 331-172 (*Standard for Repair/Replacement of Installed Mechanical Components*), 240-123588530 (*Non-Destructive Testing – Qualification of NDT Systems*), and 240-123597938 (*Non-Destructive Testing – Process and Responsibilities for Qualifying NDT Systems*).

In accordance with NRC approved utility requirements and practices, Eskom has selected the risk-informed (RI) methodology for examining piping welds. ASME Section XI examination categories B J, C-F-1, and C-F-2 contain the requirements for the non-destructive examination (NDE) of Class 1 and 2 piping welds. Class 3 piping welds have no NDE requirements other than VT-1 and VT-2 in ASME Section XI. In 2005, a risk-informed methodology for the in-service inspection of Class 1 and 2 piping welds was applied at Koeberg such that the risk-informed examination requirements superseded those of ASME Section XI, examination categories B-J, C-F-1, and C-F-2.

The NRC-approved risk-informed in-service inspection (RI-ISI) process used is described in the Electric Power Research Institute (EPRI) Topical Report TR-112657. The initial RI-ISI application was also performed using code case N-578-1 for guidance. Since that time, ASME Section XI has incorporated the criteria of code case N-578-1 into non-mandatory Appendix R. Therefore, the current RI-ISI application is also conducted in a manner consistent with ASME code case N-578-1, (Risk-Informed Requirements for Class 1, 2, and 3 Piping, Method B) and ASME Section XI non-mandatory Appendix R (Risk-Informed Inspection Requirements for Piping), using Supplement 2. If the requirements of code case N-578-1 and ASME Section XI non-mandatory appendix R differ, the criteria of code case N-578-1 take precedence.

B.4 SURVEILLANCE PROGRAMME

B.4.1 Safety-related surveillance manual

The safety-related surveillance manual (SRSM) defines the objective of the surveillance programme and specifies the scope and validity of the periodic test requirements. It further describes the principles for periodic testing and defines the form and manner in which periodic testing is performed. SSCs that perform safety functions (as credited in accident and safety studies) are subject to the SRSM periodic test programme.

To ensure that the designed level of safety is maintained, the periodic test programme assures that:

- there have been no adverse changes to the reference design;
- the plant remains compliant with the assumptions made for the SAR accident studies;

- the operability (performance and reliability criteria) for protection and safeguard SSCs are verified;
- the availability and operability (performance and reliability criteria) of safety-significant and SSCs required by the incident and accident procedures are verified.

B.4.2 In-service testing

The intent of the in-service testing (IST) programme is to establish assurance on the operability readiness of design safety class components under all design basis conditions. This assurance is established by means of a variety of periodic surveillances. The operability readiness statement confirms that the design basis safety functions of IST components remain within acceptable limits.

The components within the scope of the IST programme are pumps and valves that are classified as ASME Code Class 1, 2, 3, and MC. The scope meets the in-service test requirements as outlined in the ASME OM code. Other components whose function is credited in the safety analysis report (SAR) or operating technical specifications (OTS) are also included in the scope.

Because the IST programme is continuously revised every 120 months throughout the operating licence period, the entire scope remains monitored over the operating licence period. The results are trended to proactively identify degradation before failure occurs or applied to assess the current condition of a component and facilitate future predictions such as refurbishment. The captured results are then documented and saved in the IST database.

The acceptance limits established for IST components are based on OM code provisions or limits specified in technical specifications, SAR, protection files, or other licensing basis documents, whichever are more conservative. Acceptance limits are derived from ranges or multiples of reference values in the OM code to ensure that limits specified in the licensing basis are not exceeded. When results do not meet the acceptance limits, an evaluation is performed to identify the cause of the unacceptable performance, and appropriate corrective actions are taken. Actions include corrective maintenance measures such as adjustment, repair, or replacement of defective items to prevent recurrence.

240-97087308 (*In-Service Testing Programme Requirements Manual*) (ISTPRM) establishes testing and examination requirements to assess the operational readiness of certain components important to nuclear safety. These requirements apply to:

- Pumps and valves required to perform a specific function in shutting down the reactor to a safe shutdown condition, in maintaining a safe shutdown condition, or in mitigating the consequences of an accident;
- Pressure relief devices that protect systems or portions of systems that perform one or more of the three functions above;
- Dynamic restraints (snubbers) used in systems that perform one or more of the three functions above or to ensure the integrity of the reactor coolant pressure boundary.

B.4.3 Effectiveness of surveillance programmes

As detailed in the programme guide 331-148, it is the programme engineer's responsibility to consider operating experience and research and findings in the programme. Currently, Koeberg (IST) is a member of the in-service testing owners group (ISTOG) platforms whereby information is exchanged on code interpretations, utility benchmarking, etc. In addition, the NRC website is also used for the review of approved code cases and any further developments for ASME code editions.

Internally at Koeberg, the corrective action process described in KAA-688 is followed whereby the programme engineer is allowed to review the operating experience and, if applicable, the programme will be updated accordingly. Similarly, a cross-functional review is performed during the modification process for programme impact assessment.

Continued monitoring is also used to identify failures, malfunctions of components, or timing of maintenance activities, etc.

B.5 WATER CHEMISTRY PROGRAMME

The main objectives of primary water chemistry control are to (as stated in KBA0022CHEMJUSTIF2, where the Chemistry basis and justification for all chemistry parameters can be found):

- Ensure primary system pressure boundary integrity,
- Ensure fuel cladding integrity and achievement of fuel design performance,
- Minimise out-of-core radiation fields, and
- Ensuring plant condition for long-term operation.

Control of the primary plant chemistry at KNPS is based on a modified elevated pH programme aligned to the EPRI pressurised water reactor primary water guidelines. The current pH programme has been implemented since 2010 (cycles 119 and 218) and is aimed at a target pH of 7,25 (at operating temperature, pHT) while also respecting the fuel vendor limit on lithium concentration at the beginning of a cycle. The target pHT is maintained by adjusting the lithium concentration in coordination with the boron (boric acid) concentration as it changes throughout the fuel cycle by dilution (and boration). This regime supports long-term operation since elevated pHT reduces corrosion and corrosion product transport and hence minimises the activation of corrosion products. Corrosion initiating impurities or contaminants (e.g. chloride, fluoride, sulphate) are maintained as low as achievable in the reactor coolant, the spent fuel pool system, and the make-up water systems. Hydrogen overpressure is maintained on the primary system to ensure that oxygenated radicals formed by radiolysis of water molecules recombine to prevent the production of oxygen during power operation, which would lead to accelerated corrosion of the system materials.

Activated corrosion products (e.g. cobalt-58) and other species which could lead to source term accumulation are routinely trended. Since 2014 / 2015 (fuel cycles 121 / 221), depleted zinc acetate has been added to the reactor coolant to reduce out-of-core radiation fields, and dissolved zinc is also mitigation for the initiation of stress corrosion cracking of the system components. Fuel cladding integrity is confirmed by monitoring fission products (e.g. iodine isotopes and noble gas) in the primary coolant,

and primary-to-secondary leak rate is determined by radionuclide comparative analysis with activity present in the steam generator blowdown. The technical operating specification chemistry control parameters are listed in the Koeberg Chemistry Specifications (OTS-KCS) along with action levels, limit values, and surveillance frequencies. OTS-KCS also contains the actions to take when a parameter limit value is exceeded. The diagnostic parameters with limit values, target values, and analysis frequencies are included in KNC 001.

The main objectives of secondary water chemistry control are to:

- Protect the steam generators from degradation,
- Minimise flow accelerated corrosion,
- Minimise corrosion product transport,
- Minimise the introduction of impurities and
- Ensuring plant condition for long-term operation.

Secondary plant chemistry is controlled by adding volatile alkalising agents (all volatile treatment) to prevent general corrosion of the mainly carbon steel feed-train (all ferrous) and maintaining low dissolved oxygen to protect the steam generator nickel-alloy tubing material. Hydrazine is continuously added to the feedwater to maintain reducing conditions. During 2000 / 2001, both units commenced advanced amine treatment by injecting ethanolamine (ETA) into the feedwater to limit flow-accelerated corrosion (FAC) in the two-phase (steam/water) regions such as the moisture separator reheaters and the bled steam lines. In 2013, this regime was optimised according to Koeberg operating experience and international practices. Steam generator secondary chemistry technical specification controls include monitoring of pH, cation conductivity and sodium.

Actions to take when these limit values are exceeded are stated in OTS-KCS. Diagnostic parameters are listed in KNC-001 and KNC-002. The condensate polishing plant is bypassed under normal plant operation and is available to be placed in-service to clean up the secondary water and to protect the SGs from impurity ingress, should this occur.

Chemistry monitoring is performed on a routine schedule and trends are analysed to ensure that target values are achieved. Chemistry performance is assessed using the WANO chemistry performance indicator (CPI) and the INPO chemistry effectiveness indicator (CEI) as a tool to support long-term operation.

Plant chemistry is controlled during all operating domains, including start-up and shutdown of units, unit transients and for periods of non-operation (e.g. outage). These operational control procedures are:

- KWC-CH-001 (Chemistry Control of a Unit during Start-up from Normal Cold Shutdown to Full Power Operation);
- KWC-CH-002 (Preparation of the Feedwater Plant for Starting Up a Unit after Shutdown);
- KWC-CH-003 (Steam Generator Hide-Out Return Sampling and Analysis);
- KWC-CH-004 (Chemical Control of a Unit during Shutdown);

- KWC-CH-005 (Secondary System and Steam Generator Conservation);
- KWC-CH-006 (Chemistry Procedure for Degassing and Oxygenation of the Primary Circuit);
- KWC-CH-007 (Feedwater Pump Flushing);
- KWC-CH-008 (Chemistry Control from Hot Shutdown Conditions to Full Power Operation);
- KWC-OP-SDA-002 (Chemistry Procedure for Operating the Water Production Plant); and
- KWC-ATE-003 (Chemistry Procedure for Operating the Condensate Polishing Plant).

Producing high-purity process water at the water production plant is essential for the chemistry operational effectiveness.

The quality of plant process chemicals is assured by analysis before acceptance, and all chemical products must comply with KAA 751 (*Chemical Restrictions and Control at Koeberg*).

Transformer insulation oil, turbine and pump lubrication oil, hydraulic fluid and diesel fuel systems are included in the Chemistry Operating Specifications, and microbiological surveillance is also performed on various systems.

Effluent discharge is monitored by implementing surveillance criteria and adhering to the environmental release limits based on legislative requirements (Department of Environmental Affairs and KNPS Radiation Protection Standards) and waste minimisation good practice. The Environmental Survey Programme monitors the area surrounding the plant for radionuclides that are potentially produced by KNPS as is required by the National Nuclear Regulator (NNR).

Worker health aspects and safety regulations are taken into account in developing specifications (Hazardous Chemical Regulations).

Chemistry operating specifications of plant systems are documented, and deviation is managed in accordance with KAA-688 (*The Corrective Action Process*). Chemistry results from plant-installed online analysers and laboratory grab sampling are recorded in the laboratory information management system (LIMS) database. The LIMS provides alarms for out-of-trend and out-of-specification parameters. Analysis methods are validated, and results are reported after quality control (QC) samples pass statistical process control criteria. QC processes are documented in KSC-001 (*Radiochemistry*) and KSC-004 (*Analytical Chemistry*).

B.6 CORRECTIVE ACTION PROGRAMME

This section describes the corrective action programme in Koeberg nuclear power plant (KNPS).

The corrective action process for Koeberg is captured in document KAA-688 (*The Corrective Action Process*), and its objective is:

- to describe the process and responsibilities for identifying, reporting, investigating, and trending occurrences, problems, events, conditions, and near misses as well as ageing-related degradations;

- to ensure that operating experience information is duly identified, screened, classified, investigated, distributed, and tracked to identify actions to improve nuclear safety, conventional safety, health and environment, to prevent events from recurring, and ensure continuous improvement; and
- to establish uniform practices for reporting, recording, classifying, investigating, and closing out occurrences, problems, events, conditions, and near misses.

The identification and reporting of occurrences, problems, incidences, conditions, events, or near misses, including ageing-related degradations, is the responsibility of each person working at KNPS. The process administrators are responsible for capturing the relevant coding to their department's items in DevonWay (software system for capturing, tracking, and managing issues).

A condition report (CR) is raised for any problem, occurrence, event, anomaly, or incident that has (or has the potential to have) negative consequences for Koeberg Nuclear Power Station or affect conventional or nuclear safety that is within the concern or influence of Koeberg Nuclear Power Station within 48 hours of the event. A CR can be raised by any employee or contractor in either hand-written condition report form or completed electronically on ActionWay.

The Koeberg operating shift manager is responsible for reviewing the submitted CRs daily and assigning an initial grading in accordance with KLA-005 (*Koeberg Event Classification and Reporting Criteria Listing*) to CRs that have a plant impact or notification requirements. CRs that do not have a plant impact or notification requirements are forwarded to the KEG group without grading. The shift manager also evaluates incoming CRs for any possible operability determinations. If there is an operability concern, the operating shift manager shall evaluate the equipment to determine whether there is a further concern with a common cause or a common mode failure.

The Koeberg Event Group (KEG) is responsible for coordinating the review and evaluation of all condition reports, tracking them as required, and trending close-out actions related to the CRs.

APPENDIX C
AREA C REVIEWER'S INFORMATION: AGEING MANAGEMENT OF MECHANICAL SSCS

C.1 AMR OF MECHANICAL SSCS

C.1.1 REQUIREMENTS

In 2019, the NNR issued RG-0027, which provides the requirements for ageing management and LTO for NPPs. The AME activities required by RG-0027 are provided in Section 6 of the regulatory guide and can be categorised into three main activities, namely:

- Commodity grouping;
- Review of ageing management programmes;
- Ageing management review.

To address the regulatory objectives and to ensure that the requirements mentioned above are achieved, the SALTO AME procedure 240-125122792 (*Koeberg Safety Aspects of Long-Term Operation (SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*) was developed, which provides a high-level process for performing the AME. This will ensure that the relevant ageing degradation mechanisms and ageing effects for in-scope SSCs are comprehensively identified and assessed, and that the ageing management programmes to manage the identified ageing effects and degradation mechanisms are in place.

Scoping of the mechanical evaluation was carried out in accordance with procedure 240-125839632 (*Koeberg Safety Aspect of Long-Term Operation (SALTO) Scoping Methodology*). For further details on the methodology and criteria for scoping of SSCs, refer to Area B, Appendix B.

To ensure that the ageing management evaluation is performed effectively in accordance with procedure 240-125122792 (*Koeberg Safety Aspects of Long-Term Operation (SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*), mechanical in-scope SSCs were arranged into commodity groups, where applicable.

C.1.2 Commodity Grouping

To ensure that the AMR is performed effectively, where applicable, the list of identified SSCs susceptible to degradation due to ageing was arranged into commodity groups, allowing the assessment of an entire group with a single review task.

In accordance with requirements stipulated in SALTO AME procedure 240-125122792, the methodology is based on the IGALL master table and the Koeberg AMM. The grouping of structures or components was based on similar design, similar materials of construction, similar ageing management practices, or similar environments. In-scope SSCs that could not be grouped into commodity groups were evaluated as stand-alone structures and components.

The commodity grouping process was performed using the COMSY software. Commodity groups were created, and in-scope SSCs were linked to their respective commodity groups.

The COMSY software tool is designed to support the commodity grouping processes. Based on the pre-defined structure of the IGALL master table and the Koeberg AMM, the COMSY software can link the in-scope SSCs stored in the COMSY ageing management database with categories, commodity groups, and sub-commodity groups.

To create the KNPS-specific COMSY ageing database, the following steps were followed:

- The ageing database was populated with information (material, temperature, medium, flow conditions etc.) for the in-scope SSCs.
- A list of commodity groups for in-scope SSCs was developed based on the IGALL master table and the Koeberg AMM. In-scope items that could not be grouped into commodity groups were listed as stand-alone structures and components.

There were 571 mechanical commodity groups identified through the commodity grouping process. L1124-GN-LIS-027 (*AME Data Sheet for Commodity Grouping*) provides a comprehensive list of commodity groups for each discipline and the associated SSCs.

C.1.3 Ageing management review for mechanical SSCs

The ageing management review (AMR) for in-scope SSCs (commodity groups and stand-alone items) was performed to demonstrate that ageing management at KNPS is comprehensive and that ageing concerns will be effectively managed so that the intended function(s) of the SSCs is maintained for the period of extended operation through LTO.

The ageing management review (AMR) was performed in accordance with procedure 240-125122792 (Koeberg Safety Aspects of Long-Term Operation (SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses).

The ageing management review systematically assessed the ageing effects and their related degradation mechanisms that are experienced or are anticipated for specific commodity groups and SSCs. This was conducted to assure the ability of the SSCs to perform their intended function(s) throughout the extended plant life.

The results of the ageing management review are documented in the COMSY data sets L1124-GN-LIS-027 and in Mechanical Degradation Assessment Results Report L1124-GN-RPT-023. These reports provide the identified potential ageing management gaps with recommended actions.

C.1.4 Ageing management results for mechanical SSCs

The results of the review and verification of the recommendations conducted by the Eskom technical team concluded with 18 corrective actions. These actions were raised for implementation by line groups as tracked under CR 116340 and loaded in DevonWay. Further details on the review, Eskom' decisions and the recommended actions can be found in 08016.ROD.023 (*Review of the Mechanical Ageing Management Evaluation*) (AME) and report L1124-GN-RPT-023 and Decisions by Eskom.

A summary of the actions are as follows:

- Ten new AMPs to be developed[1]:
  - AMP 112 - Thermal ageing embrittlement of cast austenitic stainless steel;
  - AMP 119 - One-time inspections;
  - AMP 120 - Selective leaching;
  - AMP 121 - One-time inspections Class 1 small-bore piping;
  - AMP 135 - Inspection of internal surfaces in miscellaneous piping and ducting components;
  - AMP 137 - Monitoring of neutron absorbers other than Boraflex;
  - AMP 154 - PWR pressuriser;
  - AMP 156 - PWR main coolant piping;
  - AMP 157 - Internal coatings and linings;
  - AMP 161 - High-cycle fatigue monitoring.
- Updates to existing programmes and maintenance activities:
  - Thermal Fatigue Programme;
  - Water Chemistry Programme;
  - Firewater system;
  - Preventive maintenance programme;
  - External surfaces monitoring of mechanical components;
  - Closed treated water systems;
  - Heat Exchanger Programme.

C.2 AMPs OF MECHANICAL SSCs

C.2.1 Description of existing Mechanical AMPs at Koeberg

Several AMPs exist at Koeberg and are briefly summarised below.

C.2.1.1 Anchor bolting programme requirements manual (ABP)

The scope applies to all the nuclear safety class 1, 2, and 3 tie-rods anchored to concrete structures with pre-stressing or installed through concrete walls and floors that are tightened by means of hydraulic tensioning equipment, namely, APG jet deflectors, ARE and VVP pipe whip restraints inside the reactor

[1] Several of these topics are addressed at KNPS by some method, but judged to be incomplete or insufficient.

building and lateral pipe restraints in the respective bunkers, snubber supports for steam generators and reactor coolant pumps, vertical supports for steam generators and reactor coolant pumps, cross-over leg cradle, pressuriser vertical support, reactor pit stopper units, and the PTR tank hold-down bolts. The programme verifies the as designed preloads for the anchor bolts.

C.2.1.2 Atmospheric stress corrosion cracking programme (ASCC)

The scope of examinations is an augmentation to the ASME required inspections contained in the ISIPRM AUG-14. Module AUG-14 contains a selection of components in the RIS, EAS, and PTR systems that are subjected to periodic visual inspection for leaks (typically every three months) or dye penetrant (PT) inspection (either 6-monthly, yearly, or 1RO). Updates to the 4th interval ISIPRM have been made to increase the inspection frequency of units 1 and 2 PT inspection scope. The intent is to ensure potential degradation remains within the safety case of ASCC affected equipment.

The programme manual 240-147386602 (*Atmospheric Stress Corrosion Cracking of Austenitic Stainless Steel Components*) is being drafted to provide the technical basis for the ASCC programme, stipulate the specific requirements for the programme, and set the acceptance criteria for inspections/programme elements as required by 331-148 (*Programme Engineer's Guide*).

C.2.1.3 Boric acid corrosion control programme (BAC)

Document 331-511 (KGU-036) (*Engineering Guide for Boric Acid Corrosion Control (BACC) Programme Management*) describes the scope for the Koeberg BACC programme. This document also describes the relationship between the BACC programme and KAA-802 (*Leak Management Process*). Leaks are reported to the BACC programme owner by the following processes:

- ISIPRM Module AUG-10 Safety Class 1, 2, and 3 Bolting Examinations;
- ISIPRM Module E-S, System Leakage Tests;
- ISIPRM Module AUG-14, ASCC; and
- KAA-802 leak management survey sheets.

C.2.1.4 Corrosion management programme (CMP)

The corrosion management programme (CMP) is developed to manage the long-term effects of atmospheric and process-related corrosion on the reliability and overall availability of the plant. The programme is currently fully developed as documented in 331-175 (*Inspection Guide for the Koeberg Nuclear Power Station Corrosion Management Programme*).

C.2.1.5 Fire programme

Life of plant plan (LOPP) KBA 0022 N NEPO LOPP 023 (*Fire Detection and Suppression Systems*) summarises the proposed maintenance and testing regimes and life cycle plan for the Koeberg fire detection and protection systems.

The majority of the fire protection systems remain as built according to the original contract. In specific cases, however, Koeberg has upgraded the original equipment to more modern technology or superior piping grades and schedules to maintain acceptable fire protection levels. The LOPP provides upgrades that have been performed on the fire systems. It also provides known and potential threats/ageing concerns on the fire systems.

The JPD system is the central distribution network and conveys water to all the other water-based systems. The system was originally constructed using galvanised steel pipe, which has become significantly degraded. The corrosion of JPD systems has the largest impact on the reliability of the fire protection system.

The pipework is suffering from severe corrosion, the principle mechanism being microbiologically induced corrosion. Tests have shown this to be a result of sulphate-reducing bacteria. Sulphate reducing bacteria survive very well in stagnant conditions, and the anaerobic conditions generated are no hindrance. The slightly rough internal surface of galvanised piping also assists the bacteria in finding a site for attachment. Once attached to the inner surface of the pipe, the organism creates a local acidic environment which leads to severe internal pitting and eventual through-wall leaks. Modification 91069 has been completed, and this modification replaced the most severely affected sections of the reticulation system with carbon steel.

The worst affected parts of the JPD system have already been replaced with a urethane lined pipe. This material provides the mechanical strength of steel with an inert inner lining resistant to MIC. Availability of the JPD system remains relatively unaffected as MIC-induced defects have a negligible impact on system flow requirements. Unavailability of the JPD system is limited to sectional isolations required to repair the defects, where a maximum period of unavailability is limited to less than 72 hours, according to OTS.

The chemical clean-up of the JPD system was executed in the 3rd quarter of 2006, and a manual dosing system was installed on 9 JPD 001 BA. However, chemical dosing was stopped during the 3rd quarter of 2009 due to the environmental impact of the chemicals at Koeberg. Since then, the option of chemical dosing of the JPD system has been deemed not feasible and subsequently abandoned. It may still be necessary to replace the piping on the JPD, JPL, JPT, JPC, and JPP systems, depending on the frequency of future leaks.

The chemical clean-up programme notably reduced the frequency of MIC related failures, but the consequence of MIC remains extensive, and future leaks are possible. The leaks result in LCO entries on some fire systems but have never affected production. However, fire safety is affected because the fire protection capability is compromised for the duration of the repair.

The maintenance, testing, and monitoring regimes for the fire systems are captured on SAP and IQReview.

C.2.1.6 Flow-accelerated corrosion programme (FAC)

The Koeberg FAC programme covers the bulk of the secondary feedwater and turbine extraction steam heating systems, as well as the main feedwater system (ARE). Since Koeberg has adopted the EDF programme for FAC, the scope of piping included in the BRT CICERO™ predictive software is consistent

with the scope generated by EDF. In addition, the Koeberg FAC programme is aligned with the requirements of EPRI NSAC 202L.

C.2.1.7 In-service inspection programme (ISI)

The in-service inspection (ISI) programme existing at Koeberg is governed by ASME Section XI requirements for the examination and testing of ASME Class 1, 2, 3, MC, and CC components and component supports. Eskom selected the ASME Section XI edition 2007 to 2008 addenda as the base code for the fourth ISI interval. In addition to the ASME Section XI Base Code as limited by 10 CFR 50.55a, other internal and external requirements were considered during the compilation of this ISIPRM, as is also normal practice in the USA. In particular, the requirements of the South African Pressure Equipment Regulations were addressed by obtaining an exemption for nuclear safety-related equipment on the basis that the in-service inspection and test requirements for this equipment are covered by the ISI programme. Furthermore, the programme also serves to control inspections that are necessary for treating key integrity issues.

C.2.1.8 In-service testing programme (IST)

The IST programme establishes the testing and examination requirements for periodically assessing the operability readiness of certain ASME Code Class 1, 2, and 3 components important to nuclear safety. These requirements apply to pumps, valves, dynamic restraints, relief valves that are required to perform a specific function in shutting down the reactor to a safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident.

Other non-code class components with a safety function credited in the SAR, OTS, or accident analyses and with one or more of the design functions specified are also included in the ISTPRM. They are treated as augmented components, included in the test plans, attachments, and tables (including emergency diesel generators).

C.2.1.9 Microbiologically-induced corrosion programme (MIC)

This augmented programme Module AUG-15 specifies the inspections and monitoring activities on all applicable systems at Koeberg Nuclear Power Station to address potential MIC concerns in fluid-retaining safety-related systems. Starting with the 4th interval ISIPRM, the non-safety-related systems have been excluded from AUG-15, and will be addressed as part of the corrosion management programme (CMP).

C.2.1.10 NSSS design transients monitoring programme (DTM)

The Nuclear Steam Supply System (NSSS) transient monitoring programme is a result of a National Nuclear Regulatory (NNR) requirement as documented in 36-197 (*Koeberg Licensing Basis Manual*) Annexure C (*Operations; Principle Requirement 2; Functional Area: Operational limits and conditions*). The purpose of tracking the transients is to ensure compliance with the Koeberg design basis for all Safety Class 1 piping and pressure vessel components. The design basis is a set of analysed conditions within which the safe operation of the plant is assured. Should any of these transients be exceeded or become at risk of being exceeded, either re-analysis of the operating parameters and design base accidents would

have to be performed, plant components replaced, or increased specific inspections put in place to monitor the affected components. The design base transients for Koeberg are defined and described in document KBA0022E00006 (*Nuclear Steam Supply Design Transients*).

The primary piping and pressure vessel components are designed and manufactured to withstand all loadings arising from power station operation while remaining within safety limits. The conditions for which the equipment must be designed, in accordance with ASME Code Section III, Division 1, Subsection NB are as follows:

- 1st category situation – design condition;
- 2nd category situation – normal and upset condition;
- 3rd category situation – emergency condition;
- 4th category situation – faulted condition.

A list of transients detailing pressure, flow and temperature fluctuations over time is used to complete the equipment analyses for 2nd, 3rd, and 4th category situations.

The design transient list considers that the primary system pressure components will be subjected to a finite number of transients during the 40-year operational life of the power station. The equipment calculations (specifically the cumulative usage factor determining their acceptable fatigue life) justifying the structural integrity of the safety class components are based on these limits. For this reason, the transients that occur during power station operation are identified, recorded, and reported in accordance with procedure KAA-652.

Accounting of transients is a function within the Operating domain with guidance, training and overview provided by Engineering (Programmes Engineering Department: Materials Reliability Group). Following every fuel cycle on each unit, a transient report is presented to the Koeberg Operations Review Committee (KORC) and submitted to the National Nuclear Regulator for information.

C.2.1.11 Pressure equipment regulations programme (PER)

The scope of the pressure equipment subjected to the inspection and testing requirements of the PER are listed in procedures 240-115852755 (*Unit 1 Risk-Based Inspection Pressure Vessels and Steam Generators Inspection Maintenance and Testing Plan*) and 240-136828967 (*Unit 2 Risk-Based Inspection – Pressure Vessel Inspection Maintenance and Testing Plan*).

C.2.1.12 Preventive maintenance programme (PM)

The PM programme is discussed in § B.2.1.

C.2.1.13 Reactor pressure vessel management programme

The scope of the programme covers the RPV basic scope of examinations to be performed on the RPVs as driven by the basic scope of ASME Section XI, IWB-2500, and its attachments, the vessel internals (upper and lower) and the reactor vessel bottom and closure heads. Although it will be managed

independently, the RPV management programme also includes pressurised thermal shock (PTS) and the reactor vessel surveillance programme (RVSP).

C.2.1.14 Steam generator programme (SG)

The Koeberg steam generator management programme (SGMP) encompasses the inspection, repair, and online monitoring of the steam generators. 240-118809269 (*Steam Generator Management Programme*) describes the various elements of this programme, which is in line with NEI 97-06, Rev. 2 (2005), (*Steam Generator Programme Guidelines*). Koeberg has decided to align with the EDF SG maintenance and monitoring programme and strictly follow the requirements for SG monitoring and inspection. The specific outage inspections are identified by the SG engineer and formally issued to I&T, who controls the planning and execution via contract. The inspection reports are reviewed by EDF before the evaluation by the SG engineer is concluded and captured in report format (together with any required actions). Programme improvements (linked to local and international OE) and oversight are performed by the SG engineer.

C.2.1.15 Water chemistry programme

The water chemistry programme is discussed under § B.5.

C.2.1.16 Welding programme

The generic requirements for welding activities performed at Koeberg Nuclear Power Station are provided in document KNM-001 (*Maintenance Welding Programme*).

C.2.1.17 Thermal performance

The thermal performance programme (TPP) aims to maximise unit generator output and optimise plant steam cycle thermal performance under full power, steady-state operation. The programme focuses on turbine performance, efficient operation of the main steam, extraction steam, condensate, heater drains, feedwater and condenser cooling water systems, feedwater performance, condenser performance, and main generator power metering. While this programme directly interfaces with the core thermal power calculation (SHB / PHB), station service loads and equipment reliability, the administration and control of these technical areas are outside the scope of the thermal performance programme. Therefore, the thermal performance programme does not directly address core power calculations or system/component reliability monitoring. Document 331-272 (*Thermal Performance Programme*) defines the key attributes/elements, responsibilities, and performance criteria recognised by the nuclear power industry for an effective thermal performance programme.

The thermal performance programme (TPP) consists of five essential elements:

- Baseline and modelling;
- Performance goals;
- Monitoring and trending;
- Search and recovery; and

- Communications/reporting

C.2.2 Review of AMPs and results

The review was achieved by comparing the tasks originating from the KNPS maintenance databases and plant ageing management programmes with the generic IGALL AMPs. To facilitate the comparison, the IGALL AMP tasks were broken down into well-defined and subdivided tasks. If all IGALL AMP tasks were covered by tasks of a plant or maintenance programme, the existing AMP was deemed adequate due to its conformity with IGALL requirements.

The mechanical review is documented in report L1124-GN-RPT-030 and resulted in the following:

- 25× AMPs that meet the IGALL requirements;
- 8× AMPs that partially meet the IGALL requirements; and;
- 7× AMPs that need to be developed to meet the IGALL requirements.

C.3 TLAAS OF MECHANICAL SSCS

In accordance with RG-0027, for in-scope SSCs, Eskom identified all TLAAs and should demonstrate either that all these analyses will remain valid for the planned period of LTO or that the SSCs will be replaced, or that further operational maintenance or AM actions will be implemented.

The methodology is documented in 240-125122792 (*Koeberg Safety Aspects of Long-Term Operation (SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*).

C.3.1 Identification and Verification of Existing Plant TLAAs

The existing KNPS TLAAs were identified by the Consortium searching various input sources, including the Koeberg SAR, DSEs and other design-basis documents using key-words as documented in L1124-GN-RPT-022 (*Report on Verified List of Existing Koeberg Time-Limited Ageing Analyses*).

A review of international OE from stations with a similar design was also used to identify any further applicable TLAAs. These included:

- Tihange NPP;
- Doel NPP;
- Borssele NPP;
- Ringhals NPP;
- KORI 1 NPP;
- RE Ginna NPP;
- DC Cook NPP;
- Davis Besse NPP;

- North Anna and Surry NPPs;
- VC Summer NPP; and
- EDF CPY plants.

The review of international experience is documented in L1124-GN-RPT-027 (*Report on Operational Experience for the Review of Existing Koeberg TLAAs*).

C.3.2 REFERENCES NOT CONSIDERED AS TLAAS

During the TLAA search of the input sources, the following references shown below were identified. However, upon investigation, they did not fulfil the NNR or IAEA criteria and have not been considered TLAAs. Their exclusion is documented in L1124-GN-RPT-022.

- 331-260 (*Reactor Pressure Vessel – Cracking of the Core Barrel Bolts*);
- 331-262 (*Ferritic Inclusions – Significant Deficiency SD 027*);
- 240-141494955 (*Thermal Fatigue in the Mixing Zones on NSSS and BNI Piping*);
- 240-141494955 (*Thermal Stratification and Thermal Fatigue of the Dead End and Interspace Piping*);
- ISIPRM AUG 13 (*Main Steam Piping*).

Despite the documents mentioned above not being TLAAs, the SSCs referred to above are still included in the in-scope list and subject to the AME described in § C.1.2.

C.3.3 COMPARISON WITH THE IGALL TLAAs

The IAEA IGALL document, SRS 82, provides a list of typical TLAAs based on input from participating member states. The identified KNPS TLAAs were compared with the IGALL list of applicable pressurised water reactor TLAAs and tabled below as documented in L1124-GN-RPT-027.

Table 1: IGALL TLAA Comparison

TLAA title	Existing KNPS TLAAs	Additional IGALL TLAAs required by KNPS
IGALL TLAAs for mechanical components		
TLAA101 Low-Cycle Fatigue Usage	X	
TLAA102 RPV Neutron Embrittlement	X	
TLAA103 Crack Growth Analyses	X	
TLAA104 Corrosion Allowances		X
TLAA106 Environmentally Assisted Fatigue		X
TLAA107 High-Cycle Fatigue for Steam Generator Tubes		X
TLAA108 Fatigue of Cranes		X

TLAA title	Existing KNPS TLAAs	Additional IGALL TLAAs required by KNPS
TLAA109 PWR RPV Internals Swelling		X
TLAA110 Thermal Ageing of Cast Austenitic Stainless Steels	X	
TLAA112 Main Circulation Pump Flywheel		X
TLAA115 Fatigue and Thermal Ageing Analysis of Manufacturing Flaws	X	
TLAA116 Thermal Ageing of Low Alloy Steels	X	
TLAA117 Under-Clad Cracking	X	
TLAA118 Components with Undocumented Restrictions On Operation		X
TLAA119 High-Cycle Thermal Fatigue		X
TLAA120 PWR RPV Internals Vibrations		X
TLAA121 IASCC Fluence Limit for Stainless Steel		X
TLAA122 Thermal Ageing of Martensitic Stainless Steels		X

C.3.4 VALIDATION OF TLAAs APPLICABLE TO KNPS FOR 60 YEARS

Based on the identification efforts, a comprehensive list of all the KNPS TLAAs was compiled in L1124-GN-LIS-010 (*Comprehensive List of Koeberg TLAAs*).

Each TLAA was researched and evaluated, and a report was generated per component or component type. These reports described the ageing mechanisms and effects relating to the components and their parts. The applicable IGALL TLAAs were identified for each of these components and any other potential degradation mechanisms (that could be linked to time-limited assumptions according to the insights and experience of the Consortium, particularly Framatome as the KNPS NSSS OEM). Where there were original analyses, these were then studied, and where possible, their TLAAs were validated and justified for 60 years.

As part of the steam generator replacement (SGR) project, modification no. 07092, the impact of reversing operation at reduced temperature (ORT) and possible thermal power uprate (TPU) was analysed. These analyses covered several of the TLAAs identified during the Koeberg SALTO assessment project and justified for 60 years as part of the SGR project work.

The TLAAs identified but not validated for 60 years by the consortium, or the SGR project, were recommended for creation, analysis, or re-analysis.

C.3.5 RESULTS

TLAA reports were generated per component. A list of these consortium documents is presented below. Where Framatome later updated documents, their document number is listed with the original Consortium number shown between brackets.

Document number	Title
D02-ARV-01-138-106 (L1124-GN-RPT-031)	Reactor Coolant Pumps
D02-ARV-01-142-242 (L1124-GN-RPT-032)	RPV Internals
D02-ARV-01-143-003 (L1124-GN-RPT-037)	Control Rod Drive Mechanism
D02-ARV-01-144-513 (L1124-GN-RPT-033)	Reactor Pressure Vessel
D02-ARV-01-144-514 (L1124-GN-RPT-034)	Reactor Pressurizer
D02-ARV-01-144-861 (L1124-GN-RPT-038)	Steam Generators
D02-ARV-01-145-030 (L1124-GN-RPT-035)	Main Coolant and Surge Lines
D02-ARV-01-146-690 (L1124-GN-RPT-036)	In-Core Instrumentation
D02-ARV-01-149-074 (L1124-GN-RPT-046)	Auxiliary and Secondary Lines

A comprehensive list of the TLAAs is provided in L1124-GN-LIS-010. Table 2 below lists the TLAAs still requiring validation for 60 years.

Table 2: TLAAs requiring validation for 60 years

No	Components	TLAA	Degradation Mechanism	References
1	Reactor pressure vessel	Additional TLAA	PWSCC in nickel alloys	L1124-GN-RPT-033
		Additional TLAA	Wear of the adaptor flanges on the unit 1 RPV head	
		Additional TLAA	Thermal stratification phenomenon	
2	Reactor pressure vessel internals	TLAA 106 Environmentally-assisted fatigue	Fatigue	L1124-GN-RPT-032
		TLAA 110 Thermal ageing of cast austenitic stainless steels	Thermal ageing	
		TLAA 120 PWR RPV internals vibrations	Vibration degradation	
		TLAA 122 Thermal ageing of martensitic stainless steels	Thermal ageing	
		Additional TLAA	RPV internals neutron embrittlement	
3	Steam generators *(this will be done under SGR)*	TLAA 106 Environmentally-assisted fatigue	Fatigue	L1124-GN-RPT-038
4	Pressurizer	TLAA 103 Crack growth analyses	Liquation and solidification cracking of spray nozzles	L1124-GN-RPT-034
		TLAA 106 Environmentally-assisted fatigue	Fatigue	
		TLAA 115 Fatigue and thermal ageing analysis of manufacturing flaws and flaw tolerance	Liquation and solidification cracking of spray nozzles	
		Flaw tolerance calculation due to thermal ageing and fatigue	Liquation and solidification cracking of spray nozzles	

No	Components	TLAA	Degradation Mechanism	References
5	Reactor coolant pumps	TLAA 103 Crack growth analyses	Fatigue crack propagation	L1124-GN-RPT-031
		TLAA 106 Environmentally-assisted fatigue	Fatigue	
		TLAA 112 Main circulation pump flywheel	Fatigue	
6	Control rod drive mechanism	TLAA 106 Environmentally-assisted fatigue	Fatigue	L1124-GN-RPT-037
7	Main coolant lines and surge lines	TLAA 106 Environmentally-assisted fatigue	Fatigue	L1124-GN-RPT-035
8	Auxiliary and secondary lines	TLAA 106 Environmentally-assisted fatigue	Fatigue	L1124-GN-RPT-046

The mechanical results are summarised in the table below.

Table 3: Mechanical TLAA Result Summary

TLAAs	Mechanical
Existing TLAAs that are validated for 60 years of operation	66
Newly identified TLAAs that were validated for 60 years of operation	32
Components that still require analyses to validate them for 60 years of operation	8

C.4 VERIFICATION OF SCOPE SETTING RESULTS FOR MECHANICAL SSCS

The scope setting and verification for mechanical SSCs was performed and captured in report L1124-GN-RPT-041 (*SALTO Scoping and Verification for Koeberg Power Station*).

C.5 DATA COLLECTION AND RECORDKEEPING FOR MECHANICAL SSCs

Procedures KSA-011 (*The Requirements for Controlled Documen*ts), KAA-500 (*The Process for Controlled Documents*), and 331-3 (*Document and Records Management Work Instruction*) provide the documentation and records management processes, including the requirements for recording keeping. Each plant programme will have specific data collection and recordkeeping requirements.

C.6 DOCUMENTATION OF AGEING MANAGEMENT AND DOCUMENTATION IN SUPPORT OF LTO FOR MECHANICAL SSCS

The following processes exist for ageing management at KNPS:

- Ageing Management Standard

  240-149139512 (*Ageing Management Requirements for Koeberg Nuclear Power Station*) was developed to provide overall requirements for the ageing management of equipment important to safety at KNPS and to meet the requirements of RG-0027. The standard provides the requirements and the framework for physical ageing management processes at KNPS for the life of the plant, including LTO. It covers all stages of equipment life of the plant, that is, design, construction, manufacturing, commissioning, operating, LTO, suspended operation, and decommissioning.

- Process for the development and control of ageing management (AM) at Koeberg Operating Unit.

  331-275 (*Process for the Development and Control of AM at Koeberg Operating Unit*) describes the process used to manage (develop, control, and update) the Koeberg AMM, including the roles and responsibilities for updating the information contained therein. The document further describes the Koeberg AMM oversight roles and how ageing aspects requiring improved management are corrected. It demonstrates how the effects of ageing degradation are managed and monitored for the in-scope SSCs throughout plant operating life, including the planned period of LTO.

- Programme engineers' guide

331-148 (*Programme Engineers' Guide*) guides programme engineers who develop, maintain, optimise, and perform programme oversight on the ageing management programmes allocated to them.

- Ageing management matrix

  240-101650256 (*Koeberg Ageing Management Matrix*) is used to identify the ageing mechanisms relevant to KNPS and the SSCs affected by ageing mechanisms or degradations that can affect equipment life or capability. 08016.ROD.017 (*Adoption of COMSY Database for Ageing Management at KNPS*) recorded the Eskom decision to use commodity groups from the IAEA IGALL master table for ageing management at KNPS, and adopted the COMSY software tool to support this. COMSY will replace the current Koeberg AMM.

APPENDIX D
AREA D REVIEWER'S INFORMATION: AGEING MANAGEMENT OF ELECTRICAL AND I&C SSCS

D.1 AMR OF ELECTRICAL AND I&C SSCs

D.1.1 AMR requirements

In 2019, the NNR issued RG-0027 which provides the requirements for ageing management and LTO for NPPs. The AME activities required by RG-0027 are provided in section 6 of the regulatory guide and can be categorised into three main activities, namely:

- Commodity grouping;
- Review of ageing management programmes;
- Ageing management review.

To address the regulatory objectives and ensure that the requirements mentioned above are achieved, the SALTO AME procedure 240-125122792, (*Koeberg Safety Aspects of Long-Term Operation (SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*) was developed, which provides a high-level process for performing the AME. This confirmed that the relevant ageing degradation mechanisms and ageing effects for in-scope SSCs had been comprehensively identified and assessed, and the ageing management programmes to manage the identified ageing effects and degradation mechanisms are in place.

Scoping of the electrical, instrumentation, and control (EI&C) SSCs was carried out in accordance with procedure 240-125839632 (*Koeberg Safety Aspect of Long-Term Operation (SALTO) Scoping Methodology*). For further details on the methodology and criteria for scoping of SSCs, refer to § Appendix D.

To ensure that the ageing management evaluation is performed effectively in accordance with procedure 240-125122792 (*Koeberg Safety Aspects of Long-Term Operation (SALTO*) *Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*), EI&C in-scope SSCs were arranged into commodity groups, where applicable.

D.1.2 Commodity grouping

To ensure that the AMR is performed effectively, where applicable, the list of identified SSCs susceptible to degradation due to ageing was arranged into commodity groups. This allowed for the assessment of an entire group with a single review task.

In accordance with requirements stipulated in SALTO AME procedure 240-125122792, the methodology is based on the IGALL master table and the Koeberg AMM. The grouping of structures or components was based on similar design, similar materials of construction, similar ageing management practices, or similar environments.

The commodity grouping process was performed using the COMSY software. Commodity groups were created, and in-scope SSCs were linked to their respective commodity groups.

The COMSY software tool is designed to support the commodity grouping processes. Based on the pre-defined structure of the IGALL master table and the Koeberg AMM, the COMSY software can link the in-scope SSCs stored in the COMSY ageing management database with categories and commodities, and sub-commodity groups.

To create the KNPS-specific COMSY ageing database, the following steps were followed:

- The ageing database was populated with information (material, temperature, medium, flow conditions etc.) for the in-scope SSCs.
- A list of commodity groups for in-scope SSCs was developed based on the IGALL master TABLE and the Koeberg AMM. In-scope items that could not be grouped into commodity groups were listed as stand-alone structures and components.

There are 29 electrical commodity groups identified through the commodity grouping process. L1124-GN-LIS-027 (*AME Data Sheet for Commodity Grouping*) provides a comprehensive list of commodity groups for each discipline and the associated SSCs.

D.1.3 Ageing management review for electrical and I&C

The ageing management review (AMR) for in-scope SSCs (commodity groups and stand-alone items) was performed to demonstrate that ageing management at KNPS is comprehensive and that ageing concerns will be effectively managed so that the intended function(s) of the SSCs is maintained for the period of extended operation through LTO.

The ageing management review (AMR) was performed in accordance with procedure 240-125122792 (*Koeberg Safety Aspects of Long-Term Operation (SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*).

The ageing management review systematically assessed the ageing effects and related degradation mechanisms experienced or can be anticipated for specific commodity groups and SSCs. This was conducted to assure the ability of the SSCs to perform their intended function(s) throughout the extended plant life. The gaps are identified in 08016.ROD.022 (*Review of the Electrical, Instrumentation, and Control Ageing Management Evaluation*), which includes the update of the CAMP, developing new AMPs, and updates of engineering position papers.

The results of the ageing management review are documented in the COMSY data sets L1124-GN-LIS-027 and the Electrical Degradation Assessment Results Report, L1124-GN-RPT-025.

D.1.3.1 Ageing management results for electrical and I&C

The process followed to review the recommendations in report L1124-GN-RPT-025, the review results, and associated corrective actions were captured in ROD 08016.ROD.022 (*Review of the Electrical, Instrumentation and Control Ageing Management Evaluation Report with Decisions by Eskom*).

A summary of the actions are as follows:

- Six new AMPs are to be developed:
  - Environmental condition monitoring programme;
  - AMP 212 and AMP 215 – Electrical enclosures and switchgear and other active components, not subject to EQ requirements;
  - AMP 213 and AMP 218 – Whiskers and capacitors with liquid electrolyte; Electronic equipment not subject to EQ requirements
  - AMP 220 – Lightning protection and grounding grid not subject to EQ requirements.
- Updates to existing plant programmes/maintenance activities:
  - The existing cable ageing management programme (CAMP) with the additional scope of cables, cable connections, and associated measures required for different voltage levels.
  - Review the life-of-plant plan LOPP-162 for 6,6 kV/380 V dry-type transformers. This was complete, and some improvements were recommended according to Engineering Letter EA-20-108, discussed below.
- The following Nuclear Engineering Position Paper (NEPP) and Engineering letters have been compiled:
  - Nuclear Engineering Position Paper (NEPP) 240-160477589 (*Ageing Management of Oil-Filled Transformers*)
    - Based on the review of the PM programme requirements in IQReview for transformers, the role performed by the system engineer, the maintenance performed by EMS, the surveillance performed by Operating, and the quality management processes at KNPS, it is concluded that there is no need for an AMP for the oil-filled transformers at KNPS.
    - Additional actions have been raised, which includes an action to initiate replacement of the oil cooler banks on 1/2 GEV 001, 002 and 003 TPs (GA 40070 – ESE), initiate replacement of the online DGA devices on 1/2 GEV 001, 002 and 003 TPs and 1/2 GEV 001 TS (GA 40071 – ESE), and to investigate the susceptibility of KNPS to the effects of geomagnetically induced currents.
  - NEPP 240-135930056 (*Ageing Management Programme for Panels, Distribution Cabinets and Control Boxes*)
    - Based on the review of the PM programme requirements in IQReview the maintenance and surveillance strategies, it is concluded that there is no need for a new AMP for these components.
    - According to the engineering letter EA-19-080 (*Inspections of Panels, Distribution Cabinets and Local Control Boxes*), one-time visual inspections of a sample to identify

age-related degradation as described in AMP 212 have been performed and no anomalies were found.

* NEPP 240-147799448 (*6.6 kV Fuses and Fuse Holder*)
  - Based on the review of the PM Programme requirements in IQReview the maintenance and surveillance strategies, it is concluded that there is no need for a new AMP for these components.
  - SAP notifications 25009653, 25009658, 25009659 and 25009660 have been raised to remove sample fuses for testing to confirm striker pin operability in outages 138 and 238 during Outage 138 and Outage 238.
* NEPP 240-153058206 (*Low Voltage Fuses and Fuse Holders*)
  - Based on the review of the PM Programme requirements in IQReview the maintenance and surveillance strategies, it is concluded that there is no need for a new AMP for these components.
* NEPP 240-163295286 (*Ageing Management of Solenoid Operated Valves*)
  - Review of the maintenance practices, history, and OE relating to solenoid valve actuators, motor actuators and motors, and based on the review of the PM programme requirements in IQReview, the maintenance and surveillance strategies, it was concluded that there is no need for a new AMP for these components.
* Engineering Letter EA-20-108 (*Ageing Evaluation of the 6.6 kV / 380 V Dry-Type Transformers*)
  - Review of the 6.6KV / 380V dry-type transformers has been completed. A formal engineering letter EA-20-108, defining the required updates to LOPP KBA 0022 N NEPO LOPP 162 based on the review of IAEA IGALL AMP 211 issued (GA 39926) and for EMS to verify that the maintenance procedure KWM-EM-MAC-010 includes a visual examination of the transformer iron core for signs of coating damage and instruction to apply Glyptal coating to the damaged coating area to prevent future corrosion of the transformer iron core (GA 39870).
* Engineering Letter EA-20-174 (*Review of the existing LOPP, KBA 0022 N NEPO LOPP 045 – Batteries*)
  - The degradation mechanisms and detection of ageing effects for batteries, as specified by AMP 216, is adequately covered by the KNPS PM strategy for lead-acid batteries (LOPP KBA 0022 N NEPO LOPP 045 on Batteries). No further recommendations or actions are required.

- Engineering Letter EA-20-184 (*Electrical Penetration Assemblies*)
  - The letter concluded that the ageing management (that includes detecting the ageing effects) of electrical penetrations at KNPS is considered adequate, and no further action is required.

D.2 AMPs OF ELECTRICAL AND I&C SSCs

D.2.1 Description of existing programmes

D.2.1.1 Equipment qualification programme

Refer to EQ § D.3.

D.2.1.2 Cable ageing management programme (CAMP)

The cable ageing management programme (CAMP) aims to identify localised adverse environments and adverse service conditions that could lead to the early failure of electrical cables and related cable systems. It is also intended to manage significant ageing effects to preclude in-service failures as defined in procedure 331-127 (*Standard for Cable Ageing Management Programme at Koeberg Operating Unit*). In addition, the cable ageing management programme provides reasonable assurance that electrical cables are exposed to localised adverse environments. The CAMP provides documented evidence that the cables are suitably qualified and maintained to achieve their intended functions throughout their required service life, including the long-term operating (LTO) period.

The cable ageing management programme at Koeberg includes medium voltage (MV), low voltage (LV), instrumentation, control, and measurement cables, connectors, and terminations as described in the CAMP standard 331-127 (*Cable Ageing Management Programme at Koeberg Operating Unit*). Reference documents such as the EPRI guide 3002000557 for MV cables, EPRI 1020804 for LV cables, and EPRI 1021629 for I&C cables have been used during the development. Additional guidance from IAEA, NRC regulatory guides, and NUREG reports was considered in developing the CAMP for Koeberg.

In accordance with the IAEA Safety Report No 82 and the revised programme engineers guide 331-148 (*Programme Engineers' Guide*), the cable ageing management programme is structured in line with the nine attributes of an effective AM programme as defined in 331-148.

The electrical cables and cable systems at Koeberg meet the design specifications as described in KBA 0915 K09 016 (*Power, Control, Measurement Cables for DBA Conditi*ons) and KBA 0915 K09 001 (*Power Cables of 6,6 kV Rated Voltage, Technical Specification*).

Information related to specific cables can be found in the Pericles plant cable database and the MS Access design engineering cable database.

A comprehensive cable list has been developed for LTO based on a complete and accurate list of SSCs subject to ageing management review (AMR) and evaluation for long-term operation in accordance with the procedure 240-125839632 (*Koeberg SALTO Scoping Methodology*). The cable list provides a list of

all cables at all voltage levels. It provides different tabs for the different sample scopes selected for testing at various voltage levels and the applicable inspection requirements and periodicity.

D.2.1.3 PM programmes

Refer to Area B 2.1 Preventive maintenance programme.

D.2.2 Reviews of AMP against IGALL and the Results

The document L1124-GN-RPT-030 (*Comparison Report Existing KNPS Plant Programs with IGALL-AMP Requirements*), as well as L1124-GN-LIS-009B (*IGALL AMP Task Requirements Electrical*) provides the results of a review of existing KNPS programme tasks against that of IGALL as well as in-scope electrical and I&C components. A summary of gaps identified during the resulted in the following outcomes:

- 12× AMPs that meet the IGALL requirements.
- 3× AMPs that partially meet the IGALL requirements.
- 2× AMPs that need to be developed to meet the IGALL requirements.
- 3× AMPs that meet the IGALL requirements, however, the programmes are yet to be implemented.

These enhancements are included in the tasks tracked to completion by the SALTO project team (and in Devonway).

D.3 EQUIPMENT QUALIFICATION PROGRAMME FOR ALL SSCs

D.3.1 Harsh environments

The equipment qualification (EQ) standard 331-186 (*Environmental Qualification at Koeberg Operating Unit) requires that structures, systems, and components (SSCs*) important to safety at Koeberg remain functional under normal operation, abnormal conditions, and postulated accident conditions, in line with the EQ Rule 10 CFR50.49 (*Equipment qualification of Electric Equipment Important to Safety*). This EQ rule requires licensees to develop and implement a programme for qualifying the electrical equipment covered by its scope in line with 10 CFR 50 Appendix A, General Design Criteria (GDC).

The conditions used for equipment qualification for Koeberg are provided in the safety analysis report (SAR) II-1.11, Table T-II-1.11-1, and KBA 122 E 02038 (*General Specification for Qualification to DBA Conditions*).

A comprehensive list of components subject to equipment qualification requirements is given in the equipment qualification master list (EQML) provided in EQMM 331-219.

A qualified life is established for EI&C items within the scope of EQ for harsh environments based on initial qualification in which the ability of the equipment to perform its function important to safety is demonstrated. The current practice is to replace the qualified component at the end of proven life unless re-assessment and life extension justification is done based on the actual environmental conditions.

The qualified life of existing equipment has been re-assessed as part of the SALTO assessment project L1124-GN-RPT-018 (*TLAA - Equipment Qualification Report Rev. 4*).

D.3.2 Equipment qualification for mild environments

It is now common practice in other utilities to establish EQ requirements to qualify certain electrical and I&C equipment in mild environments. For equipment located in mild environments (environments that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences), it must be demonstrated that the equipment can meet its functional requirements during normal environmental conditions and anticipated operational conditions.

The scope and the requirements of certain safety-related electrical and I&C equipment located in mild plant environments are documented in document 240-130611911 (*Equipment Qualification Requirements for Safety Related Equipment Located in Mild Environments*). The main objective of the requirements in this document is to provide the basis for early detection and appropriate monitoring of ageing effects on I&C components whose correct operation is necessary to achieve the required safety functions or support safety functions but are not included in the EQ programme for harsh environments, to ensure adequate performance over the entire service life.

For equipment in mild environments, the requirements are mainly based on preventive plant maintenance (PM). A qualified life is not required for equipment located in a mild environment with no significant ageing mechanisms and is operated within the limits established by applicable specifications and standards. This is consistent with the international standard and practice according to IEC / IEEE 60780-323 (*International Standard: Nuclear Facilities – Electrical Equipment Important to Safety – Qualification*).

D.3.3 TLAA

In accordance with RG-0027, Eskom identified all required TLAAs and should demonstrate either that all these analyses will remain valid for the planned period of LTO or that the SSCs will be replaced, or that further operational maintenance or AM actions will be implemented.

The methodology followed is documented in 240-125122792 (*Koeberg Safety Aspects of Long-Term Operation (SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*).

D.3.3.1 Documentation of existing time-limited ageing analyses

The existing KNPS TLAAs were identified by the SALTO AM assessment project consortium searching various input sources, including the Koeberg SAR, DSEs and other design-basis documents using keywords as documented in L1124-GN-RPT-022 (*Report on Verified List of Existing Koeberg Time-Limited Ageing Analyses*).

A review of international OE from power stations with a similar design was also used to identify any further applicable TLAAs. These included:

- Tihange NPP;

- Doel NPP;
- Borssele NPP;
- Ringhals NPP;
- KORI 1 NPP;
- RE Ginna NPP;
- DC Cook NPP;
- Davis Besse NPP;
- North Anna and Surry NPPs;
- VC Summer NPP; and
- EDF CPY plants.

The review of international experience is documented in L1124-GN-RPT-027 (*Report on Operational Experience for the Review of Existing Koeberg TLAAs*).

The safety analysis report (SAR) Section II-1.11 references the equipment qualification of electrical equipment. Qualification documents are available on site for most of the original electrical and I&C components. They include specifications, test results, and an evaluation of the results, as summarised in seismic and DBA qualification summary document KBA 12 22 E02 034. All the on-site documents are available via the plant documentation databases. Some of the qualification documents for original equipment are available at the OEM repository.

D.3.3.2 List of existing time-limited ageing analyses

EQ time-limited ageing analyses are referenced in Section II-1.11 (*Equipment Qualification*) of the SAR of electrical equipment for accident conditions inside the containment.

A qualified life is established for EI&C items within the scope of EQ for harsh environments based on initial qualification in which the ability of the equipment to perform its function important to safety is demonstrated.

A list of in-scope qualified components for SALTO EQ TLAA has been compiled by the SALTO AM assessment project consortium and provided in document L1124-EL-LIS-001. All the items from the EQ master list, 331-219, located in harsh environments are included in the scope for the SALTO EQ TLAA.

Although a qualified life is not required for equipment located in a mild environment according to IEC / IEEE 60780-323, certain items, mainly transmitters located in a mild environment with defined qualified life, has been added to this list for the SALTO EQ TLAA.

D.3.3.3 Electrical TLAA requiring reanalysis for LTO

The complete scope of electrical and I&C components to be environmentally qualified and validated is documented in list L1124-EL-LIS-001 (*List of in-scope items for SALTO EQ TLAA*). The list of qualified

cables that provide the cable identification numbers and the cable types is provided in the document L1124-EL-LIS-004 (*EQ Cable List*).

The TLAAs of environmentally qualified equipment, as required by the IAEA IGALL TLAA 201, was performed, and the results were documented in the report, L1124-GN-RPT-018 (*EQ TLAA Report*), together with the associated results sheet L1124-EL-LIS-002 (*SALTO TLAA Result List*). This report justifies the extension of the qualified life (QL) for some components. Identified components with a QL shorter than 60 years require re-analysis or replacement (some before the start of the LTO period). Guidance and recommendations for electrical and I&C components given in IAEA IGALL TLAA 201, AMP 207, and AMP 209 were also used to determine the requirements or the EQ TLAA.

A total of 262 EQ components and 363 EQ cables are included in the scope of the EQ TLAA. The results of the EQ TLAA validation and verification are summarised below:

- 67× EQ items are periodically replaced, and this strategy will be maintained for LTO; therefore, there is no need to subject these items to further re-analysis.
- Some items (mainly transmitters in mild environments) were validated for LTO but not 60 years. They will have to be replaced before their QL expire.
- Some items were validated for 60 years.
- Some items were confirmed to be valid for 40 years and not suitable for LTO. These must be re-analysed, or the components must be replaced before the start of the LTO period.

The outstanding TLAA re-analyses have been contracted and are scheduled for completion in 2023. The first of these have been received, reviewed by Eskom and accepted.

D.3.3.4 Electrical TLAA results

The following items were subjected to re-analysis with comprehensive reports available for each item:

- Jeumont-Schneider Medium Voltage Motors - D02-ARV-01-181-583
- Valcor Solenoid Valves - D02-ARV-01-176-728
- Rotork Valve Actuators - D02-ARV-01-181-189
- AMRI Containment Isolation Valves - D02-ARV-01-182-258
- In-core Thermocouples of the RIC System - D02-ARV-01-181-612

D.4 TECHNOLOGICAL OBSOLESCENCE MANAGEMENT PROGRAMME

The Koeberg Nuclear Power Station, like many other nuclear power plants, is facing increasing demands related to the technological obsolescence (referred to as “obsolescence”) of SSCs. This is due to many original equipment manufacturers (OEMs) having terminated production and support of SSCs and their spare parts.

This puts KNPS in a vulnerable position since plant safety can be impaired if the obsolescence of SSCs is not identified in advance and corrective actions taken before the associated decrease in the reliability

or availability occurs. Some strategies to resolve obsolete SSCs include reverse engineering, replacement with newer models, modifications, or finding parts from other systems or organisations.

All SSCs important to safety and the associated spare parts that are deemed obsolete or in the process of being discontinued at KNPS were deemed to be in the scope of this programme.

The TOMP procedure is provided in 331-146, and the process for addressing obsolescence essentially has three main elements:

- Identification of obsolescence issues;
- Prioritisation of obsolescence issues;
- Developing and implementing solutions for obsolescence issues.

The process defined in 331-146 is in line with IAEA Specific Safety Guide (SSG)-48 and regulatory RG-0027 within the guidance from the Electric Power Research Institute (EPRI) and Institute of Nuclear Power Operations (INPO).

An obsolescence working group was established in accordance with 331-146 to guide and execute the aforementioned element. A prioritisation matrix has been created, and obsolete items are being added to the matrix. A priority score is being calculated on an ongoing basis. Obsolescence working groups have been set up to resolve issues, and several obsolescence strategies have been developed.

D.5 DATA COLLECTION AND RECORDKEEPING

The documentation and records management processes are performed in accordance with KSA-011 (*The Requirements for Controlled Documents*), KAA-500 (*The Process for Controlled Documents*), and 331-3 (*Document and Records Management Work Instruction*) provide requirements for record-keeping.

D.6 DOCUMENTATION OF AGEING MANAGEMENT AND DOCUMENTATION IN SUPPORT OF LTO FOR ELECTRICAL AND I&C SSCs

In Programmes Engineering, the AMPs are managed by the Material Reliability group (MRG). The ageing management programme engineer/technologist has been appointed to oversee the plant-level ageing management process, including implementation. MRG is responsible for continuous review of plant programmes and the creation of new AMPs, as required.

The following processes exist for ageing management at KNPS:

- 240-149139512 (*Ageing Management Requirements for Koeberg Nuclear Power Station*) was developed to provide overall requirements for the ageing management of equipment important to safety at KNPS and to meet the requirements of RG-0027. The standard provides the requirements and the framework for physical ageing management processes at KNPS for the life of the plant, including LTO. It covers all stages of equipment life of the plant, that is, design, construction, manufacturing, commissioning, operating, LTO, suspended operation, and decommissioning.

- Process for the development and control of ageing management (AM) at Koeberg Operating Unit. 331-275 (*Process for the development and control of AM at Koeberg Operating Unit*) describes the process used to manage (develop, control, and update) the Koeberg AMM, including the roles and responsibilities for updating the information contained therein. The document further describes the Koeberg AMM oversight roles and how ageing aspects requiring improved management are corrected. It demonstrates how the effects of ageing degradation are managed and monitored for the in-scope SSCs throughout plant operating life, including the planned period of LTO.
- 331-148 (*Programme Engineer's Guide*) guides programme engineers to develop, maintain, optimise, and perform programme oversight on the ageing management programmes allocated to them.
- Ageing Management Matrix – Adoption of the COMSY database for ageing management at KNPS (08016.ROD.017) record the Eskom decision to use commodity groups from the IAEA IGALL master table for ageing management at KNPS and adopt the COMSY software tool to support this. COMSY will replace the current Koeberg AMM.

APPENDIX E
AREA E REVIEWER'S INFORMATION: AGEING MANAGEMENT OF CIVIL SSCS

E.1 AMR OF CIVIL SSCs

E.1.1 AMR requirements

In 2019, the NNR issued RG-0027 which provides the requirements for ageing management and LTO for NPPs. The AME activities required by RG-0027 are provided in section 6 of the regulatory guide and can be categorised into three main activities, namely:

- Commodity grouping;
- Review of ageing management programmes;
- Ageing management review.

To address the regulatory objectives and ensure that the requirements mentioned above are achieved, the SALTO AME procedure 240-125122792 (*Koeberg Safety Aspects of Long-Term Operation* (*SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*) was developed, which provides a high-level process for performing the AME. This confirmed that the relevant ageing degradation mechanisms and ageing effects for in-scope SSCs had been comprehensively identified and assessed, and the ageing management programmes to manage the identified ageing effects and degradation mechanisms are in place.

Scoping of the Civil SSCs was carried out in accordance with procedure 240-125839632 (*Koeberg Safety Aspect of Long-Term Operation (SALTO) Scoping Methodology*). For further details on the methodology and criteria for scoping of SSCs, refer to Appendix B.

To ensure that the ageing management evaluation is performed effectively in accordance with procedure 240-125122792 (*Koeberg Safety Aspects of Long-Term Operation (SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*), civil in-scope SSCs were arranged into commodity groups, where applicable.

E.1.2 Commodity Grouping

To ensure that the AMR is performed effectively, where applicable, the list of identified SSCs susceptible to degradation due to ageing was arranged into commodity groups. This allowed for the assessment of an entire group with a single review task.

In accordance with requirements stipulated in SALTO AME procedure 240-125122792 (*Koeberg Safety Aspects of Long-Term Operation (SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*), the methodology is based on the IGALL master table and the Koeberg AMM. The grouping of structures or components was based on similar design, similar materials of construction, similar ageing management practices, or similar environments.

Civil structures were fragmented into individual components, and new unique identifiers were created and assigned to civil components to facilitate commodity grouping and subsequently AMR and AME. The detailed methodology for creating new civil components is documented in report L1124-CV-RPT-001 (*New Civil Component Report*). The civil structures and buildings included in the SALTO scope are listed in tables 1 and 3 of the report L1124-CV-RPT-001 (*New Civil Component Report*).

The commodity grouping process was performed using the COMSY software. Commodity groups were created, and in-scope SSCs were linked to their respective commodity groups.

The COMSY software tool is designed to support the commodity grouping processes. Based on the pre-defined structure of the IGALL master table and the Koeberg AMM, the COMSY software can link the in-scope SSCs stored in the COMSY ageing management database with categories, commodity groups, and sub-commodity groups.

To create the KNPS-specific COMSY ageing database, the following steps were followed:

- The ageing database was populated with information (material, temperature, medium, flow conditions etc.) for the in-scope SSCs.
- A list of commodity groups for in-scope SSCs was developed based on the IGALL master table and the Koeberg AMM. In-scope items that could not be grouped into commodity groups were listed as stand-alone structures and components.

There were 83 civil commodity groups identified through the commodity grouping process. L1124-GN-LIS-027 (*AME Data Sheet for Commodity Grouping*) provides a comprehensive list of commodity groups for each discipline and associated SSCs.

E.1.3 Ageing Management Review for Civil SSCs

The AMR for in-scope SSCs (commodity groups and stand-alone items) was performed to demonstrate that ageing management at KNPS is comprehensive and that ageing concerns will be effectively managed so that the intended function(s) of the SSCs is maintained for the period of extended operation through LTO.

The ageing management review (AMR) was performed in accordance with procedure 240-125122792 (*Koeberg Safety Aspects of Long-Term Operation (SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*).

The ageing management review systematically assessed the ageing effects and their related degradation mechanisms that are experienced or can be anticipated for specific commodity groups and SSCs. This was conducted to assure the ability of the SSCs to perform their intended function(s) throughout the extended plant life. Where gaps were identified, enhancement actions were provided.

The results of the ageing management review are documented in the COMSY data sets L1124-GN-LIS-027 and report L1124-GN-RPT-024 (*Degradation Assessment Results – Civil*).

E.1.3.1 Ageing Management Results for Civil

The SALTO AM assessment project results, gaps and recommendations are contained in report L1124-GN-RPT-024 (‘*Degradation Assessment Results – Civil*). The process followed to review the recommendations in report L1124-GN-RPT-024 (*Degradation Assessment Results – Civil*), the review results, and associated corrective actions were captured in ROD 08016.ROD.024 (*Scope stemming from a review of report L1124-GN-RPT-024*). Refer to CR 115457 for the actions captured in DevonWay.

A summary of the actions, which are in progress, is as follows:

- New AMPs required:
  - AMP 309 (gap): A new liner monitoring programme is required to implement the requirements of AMP 309 for metallic and non-metallic/epoxy lined pools and sumps (for the spent fuel pool liners, reactor pool liners, and all steel & epoxy lined sumps).
  - AMP 306 (partial gap): A new civil ageing management manual is required to augment the existing civil monitoring programme to ensure alignment with the AMP IGALL requirements and address the partial programmatic gaps identified in report L1124-GN-RPT-030 (*Comparison of the existing Plant Programmes with IAEA IGALL-AMP Requirements*) and L1124-GN-RPT-024 (*Degradation Assessment Results – Civil*).
- Updates to Existing Plant Programme and Inspection Documents:
  - Updates to the existing civil monitoring programme inspection/monitoring procedures to address the identified gaps and fully satisfy the requirements of AMP 301, 305, 306, 307, 308, 311, and 313.
  - Address civil programmatic gaps identified in L1124-GN-RPT-030 (*Comparison of the existing Plant Programmes with IAEA IGALL-AMP Requirements*) and documented in ROD 08016.ROD.024 (*Scope stemming from a review of report L1124-GN-RPT-024*).
  - Confirmation that requirements in accordance with AMP 308 (*Protective Coating Monitoring and Maintenance*) for the ageing effects due to irradiation are addressed in the existing corrosion monitoring programme.
  - Confirmation that the requirements in accordance with AMP 306 for the ageing of paints, vibration fatigue and the thermal cracking of steel liners are addressed in the existing ISI Programme.
- One-Time Inspections:

  Perform one-time inspections of specific items linked to the following commodity groups to identify the present state of condition.
  - Vent stack and chimney,
  - Joints,
  - Penetrations,

- Containment joints, and
- Containment structural concrete.

The one-time inspection results will then be evaluated, and a decision will be taken whether a periodic inspection task or a new plant programme will be required. (Typically, these are potential ageing/degradation concerns based on partial applicability and no previous KNPS history or documented failures.)

- Engineering Assessments:

  System engineering assessment documenting the nuclear safety risk of blockage and flooding of floor drains (in the containment structures, fuel buildings, connecting buildings, electrical buildings, and low-level waste building) and advise which action to be taken (if any or if not justifiable).

E.2 AMPs OF CIVIL SSCs

E.2.1 Description of an existing programme

Physical condition assessment of the plant's civil structures is managed by the established KSA-128 (*Civil Preventive Maintenance Strategy for Koeberg Nuclear Power Station*) in accordance with procedures KAU-030 (*Basis and Scope for Licence Binding Civil Surveillances at Koeberg Nuclear Power Station*) and KAU-029 (*Basis and Scope for Non-Licence Binding Civil Surveillances at Koeberg Nuclear Power Station*). Updates to KSA-128, KAU-029, and KAU-030 are currently in progress to address the AME gaps referred to under section E1.3.1 above.

This programme aims to administer and routinely monitor all civil structures to maintain structural integrity and functionality. Inspections of all plant structures are carried out by qualified civil engineering personnel to identify defects and degradation mechanisms, provide corrective actions, raise maintenance actions, trend results where required, and submit reports on the overall condition of structures.

Inspection surveillances of reinforced and pre-stressed concrete structures (external facades) have been supplemented with non-destructive-testing techniques, such as chloride profiles, delamination/hammer survey, and thermal imaging to monitor ageing/degradation effectively.

In addition to the civil monitoring programme, programme health reports for established engineering programmes (including the civil monitoring programme) are compiled and issued periodically, indicating the health status of the SSCs in accordance with 331-148 (*Programme Engineer's Guide*). The programme oversight committee (POC) also monitors the effectiveness of plant initiatives and operational forums, and strategically determines the way forward for plant health.

Life of plant plans (LOPPs) in accordance with KGU-011 (*Preparation of Life of Plant Plans*), exists for civil SSCs and provides the system/lead technical engineer with guidelines for the compilation of LOPPs that include plant system history, background information, current concerns, and future strategic initiatives. The LOPP serves as a document to record how the plant system is being managed over its life. The LOPP

document the expected future interventions and expenditure profile on the system, structure, or component (SSC).

E.2.2 Review of IGALL AMPs and the RESULTS

This review was achieved by comparing the tasks originating from the KNPS maintenance databases and plant ageing management programmes with the generic IGALL AMPs. To facilitate the comparison, the IGALL AMP tasks were broken down into well-defined and subdivided tasks.

If all IGALL AMP tasks were covered by tasks of a plant or maintenance programme, the existing AMP was deemed adequate due to its conformity with IGALL requirements. The applicable Civil IGALL AMPs and the results are documented in report L1124-GN-RPT-030 (*Comparison of the Existing Plant Programmes with IAEA IGALL-AMP Requirements*), which concluded the following:

- 5× AMPs that meet the IGALL requirements;
- 7× AMPs that partially meet the IGALL requirements; and
- 1× AMP that needs to be developed to meet the IGALL requirements [full gap].

Eskom reviewed the above results and recommendations relating to AMP reviews and established the Eskom position for all recommendations, documented decisions with appropriate justifications and captured corrective actions in the AME recommendation review reports for civil, as discussed in section D1.3.2, above.

The required enhancements are included in the tasks tracked to completion by the SALTO project team (and Devonway).

Further to section B1.1.3 above, the specific civil interfaces and boundaries between the various discipline SSC

s, are clarified and addressed in the counterpart response to Issue Sheet E-4 (refer to Appendix J) and procedure 240-165425812, Civil Ageing Management Programme Requirements Manual (draft).

E.3 TLAAs OF CIVIL SSCs

In accordance with RG-0027, Eskom identified all required TLAAs and should demonstrate either that all these analyses will remain valid for the planned period of LTO, or that the SSCs will be replaced, or that further operational maintenance or AM actions will be implemented.

The methodology followed is documented in 240-125122792 (*Koeberg Safety Aspects of Long-Term Operation (SALTO) Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses*).

E.3.1 Identification and verification of existing Plant TLAAs

The existing KNPS TLAAs were identified by the SALTO AM assessment project Consortium searching various input sources, including the Koeberg SAR, DSEs and other design-basis documents using keywords as documented in L1124-GN-RPT-022 (*Report on Verified List of Existing Koeberg Time-Limited Ageing Analyses*).

A review of international OE from power stations with a similar design was also used to identify any further applicable TLAAs. These included:

- Tihange NPP;
- Doel NPP;
- Borssele NPP;
- Ringhals NPP;
- KORI 1 NPP;
- RE Ginna NPP;
- DC Cook NPP;
- Davis Besse NPP;
- North Anna and Surry NPPs;
- VC Summer NPP; and
- EDF CPY plants.

The review of international experience is documented in L1124-GN-RPT-027 (*Report on Operational Experience for the Review of Existing Koeberg TLAAs*).

E.3.2 Comparison to IGALL TLAAs

The IAEA IGALL document, SRS 82, provides a list of typical TLAAs based on input from participating member states. The identified KNPS TLAAs were compared with the IGALL list of applicable pressurised water reactor TLAAs and tabled below as documented in L1124-GN-RPT-027 (*Report on Operational Experience for the Review of Existing Koeberg TLAAs*).

Table 4: IGALL TLAA (civil) comparison

TLAA title	Existing KNPS TLAAs	Additional IGALL TLAAs required by KNPS
TLAA 108 Fatigue of Cranes (incl. under Mechanical)	–	x
TLAA 301 Concrete Containment Tendon Pre-stress	–	x
TLAA 303 Cumulative Fatigue Damage of Containment Liners and Penetrations	–	x
TLAA 304 Foundation Settlement due to Soil Movement	–	x

E.3.3 Validation of TLAAs Applicable to KNPS for 60 years

Based on the identification efforts, a comprehensive list of all the KNPS TLAAs was compiled in L1124-GN-LIS-010 (*Comprehensive List of Koeberg TLAAs*). Each TLAA was researched and evaluated, and a report was generated per component or component type. These reports described the ageing mechanisms and effects relating to the components and their parts. The applicable IGALL TLAAs were identified for each of these components and any other potential degradation mechanisms (that could be linked to time-limited assumptions according to the insights and experience of the Consortium, particularly Framatome as the KNPS NSSS OEM). Where there were original analyses, these were then studied, and where possible, their TLAAs were validated and justified for 60 years.

As part of the steam generator replacement (SGR) project, modification no. 07092, the impact of reversing operation at reduced temperature (ORT) and possible thermal power uprate (TPU) was analysed. These analyses covered several of the TLAAs identified during the Koeberg SALTO Assessment Project and justified for 60 years as part of the SGR Project work.

The TLAAs identified but not validated for 60 years by the consortium, or the SGR project was recommended for creation, analysis, or re-analysis. A comprehensive list of the TLAAs is provided in L1124-GN-LIS-010 (*Comprehensive List of Koeberg TLAAs*), and the Civil TLAA results are as provided below.

E.3.3.1 Civil TLAAs validated and justified for LTO

- L1124-GN-RPT-044 (*KNPS Containment Liner TLAA 303*) – Validated

  The risk of cumulative fatigue damage of containment liner and penetrations of KNPS containments units 1 and 2 was assessed as practically non-existent. From all events considered, only the stresses caused by pressure tests produce noteworthy differential stresses in the liner. The stresses caused by start-ups generate noteworthy differential stresses in the penetrations. However, the differential stresses and the number of load cycles are very low, and the CUFs are near zero so that fatigue damage cannot occur. As a result, it was concluded that the TLAA 303 for the containment liner and penetrations in KNPS is re-validated.

- L1124-GN-RPT-045 KNPS Civil TLAA 304 Foundation – Validated

  The risks associated with the residual settlements and differential settlements were assessed and are negligible. Hence, it was concluded that the measured settlements could not affect the LTO of units 1 and 2 for 60 years. Re-analysis or additional documentation for justification of LTO is thus not required.

E.3.3.2 Civil TLAAs re-analysis/creation for LTO

Containment tendon pre-stress TLAA 301: The initial assessment of the KNPS containment civil TLAA 301 is documented in report L1124-GN-RPT-019 (*Validity of KNPS Containment Civil TLAA 301*), which confirmed that TLAA 301 concrete containment tendon pre-stress shall be re-analysed for KNPS units 1 and 2.

The required re-analysis was finalised and accepted (refer to Report D02-ARV-01-183-095_KOEBERG (*TLAA 301 Containment Reanalysis*), which has concluded that TLAA 301 for the concrete containment tendon pre-stress has been revalidated for KNPS units 1 and 2.

Crane TLAA 108: The initial assessment of the KNPS Polar Crane TLAA 108 is documented in report L1124-GN-RPT-020 (*Validity of KNPS Polar Crane TLAA SALTO TLAA Assessment Report*), which confirmed that TLAA108 must be re-analysed for KNPS units 1 and 2.

The required re-analysis was finalised and accepted (refer to Report D02-ARV-01-183-091_KOEBERG (*TLAA 108 Reanalysis Crane*) and has concluded the following:

- There are no significant issues that could prevent the polar crane from operating for the duration of LTO. However, the following interventions in readiness for plant life extension are required to ensure a safe and reliable mode of usage and long-term operability.
- Undertake a 10 RO topographical survey of the polar crane circular runway.
- Rail clamp bolts are recommended to be sample checked using non-destructive and possibly also destructive testing (with immediate replacement of defective bolts).

The concluding actions related to the containment tendon (TLAA-301) and Polar Crane (TLAA-108) re-validation will be captured and tracked as LTO commitments.

E.4 VERIFICATION OF SCOPE SETTING RESULTS FOR CIVIL SSCs

Scoping of SSCs is required in accordance with procedure 240-125839632 (*Koeberg Safety Aspect of Long-Term Operation (SALTO) Scoping Methodology)*. The scope setting and verification for civil SSCs were performed and captured in report L1124-GN-RPT-041 (*SALTO Scoping and Verification for Koeberg Power Station*) and described in Appendix B.

Structures and buildings housing SSCs important to safety are included in the scope as primarily identified in classification listing 331-94 and plant layout drawings. The civil structures and buildings included in the SALTO scope are listed in report L1124-CV-RPT-001 (*New Civil Component Report*), tables 1 and 3.

A review of the data sources used for civil components revealed that the level of detail for civil and structural components associated with the civil and building structures of the plant is not sufficiently detailed to allow for ageing evaluation. Individual components and parts comprising buildings and structures were not uniquely identifiably, and some components would experience different ageing, for example, due to the exposure environment being inside or outside.

As stated in § E.1.2, to facilitate commodity grouping and subsequently AME, buildings and structures were considered as individual components, and unique identifiers were created and assigned to these components. An example of such a trigram creation is shown in the table below.

Table 5: Civil trigram example

Building name:	Unit 1 fuel building: 1 HKA OOO BG
Room number in the fuel building:	K113
The civil component is the concrete floor slab; its bigram is:	OS
The resulting unique identifier for the floor slab in building HKA OOO BG room K113 of the unit 1 fuel building is:	1 HKA OOO BG-K113-0S

The detailed methodology for creating new civil components is documented in L1124-CV-RPT-001 (*New Civil Component Report*).

E.5 DATA COLLECTION AND RECORD KEEPING FOR CIVIL SSCs

Data collection is dependent on the individual programme or plant process. Each engineering programme will have specific data collection and recordkeeping requirements. For civil structures, civil monitoring programme KSA-128 (*Civil Preventative Maintenance Strategy for Koeberg Nuclear Power Station*) and KAU-029 (*Management of Non-Licence Binding Civil Surveillances at KNPS' and KAU-030 (Management of Licence Binding Civil Surveillances at KNPS*) provide such requirements.

The documentation and records management processes are performed in accordance with KSA-011 (*The Requirements for Controlled Documents*), KAA-500 (*The Process for Controlled Documents*), and 331-3 (*Document and Records Management Work Instruction*) provide requirements for record-keeping.

E.6 DOCUMENTATION OF AGEING MANAGEMENT AND DOCUMENTATION IN SUPPORT OF LTO FOR CIVIL SSCs

In Programmes Engineering, the AMPs are managed in the Material Reliability group (MRG). The ageing management programme engineer/technologist has been appointed to oversee the plant-level ageing management process, including the implementation thereof. MRG is responsible for continuous review of plant programmes and the creation of new AMPs, as required.

The following processes exist for ageing management at KNPS:

- **Ageing Management Standard:** 240-149139512 (*Ageing Management Requirements for Koeberg Nuclear Power Station*) was developed to provide overall requirements for the ageing management of equipment important to safety at KNPS and to meet the requirements of RG-0027. The standard provides the requirements and the framework for physical ageing management processes at KNPS for the life of the plant, including LTO. It covers all stages of equipment life of the plant, that is, design, construction, manufacturing, commissioning, operating, LTO, suspended operation, and decommissioning.
- **Process for the development and control of ageing management (AM) at Koeberg Operating Unit:** 331-275 (*Process for the Development and Control of AM at Koeberg Operating Unit*) describes the process used to manage (develop, control, and update) the Koeberg AMM, including the roles and responsibilities for updating the information contained therein. The document further describes the Koeberg AMM oversight roles and how ageing aspects requiring

improved management are corrected. It demonstrates how the effects of ageing degradation are managed and monitored for the in-scope SSCs throughout plant operating life, including the planned period of LTO.

- **Programme Engineers Guide 331-148:** This guide guides programme engineers who develop, maintain, optimise, and perform programme oversight on the ageing management programmes.
- **Ageing Management Matrix** – Adoption of the COMSY database for ageing management at KNPS, 08016.ROD.017, record the Eskom decision to the use of commodity groups from the IAEA IGALL master table for ageing management at KNPS and adopt the COMSY software tool to support this. COMSY will replace the previous Koeberg AMM.

APPENDIX F
AREA F REVIEWER'S INFORMATION
HUMAN RESOURCES, COMPETENCE AND KNOWLEDGE MANAGEMENT FOR LTO

F.1 HUMAN RESOURCES POLICY AND STRATEGY TO SUPPORT AGEING MANAGEMENT

Human Resources (HR) is mandated to partner and support line management to recruit, develop, and retain skilled, committed, engaged, and accountable employees across Eskom. In response to the Eskom strategy to shift performance and grow sustainability, HR has defined its enabling strategy to create a high-performing culture as the desired end state. The foundation of the HR strategy is that people management begins with the alignment of HR objectives to business objectives.

In enabling a high-performing culture, the Eskom HR strategy is anchored around the following five core themes that work together to support the execution of the overall business strategy:

- **Engaged employees:** To create workplace harmony and win hearts and minds.
- **A safe workplace:** To promote discipline, accountability, and behaviour change for safety.
- **Competent and highly skilled workforce:** To ensure the right mix and right quantities of skills at the right time.
- **Performance-based workplace:** To drive collaborative methods of work that ensures a high performing organisation accompanied by an appropriate reward and recognition system.
- **Transformed workplace:** To promote value-based effective and accountable leaders driving transformation beyond compliance.

During the 2019 pre-SALTO peer reviews, there were findings that the Human Resources policy and strategy are inadequate for the LTO period. There was no specific HR strategy and policy reflecting the LTO programme.

HR strategy and policies are determined by corporate HR, and they may not be adapted to support the specific terminology for LTO. This HR strategy remains unchanged for LTO. To supplement corporate procedures and policies, the NOU has developed the Human Resources Strategy on LTO 240-156938857, which elaborates how LTO will be supported using the current Eskom policies and procedures.

During the pre-SALTO mission peer review, which was conducted in September 2015, there were several organisational deliverables (OD = actions), which were raised under area F. All the ODs have been closed except one, which requires an effectiveness review on implementation of the HR Position Paper to be conducted before the Salto mission.

In particular, the Nuclear Operating Unit (NOU) is staffed with a mixture of skills and competencies; the focus, however, is on the core and critical skills for the business.

As part of the pipeline strategy, where required and when business circumstances permit, Eskom recruits learners to fulfil the skills required in various fields. Nuclear Operating currently has 21 engineering learners and 36 artisan learners for pipelining.

To ensure a pipeline that will feed core and critical skills, Eskom recruits learners after they have completed schooling and offers them bursaries to study towards a tertiary qualification in engineering, technician, or artisan. Once the engineering learners qualify, they join Eskom as engineers-in-training (EIT). The EITs, for example, are exposed to different aspects of plant and engineering disciplines for up to 24 months.

The NOU has a training facility that offers classroom and on-job training for technicians and artisans to assist them in obtaining their qualifications. These learners, when they qualify, can be recruited into vacant positions within the organisation if required and where business circumstances permit.

The Radiation Protection and Operating departments recruit learners after schooling and train them internally. These learners may also be recruited into vacant positions within the organisation if required and where business circumstances permit, ensuring that Koeberg has a constant flow of new employees entering the organisation.

Each profession has a career path that can be followed into a specialist or managerial role.

Eskom is a learning organisation that allows employees to acquire competencies for their current positions, as well as for future roles. All employees are encouraged to have individual development plans (IDP) that capture the training required to close competency gaps. These IDPs are reviewed by managers annually. Furthermore, employees are encouraged to enhance their knowledge and expertise by studying further part-time and full-time. Within the NOU, there are currently approximately 1 514 permanent employees. To meet business efficiency and financial objectives, recruitment in Eskom was put on hold from November 2017 until recently, when recruitment of critical skills was approved. Despite the recent recruitment initiatives, numbers have continued to decrease. Going forward, the business efficiency and financial objectives will need to continue to be balanced with LTO requirements in terms of the staffing strategy.

No additional positions were identified for LTO purposes, the functional operation structure (FOS) was updated to reflect the additional requirements resulting from LTO.

F.1.1 Application of the graded approach to the management system

NOU has applied a graded approach when developing the management system. The quality management requirements are determined by the importance to nuclear safety and availability of the processes, activities and structures, systems and components (SSCs) concerned, following a graded approach documented in 238-8 (*Nuclear Safety and Quality Manual*).

F.1.2 Documentation of the management system

The Nuclear Operating Unit (NOU) has implemented an integrated management system (IMS). Table 6 shows the NOU IMS.

Table 6: NOU IMS

Document Title	Reference
Nuclear Management Policy	32-83
Safety Health Environment and Quality Policy	32-727
Nuclear Safety Oversight in Eskom	36-1518
Eskom Nuclear Objectives	240-108035478
Integrated Management System Description	238-1
Nuclear Management Systems Processes Development Guide	238-5
Nuclear Documents and Records Management Requirements	238-6
Nuclear Safety and Quality Manual	238-8
Nuclear Quality Management Guide	238-10
Nuclear Operating Unit Occupational Health and Safety Requirements	238-11
Eskom's Nuclear Business Management Manual	238-12
Nuclear Integrated Risk Management Requirements	238-22
Nuclear Safety Management Programme	238-28
Nuclear Operational Plan	238-89
Nuclear Supplier Qualification and Audit Manual	238-105
Guide for Executive Engagement in Performance Assessment against Eskom Nuclear Objectives	240-146898932
Nuclear Operating Unit Structure and Mandates	240-64602879
NOU Configuration Management Process Manual	240-99837788
KNPS Management Manual	335-2
NFD Management Manual	333-1
Nuclear Engineering Management Manual	331-2
Nuclear Commercial Management Manual	238-25
NPM Management Manual	240-119086005
Nuclear Strategy and Regulation Management Manual	238-108

F.1.3 Provision of resources

The current staffing complement in the core, critical areas of the NOU (engineering and Koeberg plant) has various skill sets (i.e. engineers, technicians, physicists, artisans, licensed operators, advisors, and support staff).

Engineering has a complement of 260 employees, whilst the Koeberg plant (maintenance, operating, radiation protection, chemistry, work management, and QC) has 683 employees.

Engineering:

- 75× (28%) engineers
- 42× (16%) technologists
- 53× (20%) technicians, advisors, physicists
- 90× (34%) support staff

Koeberg Plant

- 167× (24%) are technicians, advisors, and physicists
- 54× (7.9%) are licensed operators
- 462× (67%) are technical and non-technical support staff

The average age in Engineering is 45 years, with 6,15% staff retiring within the next five years.

In the Koeberg plant, the average age is 42 years, with 6.88% of staff retiring within the next five years.

The NOU conducted a strategic workforce planning exercise in 2019 / 2020. The strategic workforce planning outlines the strategic alignment of human resources with the business direction of the organisation. It analyses the current workforce requirements, identifies gaps between the present and the future, and implement solutions/strategies that will enable the accomplishment of the vision, mission, goals, and objectives of the organisation. An NOU workforce management plan, 240-123782330, has been developed, considering additional resources required for LTO.

Talent management and succession planning are business as usual requirements as contained in Eskom's procedures. The business unit will not have a separate process for LTO but is incorporated in the talent management and succession planning discussion.

The provision for the required competencies is detailed in section F.2.1 below.

F.1.4 Management of processes and activities

Eskom has extensive human resources management processes aligned with international good practices to ensure sufficient human resources to support ongoing operations. To meet the resource needs, Koeberg has developed a workforce plan, 240-123782330, which is informed by the operational plan requirements, which consider historical trends, such as attrition, new responsibilities, competence development, workforce ageing and pipeline requirements. Human resources are required to deal with the increased workload due to the preparation activities for LTO. A human resources strategy on LTO: 240-156938857 has been developed to address the increased workload mentioned above. The strategy considers using a combination of current resources, supplemental workers, and outsourcing of products and services.

ISO 9001 and RD-0034 require the management system to be process-based. The approach requires managers to control processes that make up the business, their interactions and their inputs and outputs. The process interactions are managed as a system. A process-based management system is a network of interrelated and interconnected processes, and this has been documented in 238-5 (*Nuclear*

Management System Processes Development Guide). 335-2 (*Koeberg Power Station Management Manual*) was developed to demonstrate how NOU manages its process to comply with RD-0034 and ISO 9001. 335-2 encompasses all documented processes within the NOU that all departments carry out to fulfil their safety requirements.

The NOU adopted a single operational framework that, at a high level, illustrates NOU's process model (adopted from the IAEA model, reference NG-T-1.3 (*Development and Implementation of a Process-Based Management System*).

F.1.5 Structure and functions of the operating organization

The roles and responsibilities for all functional areas of the NOU are detailed in the Nuclear Operating Unit organisational structure document 240-64602879 (*NOU Organisational Structures*). They have been updated to incorporate support long-term operations objectives and initiatives. Job descriptions exist for all positions and detail the key performance indicators and job outputs associated with each position. Functional responsibilities are captured in mandated FOS documents.

The job description sets out:

- the purpose of the job and where it fits into the organisational structure;
- the context in which the job holder functions;
- the principal accountabilities of the job holder;
- the main responsibilities of the employee; and
- the qualifications and competencies required.

All job descriptions are graded at the corporate level. The corporate grading committee was established to grade generic jobs across Eskom businesses (e.g. engineering). All jobs across disciplines throughout Eskom are evaluated using the TASK factor, i.e. complexity, knowledge, influence and pressure of the job. All jobs are reflected in the organisational structure. Generic job descriptions are utilised to ensure consistency across Eskom. The competence and the minimum education requirements in the job descriptions are utilised in the advertisement and selection purposes during the recruitment process. Recruitment and selection occur as a standard process governed by Eskom's recruitment and selection procedure.

In many respects, Koeberg is already managing the effects of ageing and LTO. The competencies to manage these effectively have been identified. The authorisation index (competency index) is utilised to track and monitor required staff competencies within the NOU and is the driving force for new competencies. No additional positions were identified for LTO purposes; the organisational structure organogram was updated to reflect the additional requirements resulting from LTO.

As part of the preparations for LTO, Eskom established 240-161561906 (*LTO Steering Committee Terms of Reference*). This committee oversees the implementation of all related LTO activities and acts as the link with Eskom executive management. There are other committees, work groups and meetings dealing

with the details of the many LTO related actions and activities. These entities assist in the transition of LTO tasks to existing groups and departments.

Eskom employs various resourcing strategies, which encompasses the use of permanent and non-permanent employees. The organisation is committed to ensuring that resourcing of the organisation is conducted in a fair, open, and transparent way. Eskom promotes the development of staff and career opportunities; therefore, any recruitment to fill positions first considers permanent internal employees, especially for promotional opportunities. If the internal campaign does not yield results, candidates external to Eskom may be considered.

The following non-permanent employment categories are used at Eskom:

- Third-party contracts: Are used where the specific scope of work and contracts are negotiated and agreed with a third party.
- Fixed-term contract: Can include ex-Eskom employees identified by Eskom-specific and determinable scope of work that is not permanent but can be for a maximum of five years.

In addition, as part of resourcing and development, Eskom uses secondments to respond to business needs. Secondment is a process when an employee is temporarily placed (seconded) to a specific post to gain exposure or training in another area of business (internal) or an organisation external to Eskom. Upon the termination of the secondment, it is expected that the seconded employee will return to the position within the business unit from which he was previously released.

F.1.6 Operating personnel

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

According to LD-1077 and KAA-591 requirements, all licensed operators (LO) and initial licence trainees (ILT) shall undergo continued medical and psychological surveillance. LD-1077 outlines the comprehensive medical and psychological surveillance of LOs, indicating that certification of medical and psychological FFD is done bi-annually (but at intervals not exceeding seven months), following an absence of work for more than 14 days due to illness, medical or psychological change, which may not be transient or as stipulated by the NNR.

According to KAA-591, the psychological surveillance protocol for selection and training of LOs, and the comprehensive psychometric assessment of all potential operators are conducted and structured in psychological interviews with the candidates, including a fitness-for-duty (FFD) assessment. The LOs undergo extensive training in command and control communication, team functioning, self-control under pressure and human performance during ILT. Ongoing simulator observations and feedback (group and individual) and continuous individual assessment and developmental feedback during the ILT training programme are done, and the licensed operator requalification training (LORT). Furthermore, individual and group coaching is provided as needed. Bi-annual psychological evaluations conducted by the site-appointed psychologist are conducted with a report submitted to the operating manager and the NNR. LORT undergo training sessions and simulator observations every six weeks. Furthermore, all operators

undergo continuous psychological evaluations and monitoring, FFD evaluations and interventions as necessary.

The Koeberg Operating department has developed, implemented, and maintained the standard of operating under all plant conditions. The conduct of operating is defined in KSB-005 (*Operating Standards and Expectations*). This document provides the framework for standards and expectations required to consistently conduct nuclear operations, ensuring excellence and compliance with applicable station licences, OTS, operating procedures, NNR regulations, administrative requirements, and safety rules. All plant operation is performed in accordance with authorised procedures.

All operating activities are performed by ensuring that the operating limits prescribed in the OTS are respected. A conservative approach is applied to ensure a high level of safety and control of plant conditions. During unclear or partial plant equipment operability, the operability determination process, KAA-690 (*Operability Determination*), is used to support decision making and aide the operators.

All operating periodic tests and surveillances performed by operating are performed in accordance with KAA-656, and for special test and non-routine activities, KAA-647 is applied. Furthermore, any plant maintenance activities are conducted under safe isolations and permits to work according to the PTW process (KAA-667). The operating department processes and procedures are constantly verified to ensure that any plant changes and process updates are incorporated. All operating procedures are controlled according to KAB-018, and records produced from operating activities are captured in accordance with KAB-036. The procedure KGB-012 is used to guide outage preparation and execution of activities as planned without compromising safety.

During normal plant operation, routing maintenance and outage, high-risk activities must be carefully monitored to maintain nuclear safety. To ensure that proper controls and oversight of risk significant activities are maintained, an integrated operational risk management process (KGA-113) is applied.

In addition, the operating department is aligned with the processes described in § F.2.3 below for performance improvement. According to 36-197 (*Koeberg Licensing Basis Manual*), the responsibilities and authorisations of operational staff shall be clearly defined within the organisation's overall structure. The Operating department has been staffed by adequate numbers of competent personnel. Emphasis has been placed on staff selection, training, qualification and retraining. Training programmes have been developed and implemented to enable operating staff to perform their duties safely and efficiently. Two full-scope simulators assist with this aspect. Only staff certified and authorised as competent are allocated operating duties.

F.1.7 Maintenance of good coordination among different groups, among the site organizations and contractors involved in LTO

The Organisational Effectiveness group within HR has developed interventions to encourage and foster good coordination, collaboration, breaking silos, and working together for LTO activities and as a business efficiency effort in general. Below are some of the interventions (several included LTO aspects).

- Management paired observations: Managers pair up to do workplace observations in different departments.

- Generic leadership training (EAL)
- INPO leadership training for supervisors and managers (nuclear-specific)
- Staff engagement (middle management) sessions with senior management
- Secondments to different departments are also facilitated and encouraged to build bridges between departments as well as for staff development
- Leadership alignment sessions
- Leadership journey with senior management teams
- Work team sessions
- Open forum engagement with senior leadership

F.1.8 Pool of experienced and knowledgeable staff, retained by staffing policy

Eskom's staffing policy is geared towards attracting and retaining a pool of experienced and knowledgeable staff.

Eskom positions its business strategies as a preferred employer in the market. Eskom provides market-related remuneration structures. Eskom targets to pay competent employees aligned to the external market. The task job evaluation is used to determine the relative worth of each position in the organisation. The Basic Conditions of Employment Act was established to enforce basic conditions of employment in South Africa. Eskom strives to equal or better these conditions of employment. Eskom provides several fringe benefits and flexible remuneration packages, which include medical aid, pension fund, car allowances, 13th cheque, meal subsidies, and housing allowance, to mention a few. In addition, Eskom has its own finance company that offers employees competitive rates for housing loans.

In addition, due to the unique nature of the nuclear business, the Nuclear Operating Unit (NOU) developed a strategy to attract and retain core, scarce, and critical skills by paying a monthly premium to holders of these skills, referred to as nuclear skills premium (NSP) which can vary from 0-40% (depending on the position on the rate scale) of employees' salaries.

The staffing policy also provides secondment opportunities for employees to complement their skills within areas outside of their technical functions.

The statistic on staff movement is analysed and reported to management for tracking. All employees leaving the organisation are interviewed by Human Resources to ascertain their reasons for leaving and how the organisation can improve its retention strategies.

F.1.9 Implementation of long-term succession planning

Eskom has a talent management process for M-, P-, G-, and S-bands which aims to provide a pool of talented individuals to be recruited into key positions and become successors for critical and core skill categories.

Eskom uses performance segmentation (i.e. bottom performer – does not deliver; solid performer – important to the potential success of the business; and top quartile performer – exceptional functional/technical performance) and potential. From this, employees are segmented into a 9-box talent bench which forms a dashboard for the talent in the organisation.

Succession management builds internal capability and skills across managerial roles and critical roles to ensure business continuity by identifying possible replacements for key positions and providing strategies for developing individuals to meet the organisation's future needs. A succession pool is therefore established from the talent pool identified from the talent management process. The potential successor is identified from the talent pool by the talent review board. They would identify competences gaps (technical/non-technical) to be closed before the employee can successfully occupy the position. The Eskom recruitment procedure allows for identifying suitable candidates from succession pools at M-, P-, G-, and S-levels. A minimum of three potential successors should be in the succession pool for this process to be considered. Employees in a succession pool undergo a selection process to identify the best suitable candidate for appointment.

F.1.10 Resources to carry out plant managers' assigned LTO responsibilities and accountabilities

The functional responsibilities for LTO have been updated where required, and it was determined that the currently allocated resources are sufficient to perform the required tasks.

F.2 COMPETENCE MANAGEMENT FOR LTO AND RECRUITMENT, AND TRAINING / QUALIFICATION PROCESSES FOR PERSONNEL INVOLVED IN LTO ACTIVITIES

F.2.1 Provision of competency management

To determine the competency required to carry out the organisation's activities safely, a graded approach to implementing the systematic approach to training (SAT) is followed for training programmes at Koeberg according to KGT-006.

Koeberg has an established training and qualification programme to ensure that personnel receive initial and continuing training to maintain required plant qualifications to accomplish their assigned plant duties. The process for this training is described in the station training standard KSA-049 (*Koeberg Training Standard*) and the associated systematic approach to training procedures KAA-780, -781, -782, -783, and -784), and KGT-006. Furthermore, KGT-089 describes the requirements to implement the SAT process.

Identifying competencies required for the NOU will follow the TCR process to identify training/non-training solutions. Furthermore, the discipline-specific training is described in the suite of training programme guides as follows:

- Operating Training Programmes: KGT-020, -021, -022, -023, -024, -025, and -026
- Maintenance: KGT-040, 079 (welder qualification KTM-003)
- Security: KGT-046
- I&T: KGT-047, KAR-240

- Chemistry: KGT-054
- Radiation Protection: KGT-055, -056
- Engineering: KGT-071, -072, and -073, as well as plant KGUs
- Quality Control: KGT-080
- Station Safety Training: KGT-087
- Fire Training: KAT-021: KTV-002
- Outage Control Centre: KGX-001
- Emergency Plan: KAG-002
- Technical Instructor (ETDP): KGT-070

The training processes follow both national and international guidance, for example, the process for accreditation of training in the nuclear power industry INPO ACAD 02-001 Rev 1, INPO ACAD 98-004 and standard for qualification and certification of NDT personnel CP-189 of 1995 (ASME 11) and ISO 9712 as well as the WANO PO&Cs (TR.1) and station training guides (KGU-002, KGU-023, KGU-034, KSR-003, KAR-240).

No generic changes to the training programmes were identified due to LTO. Specific changes and adaptations of individual training can follow the standard SAT process.

F.2.2 Qualification and training of personnel

Personnel qualification and training have been described under the operating training programmes: KGT-020, -021, -022, -023, -024, -025, and -026.

F.2.3 Competence management procedures and guidelines and flowcharts;

Implementing a graded approach achieves the NOU competency management through a systematic approach to training (SAT), and the guidance to training is documented in KGT-006.

KOU has developed a training standard, KSA-049, which describes the training policy and applies to all training programmes. The systemic approach to training procedures are as follows:

- KAA- 780 (*Systematic Approach to Training - Analysis Phase*)
- KAA-781 (*Systematic Approach to Training - Design Phase*)
- KAA-782 (*Systematic Approach to Training – Development Phase*)
- KAA-783 (*Systematic Approach to Training – Implementation Phase*)
- KAA-784 (*Systematic Approach to Training – Evaluation Phase*)
- KGT-089 (*Systematic Approach to Training Process Implementation*)

The discipline-specific training programmes are as follows:

Operating

- KGT-020 (*Non-Licensed Operator Initial Training Programme Guide*)
- KGT-021 *(Non-Licensed Operator Requalification Training Programme Guide*)
- KGT-022 (*Operator Initial Licence Training Programme Guide*)
- KGT-023 (*Licensed Operator Requalification Training Programme Guide*)
- KGT-024 (*Shift Manager Development Programme Guide*)
- KGT-025 (*Simulator Maintenance, Access/Operation and Initial Conditions and the Training and Authorisation of Simulator Operators*)
- KGT-026 (*Generic Fundamentals Programme*)

Maintenance

- KGT-040 (*Certification, Qualification and Proficiency of Loading Handling Personnel*)
- KGT-079 (*Maintenance Training Programme for Intermediate Graded Programmes*)
- KTM-003 (*Welder Performance Qualification Requirement*)

Security

- KGT-046 (*Training Programme Guide for Security*)

Inspection and Test

- KGT-047 (*Training Programme Guide for Inspection and Test*)
- KAR-240 (*The qualification and certification of Inspection and Test and personnel and its sub-contractors*)

Chemistry

- KGT-054 (*Chemistry Training Programme Guide*)

Radiation Protection

- KGT-055 (*General Radiation Protection Training Guide*)
- KGT-056 (*Radiation Protection Department Training Programme Guide*)

Engineering

- KGT-071 (*Engineering Training Programme Guide*)
- KGT-072 (*Nuclear Engineering Programme Guide*)
- KGT-073 (*Nuclear Engineer-In-Training Programme Guide*)
- KGU-002 (*Guide for System Engineers*)

- KGU-023 (*Guide for Component Engineers*)
- KGU-034 (*Guide for Reliability Engineers*)

Quality Control

- KGT-080 (*Maintenance Quality Control Training Programme Guide*)

Safety and Health Training

- KGT-087 (*SHE Training Guideline*)

Fire Training

- KAT-021 (*Training for Fire and Rescue Response Team Members*)
- KTV-002 (*KNPS Fire and Rescue Team Training Programme*)

Outage Control Centre

- KGX-001 (*Outage Management Training Programme*)

Emergency Plan

- KAG-002 (*Koeberg Emergency Plan Training Programme*)

Technical Instructor

- KGT-070 (*Educator, Training and Development Practitioner Training Programme*)

The hierarchy of training documentation structure (flow diagram) is documented in Appendix 1 of KSA-049.

F.2.4 Training records and databases

Each training programme guide has a section in the document that describes the process to be followed to keep records that have been generated. Most of the training programmes maintain their training records in accordance with KSA-038 (Requirements for quality records).

F.2.5 Training programme descriptions

Training programme descriptions are detailed in each training programme guide as listed in § F.2.3.

F.2.6 Resources related to training

Resources related to training for plant training are structured in groups as follows:

- Training Technology;
- Training Accreditation;
- Operating Training;
- Technical Training;

- Maintenance Training, and
- Training material.

All the groups mentioned above have resources that drive training-related activities. The plant training organogram for the disciplines mentioned above have been authorised (Filename: Training Organogram for SAP signed July 2020).

F.2.7 On-the-job training programmes and records

A guideline for on-job training and task performance assessment, KGT-088, was developed to guide the implementation of the process. In accordance with the systematic approach to training for the implementation phase (KAA-783), on-job training is described as one of the training methods. The records that are generated during the on-job training are to be achieved in accordance with KSA-038.

F.2.8 Trainee assessment records

All training assessment records are archived in accordance with the specific training programme guides, which are listed in § F.2.3.

F.2.9 Goals, strategies, plans and objectives

KNPS is managed as part of Eskom's Nuclear Operating Unit (NOU). The NOU is mandated by Eskom to implement the Eskom nuclear policy to achieve Eskom nuclear objectives of safely delivering world-class nuclear energy today, tomorrow, and in the future. The policy requirements are managed through an operational plan with a specific focus to stabilise, sustain, and grow the operations. The operational plan is reviewed annually.

The following documents provide evidence of the initiatives taken by Senior Management to ensure that goals, strategies, and plans are periodically reviewed against the safety objectives and that actions are taken where necessary to address any deviations:

- 240-108035478: Nuclear Objectives
- 238-89: Nuclear Operational Plan (2017/2018- 2021/2022)

Eskom's nuclear objectives are documented in 240-108035478, which describes the approach to senior leadership within the Nuclear Operating Unit (NOU), the need to adopt and maintain a common understanding of the progress and performance against the Eskom nuclear objectives and the nuclear operational plan. This aims to define a transparent assessment process that can identify early signs of performance decline against the desired objective at the appropriate level to enable the appropriate actions to be taken and applied throughout the Nuclear Operating Unit (NOU).

238-89 (*The Nuclear Operational Business Plan*) reflects an overview of the basis for the NOU business planning for the next five years and demonstrates alignment with Eskom's vision and objectives. § 7.15 of 238-89 refers to a summary of important external and internal issues which the Nuclear Operating Unit considers (in no order) in setting its objectives for the next five years. Some non-negotiable aspects to consider are compliance with QMS and ISO standards and NNR regulations.

238-8 (*Nuclear Safety and Quality Manual*) requires that the management of each division / OU / BA and support departments assess the adequacy and effectiveness of the part of the safety and quality management system for which they are responsible, to assure its adequacy and effective implementation for addressing RD-0034 and all other requirements. In addition, it requires that management provides for the achievement of a safe long-term operation, including ageing management of plant components important to safety, periodic safety review and knowledge management.

F.2.10 Measurement, assessment and improvement of the management system

The NOU has the following approaches as part of its monitoring and measurement assessment strategy.

Internal audits/surveillances

KAA-833 (*Quality Assurance Monitoring Programme*) for the NOU describes the process used by the QA department to develop, manage and implement the QAMP within the NOU. Internal audits /surveillances have been carried out (also for ageing management and LTO aspects), using the QA 3-yearly report to provide an overview of monitoring and measurement activities completed in a 3-year monitoring cycle.

Nuclear Safety Assurance (NSA) Oversight

The strategy document 36-1518 (*Nuclear Safety Oversight in Eskom*) describes the various functions and committees and their respective reporting lines, which, as a minimum, are required to provide the necessary nuclear safety perspective of the business. NSA forms part of nuclear oversight and is an internal organisation established to do independent reviews, assess and report to the nuclear oversight manager and the chief nuclear officer to the extent to which the NOU fulfils its nuclear safety role effectively and sustainably in the discharge of its mandate.

The NSA performance objectives are grouped into two basic areas:

- The first group contains eight focused areas, which generally coincide with the operation, maintenance and production support activities needed to operate a nuclear power plant safely and reliably.
- The second group applies to the wider workforce and represents attitudes, behaviours, work practices and controls of the NOU. This group consists of eleven non-focused areas.

NSA's main goal is to facilitate nuclear safety improvement, assist the NOU in preventing repeat WANO areas-for-improvement (AFIs), prevent the identification of new unsighted AFI's, and assist in resolving AFIs. The terms of reference and implementation processes of NSA are documented in 36-190 (*NSA Work Process*).

External nuclear oversight bodies are also identified in the Nuclear Safety Oversight in Eskom. These are entities that provide independent nuclear safety oversight. These include the Nuclear Safety Review Board (NSRB), International Atomic Energy Agency (IAEA) and the Nuclear Regulator.

Self-Assessment Activities

Self-assessment (SA) is a line-owned process that follows a structured approach in assessing the effectiveness of programmes, processes, or performance against specific criteria and identifying areas for improvements. The SA process has been introduced for managers to assess processes they manage to ensure maintenance and improvement by being critical, inward-looking, and aware of related developments. Section 5.8.1 of KGA-053 (*Self-Assessment at KNPS*) requires that each department analyse its performance annually and identify areas that warrant self-assessment in the coming year. Several years ago, a change in the approach to the self-assessment programme was decided (i.e. to conduct 17 to 24 self-assessments per year to allow the NOU to conduct mainly SA of core groups, e.g. Operating, Maintenance, Engineering, and a few others) to re-align it with world best practice to improve the effectiveness of the programme.

Safety Culture

238-28 (*Nuclear Safety Management Programme*) describes key elements of the safety management system, including occupational safety, nuclear safety and human performance. Periodic assessment and evaluation of safety culture ensure that a healthy safety culture is developed and maintained in the NOU. The health of the safety culture is reviewed on a three-year cycle basis. This takes the form of self-assessment on an annual basis for two years; and an independent internal audit for the third year.

F.2.11 Knowledge management (KM) policy and strategy

The understanding of the function of knowledge management at Koeberg has evolved since the first pre-SALTO assessment to more than only the OE programme into an inclusive view of the various processes in the NOU that generate information. In light of this change, the NOU has updated 238-8 (*Safety and Quality Manual*) to include the KM processes.

Section 5.1.3 (Knowledge Management) of 238-8 has been updated as follows:

> *The designated personnel responsible for ageing management of the nuclear facility should possess the necessary competence, skills and experience to discover such solutions that the adverse effects of ageing mechanisms on the operability of SSC may be prevented.*

F.2.12 Descriptions of knowledge management process, procedures, guidelines and flowcharts

The NOU has elements of KM principles embedded in its routine business practices and are owned by the various functional owners according to their mandates. The processes in the organisation give life to the principles and practices required by the organisation to ensure KM is functioning correctly. KM is viewed as being similar to configuration management, where many processes that collectively entrench the principles and practices in the NOU and are shared by all departments.

The NOU has elements of KM principles embedded in its integrated management system. On 12 October 2020, NEXCO endorsed the implementation of KM. The Chief Nuclear Officer (CNO) and Nuclear Engineering Manager (NEM) agreed to use Nuclear Engineering (NE) as a pilot for KM. The owner of the pilot is Nuclear Engineering, and the experience from the pilot will be available for when KM is rolled out to the rest organisation. This permitted the Nuclear Engineering Manager to authorise the 240- 146686589

KM standard for use in NE. The standard has been developed by benchmarking with IAEA workshops and International Nuclear Power Stations (NPS). The standard has been developed and authorised.

This newly created KM standard aims to bring KM elements together under the banner of KM and to focus on making it part of routine activities in the NOU. Those principles include:

- identifying knowledge gaps and addressing them;
- placing an importance on the value of knowledge in the organisation through investment in information systems;
- embarking on identifying where and how tacit knowledge can be converted to explicit knowledge to ensure long-term sustainability;
- creating new sources of knowledge or ways at making it available to the organisation in its quest to improve both operational and safety performance;
- striving for continual learning through programmes that encourage the promotion and sharing of experiences, both positive and negative; and
- setting up ways to engage and connect ageing and new workers so that knowledge can be transferred, shared, and retained.

F.2.13 To learn from events at the plant and events in the nuclear industry and other industries worldwide

NOU has developed processes and guidelines that support the sharing and transferring knowledge, information, and data to and from external entities. The following processes and guides exist to ensure optimal transfer of knowledge:

- 238-183 *(Corrective Action Programme*)
- 331-23 (*Processing of Industry Operating Experience in Nuclear Engineering*);
- 331-24 (*Screening of Operating Experience for Applicability and Significance*); and
- KGA-035 (*Processing of Experience Feedback received through the EDF Co-Operation Agreement*).

These documents provide guidance on how to evaluate the applicability of events that happened in other utilities to improve plant safety and reliability. KGA-035 elaborates on the roles and responsibilities of the dedicated Koeberg integrated team (KIT). The Koeberg Event Group (KEG) is responsible for evaluating the applicability of events and communicating them to relevant departments. The OE programme allows optimal information and data sharing and provides the NOU with the opportunity to align with other utilities.

The station has a designated OE function to analyse and coordinate all aspects of operating experience (internal and external). Operating experience from WANO SOERs, EDF Affaire Parc, and Eskom events are reviewed for applicability to Koeberg before being distributed to the relevant staff. The corrective action processes (KAA-688 and 331-4) are administrative procedures that describe the process and responsibilities for problem identification, reporting, investigating, and trending occurrences, events, and

near misses at the NOU. This process aims to ensure that OE information is effectively identified, screened, classified, investigated, distributed, and tracked to improve nuclear and conventional safety, health and the environment, and the recurrence of events. Operating experience and all other events are captured on DevonWay.

Since commissioning, there has been close collaboration between the NOU and EDF to share operating experience (now also expanded to include LTO initiatives). The process for screening the OE for applicability and significance is documented in 331-23 and 331-24. Significant technical OE applicable to Koeberg is presented at Engineering Technical Management Meeting (ETMM) and actions tracked on DevonWay.

Knowledge Management is driven through the Top Ten Priorities as defined by the E3C (senior-level committee between Eskom and EDF) of the EDF collaboration agreement.

As stipulated in 32-83 (*Nuclear Management Policy*) and all the documents derived from these, the long-term strategy caters for knowledge management.

There have been various IAEA workshops for the PSR Project and SALTO project team to benchmark the lessons learnt and guidance in preparation for LTO.

F.2.14 Documents related to knowledge-loss risk assessment

The implementation of the KM is in accordance with 240-146686589 (*Knowledge Management Standard*). Documents and procedures associated with knowledge-loss risk are:

- KAA-688 (*The Corrective Action Process*)
- 240-128158712 (*Procedure for Deployment*)
- KSA-049 (*Koeberg Training Standard*)
- 240-128157536 (*Eskom Talent Discovery Procedure*)
- 240-128258875 (*Procedure for Development*)
- 240-138530260 (Management Position Handover Requirements for the NOU)
- 240–162195089 (*Knowledge Management Interview Report*)
- 240-162970311 (*Knowledge management Total Risk Factor*)

The Nuclear Operating Unit (NOU) process for dealing with vendor knowledge loss is documented in 238-105 (*Supplier Qualification and Audit Manual*). Procurement Quality Engineering (PQE) performs supplier capability assessments to check for the technical competency of an organisation before it is qualified as a supplier to the NOU.

F.2.15 Report on PSR assessment on the use of experience from other plants and research findings

The KNPS 3rd PSR Safety Factor 9 report 240-161608733 (*Use of Experience and Research Findings*) assessed the applicable safety requirements. The review assessed the adequacy of the collection,

screening, dissemination, evaluation, and incorporation of internal and external OE from other nuclear plants and research institutions. The review identified no deviations and confirmed that safety-related incidents are investigated using root cause analysis and lessons learned as expected. The review also confirmed that the results of the cause analysis are used to minimise the chances of the same incident reoccurring.

F.2.16 Work processes, methodologies, and procedures for life extension decision

In 2008, due to concerns about the long-term integrity of its steam generators, KNPS required Eskom approval for an investment decision to replace its six steam generators. Due to the magnitude of the investment, it was required to present an acceptable business case for this significant investment. The investment required a certain payback period to make the capital outlay feasible, paving the way for a more significant decision to invest in new steam generators and other plant upgrades that would enable operation for an additional 20 years.

By 2010, Eskom completed an economic study associated with plant life extension (PLEX), which concluded that although capital investment for some component replacements will be required, there is no known life-limiting component (that is impossible to repair or replace) that would preclude safe PLEX of the KNPS units up to 60 years.

The feasibility study is documented in K08016VAR (*Koeberg Plant Life Extension*).

In accordance with the guidance provided by the National Nuclear Regulator in 2019, it is required as part of the feasibility study to perform a periodic safety review in support of long-term operations, which was not performed as part of the feasibility phase but has been incorporated as part of the overall LTO scope.

Description of information technology and information systems processes

The KM has existing electronic platforms to facilitate knowledge capturing activities, ensuring consistent application and implementation. These processes support the conversion of tacit knowledge to explicit knowledge and explicit to tacit knowledge and the outcome documented. As documented in the 240-146686589 KM standard, several systems exist for facilitating the creation and sharing of knowledge, such as SAP, Devonway, EDMS, SharePoint and departmental databases and servers.

To facilitate and store the knowledge sourced from the application of the KM process, a SharePoint website is a preferred system used for other similar applications.

The NOU uses several IT / IS processes and systems to manage its information and records due to its diverse operational nature, as described in its integrated management system.

The IT / IS systems currently utilised by the NOU caters for its current needs. There are plans to replace or upgrade selected systems in the future to ensure the sustainability of the business capabilities that it must provide.

The plant retains records of traceability, rationale and assumptions of why and how operations, maintenance, and design changes (corporate memory) have been made.

The documentation management process followed at the NOU cascades directly from the 32-6 (Eskom documentation and records management procedure).

Each business area within the NOU follows its own documentation and records management work instruction that cascades down from the NOU standard. Records generated from the various processes are managed via the appropriate documentation and records management processes.

Operational, maintenance, and design document changes are managed via the Eskom procedure 331-85 (*Design Documentation Change Process*) for document changes affected by modifications, equivalencies, and temporary alteration forms (TAFs).

The modification process KAA-501 (*Project Management Process for Koeberg Nuclear Power Station Modification*s) describes the process for changes required by a modification and the developed design using a document change identification form to list all documents required to be changed. The electronic change process (ECP) within the Pigo database is then used to manage the revision statuses of these changed documents. The new current version is then made available electronically via Excalibur and then filed; the previous revision is transmitted to records management as a record.

F.2.17 Description of the process for managing records, reports and data related to maintenance, surveillance and inspections

All records generated at Koeberg Nuclear Power Station and NOU Business areas follow the KSA-038 (*Records Management Standard*). Records are generated by business areas and transmitted to the TD&RM records section.

The records to be kept are captured 240-43723778 (*Records Retention Matrix*) and KFI-RE-007 (*Quality Records List*). The period for retention is allocated according to 240-56296995 (*Standard for Records Retention Periods*) and reflected as such in the document generating the record and on the relevant record retention matrix. 240-56296995 (*Standard for Records Retention Periods*) identifies the minimum retention period for original hard copies or electronic copies.

The group and department heads must ensure that authorised authenticators of records are appointed. An authenticator must be an individual who is competent to determine and to certify or attest to the validity, truthfulness and accuracy of the statements, facts or pictorial representations presented. A controlled list of persons authorised to authenticate records (KFI-RE-008) is maintained by the document control organisation and the groups and sections responsible for processing records. The Authentication List requires a review every two years on content and then signed off by the line group. The documents must be authenticated before indexing and storing by the authenticator to ensure that the record is not altered. An authorised authenticator either stamp the first page of the record “AUTHENTICATED”, sign and date it underneath or authenticates the document by signing and dating it in the appropriate blank provided on the coverslip. Equipment history records (EHRs) are the exception, in which case the supervisor’s signature is accepted as authentication of the record. Departments or groups shall establish the frequency and period for retention and enter the period on 240-43723778 (*Records Retention Matrix*) and KFI-RE-007 (*Quality Records List*).

The TD&RM records management group ensures that the index list of records held by the documentation control organisation is identical to the list held by the department, group, or section.

APPENDIX G
REFERENCES

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[203] SAR: Koeberg Safety Analysis Report

NOTE: When referring to any of the documents listed above, always ensure that it is the latest authorised revision.

APPENDIX H
DEFINITIONS

Ageing Effect	A change in a component's characteristics (due to specific processes that gradually change the characteristics of a component with time or use) that could cause the component to lose its intended function before the end of its operating life.
Ageing Management	Engineering, operations, or maintenance actions that manage ageing effects within acceptable limits such that the intended functions will be consistently maintained in line with the current licensing basis during the period of extended operation.
Ageing Management Evaluation (AME)	A process to identify SSCs subject to technical evaluation includes revalidation of the time-limited assumptions and the performance of ageing management review, demonstrating that the effects of ageing degradation will be managed for the planned period of LTO.
Ageing Management Programme (AMP)	A programme that manages the effects of ageing on structures and components so that the intended functions will be maintained in accordance with the current licensing basis (CLB) for the period of extended operation.
Ageing Management Review (AMR)	The process whereby systems, structures, and components are evaluated for ageing effects based on their materials of construction, operating environments, and operating experience to determine those that require ageing management on an ongoing basis. The process also determines the relevant ageing programmes needed to manage the ageing effects and associated degradation mechanisms for ageing effects requiring management.
Ageing Mechanism	A physical or chemical process that leads to ageing effects. Mechanisms include but are not limited to fatigue, erosion, corrosion, wear, thermal embrittlement, radiation embrittlement, microbiologically-induced effects, creep, and shrinkage.
Classification	A generic term encompassing importance categories, nuclear safety classes, seismic classes, environmental categories, and quality levels.
Class 1E	The safety classification of the electric equipment and systems essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal is otherwise essential in preventing the significant release of radioactive material to the environment.
Commodity Group	A group of structures or components with similar design, similar materials of construction, similar ageing management practices, and similar environments.
Design Extension Conditions (DEC)	Specific accident conditions that are not considered design basis accidents but are considered in the design process for SSCs required for the prevention or mitigation of accidents that exceed the design basis requirements. The design process (requirements) will be according to the best estimate methodology for which the release of radioactive material is kept within acceptable limits. Design extension conditions could include severe accident conditions.
Design Extension Related (DER)	An importance category assigned to systems, functions, components, structures, software, services, or processes that are designed for or required for the prevention or mitigation of design extension conditions (i.e. exceeding the original design basis). DER requires similar levels of maintenance and availability as those items with an importance category of CSR or SR to ensure reliability and availability.

Importance Category	Indicates the importance of functions, systems, processes, components, structures, services, and software pertaining to nuclear safety and plant availability.
Importance to Safety	SSCs are assigned an importance category of SR or CSR in accordance with document 240-89294359 (*Nuclear Safety, Seismic, Environmental, Quality, Importance, and Management System Level Classification Standard*).
Reanalysis of Time-Limited Ageing Analyses	When the original design life of a particular SC is to be exceeded as identified during the TLAA revalidation, these calculations need to be reanalysed with respect to LTO.
Revalidation of Time-Limited Ageing Analyses	Treatment of those plant-specific safety analyses for which time-limited assumptions were included in the original calculations to determine the design life of plant-specific SCs. Revalidation is the exercise to confirm whether the existing TLAA is valid for LTO in its current state. If not, a reanalysis of the TLAA is required.
Safety Class	Indicates the impact on nuclear safety of functions, systems, components, structures, parts, and software used to determine technical requirements.
Scoping	A systematic process to identify systems, structures, and components (SSCs) subject to ageing management review and the evaluation for long-term operation.
Seismic Class	Indicates the functional or structural integrity, which must be maintained in the event of a design basis earthquake. Applies to structures, systems, components, and parts.
Time-Limited Ageing Analyses (TLAA)	Plant-specific safety analyses that consider time and ageing and involve SSCs within the scope of ageing management.

APPENDIX I
ABBREVIATIONS AND ACRONYMS

Abbr.	Description
ACP	Access Control Point
AE	Ageing Effect
AFI	Area for Improvement
AME	Ageing Management Evaluation
AMM	Ageing Management Matrix
AMP	Ageing Management Programme
AMR	Ageing Management Review
ANSI	American National Standards Institute
AR	Availability Related
ASCC	Atmospheric Stress Corrosion Cracking
ASME	American Society of Mechanical Engineers
BAC	Boric Acid Corrosion
C&I	Control and Instrumentation
CACD	Criteria for Analyzing and Classification of Defects
CAMP	Cable Ageing Management Programme
CAP	Corrective Action Process
CFR	Code of Federal Regulations
CLB	Current Licence Basis
CMP	Corrosion Management Programme
COMSY	Condition Oriented Ageing Management System
CSR	Critical Safety Related
CUF	Cumulative Usage Factor
DBA	Design Basis Accident
DBD	Design Basis Documentation
DEC	Design Extension Conditions
DSE	Design System Files
E3C	Eskom EDF Engineering Committee
ECP	Electronic Change Process
EDF	Électricité de France
EHR	Equipment History Records
EIT	Engineers in Training
EMS	Electrical Maintenance Services

Abbr.	Description
EPMS	Engineering Problem Management System
EPRI	Electrical Power Research Institute
EQ	Environmental Qualification
EQML	Equipment Qualification Master List
EQMM	Environmental Qualification Maintenance Manual
ER	Equipment Reliability
ERI	Equipment Reliability Index
EQML	Equipment Qualification Master List
ETMM	Engineering Technical Management Meeting
FAC	Flow-Assisted Cracking
FMA	Failure Mode Analysis
FOS	Functional Organisational Structure
FROG	Framatome Owners Group
GDC	General Design Criteria
GWh	Gigawatt hour
I&T	Inspection and Test
IAEA	International Atomic Energy Agency
IEEE	Institute of Electrical and Electronic Engineers
IGALL	International Generic Ageing Lessons Learned
ILRT	Integrated Leak Rate Test
IMS	Integrated Management System
INPO	Institute of Nuclear Plant Operators
IPDK	Integrated Plant Design-Koeberg
ISI	In-Service Inspections
ISO	International Standards Organisation
IST	In-Service Testing
ISTOG	In-Service Testing Owners Group
ISTPRM	In-Service Testing Programme Requirements Manual
IT/IS	Information Technology/Information Systems

Abbr.	Description
KBG	Koeberg
KEG	Koeberg Event Group
KIT	Koeberg Integrated Team
KLBM	Koeberg Licensing Basis Manual
KM	Knowledge Management
KNPS	Koeberg Nuclear Power Station
LIMS	Laboratory Information Management System
LOCA	Loss of Coolant Accident
LOPP	Life of Plant Plan
LTO	Long-Term Operation
MIC	Microbiology Induced Corrosion
MRG	Materials Reliability Group
MV	Medium Voltage
MWe	Megawatt electrical
MWt	Megawatt thermal
ND	Non-Destruct
NDE	Non-Destructive Examinations
NDT	Non-Destructive Testing
NE	Nuclear Engineering
NEI	Nuclear Energy Institute
NEPP	Nuclear Engineering Position Paper
NNR	National Nuclear Regulator
NOU	Nuclear Operating Unit
NPM	Nuclear Project Management
NPP	Nuclear Power Plant
NRC	Nuclear Regulatory Commission
NSA	No Safety or Availability Function
NSF	No Safety Function
NSSS	Nuclear Steam Supply System
NTP	Nuclear Technical Plan
OE	Operating Experience
OEM	Original Equipment Manufacturer
OHSA	Occupational Health and Safety Act
ORT	Operating at Reduced Temperature

Abbr.	Description
OSART	Operational Safety Assessment Review Team
OTS	Operating Technical Specifications
PAR	Passive Autocatalytic Recombiner
PCR	Procedure Change Request
PER	Pressure Equipment Regulation
PHB	Primary Heat Balance
PHC	Plant Health Committee
PLCM	Project Life Cycle Model
PM	Preventive Maintenance
PMP	Project Management Plan
POC	Programmes Oversight Committee
PQE	Procurement Quality Engineering
PSA	Probabilistic Safety Analyses/ Assessment
PSR	Periodic Safety Reassessment
PWR	Pressurised Water Reactor
PWROG	Pressurized Water Reactor Owners Group
PWSCC	Primary Water Stress Corrosion Cracking
QA	Quality Assurance
QADP	Quality Assurance Documentation Package
QC	Quality Control
QM	Quality Management
RCM	Reliability Centred Maintenance
RI	Risk Informed
RG	Regulation Guide
RO	Refuelling Outage
RPV	Reactor Pressure Vessel
RVSP	Reactor Vessel Surveillance Programme
S&QMS	Safety and Quality Management system
SALTO	Safety Aspects of Long-Term Operation
SAMG	Severe Accident Management Guide
SAP	Systems, Applications, and Products
SAR	Safety Analysis Report

Abbr.	Description
SAT	Systematic Approach to Training
SBO	Station Black-Out
SG	Steam Generator
SHA	Seismic Hazard Assessment
SHB	Secondary Heat Balance
SHEQ	Safety, Health, Environment, and Quality
SIN	Nuclear Instrumentation Systems
SIP	Process Instrumentation Systems
SME	Subject Matter Expert
SOER	Significant Operating Experience Report
SR	Safety Related
SRA	Safety Re-Assessment

Abbr.	Description
SRSM	Safety Related Surveillance Manual
SSC	Systems Structures and Components
TAF	Temporary Alteration Form
TCR	Training Change Request
TOMP	Obsolescence Management Programme
TPP	Thermal Performance Programme
TPU	Thermal Power Uprate
TRM	Technical Review Meeting
TRS	Technical Requirements Specification
TSO	Technical Support Order
WANO	World Association of Nuclear Operators

APPENDIX J
UPDATED ISSUE SHEETS FROM PRE-SALTO 2 MISSION (2019)

J.1 AREA A ISSUE SHEETS

1. ISSUE IDENTIFICATION	**Issue Number: A - 1**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Organization of ageing management and LTO activities	
1.1 - ISSUE TITLE: Inadequate Eskom provisions for LTO-related activities	
1.2 – FUNDAMENTAL OVERALL PROBLEM: The Eskom management does not provide adequate organisation, processes or resources for timely completion of all activities for safe LTO.	
2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) The organization structure at the plant is detailed in 240-64602879, Rev. 2, 'The Koeberg Organizational Operating Structures', 12 March 2014. This procedure does not reflect the recently restructured Nuclear Operating Unit, NOU, organization.

F2) The current definition phase of the project is resourced in accordance with the requirements detailed in the PMP, 080160-SALTO-PMP. The execution phase PMP and the related resources have not been approved by Eskom.

F3) Three out of five findings from PSR-II are still outstanding and 8 post Fukushima requirements are also outstanding.

SRA-II/PSR-II outstanding scope:

- Seismic Safety Hazard Curve Update;
- Project to Prevent Clogging of High Head Safety Injection Valves;
- Hydrogen Explosion Risk.

EE-SRA/Post Fukushima assessment outstanding scope:

- Hardened Water Supply Piping and Injection Lines;
- Accident Mitigation Equipment Storage Facility;
- Hardened Indication (for ELAP transient);
- Hardened Water Reservoirs;
- Procedures Phase B;
- Enhanced Communications;
- Filtered Containment Venting;
- RCP Pump Shutdown Seals.

The outstanding actions are still open due to no fixed due dates being applied by the NNR and difficulties associated with securing the necessary resources.

F4) A ring-fenced budget has been allocated by Eskom, but individual project funding approval is still required before contracts can be let. It is estimated by the plant staff that it takes a minimum of 9 months to approve project sanction, based on past experience.

F5) The plant 10-year outage schedule is not aligned with the LTO safety case and PSR NNR submission date of 21 July 2022, and project approval and delivery timescales, (e.g. component replacement of long lead items, significant inspection activities). The rescheduled LTO definition phase will be completed at the end of 2019. This is a prerequisite to allow the start of the LTO execution phase Project Management Plan (PMP), which is required to commence the production of the LTO project delivery plan. Following production of the PMP, resources can be assigned following Eskom approval, the estimated lead time for approval is 9 months.

Plant Outage Dates and Durations:

Unit 1								
Outage	124		125		126		127	
Start	20/09/19		Feb-21		26/09/22		12/02/24	
Duration	35d		96d		26d		53d	
Unit 2								
Outage		224		225		226		227
Start		27/04/20		Oct-21		27/03/23		06/09/24
Duration		35d		96d		26d		53d

F6) The NNR have imposed regulatory guides RG-0027 and RG-0028 in the Koeberg Site Licence Variation 19. The plant is developing a suite of documents to comply with the requirements which must be submitted to the NNR for their review and acceptance. A number of supporting documents, associated with PSR, have not been drafted. The scope of documents includes the project management plan for the PSR which is required to allow funding and resource release.

F7) The ability of the plant to deliver both the LTO and PSR projects in the required timescale requires significant resource commitment over the next 6 months. An estimate was provided for the resource need of the PSR delivery: 60 FTE in 2020 and 15 in 2021. In case external resources have to be utilized, there is an approximate 9-month contract placement cycle which does not provide for timely external support.

F10) Chloride ingression into the concrete of containment is a degradation mechanism which can terminate operation of the plant. Implementation of ICCP (impressed current cathodic protection) of concrete containment, which was recognized as a suitable solution, is being delayed due to financial restrictions.

F11) The plant design basis documentation is part of the station lifetime records which are stored as part of the station archive. Following a programme of work to transfer the records to electronic storage, 85% of the data has been digitized using an external contractor. The remaining 15% of lifetime records are still to be converted to digital records for access and saving. There is no contract in place to undertake the remaining work.

F12) Lack of proactive obsolescence management programme was identified by a Pre-SALTO mission in 2015. Development of Technical Obsolescence Management Programme delayed and Obsolescence Working Group including the OSC was established only in December 2018.

2.2 – SAFETY CONSEQUENCE:

Without Eskom management providing adequate organisation, processes or resources for timely completion of all activities for safe LTO, the plant will not be able to demonstrate preparedness for safe LTO.

2.3 – RECOMMENDATION/SUGGESTION:

R) The Eskom management should provide sufficient means and mandate to provide an organisation, processes and resources for timely completion of all activities for safe LTO.

2.4 – IAEA BASIS:

GSR Part 2

2.2. The senior management of organizations, in accordance with their accountabilities:

(e) Shall ensure that provision is made for adequate resources and funding,…

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.

SSR-2/2 (Rev.1)

4.5 The safety policy of the operating organization shall include a commitment to achieving enhancements in operational safety. The strategy of the operating organization for enhancing safety and for finding more effective ways of applying and, where feasible, improving existing standards shall be continuously monitored and supported by means of a clearly specified programme with clear objectives and targets.

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5.1. For the implementation of the plant programme for ageing management, the policy and objectives of the programme should be established, and the necessary resources (e.g. human resources, financial resources, tools and equipment, and external resources) should be identified and allocated...

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

2.5 – DOCUMENTS REVIEWED:

- RG-0027, Rev 0, Aging Management and Long Term Operations Of Nuclear Power Plants, March 2019;
- RG-0028, Rev 0, Periodic Safety Review Of Nuclear Power Plants, March 2019;
- 240-134895976, Rev 0, Long Term Operation – Licencing, July 2019;
- 240-64602879, Rev. 2, The Koeberg Organizational Operating Structures, 12 March 2014;
- 36-197, Rev 2, Koeberg Licencing Basis Manual, March 2019;
- KNPS NIL01, Rev 19, Site Licence, Q1 2019;
- 32-83, Rev 4, Eskom Nuclear Management Policy, December 2018;
- 240-108035478, Rev 1, The Eskom Objectives, September 2016;
- 240-134895976, Rev 1, Koeberg SALTO Scoping Methodology, June 2019;
- 240-125122792, Rev 2, Koeberg Safety Aspects of Long Term Operation (SALTO) Aging Management Evaluation Process and Revalidation of the Time Limited Ageing Analyses, May 2019;
- 08016-S-PMP, Rev 1, Nuclear Project Management Plan, June 2017;
- 08016-S-LIC, Rev 1, Nuclear Licencing Strategy for Koeberg SALTO Assessment Project;
- 240-125839632, Rev. 1, Koeberg Safety Aspects of Long Term Operation (SALTO) Scoping Methodology, June 2019;
- 240-134382460, Rev 2Draft, SRA-III PSR Basis Document (3rd Periodic Review for Koeberg Power Station), Draft;
- KAA-709, Rev. 6, Process for Performing Safety Screenings, Safety Evaluations, Safety Justifications and Safety Cases, 12 October 2011;
- Koeberg SAR, Rev.5;
- 240-1489980644, Rev. Draft, Strategy for Updating the Safety Analysis Report, Draft.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 08/11/2021

F1) 240-64602879 was revised in 2019 and reflects the current structures and mandates of the various organisations in the NOU.

F2) Eskom is now in the execution phase of the projects and the ERA was approved, funds are allocated.

F3) Below is the status of the findings from PSR-II and 8 post Fukushima requirements.

SRA-II/PSR-II outstanding scope:

- Seismic Safety Hazard Curve will follow the update to the DSSR - An Interim re-evaluation strategy was accepted by the Regulator, and is progressing in accordance with the schedule.
- Project to Prevent Clogging of High Head Safety Injection Valves - The Medium item has now been downgraded to a LOW item, and communicated to the NNR. The modification is also planned, in accordance with Eskom processes for modifications.
- Hydrogen Explosion Risk. - The feasibility study was combined with the EE-SRA item (see schedule)

EE-SRA/Post Fukushima assessment outstanding scope:

- Hardened Water Supply Piping and Injection Lines;
- Accident Mitigation Equipment Storage Facility;
- Hardened Indication (for ELAP transient);
- Hardened Water Reservoirs;
- Procedures Phase B;
- Enhanced Communications;
- Filtered Containment Venting;
- RCP Pump Shutdown Seals.

Eskom has progressed with close-outs of these issues. Please refer to the schedule for execution of the Fukushima mods.

F4) All LTO projects are progressing, see the schedule and LTO dashboard.

F5) The 10 year outage plan was revised and takes into account the end of the licence

F6) The Programme Management Plan and PSR basis document have been compiled and accepted by the Regulator.

F7) The PSR is fully resourced and currently performing the Global Assessment phase of the project.

F10) Eskom plans to execute an ILRT in X 126 outages, to verify containment integrity. The ICCP is also being pursued and will be executed by April 2024.

F11). As part of the SALTO AM assessment project an assessment was made of all documentation required and concluded all are available and will be managed as per procedure.

F12) Technical Obsolescence Programme is has been established at Koeberg.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS:

F1) n.a.

4.2 – DOCUMENTS REVIEWED:

n.a.

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

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

1.1 – ISSUE TITLE:

Inadequate plant-based LTO project arrangements

1.2 – FUNDAMENTAL OVERALL PROBLEM:

The plant-based LTO project arrangements are not adequate to implement the ageing management related LTO assessments in a timely manner.

2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) The Project Management Plan, PMP, 08016-S-PMP, Rev 1, Nuclear Project Management Plan, June 2017, for LTO is being updated to address the execution phase of the project, however, the organizational structure and integrated resource planning for all LTO related projects, for the execution phase, has not been issued.

F2) There is no detailed plan for the execution phase of the LTO project. The final outcome of the definition phase will be used to create a Project Management Plan, which will be used for the approval of the next work phase (execution phase).

F3) Completion of the definition phase of the LTO scoping and screening has been rescheduled to the end of 2019, a deferral of 6 months from the original baseline project milestones.

F4) The Project Plan, ID LTO2019, 'Long Term Operation of Koeberg Nuclear Power Station' dated 6/6/2019, has no detailed schedule for all of the LTO definition phase, in the current issue of the plan.

F5) All actions to be performed for the definition phase of LTO are listed in a sharepoint spreadsheet (SE38545) for progress monitoring and tracking. From the total of 124 definition phase actions, 41 are overdue against their base line completion date. The oldest overdue action had a base line completion date of 28/3/2019 which was rescheduled to 30/8/19 and is still outstanding. Reference OD 20.2 action to update 331-127.

F6) No recommendations or suggestions arising from different reviews and ageing management assessments have been incorporated into plant activities. At this time, only 15 screening documents from the consortium have been accepted, out of a total of 80 documents to be delivered.

F7) The Station has documented the process in 08016-S-LIC, Rev. 1, Nuclear Licensing Strategy for Koeberg SALTO Assessment Project, 4 July 2019. The document is awaiting final NNR agreement. The plant commenced scoping and screening involving the Lesedi/Framatome consortium without formal NNR agreement to the document.

F8) The following documents detail the responsibilities for defining the scoping methodology and performance of the Aging Management Evaluations, AME.

- 240-125839632, Rev. 1, Koeberg Safety Aspects of Long-Term Operation (SALTO) Scoping Methodology, June 2019;
- 240-125122792 , Rev. 2, Koeberg Safety Aspects of long Term Operation (SAL TO) Ageing Management Evaluation Process and Revalidation of the Time Limited Ageing Analyses, May 2019.

An up to date description of the complete set of roles and responsibilities for all personnel involved in ageing management and LTO has not been issued.

F9) The resource required for the execution phase of the LTO project have not been defined.

F10) The LTO programme is aligned with RG0027 of NNR. Reg Guide RG0027. An alignment check has been performed by the SALTO project using an uncontrolled spreadsheet. Not all the requirements are addressed. The unaddressed requirements are planned for later phases of the project e.g. updating of AMPs, monitoring and reporting of AMPs: a total of 349 actions are defined for the definition and execution phases of the LTO project. The definition phase will address 1/3rd of the total, the remainder will be addressed as part of the execution phase. The actual progress of the definition phase deliverables is ~50% with the phase completion due date of 31 December 2019.

F11) The plant SALTO document, 08016-S-LIC, Rev 1, 'Nuclear Licencing Strategy for Koeberg SALTO Assessment Project, Awaiting Approval', describes the SALTO ageing management assessment process. The current status of the scoping and screening consortium deliverables is that there are 80 documents required by the project of which 16 have been accepted and 1 issued for acceptance. The remaining consortium documents are all overdue and the revised completion date of all remaining documents is December 2019, 6 months later than the original project baseline delivery milestone.

F12) A detailed monthly progress report, 'The Koeberg SALTO Scoping and Ageing Management Evaluation Project monthly progress report 1 August 2019 until 31 August 2019' was provided by the consortium Lesedi/Framatome in which the overdue actions are listed. No recovery actions are detailed in the monthly report.

F13) The Koeberg licensing basis manual, KLBM, 36-197, Rev 2, 'Koeberg Licencing Basis Manual', March 2019, includes an ageing management matrix (AMM) for the station. This AMM is not aligned with the requirements with RG0027.

2.2 – SAFETY CONSEQUENCE:

Without adequate plant-based LTO project arrangements, the LTO project will not provide for complete implementation of ageing management related LTO activities.

2.3 – RECOMMENDATION/SUGGESTION:

R) The plant should ensure adequate plant-based LTO project arrangements exist for implementation of ageing management related LTO activities.

2.4 – IAEA BASIS:

GSR Part 2

Requirement 10: Management of processes and activities

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

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

GS-G-3.1

3.1. The efficiency of a management system begins at the level of senior management. Responsibility for the effectiveness of the management system should not be delegated

3.2. The senior management is responsible and accountable for the planning and implementation of a management system that is appropriate to the organization. It is the role of senior management to establish and cultivate principles that integrate

all requirements into daily work. Senior managers should provide the individuals performing the work with the necessary information, tools, support and encouragement to perform their assigned work properly.

3.10. As part of the management system, senior management should develop and disseminate throughout the organization a documented set of policies that establish the management's plans, objectives and priorities with regard to safety, health, environmental, security, quality and economic considerations. The policies should reflect the commitment of senior management to attaining their goals and objectives; their priorities; and the means by which continual improvement will be implemented and measured.

3.11. The policies:

- Should be appropriate to the purpose and the activities of the organization and should contain statements on safety, health, environmental, security, quality and economic considerations;
- Should include a commitment to comply with management system requirements and to seek continual improvement;
- Should be aligned with and should support the development of a strong safety culture;
- Should reflect relevant statutory requirements;
- Should provide an appropriate framework for action and for establishing and reviewing goals and objectives;
- Should be reviewed periodically for their continuing suitability and applicability;
- Should be effectively communicated, understood and followed within the organization;
- Should commit management to providing adequate financial, material and human resources.

3.12. Senior management should demonstrate its commitment to all the policies through its actions and should provide firm and unambiguous support for the implementation of these policies. Its actions should foster a corresponding commitment to high levels of performance by all individuals. All individuals should be expected to demonstrate their commitment to the policies. Adequate resources should be made available to implement all the policies…

5.10. To manage the processes of the organization, an organization should determine the following:

- The processes that implement the vision, goals, strategy, policies and objectives of the organization;
- The requirements for the input to the processes and the output from the processes;
- How the processes interact to enable the organization's objectives to be achieved.

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3.31. If long term operation is contemplated, the operating organization should establish policy documents, dedicated organizational structures and action plans to perform evaluations for long term operation well before the plant enters into long term operation. The operating organization should specify subjects for evaluation for long term operation and should assess the current physical status of relevant SSCs during the preparation phase for long term operation (see paras 7.3–7.15).

7.7. A plant policy for long term operation should be established and should cover the principles of and concept (strategy) for long term operation. When a decision on long term operation is connected to a regulatory process, such as licence renewal or periodic safety review, the plant policy should take account of the related regulatory process.

7.8. The long term operation programme should be based on the following principles:

(a) Operational practices should meet national regulations, should follow international guidelines, as applicable, and should be adequate to ensure safe operation of the plant.

(b) The regulatory process should be adequate to ensure that safe operation of the nuclear power plant is maintained and should focus on ageing effects that need to be properly managed for the planned period of long term operation.

(c) The current licensing basis should provide an acceptable level of safety and should be carried over to the planned period of long term operation in the same manner and to the same extent, with the exception of any changes specific to long term operation.

7.9. The concept (strategy) for long term operation should address basic goals and objectives, milestones, activities, organizational roles and responsibilities, interactions with other major projects, and interactions with external organizations.

7.19. The programme for long term operation should address the safety improvements required for safe long term operation, the schedule, and the commitments of the operating organization relating to long term operation.

7.29. The assumptions, activities, evaluations, assessments and results of the plant programme for long term operation should be documented by the operating organization in accordance with national regulatory requirements as well as in accordance with the IAEA safety standards [2]. The documentation should be developed and retained in an auditable and retrievable form so that it provides a part of the technical basis for approval of long term operation.

7.41. The programme for long term operation should be implemented by the operating organization in a manner consistent with the requirements of the national regulatory body and national regulations.

2.5 – DOCUMENTS REVIEWED:

- RG-0027, Rev 0, Aging Management and Long Term Operations Of Nuclear Power Plants, March 2019;
- RG-0028, Rev 0, Periodic Safety Review Of Nuclear Power Plants, March 2019;
- 240-134895976, Rev 0, Long Term Operation – Licencing, July 2019;
- 240-64602879, Rev. 2, The Koeberg Organizational Operating Structures, 12 March 2014;
- 36-197, Rev 2, Koeberg Licencing Basis Manual, March 2019;
- KNPS NIL01, Rev 19, Site Licence, Q1 2019;
- 32-83, Rev 4, Eskom Nuclear Management Policy, December 2018;
- 240-108035478, Rev 1, The Eskom Objectives, September 2016;
- 240-134895976, Rev 1, Koeberg SALTO Scoping Methodology, June 2019;
- 240-125122792, Rev 2, Koeberg Safety Aspects of Long Term Operation (SALTO) Aging Management Evaluation Process and Revalidation of the Time Limited Ageing Analyses, May 2019;
- 08016-S-PMP, Rev 1, Nuclear Project Management Plan, June 2017;
- 08016-S-LIC, Rev 1, Nuclear Licencing Strategy for Koeberg SALTO Assessment Project;
- 240-125839632, Rev. 1, Koeberg Safety Aspects of Long Term Operation (SALTO) Scoping Methodology, June 2019;
- 240-134382460, Rev 2Draft, SRA-III PSR Basis Document (3rd Periodic Review for Koeberg Power Station), Draft;
- KAA-709, Rev. 6, Process for Performing Safety Screenings, Safety Evaluations, Safety Justifications and Safety Cases, 12 October 2011;
- Koeberg SAR, Rev.5;
- 240-1489980644, Rev. Draft, Strategy for Updating the Safety Analysis Report, Draft.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 08/11/2021

F1) The Project Management Plan, PMP, 08016-S-PMP, Nuclear Project Management Plan, and Stakeholder Management Plan have been updated.

F2) A detailed LTO schedule is available

F3) The SALTO project is currently in execution phase.

F4) A detailed LTO schedule is available

F5) All ODs are tracked and there are currently no OD s delayed that are required before the SALTO mission

F7) 08016-S-LIC was seen and accepted by NNR, and the scoping process accepted by the NNR.

F8) All AM roles and responsibilities are formally documented in the Ageing management requirements for KNPS, 240-149139512.

F9) The resources required for the execution phase of the LTO project are defined and planned and planned for.

F10) All ODs are tracked and focus on requirements in RG-0027.

F11) The plant SALTO document, 08016-S-LIC, Rev 1, 'Nuclear Licencing Strategy for Koeberg SALTO was accepted by the Regulator. The SALTO AM assessment project definition phase was completed, the Interim SALTO Ageing Management Assessment Report was sent to the Regulator and comments received.

F12) SALTO AM assessment project definition phase was completed, the project is in execution phase.

F13) KLBM rev 3 drafted with inclusion of AM and submitted to the NNR (Eskom is awaiting acceptance). Sufficient organisational arrangements have been made for entry into LTO	
4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3
4.1 – FACTS: **F1)** n.a.	
4.2 – DOCUMENTS REVIEWED: n.a.	
4.3 – RESOLUTION DEGREE:	

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

1. ISSUE IDENTIFICATION	**Issue Number: A - 3**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Organization of ageing management and LTO activities	
1.2 – ISSUE TITLE: Concerns for complete and timely implementation of PSR for LTO	
1.3 – FUNDAMENTAL OVERALL PROBLEM: Current status of PSR activities does not ensure complete and timely implementation of PSR for LTO.	
2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) The high-level methodology for the PSR does not exist and is being developed in document, 240-134382460, Rev. 2 Draft, SRA-III PSR Basis Document (3rd Periodic Safety Review for Koeberg Power Station.

F2) Development of the detailed working instructions to perform the PSR activities have not been started.

F3) The detailed resource matrix which is required to support the delivery timescales associated with the PSR has not been populated and limited station resources have been allocated to the development phase at this stage.

F4) The PSR has to be delivered by December 2021 (committed date). The plant requires resources to commence the project in January 2020, however no resource plan has been approved for the project delivery.

F5) The due date for completion of all of the LTO assessment work is 12/2021 to satisfy the NNR submittal date of 21 July 2022, for the safety case for LTO and the PSR documentation. None of the detailed PSR activities required to support the

12/2021 completion date, to meet the NNR submittal date requirements for the PSR documentation, are identified in the project plan, ID LTO2019, 'Long Term Operation of Koeberg Nuclear Power Station', dated 6/6/2019.

F6) The PSR methodology, 240-134382460, Rev. 2 Draft, SRA-III PSR Basis Document (3rd Periodic Safety Review for Koeberg Power Station identifies the requirement to evaluate the effectiveness of the TLAAs and ageing management in safety factors Chapter 4.6, review tasks 4.2-4.5. The PSR basis document limits the scope of assessment to replaceable components only.

F7) The PSR Reg Guide, RG-0028, has a cross reference matrix which details which safety factors are inputs to other safety factor review, but it does not identify safety factor 4 (ageing management) as an input into safety factors 8 or 10.

F8) The matrix for the safety factors has been used to develop the high-level methodology for PSR Basis Document, 240-134382460, Rev. 2 Draft, SRA-III PSR Basis Document (3rd Periodic Safety Review for Koeberg Power Station. A review of the draft basis document has identified that safety factor chapter 2 does not include all the regulatory guide cross references.

2.2 – SAFETY CONSEQUENCE:

Without complete and timely implemented PSR for LTO, the plant cannot identify safety upgrades necessary for safe LTO.

2.3 – RECOMMENDATION/SUGGESTION:

R) The plant should ensure timely implementation of complete PSR for LTO.

2.2 – IAEA BASIS:

SSR 2/2 (Rev.1)

Requirement 16: Programme for long term operation

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.

SSG-48

2.31. The plant's programme for long term operation is a set of activities, including evaluations, assessments, maintenance, inspections and testing, aimed at justifying and demonstrating plant safety for the planned period of long term operation. The programme for long term operation should be based on national regulatory requirements, should consider international best practices, operating experience and research findings, and should include an implementation plan, as described in Section 7.

3.2. Regulatory requirements for ageing management should be established and guidance should be developed to ensure that the operating organization of the nuclear power plant implements effective ageing management at each stage of the lifetime of the nuclear power plant.

3.31. If long term operation is contemplated, the operating organization should establish policy documents, dedicated organizational structures and action plans to perform evaluations for long term operation well before the plant enters into long term operation. The operating organization should specify subjects for evaluation for long term operation and should assess the current physical status of relevant SSCs during the preparation phase for long term operation (see Section 7).

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

7.2 Requirements for long term operation should be specified within the national regulatory framework. They should cover, as appropriate, interfaces with the requirements for periodic safety review [7].

7.3 The operating organization should adopt a comprehensive project structure or similar organizational arrangements for preparation and implementation of the programme for long term operation, which should take into account the arrangements for the management of physical ageing as described in Section 5. The organizational arrangements for the management of

physical ageing, including technological obsolescence, should be properly implemented and should be one of the prerequisites for a decision to pursue long term operation for the nuclear power plant.

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

7.5 Major steps of the programme for long term operation, in particular for ageing management of SSCs necessary to ensure safe long term operation [23], are illustrated in Fig. 8.

7.7 A plant policy for long term operation should be established and should cover the principles of and concept (strategy) for long term operation. When a decision on long term operation is connected to a regulatory process, such as licence renewal or periodic safety review, the plant policy should take account of the related regulatory process.

7.19 The programme for long term operation should address the safety improvements required for safe long term operation, the schedule and the commitments of the operating organization in this respect.

7.29 The assumptions, activities, evaluations, assessments and results of the plant programme for long term operation should be documented by the operating organization in accordance with national regulatory requirements as well as in accordance with the IAEA safety standards [2]. The documentation should be developed and retained in an auditable and retrievable form so that it provides a part of the technical basis for approval of long term operation.

2.5 – DOCUMENTS REVIEWED:

- RG-0027, Rev. 0, Aging Management and Long Term Operations Of Nuclear Power Plants, March 2019;
- RG-0028, Rev. 0, Periodic Safety Review Of Nuclear Power Plants, March 2019;
- 240-134895976, Rev. 0, Long Term Operation – Licencing, July 2019;
- 240-64602879, Rev. 2, The Koeberg Organizational Operating Structures, 12 March 2014;
- 36-197, Rev. 2, Koeberg Licencing Basis Manual, March 2019;
- KNPS NIL01, Rev. 19, Site Licence, Q1 2019;
- 32-83, Rev 4, Eskom Nuclear Management Policy, December 2018;
- 240-108035478, Rev. 1, The Eskom Objectives, September 2016;
- 240-125122792, Rev. 2, Koeberg Safety Aspects of Long Term Operation (SALTO) Aging Management Evaluation Process and Revalidation of the Time Limited Ageing Analyses, May 2019;
- 08016-S-PMP, Rev. 1, Nuclear Project Management Plan, June 2017;
- 08016-S-LIC, Rev. 1, Nuclear Licencing Strategy for Koeberg SALTO Assessment Project;
- 240-134382460, Rev. 2, SRA-III PSR Basis Document (3rd Periodic Review for Koeberg Power Station), Draft;
- KAA-709, Rev. 6, Process for Performing Safety Screenings, Safety Evaluations, Safety Justifications and Safety Cases, 12 October 2011.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 08/11/2021

F1) 240-134382460, PSR basis document, Rev.3 was accepted by the NNR

F2) Requirements and methodology for each of the safety factors were compiled and sent to the NNR for review and concurrence.

F3). The PSR licensing strategy 0319-LIC is approved by the NNR. The PSR is fully resourced.

F4) Due date has been revised, see attached 0319-LIC and programme schedule. The PSR will be completed in May 2022.

F5) The LTO programme schedule has been updated

F6) The PSR assesses ageing management for all components, and not only replaceable components. The comprehensiveness of the programme was done to include all SR equipment. The scope list used was identical to that used for the SALTO AM assessment project.

F7) Safety factor 4 considered all other safety factors for overlap, input and implications. This can be seen in the SF4 review report.

F8) For SF2 (similar to all other safety factors), the requirements determination document identified all safety requirements (including national regulations) to be reviewed. This document is more detailed than the basis document.

240-134382460, PSR basis document, Rev.3 was accepted by the NNR. The PSR project is underway and on target to complete in June 2022 in accordance with the revised schedule.

OD_3.16 addresses this issue. The OD was closed out

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/YYY3

4.1 – FACTS:

F1) n.a.

4.2 – DOCUMENTS REVIEWED:

n.a.

4.3 – RESOLUTION DEGREE:

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

1. ISSUE IDENTIFICATION	**Issue Number: A - 4**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Organization of ageing management and LTO activities	

1.4 – ISSUE TITLE:

Ageing management and LTO not reflected in the SAR

1.5 – FUNDAMENTAL OVERALL PROBLEM:

The SAR does not contain ageing management and LTO assessments.

2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) The SAR (Koeberg SAR Rev. 5) has no specific information on ageing management and LTO assessments.

F2) Although it is the intention of the plant to include the AMR and AMP information in the 'Koeberg licensing basis manual', 36-197, the current SAR, Rev.5, does not contain justification relevant to the planned period of LTO.

F3) The plant procedure for updating the SAR is 240-148980644, Rev. Draft, 'Strategy for Updating the Safety Analysis Report' is under review. The document does not include the requirement to include ageing management and LTO assessments. It is planned to include only TLAAs data but not information about AMR or AMP.

F4) It is not planned to include all the results of the assumptions, activities and results of other plant programmes for LTO into SAR.

F5) Document KAA-709, Rev. 6, Process for Performing Safety Screenings, Safety Evaluations, Safety Justifications and Safety Cases, 12 October 2011, has a next review date of 12 October 2017, but has not been reviewed so far.

2.2 – SAFETY CONSEQUENCE:

Without incorporating ageing management and LTO assessments into the SAR, ageing management over the LTO period cannot be demonstrated.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider incorporating ageing management and LTO assessments into the SAR.

2.2 – IAEA BASIS:

SSR 2/2 (Rev.1)

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.

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3.160. The SAR should specify which safety related plant items will require any form of monitoring to ensure that they remain fit for their purpose and that their operation is within the identified operational limits for reliable and safe operation.

3.161. In this section the SAR should provide a description and justification of the arrangements that the operating organization intends to have in place to identify, control, plan, execute, audit and review maintenance, surveillance, inspection and testing practices that influence reliability and affect nuclear safety.

3.163. This section should also include information justifying the appropriateness of the plant inspections, including in-service inspections, required to help demonstrate that the plant meets the specified standards, satisfies the inspection criteria adopted and remains capable of performing the required safety functions. In particular, emphasis should be placed on the adequacy of the in-service inspections of the integrity of the primary and secondary coolant systems, owing to their importance to safety and the severity of the possible consequences of failure.

3.166. The operating organization should identify all parts of the plant that can be affected by ageing and should present the proposals made for addressing the issues identified. This includes, among others, the operating organization's proposals for appropriate material monitoring and sampling programmes where it is found that ageing or other forms of degradation may occur that may affect the ability of components, equipment and systems to perform their safety function throughout the lifetime of the plant. Appropriate consideration should be given to analysing the feedback of operational experience with respect to ageing.

4.3. Since the SAR is part of the overall justification of plant safety, it should reflect the current state and the licensing basis of the plant and should be kept up to date accordingly (this is sometimes referred to as a 'living' SAR).

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3.11. Ageing management should be addressed in the safety analysis report and other licensing documents. The description of ageing management in the safety analysis report should include general information on the following topics [12]:

- The strategy for ageing management and prerequisites for its implementation;

– Identification of all SSCs of the plant that could be affected by ageing and are in the scope of the ageing management;

– Proposals for appropriate materials monitoring and sampling programmes in cases where it is found that ageing effects may occur that may affect the capability of SSCs to perform their intended function throughout the lifetime of the plant;

– Ageing management for different types of in-scope SSCs (e.g. concrete structures, mechanical components and equipment, electrical equipment and cables and instrumentation and control equipment and cables) and means to monitor their degradation;

– ...

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

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

4.4 The safety analysis report should be kept updated to reflect the results of the ageing management review [12].

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

4.10 All modifications of SSCs, releases of process software, operational limits and conditions, set-points, instructions and procedures should be properly documented and retained in an auditable and retrievable form. All safety significant modifications should be included within the safety analysis report [12, 13, 14].

2.5 – DOCUMENTS REVIEWED:

- RG-0027, Rev 0, Aging Management and Long Term Operations Of Nuclear Power Plants, March 2019;
- 240-134895976, Rev 0, Long Term Operation – Licencing, July 2019;
- 240-64602879, Rev. 2, The Koeberg Organizational Operating Structures, 12 March 2014;
- KNPS NIL01, Rev 19, Site Licence, Q1 2019;
- 32-83, Rev 4, Eskom Nuclear Management Policy, December 2018;
- 240-108035478, Rev 1, The Eskom Objectives, September 2016;
- Koeberg SAR, Rev.5;
- 240-1489980644, Rev. Draft, Strategy for Updating the Safety Analysis Report, Draft.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 08/11/2021

F1) SAR updates for ageing management are in progress. The SAR will be updated with AMP and TLAAs upon completion of the analyses

F2) SAR updates for ageing management are in progress. The SAR will be updated with AMP and TLAAs upon completion of the analyses

F3) The authorised 240-148980644 includes updating the SAR with AM and LTO.

F4) Correct, this will be documented in the final version of the SALTO AM assessment report. The SAR will include a description of AM and all TLAAs.

F5) The Safety Evaluation Process (240-143604773) was revised and authorised in 2021.

SAR updates will be completed following the ageing management assessment, in accordance with the revised schedule (July 2023). The schedule has been seen by the NNR

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3
4.1 – FACTS: **F1)** n.a.	
4.2 – DOCUMENTS REVIEWED: n.a.	
4.3 – RESOLUTION DEGREE:	

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

J.2 Area B Issue Sheets

1. ISSUE IDENTIFICATION	**Issue Number: B - 1**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Scope setting, plant programmes and corrective action programme	
1.6 – ISSUE TITLE: Insufficient documentation of scope setting methodology for LTO	
1.2 – FUNDAMENTAL OVERALL PROBLEM: The documentation of scope setting methodology for LTO does not provide for complete, justified and traceable scope setting results.	
2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019
2.1 – FACTS: **F1)** A function-based scope setting analysis is not performed to confirm the in-/out-scope setting. **F2)** Lists of SSCs in scope for LTO do not provide information related to the used scoping criteria. **F3)** Justification of compliancy of plant safety classification, seismic classification and importance categorization with scope setting criteria is not available in the scoping methodology, neither in any other relevant document for LTO assessment. **F4)** The plant cannot demonstrate that the scoping methodology address the following functions: confinement of radioactive material, shielding against radiation, control of planned radioactive releases and limitation of accidental radioactive releases. These functions refer also to the items that are part of a safety group and/or whose malfunction or failure could lead to radiation exposure of the site personnel. **F5)** A description of spatial interactions and physical connections between SSCs important to safety and not important to safety, is not included in the plant scoping methodology.	

F6) An exhaustive list of internal and external events and hazards, and design extension conditions, with an out-of-scope justification, is not included in the scoping methodology.

F7) The scoping methodology does not refer the walk-downs for criterion B scoping. No walk-downs are performed in this stage of the scope setting, to clarify criterion B application, except for those that were done in the framework of specific studies performed for fire, flooding, etc. Walk-downs are defined to be part of implementation actions in the execution phase.

F8) The scoping methodology refers to the "Ageing Management Evaluation Process and Revalidation of the Time Limited Ageing Analyses" methodology for the use of commodity groups. This reference is not made for technical boundaries.

F9) Third party guidelines are provided, related to technical boundaries and commodity grouping. These are insufficiently positioned, detailed and assured within the plant scoping or the ageing management evaluation (AME) methodologies documents. These aspects are crucial part of the methodology.

F10) There is no guidance in the scoping or AME methodologies on the applied approach for short living components.

F11) The plant applies the same approach for passive and active components. The distinction of SCs is made based on the applied safety, seismic classification and importance category of the involved components or items, but the scoping methodology does not provide guidance for this approach. The approach does not support listing the components in scope with an active function, and so does not support an effective ageing management review and interactions with other programmes (Reliability Centered Maintenance, IQReview for developing maintenance strategies).

F12) The scope setting methodology does not provide guidance on how to define the optimum lowest component level to be considered for ageing management. This could lead to inefficiency in the overall assessment (E.g. Scoping of Reactor Building is split in >200 components: walls, penetrations, etc. which are all individually identified, without having a view on the need of this detail of information, as the commodity grouping still needs to be defined).

F13) The plant does not use a consistent terminology in the scoping methodology. E.g.: in section 2.1 of the scoping methodology the following is found: "The scope of the scoping methodology document is limited to providing the methodology for the scoping of SSCs important to safety for the Koeberg SALTO ageing management evaluation".

2.2 – SAFETY CONSEQUENCE:

Without a complete, justified and traceable scope setting methodology documentation, the completeness and consistency of the SSCs scope of AMR is not assured.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider improving documentation of the scope setting methodology for LTO to provide for complete, justified and traceable scope setting results.

2.4 – IAEA BASIS:

SSR 2/2 (Rev.1)

Requirement 16: Programme for long term operation

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

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

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5.14. A systematic scope setting (also called 'scoping') process to identify SSCs subject to ageing management should be developed and implemented.

5.15 A list or database of all SSCs at the nuclear power plant should be made available before the scope setting process is commenced.

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

5.18. If an SSC within the scope is directly connected to an SSC out of the scope, clear definitions of the boundaries between them should be established.

5.19. …, dedicated plant walkdowns should be used to check the completeness of the list of SSCs whose failure may prevent SSCs important to safety from performing their intended functions.

5.20. … If the components or structures within a group have similar functions and similar materials and are in a similar environment, that group may be defined as a structure or component 'commodity group'.

5.21. After the scope setting process, a clear distinction between SSCs within the scope and those out of the scope should be evident.

7.20. Scope setting for long term operation should follow the approach set out in paras 5.14–5.21 and should account for differences in regulatory requirements, codes and standards.

2.5 – DOCUMENTS REVIEWED:

- RG-0027, Rev. 0, Interim Regulatory Guide, Ageing management and Long Term Operation of Nuclear Power Plants, 2019-03;
- L1124-DE-RPT-003, Rev. 1, Consortium's ageing management methodology document, 2019-05-06;
- 240-89294359 (KSA-010), Rev.1, Nuclear Safety, Seismic, Environmental, Quality, and Importance and Management System Level Classification Standard, 2010-01-16;
- 240-125839632, Rev. 1, Koeberg Safety Aspects of Long-Term Operation (SALTO) Scoping Methodology, 2019-06-18;
- L1124-GN-RPT-004, Rev.0, Boundary definition by bigrammes for SALTO, 2018-10-10;
- 240-101459264, Rev. 1, Strategy for demonstration Safe Long Term Operation for KOU, 2018;
- 240-128716554, Rev. 1, Koeberg SALTO input sources, 2017-07-17;
- 240-125122792, Rev.2, Koeberg SALTO Ageing Management Evaluation Process and Revalidation of the Time-Limited Ageing Analyses, 2019-05-23;
- L1124-GN-LIS-006A , Rev.0, IGALL commodity group linking table, 2019-06-24;
- 331-94 (KLA-001), Rev.1, Importance Category Classification Listing, 2019-05-29;
- 331-93, Rev. 0, Guide for Classification of Plant Components, Structures and Parts, 2017-06.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

Koeberg's Scoping methodology is documented in 240-125839632, 'Koeberg Safety Aspects of Long Term Operation (SALTO) Scoping Methodology'. The Ageing Management (AM) scoping documentation now include the AM standard and scoping procedure (accepted by the NNR) The actual process followed in scoping is provided in 240-156945472, 'SALTO Ageing Management Assessment Report (Interim)'. The complete scope list was provided as a deliverable of the SALTO assessment in L1124-GN-LIS-020, 'Comprehensive List of all SSCs'.

F1) The Eskom method of identifying AM scope is extensive and uses the existing classification system.

F2) Scope determined for AM complies with scoping procedure (as accepted by the NNR).

F3) Scoping methodology is documented in the scoping procedure (and accepted by the NNR).

F4) The scope includes all systems involved with confinement of radioactive material, shielding against radiation, control of planned radioactive releases and limitation of accidental radioactive releases and is in alignment with the scoping procedure.

F5) Specific plant walkdowns of the most important SSCs were undertaken to confirm no spatial not important to safety equipment have not been excluded erroneously.

F6) All DEC equipment have been included in the scope.

F7) Specific plant walkdowns of the most important SSCs were undertaken to confirm no spatial not important to safety equipment have not been excluded erroneously.

F8) All included SSC were captured in commodity groups based on the manufacturing materials and exposed environments. Overlaps were identified by the Consortium.

F9) Commodity grouping is described in the SALTO interim report.

F10) All short lived components are catered for in the PM programme and underpinned by equipmement reliability principles.

F11 All equipment included in the scope underwent identification of potential degradation/ageing and these effects checked for adequate management, irrespective of active or passive.

F12) Commodity grouping for structures completed without problem.

F13) Scoping terminology used at Koeberg is well understood.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS:

F1) n.a.

4.2 – DOCUMENTS REVIEWED:

n.a.

4.3 – RESOLUTION DEGREE:

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

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

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

1.7 – ISSUE TITLE:

Incomplete evaluation of plant programmes effectiveness for LTO

1.2 – FUNDAMENTAL OVERALL PROBLEM:

Evaluation of existing plant programmes for effectiveness in managing ageing for LTO is not completed.

2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 14/03/2019

2.1 – FACTS:

F1) The plant organization is developing organizational arrangements to manage the effects of ageing, the effectiveness of AM and the need for programme improvements through Programme Health Reporting, Component Health Reporting and System Health Reporting. However, these arrangements are not described and validated in a procedure and are not fully implemented.

F2) Ageing Management Evaluation is in progress, and so it is not completely defined for each in-scope SC what plant programmes are applied, which ageing effects they manage, what maintenance/inspection methods are used and which

documentation is applicable in the Ageing Management Matrix (AMM). This jeopardize Health Reporting as an effective living process for LTO.

F3) The draft gap analysis (CR 102827-001 GA 'Review PM Programme') on consistency of the plant maintenance programme (represented by plant Equipment Reliability Programme) against the 9 generic attributes of an effective ageing management programme is not finished. The team review of the attribute 'Scope' did not show evidence of effective ageing management.

F4) In the highest-level documentation ('the standard') of the plant programmes relevant for ageing management (maintenance, in-service inspection, surveillance, chemistry), no evidence was shown for of effectiveness, except for the water chemistry programme.

F5) The effectiveness for ageing management of the 'Surveillance programme for periodic testing of Safety Related Components' is not verified according to the nine attributes.

F6) The process of interaction between ISI and AMM was not checked for effectiveness and is planned to be revised after full implementation of the LTO Programme.

F7) The full implementation of 331-148 "Programme Engineer's Guide", containing several Ageing Management objectives, including verification of effectiveness according to the 9 attributes, is still on-going. This guide was recently issued (in 2018) but is only applicable to the plant programmes managed by Programme Engineering. Application of the 9 effectiveness attributes on ISI Programme is not completely finished. There are no explicit provisions for new AMPs to be verified for the 9.

F8) Absence of a unique identification of AMPs and multiple information input in the column identifying the applicable programmes in AMM, jeopardises the reporting capacities important to achieve effectiveness (e.g. a listing in AMM of all records relevant for water chemistry programme cannot be easily be extracted to compare it with the information provided in the Water Chemistry Procedures).

2.2 – SAFETY CONSEQUENCE:

Without complete evaluation of existing plant programmes for ageing management, effective ageing management of the components cannot be demonstrated.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider completing evaluation of existing plant programmes effectiveness for managing ageing for LTO.

2.4 – IAEA BASIS:

SSR-2/2 (Rev.1)

Requirement 14: Ageing management

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

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.

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2.24 The effectiveness of ageing management should be periodically reviewed to maintain plant safety and to ensure feedback and continuous improvement (see paras 5.54–5.63).

4.1. The following nuclear power plant documentation and programmes relevant to ageing management and, where relevant, evaluation for long term operation (also called 'preconditions for long term operation') should be in place at the plant:

…

(c) Plant programmes relevant to ageing management;

(d) Plant programmes relevant to long term operation;

4.16. The following existing plant programmes are essential to ageing management and evaluations for long term operation:

(a) Maintenance programmes;

...

(c) In-service inspection programmes;

(d) Surveillance programmes;

(e) Water chemistry programmes.

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

7.26...., the existing plant programmes used for ageing management and existing ageing management programmes should be reviewed to ensure that they will remain effective in managing the effects identified for the planned period of long term operation...

7.27 Any existing and new plant programmes for long term operation should be reviewed to determine whether they are consistent with the nine attributes...

2.5 – DOCUMENTS REVIEWED:

- KSM-LIC-001, Rev. 2, Requirements for the control of Maintenance, 2013-09-26;
- KSA-913, Rev.0, Integrated Equipment Reliability Standard: Preventive Maintenance Basis, 2017-9-30;
- KGU-035, Rev.3, Integrated Equipment Reliability Standard: Scoping & Classification of components, 2016-9-15;
- KSA-913, Rev. 0, Integrated Equipment Reliability Standard Process, 2014-09-30;
- KGU-033, Rev. 3, Failure Investigation of Plant equipment and evaluation of experience, 2017-01-19;
- CR 102827-001 GA, draft document, Review PM Programme;
- KSA-012, Rev.3, Storage and Preservation of Spare Parts, 2010;
- 240-110745414, Rev. 2, Standard for the In-Service-Inspection Programme at Koeberg NPP, 2018-08-14;
- 240-119362012, Rev. 1, Fourth interval In-Service-Inspection Programme Requirements Manual (ISIPRM) for Koeberg NPP, 2017-005-03;
- 240-97087308, Rev. 2, Fourth interval In-Service-Testing Programme Requirements Manual (ISTPRM), 2019-04-15;
- 331-148, Rev. 2, Programme Engineer's Guide (Appendix A with the 9 attributes), 2018;
- KSC-003, Rev. 5, The Chemistry Programme, 2018-10-18;
- KBA0022CHEMSPEC00, Rev. 1 Koeberg Chemistry Specifications, 2017-04-10;
- KBA0022CHEMJUSTIF1, Rev.0, Technical Bases for KOEBERG NPS Chemistry Specifications, 2016-03-11;
- KBA0022CHEMJUSTIF2, Rev. 2, Justification for the Koeberg Chemistry Specifications, 2019-05-06.
- KAA-688, Rev. 16, Corrective Action Process, 2015;
- KGA-076, Rev. 3a, Performing Trending and Trending Analysis, 2013-09-18;
- 240-101650256, Rev. 2, Ageing Management Matrix, 2019-07-15;
- 331-275, rev.2, Process for the development and control of Ageing Management at KOU, 2018.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

Alignment of all AM programes to the 9 elements are internally processed as required by the AM standard and formally tracked to completion. The process for ageing management programmes review is covered in section 5.2.3 of 240-156945472, 'SALTO Ageing Management Assessment Report(Interim)'

F1) The AM standard stipulate all AM requirements and references all AM programmes as documented in a formal listing (each with its own requirements)

F2) SALTO AME is complete and identified enhancements to fully comply with IGALL is in progress.

F3) Review completed to identify gaps to IGALL 9 elements and updates to programmes are in progress.

F4) AM standard stipulate the requirements for 9 attributes in section 3.4.

F5) SRSM is included in AM programmes and as such required to comply with section 3.4 of AM standard.

F6) The ISI scope was included in the SALTO scope and therefore subjected to AME.

F7) AM standard stipulate the requirements for 9 attributes in section 3.4.

F8) The COMSY database is to be used in future as the AM database. Electronic extractions can be performed as required.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS:

F1) n.a.

4.2 – DOCUMENTS REVIEWED:

n.a.

4.3 – RESOLUTION DEGREE:

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

J.3 Area C Issue Sheets

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

1.8 – ISSUE TITLE:
Incomplete ageing management review for mechanical, electrical and I&C SCs

1.9 – FUNDAMENTAL OVERALL PROBLEM:

Effective and conclusive AMR for mechanical, electrical and I&C SCs has not been completed.

2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) 240-125122792, Rev. 2, identifies that one step in the AMR for mechanical SCs is “Assessment of the current condition of the structure or component.” Walk downs are planned only for in-scope SSCs not covered by a Programme, System or Component Health Report, and the condition of in-scope SSCs covered by a health report will be inferred by a positive health report without a walk down to assess the current condition of the SSC.

F2) Completion of the AMR for mechanical SCs is dependent on contractor completion of an ageing management evaluation and can be finalized only after additional review by the plant.

F3) Ageing management matrix has been developed taking into account operating experience and other ageing related knowledge from EDF and Koeberg NPP. However, the following is missing or not appropriate for electrical and I&C SCs:

- Information on materials is missing in some lines for I&C cables;
- Ageing management matrix does not clearly differentiate ageing effect (AE) and degradation mechanism (DM);
- AE and/or DM are provided just as "ageing" in some lines for cables;
- Some cells for references to applicable plant programmes are blank.

F4) 240-125122792, Rev. 2, has provisions to ensure that "appropriate methods to detect, monitor, prevent and mitigate ageing effects and degradation mechanisms specified for each structure or component" occurs. For example, section 3.3.4 on existing plant programmes specifies that "If the activities and the techniques used to manage ageing of specific SSC or commodity group are not adequate, the plant programme activities must [be] modified." This has not been accomplished due to the lack of finalized AMR for mechanical SCs.

F5) No new programmes have been proposed since the AMR for mechanical SCs has not been completed and the need for new programmes cannot be assessed.

F6) Comprehensive assessment of AMR results against the international benchmarks, such as results from the International Generic Ageing Lessons Learned (IGALL) programme has not been completed.

2.2 – SAFETY CONSEQUENCE:

Without completion of an effective and conclusive AMR for mechanical, electrical and I&C SCs, suitable aging management activities cannot be identified and implemented to ensure safe LTO.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider completing an effective and conclusive AMR for mechanical, electrical and I&C SCs.

2.4 – IAEA BASIS:

SSR-2/2 (Rev.1)

Requirement 16: Programme for long term operation

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.

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

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

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

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

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

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

(f) The implementation programme for long term operation

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

5.23 The ageing management review should systematically assess ageing effects and the related degradation mechanisms that have been experienced or are anticipated. The assessment should include an evaluation of the impact of the ageing effect on

the in-scope SSCs' capability to perform their intended functions as specified in para. 5.16, including consideration of the current condition of the SSC.

5.24 Relevant applicable lessons relating to ageing provide a good reference basis for the ageing management review [5] but should not be used in place of a plant specific ageing management review.

5.25 A process to identify relevant ageing effects and degradation mechanisms for each structure or component should be established, and the programmes to manage the identified ageing effects and degradation mechanisms should be in place (see Fig. 4). This process should cover the following steps:

(1) Time limited ageing analyses associated with these structures or components should be evaluated to determine the continued validity of the analyses for the intended period of operation. Results of the evaluation of the time limited ageing analyses should be taken into account in the ageing management review.

(2) All relevant ageing effects and degradation mechanisms should be identified.

(3) If the ageing of structures or components is managed by existing ageing management programmes, it should be verified that the ageing management programmes are consistent with the nine attributes shown in Table 2.

(4) If the ageing of structures or components is managed by other plant programmes, such as maintenance, it should be verified that these programmes are consistent with the nine attributes shown in Table 2.

(5) If the ageing of structures or components is not managed by any existing programme, a new programme should be established or existing programmes should be modified or improved (e.g. by extending the scope of an ageing management programme) or a specific action (e.g. a new time limited ageing analysis, replacement of the structure or component, or further analysis) should be taken.

(6) If the qualified lifetime of equipment important to safety expires, such equipment should be requalified or replaced at the expiration of its present qualification.

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

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

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

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

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

7.23 The ageing management review for long term operation should focus on the following issues:

(a) Whether any new ageing effect or degradation mechanism is anticipated in the course of the planned period of long term operation;

(b) Whether the significance, degradation rate or susceptible sites of degradation mechanisms are expected to change during the planned period of long term operation;

(c) Whether current relevant operating experience and research findings have been incorporated into ageing management programmes.

7.24. If the operating organization has not performed an ageing management review, the results of an ageing management review for long term operation should be used to identify or develop effective ageing management programmes in order to detect and mitigate those ageing effects identified in the ageing management review before the integrity and the functional capability of the SSCs are compromised.

2.5 – DOCUMENTS REVIEWED:

- 240-101650256, Ageing Management Matrix (AMM), May 19, 2016 (under Review);
- 240-125122792, Rev. 2, Koeberg Safe Aspects of Long Term Operating (SALTO) Ageing Management Evaluation Process and Revalidation of Time Limited Ageing Analyses, May 13, 2019;

- 240-125839632, Rev. 1, Koeberg Safety Aspect of Long Term Operation (SALTO) Scoping Methodology, June 18, 2019;
- 331-275, Rev. 2, Process for the Development and Control of Ageing Management at Koeberg Operating Unit, April 6, 2018.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

All AMR now complete and enhancements are in progress. Below is the general responses to the facts as raised 2.1 above:-

F1) The position on the approach KNPS has adopted for the assessment of the current physical status of relevant SSCs for SALTO AME has been documented in the output deliverable close-out form (ODCOF), 08016.ODCOF.049, 'Position on Current Conditions of SSCs for SALTO'**Error! Reference source not found.**. This provides the justification for taking credit f or the existing programmes and processes at KNPS in confirming the current conditions of the relevant SSCs. This is in accordance with the requirements stipulated in the SALTO AME procedure 240-125122792.

Plant walk downs for in-scope SSCs not covered by a Programme, System or Component Health Report, has been performed. For more details refer to output deliverable close-out form 08016.ODCOF.110 SALTO NSAS walk-down findings and follow up actions are documented in 240-160675265, 'Plant-Walk-downs for SALTO Scope Confirmation Report'.

F2) AMR completed and evaluated/accepted by Eskom. Enhancements are in progess.

F3) The plant is busy with the new draft Cable List, number 240-166828385. The new list will align to the 2019 Pre-SALTO findings and recommendations. All AM scope now included in COMSY database. The COMSY database is to be used in future as the AM database and captured all ageing and degradation.

F4) The following existing plant programmes requiring modifications have been updated:-

- Equipment Qualification Programme
- Cable Ageing Programme
- NSSS Design Transient
- Water Chemistry
- External Surfaces Monitoring of Mechanical Components
- Preventative Maintenance Programme
- Monitoring Water Chemistry Closed Treated Water systems
- Fire water system inspection programme

F5) Since the AMR for mechanical and electrical, I&C SCs has been completed, new programmes have been proposed. Programmes development is in progress, as listed below:-

- AMP112 Thermal Fatigue Monitoring Programme (CASS components)
- AMP119 One Time Inspections
- AMP120 Selective Leaching
- AMP121 Small Bore One Time Inspections
- AMP135 Inspection of Internal Surfaces
- AMP154 Ageing Management Programme for the Pressurizer
- AMP156 Ageing Management for the Main Coolant Piping
- AMP157 Internal coatings of in-scope piping, piping components, heat exchangers, tanks, and piping
- AMP161 High-cycle Fatigue Monitoring
- AMP 210 Condition Monitoring of Electrical and I&C Cables
- AMP 212 Electrical Enclosures not subject to Environmental Qualification Requirements
- AMP 213 Whiskers and Capacitors with Liquid Electrolyte
- AMP 215 Switchgears/ Breakers/ Distribution Panels/ Contactors/ Protection Relays/ Relays not Subject to Environmental Qualification Requirements
- AMP 218 Electronic Equipment not subject to Environmental Qualification Requirements

- AMP 220 Lightning Protection And Grounding Grid Not Subject To Environmental Qualification Requirements

F6) Comprehensive assessment of AMR results against the international benchmarks, such as results from the International Generic Ageing Lessons Learned (IGALL) programme has been completed. For further details refer report L1124-GN-RPT-030, "Comparison report existing KNPS plant programs with IGALL-AMP Requirements"

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS:

F1) n.a.

4.2 – DOCUMENTS REVIEWED:

n.a.

4.3 – RESOLUTION DEGREE:

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

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

Reviewed Area: Ageing management of mechanical SCs

1.10– ISSUE TITLE:
Lack of adequate ageing management programmes for mechanical, electrical and I&C SCs

1.11– FUNDAMENTAL OVERALL PROBLEM:

Adequate ageing management programmes for mechanical, electrical and I&C SCs are not developed and/or implemented for LTO.

2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) Regarding responsibility boundaries for cable trays, Rev. 0 of the boundaries document (L1124-GN-RPT-004) states that the mechanical area covers the cable trays, cable supports, strapping and tray supports; the civil area covers bolting; and the electrical area covers conductor and insulation. Rev. 2 of L1124-GN-RPT-004 does not specify the responsibilities. In contrast, the cable AMP states that cable systems include the cable trays and supports. The responsibility for aging management of cable trays and associated items is not clearly defined.

F2) The plant has developed cable ageing management programme (CAMP) for cables. However, for other electrical and I&C SSCs, identification and development of AMPs required for LTO has not been completed, because AMR has not been completed.

F3) Several documents (240-125122792, Rev. 2, and 331-148) specify that 'existing plant and other plant programmes used for ageing management should be verified with the nine attributes', but do not have similar explicit provisions for the development of new programmes.

F4) The suitability of new AMPs that may be necessary cannot be confirmed until completion of the AMR.

F5) The description of the Flow Accelerated Corrosion (FAC) programme (331-173, dated 2013) was due for review in 2016 but the document was not updated until May 2019.

F6) Not all existing AMPs follow the 9-element description (e.g., FAC programme, steam generator management).

F7) Repeated findings of boric acid deposits by the Boric Acid Corrosion Control (BACC) programme indicate delays in actions to remediate leaks.

F8) Although quarterly walk downs are implemented in accordance with the general leak management process to identify and remediate leaks, boric acid findings by the BACC programme inspections continue to increase.

F9) Although corrective actions related to boric acid leaks for SSCs with code requirements are implemented promptly, corrective actions for other SSCs lag significantly.

F10) The Corrosion Monitoring Programme (CMP) is prepared but has not been fully implemented as a programme.

F11) CMP corrective action items are completed in a timely manner for SSCs with mandatory regulatory actions, but not for other SSCs, resulting in a significant backlog and lack of timely action.

F12) Data trending is implemented to predict SSC performance during the LTO period for the Flow Accelerated Corrosion (FAC) programme and in-service testing (IST) programme, but it is not readily possible for other programmes.

2.2 – SAFETY CONSEQUENCE:

Without adequate ageing management programmes for mechanical, electrical and I&C SCs, safe LTO of mechanical, electrical and I&C SCs cannot be assured.

2.3 – RECOMMENDATION/SUGGESTION:

R) The plant should develop and implement adequate ageing management programmes for mechanical, electrical and I&C SCs.

2.4 – IAEA BASIS:

SSR-2/2 (Rev.1)

Requirement 14: Ageing management

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

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

Requirement 16: Programme for long term operation

4.54 The comprehensive programme for long term operation shall address:

…

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

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3.33 Concerning ageing management, the operating organization should review and validate the existing programmes and processes (or elements thereof) relevant to ageing for all in-scope structures or components.

5.37 The identified ageing effects and degradation mechanisms that require ageing management should be managed using existing ageing management programmes or existing plant programmes (possibly with improvements or modifications), or new programmes should be developed. These programmes should be coordinated, implemented and periodically reviewed for improvements.

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

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

5.44 Whether an ageing management programme is structure or component specific or degradation mechanism specific, specific actions relating to the detection, monitoring and prevention or mitigation of ageing effects should be specified within each ageing management programme. Such specific actions may include plant programmes for maintenance, equipment qualification, in-service inspection, testing and surveillance, as well as for controlling operating conditions.

5.45 The development of the ageing management programmes should be based on the results of the ageing management review.

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

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

5.54 The effectiveness of ageing management programmes should be periodically evaluated in the light of current knowledge and feedback from the programme and the performance indicators, and should be updated and adjusted as appropriate. Relevant knowledge includes information on the operation of the structure or component, surveillance and maintenance histories, information from the results of research and development, and operating experience from other nuclear facilities.

7.27 Any existing and new plant programmes for long term operation should be reviewed to determine whether they are consistent with the nine attributes set out in Table 2. In addition, the plant documentation and programmes described in Section 4 should also be reviewed with respect to the planned period of long term operation.

- 2.5 – DOCUMENTS REVIEWED:
- 240-102103854, Review of the Koeberg plant programmes to assess alignment with the IAEA Ageing Management Programmes, November 13, 2015;
- 240-115852755, Rev. 2., Unit 1 Risk Based Inspection Pressure Vessels and Steam Generators Inspection Maintenance and Testing Plan, October 19, 2016;
- 240-119362012, Rev. 1, Fourth Interval In-Service Inspection Programme Requirements Manual (ISIPRM) for Koeberg Nuclear Power Station, May 3, 2017;
- 240-125122792, Rev. 2, Koeberg Safe Aspects of Long Term Operating (SALTO) Ageing Management Evaluation Process and Revalidation of Time Limited Ageing Analyses, May 13, 2019;
- 240-138623765, Rev. 1, Anchor Bolting Programme Requirements Manual, November 9, 2019;
- 240-143109187, Rev. 1, Reactor Pressure Vessel Programme Requirements Manual, April 5, 2019;
- 331-127, Rev. 2, Cable Ageing Management Programme, April 11, 2019;
- 331-148, Rev. 2, Programme Engineer's Guide, November 28, 2018;
- 331-173, Requirements for Flow Accelerated Corrosion Programme, July 25, 2013;
- 331-173, Rev. 1, Requirements for Flow Accelerated Corrosion Programme, May 2019;
- 331-175, Rev. 1, Inspection Guide for the Koeberg Nuclear Power Station Corrosion Management Programme, May 6, 2019;
- 331-222, Rev. 2, Position on Tanks and Underground Piping Integrity and Associated Environmental Impact, July 29, 2015;
- 331-349, Rev. 1, Reactor Vessel Surveillance Programme (RVSP), October 27, 2017;

- 331-252, Rev. 1, Pressurised Thermal Shock, July 19, 2017;
- 331-260, Rev. 4, Reactor Pressure Vessel – Cracking of Core Barrel Baffle Bolts, July 29, 2017;
- 331-262, Rev. 2, Reactor Pressure Vessel Integrity Issues, February 28, 2018;
- 331-275, Rev. 2, Process for the Development and Control of Ageing Management at Koeberg Operating Unit, April 6, 2018;
- 331-511, Engineering Guide for Boric Acid Corrosion Control (BACC) Programme Management, February 27, 2018;
- EA-19-017 Rev. 0, Koeberg Nuclear Power Station Programme Health Report, April – September 2018, February 2019;
- EA-19-070, Fire Programme Review Report (CR 102826-019 GA), May 29, 2019;
- KAD-025, Rev. 1, Processing of Operating Experience, September 29, 2014;
- KBA 0022 N NEPO LOPP 023, Rev. 13, Fire Detection and Suppression Systems, February 28, 2019;
- KGA-035, Rev. 4, Processing of Experience Feedback Received Through the EdF Co-Operation Agreement, June 24, 2019;
- KFI-RE-003, Rev. 1, ISIP: Outage 223 Summary Report (K2018/223/OS) Revision 0, March 18, 2019;
- L1124-GN-RPT-004, Boundary Definition by Bigramme SALTO Assessment, October 10, 2018;
- L1124-GN-RPT-004, Rev. 2, Boundary Definition by Bigramme SALTO Assessment, August 7, 2019.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

F1) The civil structural inspection related scope and requirements for the cable trays and supports are documented in the Civil Ageing Management Programme Manual draft, 240-165425812, and will be included in the civil inspection procedures of in-scope civil structures.

F2) AMR completed and new programme development is in progress. The new MV, LV and I&C CAMP manuals are currently under review and are expected to be completed by Decemeber 2021.

F3) Provisions were made for new programmes to align with the nine attributes as stipulated in RG-0027, AM Standard and 331-148. This is formally tracked to completion

F4) The suitability of new AMPs has been confirmed following the AMR process and are listed under Issue Sheet C-1 (F5 response) above. AMR completed and new programme development is in progress.

F5) The description of the Flow Accelerated Corrosion (FAC) programme (331-173, is now updated, dated May 2024).

F6) Self-assessment SE 38545 concluded with aligned of the existing programmes to follow the 9-element description. This assessment includes the examples that were previously mentioned e.g. FAC programme is aligned with the 9-elements, detailed 08016.ODCOF.125, also Steam Generator Management Programme Manual, 240-118809269 is also aligned to the 9-elements. Alignment of all AM programes to the 9 elements are I/P as required by the AM standard and formally tracked to completion.

F7) Repairs to leaks are determined as per the prioritisation of a graded approach.

F8) Repairs to leaks are determined as per the prioritisation of a graded approach.All leaks are evaluated and accepted for service if not repaired.

F9) As per F7) and F8) above.

F10) The Corrosion Monitoring Programme (CMP) is prepared but has not been fully implemented as a programme. The only outstanding action remaining for CMP implementation is the raising of SAP Service notes for the CMP scope. CMP implementation is rolled out as per Programme Oversight Committee.

F11) Repairs to leaks are determined as per the prioritisation of a graded approach.

F12) Trending is implemented as per the requirements of the specific AM programme.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS: **F1)** n.a.		
4.2 – DOCUMENTS REVIEWED: n.a.		
4.3 – RESOLUTION DEGREE:		
1.	**Insufficient progress to date**	n.a.
2.	**Satisfactory progress to date**	n.a.
3.	**Issue resolved**	n.a.

1. ISSUE IDENTIFICATION	**Issue Number: C - 3**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of mechanical SSCs	
1.12– ISSUE TITLE: Incomplete revalidation of TLAAs for mechanical and civil SCs	
1.13– FUNDAMENTAL OVERALL PROBLEM: Revalidation of TLAAs for mechanical and civil SCs has not been completed.	
2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019
2.1 – FACTS: **F1)** TLAAs have been identified by a contractor review of plant documentation and from a review of the applicability to the plant of TLAAs identified in the IGALL report (L1124-GN-RPT-028). However, the plant has not determined acceptability of the contractor reports and thus an approved list of TLAAs is not available. **F2)** TLAAs for mechanical SCs have been updated only as related to the steam generator replacement and pressurized thermal shock. **F3)** Among the four TLAAs for the civil structures, which have been identified and then analysed in four dedicated documents, two are considered by the plant as already revalidated. However, all four of these documents are still under plant review. **F4)** The revalidated TLAAs have not used the LTO acceptance criteria.	
2.2 – SAFETY CONSEQUENCE: Without complete revalidation of TLAAs for mechanical and civil SCs, these SCs cannot be assured to support safe LTO for the plant.	
2.3 – RECOMMENDATION/SUGGESTION: **S)** The plant should consider completing revalidation of TLAAs for mechanical and civil SCs.	

2.4 – IAEA BASIS:

SSR-2/2 (Rev.1)

4.54 The comprehensive programme for long term operation shall address:

….

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

….

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

7.14 The approach to an assessment for long term operation is outlined in Fig. 8. With regard to ageing, an overview of major steps of the programme for long term operation should involve the following main steps:

…

b) Review of time limited ageing analyses to ensure that the analyses continue to meet the criteria specified in para. 5.67.

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

7.18 The programme for long term operation should include the following activities, evaluations, assessments and results:

….

(d) Demonstration that the time limited ageing analyses have been revalidated and that the evaluation includes:

– Identification of time limited ageing analyses in accordance with the definition specified in para. 5.64;

– Revalidation of each identified time limited ageing analysis in accordance with the recommendations provided in para 7.28 to demonstrate that the intended function(s) of the structure or component will be maintained throughout the planned period of long term operation in a manner that is consistent with the current licensing basis.

2.5 – DOCUMENTS REVIEWED:

- 240-125122792, Rev. 2, Koeberg Safe Aspects of Long Term Operating (SALTO) Ageing Management Evaluation Process and Revalidation of Time Limited Ageing Analyses, May 13, 2019;
- 331-252, Rev. 1, Pressurised Thermal Shock, July 19, 2017;
- 331-262, Rev. 2, Reactor Pressure Vessel Integrity Issues, February 28, 2018;
- D02-ARV-01-056-296, Rev. D, KBY - PRESSURIZED THERMAL SHOCK – Reactor Pressure Vessel Integrity: Mechanical analyses for 40 years, March 2, 2018;
- D02-ARV-01-056-300, Rev. B, KBY - PRESSURIZED THERMAL SHOCK – Reactor Pressure Vessel integrity: Mechanical analyses for 60 years, March 30, 2018;
- D02-ARV-01-072-889, Rev. C, Koeberg 1 & 2 Reactor Vessels Evaluation of End of Life RTNDT Temperature, September 2, 2016;
- L1124-GN-LIS-008, Verified list of Existing TLAAs, March 20, 2019;
- L1124-GN-RPT-004, Boundary Definition by Bigramme SALTO Assessment, October 10, 2018;
- L1124-GN-RPT-004, Rev. 2, Boundary Definition by Bigramme SALTO Assessment, August 7, 2019;
- L1124-GN-RPT-028, Report on Comprehensive List of Koeberg TLAAs, June 21, 2019;
- L1124-GN-RPT-044, Validity of KNPS Containment Liner TLAA 303 Assessment Report, August 7, 2019.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

F1) A comprehensive list of all the KNPS TLAAs was compiled in L1124-GN-LIS-010, 'Comprehensive List of Koeberg TLAAs'. SGR related TLAAs have been accepted for LTO. Additional TLAAs identified during the SALTO assessment are currently being reanalysed. The following TLAAs requires re-analysis for 60 years as listed below:-

TLAAs Requiring Validation for 60 years

No	Components	TLAA	Degradation Mechanism	**References**
1	Reactor pressure vessel	Additional TLAA	PWSCC in nickel alloys	L1124-GN-RPT-033
		Additional TLAA	Wear of the adaptor flanges on the unit 1 RPV head	
		Additional TLAA	Thermal stratification phenomenon	
2	Reactor pressure vessel internals	TLAA 106 Environmentally-assisted fatigue	Fatigue	L1124-GN-RPT-032
		TLAA 110 Thermal ageing of cast austenitic stainless steels	Thermal ageing	
		TLAA 120 PWR RPV internals vibrations	Vibration degradation	
		TLAA 122 Thermal ageing of martensitic stainless steels	Thermal ageing	
		Additional TLAA	RPV internals neutron embrittlement	
3	Steam generators (this will be done under SGR)	TLAA 106 Environmentally-assisted fatigue	Fatigue	L1124-GN-RPT-038
4	Pressurizer	TLAA 103 Crack growth analyses	Liquation and solidification cracking of spray nozzles	L1124-GN-RPT-034
		TLAA 106 Environmentally-assisted fatigue	Fatigue	
		TLAA 115 Fatigue and thermal ageing analysis of manufacturing flaws and flaw tolerance	Liquation and solidification cracking of spray nozzles	
		Flaw tolerance calculation due to thermal ageing and fatigue	Liquation and solidification cracking of spray nozzles	
5	Reactor coolant pumps	TLAA 103 Crack growth analyses	Fatigue crack propagation	L1124-GN-RPT-031
		TLAA 106 Environmentally-assisted fatigue	Fatigue	
		TLAA 112 Main circulation pump flywheel	Fatigue	

6	Control rod drive mechanism	TLAA 106 Environmentally-assisted fatigue	Fatigue	L1124-GN-RPT-037
7	Main coolant lines and surge lines	TLAA 106 Environmentally-assisted fatigue	Fatigue	L1124-GN-RPT-035
8	Auxiliary and secondary lines	TLAA 106 Environmentally-assisted fatigue	Fatigue	L1124-GN-RPT-046
9	Polar Crane	Fatigue of Cranes (TLAA 108)	Fatigue	L1124-GN-RPT-020
10	Containment	TLAA 301 Concrete containment tendon pre-stress	Tendon relaxation	L1124-GN-RPT-019

F2) Additional TLAAs for mechanical SCs to be re-analysed as listed in Table above.

F3) Civil TLAAs Validated and Justified for LTO; and

L1124-GN-RPT-044 'KNPS Containment Liner TLAA 303' – Validated and accepted by Eskom

The risk of cumulative fatigue damage of containment liner and penetrations of KNPS containments units 1 and 2 was assessed as practically non-existent. From all events considered, only the stresses caused by pressure tests produce noteworthy differential stresses in the liner. The stresses caused by start-ups generate noteworthy differential stresses in the penetrations. However, the differential stresses and the number of load cycles are very low and the CUFs are near to zero, so that fatigue damage cannot occur. As a result, it was concluded, that the TLAA 303 for the containment liner and penetrations in KNPS is re-validated.

L1124-GN-RPT-045 KNPS Civil TLAA 304 Foundation – Validated

The risks associated with the residual settlements and differential settlements were assessed and are considered negligible. Hence, it was concluded that the measured settlements cannot affect the LTO of unit 1 and 2 for 60 years. Re-analysis or additional documentation for justification of LTO was thus not required.

Civil TLAAs Re-analysis for LTO:

Containment Tendon Pre-Stress TLAA 301: The initial assessment of the KNPS Containment Civil TLAA 301, is documented in report L1124-GN-RPT-019, Validity of KNPS Containment Civil TLAA 301, which confirmed that TLAA 301 Concrete Containment Tendon Pre-Stress shall be re-analysed for KNPS units 1 and 2. The required re-analysis has been completed (refer to Report D02-ARV-01-183-095_KOEBERG 'TLAA 301 Containment Reanalysis).

Crane TLAA 108: The initial assessment of the KNPS Polar Crane TLAA 108, is documented in report L1124-GN-RPT-020 'Validity of KNPS Polar Crane TLAA SALTO TLAA Assessment Report', which confirmed that TLAA108 shall be re-analysed for KNPS units 1 and 2.

The required re-analysis has been completed (refer to Report D02-ARV-01-183-091_KOEBERG 'TLAA 108 Reanalysis Crane).

The concluding actions, related to the Containment Tendon (TLAA-301) and Polar Crane TLAA108 re-validation, will be captured and tracked as LTO commitments.

F4) The LTO revalidation acceptance criteria are determined following revalidation of all KNPS TLAAs as tracked by OD_10.13.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS: **F1)** n.a.		
4.2 – DOCUMENTS REVIEWED: n.a.		
4.3 – RESOLUTION DEGREE:		
1.	**Insufficient progress to date**	n.a.
2.	**Satisfactory progress to date**	n.a.
3.	**Issue resolved**	n.a.

1. ISSUE IDENTIFICATION	**Issue Number: D - 1**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of electrical and I&C SSCs	
1.14– ISSUE TITLE: Equipment qualification (EQ) programme not fully implemented	
1.2 – FUNDAMENTAL OVERALL PROBLEM: The plant has not fully implemented the EQ programme and has not revalidated the EQ TLAA.	
2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) Environmental condition monitoring requirements are described in 331-186 (Environmental Qualification at Koeberg Operating Unit) and 331-219 (Environmental Qualification Maintenance Manual for Harsh Environment) for EQ SSCs installed inside the containment and the steam bunker. However, environmental condition monitoring has only been partially implemented.

F2) Identification of hot spots for temperatures and radiation dose rates has not been performed yet.

F3) Environmental condition monitoring at additional locations is planned in the next operating cycle, and devices is scheduled to be installed in outage 24 for both units. Currently, the plant is in the process of procurement of 45 devices for environmental condition monitoring per unit. However, monitoring locations of these devices is not determined. Technical justification for selecting locations and determining the number of locations is still not available.

F4) Revalidation of EQ TLAA for LTO has not been completed. The maximum design temperatures as stated in KBA 1216J10256 are currently used as a basis for evaluating qualified life of EQ SSCs. Real operational conditions cannot be used for revalidation of qualified lifetime of EQ equipment because environmental condition monitoring is still ongoing.

F5) Installation date, qualified life, and replacement date for EQ SSCs are defined in the master list included 331-219. However, replacement dates for cables are not listed.

2.2 – SAFETY CONSEQUENCE:

Without fully implemented EQ programme including revalidation of the EQ TLAA, the plant cannot demonstrate fulfilment of safety functions during design accidents for the period of LTO.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider fully implementing EQ programme including revalidation of the EQ TLAA.

2.4 – IAEA BASIS:

SSR 2/2 (Rev.1)

Requirement 13

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

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

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

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3.34. For in-scope structures or components, the operating organization should identify all time limited ageing analyses and should demonstrate either that all these analyses will remain valid for the planned period of long term operation, or that the structures or components will be replaced, or that further operation, maintenance or ageing management actions will be implemented.4.26. Environmental qualification should establish the qualified life of the equipment, within which ageing effects would not prevent satisfactory performance of the equipment if a postulated accident were to occur within the established operating period (possibly including long term operation).

4.27. Monitoring of actual environmental conditions should be implemented in order to get additional information necessary for the assessment of ageing effects on the equipment in its actual operating environment.

4.28. The qualified life of equipment should be reassessed during its lifetime, taking into account progress in the knowledge and understanding of degradation mechanisms and the actual operating environment of the equipment. If the qualified life is to be extended, a thorough safety demonstration should be provided by the operating organization.

4.29. The qualification status of equipment should be properly documented and maintained throughout the lifetime of the plant. The documentation relating to equipment qualification, which is typically part of the equipment qualification programme, should include:

(a) A master list of qualified equipment;

(b) Results of temperature monitoring and radiation monitoring in the plant;

(c) The evaluation report for equipment qualification;

(d) Test reports relating to equipment qualification;

(e) Reports of time limited ageing analyses relating to equipment qualification (for the evaluation for long term operation) or reports of another suitable equivalent analysis.

4.30. The review of equipment qualification should include an assessment of the effectiveness of the plant's equipment qualification programme in accordance with Requirement 13 of SSR-2/2 (Rev. 1) [2]. The review should also consider the effects of ageing on equipment during service and the effects of possible changes in environmental conditions during normal operation and postulated accident conditions since the equipment qualification programme was implemented.

5.66. Time limited ageing analyses should be evaluated using a projected value of the time dependent parameter, for example through a calculation of the neutron fluence for a certain operating period. This projected value of the time dependent

parameter (e.g. the projected neutron fluence) should then be used to evaluate certain analysis parameters, such as the adjusted nil ductility temperature or the fracture toughness.

5.67. The validity of time limited ageing analyses over the intended period of operation should be ascertained by demonstrating satisfaction against one of the following criteria [5]:

(a) The analysis should remain valid for the intended period of operation. The time dependent parameter value for the intended operating period should not exceed the time dependent parameter value used in the existing analysis.

(b) The analysis should have been projected to the end of the intended period of operation. The value of the analysis parameter value should be changed on the basis of the time dependent parameter projected for the intended operating period, and the value of the analysis parameter should continue to meet the regulatory limit or criterion.

(c) The effects of ageing on the intended function(s) of the structure or component should be adequately managed for the intended period of operation. The value of the analysis parameter should be managed (using an ageing management programme) to ensure that ageing effects are adequately managed and that the value of the analysis parameter will continue to meet the regulatory limit or criterion throughout the intended period of operation.

5.68. If the time limited ageing analyses cannot be found acceptable using the criteria in para. 5.67, then corrective actions should be implemented. Depending on the specific analysis, corrective actions could include:

(a) Refinement of the analysis to remove excess conservatism;

(b) Implementation of further actions in operations, maintenance or the ageing management programme;

(c) Modification, repair or replacement of the structure or component.

2.5 – DOCUMENTS REVIEWED:

- KBA1216J10256, Rev. 1, General Electric Installation, 01.04.1981;
- KBA1206D00551, Rev. A, Koeberg Pressure and Temperature in the Containment in Case of Reactor Coolant Pipe Break Input Data, 10.02.1978;
- 331-186, Rev. 1, Environmental Qualification Programme at Koeberg Operating Unit, 05.05.2017;
- 331-187, Rev. 2, Environmental Qualification Programme Process and Responsibilities, 18.03.2019;
- 331-219, Rev. 2, Environmental Qualification Maintenance Manual for Harsh Environment, 12.03.2018;
- 240-135808889, Rev. 1, Technical Requirements Specification for Combined Temperature and Radiation Monitoring Devices, 05.04.2018;
- EA-19-017, Rev. 0, Programme Health Report, 12.02.2019;
- 331-148, Rev. 2, Programme Engineer's Guide, 28.11.2018;
- DEVONWAY Data Base.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

F1 & F2) 331-219 provides the requirements for monitoring. As part of the SALTO project envioromental zones were established. Enviormental conditions to which the EQ components are located were established. Details of the zones are capture in LIS 29 and LIS 16. For temperature data, the data system (InSQL) was used to capture the data from the sensors installed throughtout the various rooms. The InSQL system is a live system that provides real times condition monitoring and trend. In addition containment tempretures are monitored through ETY 001, 002, 003 and 004 MT sensors. Radaition levels in various locations were determined using the routine radiation surveys. The enviormental condition monitoring is developed and being implemented as per Programme Manual 240-165386950.
F3) During outage 223 additional locations were identified and the remote tempreture measuring decvices were installed. The data was retrieved in outage 224, the data showed the environmental conditions in those locations remain within the design conditions. Refer to EA. Procurement of additional devices is in progress.
F4) This has been completed as part of the SALTO project. Refer to L1124-GN-RPT-018 (EQ TLAA report), 08016.ROD.018 (Equipment Qualification Time Limited Ageing Analysis
Strategy) and the various EQ TLAA reports.

F5) The EQ manual 331-219 and the EQ ML have been updated to include this information.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3
4.1 – FACTS.	
4.2 – DOCUMENTS REVIEWED: n.a.	
4.3 – RESOLUTION DEGREE:	

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

1. ISSUE IDENTIFICATION	**Issue Number: D - 2**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of electrical and I&C SSCs	
1.15– ISSUE TITLE: Deficiencies in obsolescence management programme	
1.2 – FUNDAMENTAL OVERALL PROBLEM: Development of obsolescence management programme does not ensure timely and complete implementation.	
2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) A Pre-SALTO mission in 2015 noted that the obsolescence strategic committee (OSC) had not been established. Development of Technical Obsolescence Management Programme (TOMP) was delayed, because Obsolescence Working Group including the OSC was established only in December 2018.

F2) Schedule for development and implementation of the TOMP has not been determined.

F3) The procedure 331-146 defines the scope of TOMP as 'critical' components defined in KGU-035. However, from interview with engineers of the plant, it was stated that the scope of TOMP has been set as components classified as 'critical', 'significant', and 'economic' defined in KGU-035. The scope of TOMP has not been clearly defined.

F4) Identification of obsolete items is still ongoing:

- The plant is preparing the TOMP baseline list and collecting necessary information (manufacture and model number) for critical components (C1 and C2, approx. 1,000 items). For C1 and C2, Approx. 60% of the list is completed. The list is scheduled to be completed by the end of November in 2019.
- Collection of information for remaining 'critical' (C3-C9, approx. 11,000 items) and for 'significant', and 'economic' components has not been initiated and its schedule does not exist.
- Information on the stock level has not been incorporated to the TOMP baseline list.

F5) Prioritization of obsolete items and development and implementation of solutions has not been initiated but are scheduled to be completed by June in 2020 only for C1 and C2 components. They cannot be performed without complete identification of obsolete items, which is currently not even scheduled.

F6) From the interview with engineers of responsible group of the plant, it was stated that frequent reforms of the organization structure and reassignment of responsibility on TOMP contributed to the causes of the delay in development of the TOMP.

F7) There were 3 obsolescence issues during last operation cycle, two for mechanical component and one for electrical components. They were resolved by equivalent evaluation.

2.2 – SAFETY CONSEQUENCE:

Without an obsolescence management programme, the plant risks unavailability of SSCs important to safety.

2.3 – RECOMMENDATION/SUGGESTION:

R) The plant should develop and implement obsolescence management programme in a timely manner.

2.4 – IAEA BASIS:

SSR 2/2 (Rev.1)

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.

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3.20. A systematic approach (see Fig. 1) should be applied to managing the ageing and obsolescence of SSCs to ensure that required intended functions are maintained at all times during the operation stage of the nuclear power plant.

3.27. The availability of spare parts or replacement parts and the shelf life of spare parts or consumables should be continuously monitored and controlled (see paras 6.6 and 6.7).

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

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

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

6.6. The technological obsolescence programme should include three basic steps (see Fig. 6):

(1) The operating organization should identify the installed SSCs important to safety that are technologically obsolete or will become obsolete in the upcoming years.

(2) The identified equipment should be prioritized on the basis of the safety and criticality significance of the obsolete equipment (i.e. its impact on the plant safety).

(3) The operating organization should develop and implement effective replacement solutions in a timely manner. Solutions to manage technological obsolescence are illustrated in Fig. 7 and are described in the IGALL technological obsolescence programme [5].

6.7. For the identification of obsolete equipment and parts, the following activities should be performed:

(a) Collection of data on structures and components, usually from plant asset management systems (equipment databases with information on manufacturers and parts);

(b) Determination of whether the manufacturer still provides replacement equipment and spare parts.

6.8. For the prioritization (see step 2 of para. 6.6), suitable criteria should be used, such as: safety relevance; plant demand; quantity in stock; safety classification of components; failure history; reliability of structures or components; work order information; stock history; and uncertainty (spare parts with insufficient data).

2.5 – DOCUMENTS REVIEWED:

- KSA-913, Rev. 0, Integrated Equipment Reliability Standard: Preventive maintenance Basis, 30.09.2014;
- KAA-913, Rev. 1, Integrated Equipment Reliability Process, 30.07.2017;
- KGU-035, Rev. 3, Integrated Equipment Reliability Process: Scoping & Classification of Components, 15.09.2016;
- DEVONWAY Database
- 331-146, Rev. 2, Obsolescence Management Process, 05.08.2019;
- RG0027, Rev. 0, Interim Regulatory Guide Chapter 6.11, 03.2019;
- ToR 240-129906353, Rev. 1, Obsolescence Working Group Terms of Reference, 10.12.2018
- EA-19-111, TOMP Master Listing, Draft.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

F1) Obsolescence steering committee is setup and meeting monthly, Terms of Ref is available and signed off.

F2) KOU NI 78404 has sip actions on DevonWay with due dates and this is been used as the schedule.

F3) The scope follows RG027 (Defined as items important to safety).

F4) C1 and C2, approx. 1,000 items (SPV) manufacture and model data collected. OMS contract is in the final stages of procurement process and is having its deviation looked at. This contract will collect data for balance of scope (C3-C9, approx. 11,000 items and other items important to safety).

F5) A prioritisation matrix has been created and obsolete items are being added to the matrix and a priority score calculated on an ongoing basis. Obsolescence working groups have been set up to resolve obsolescence issues and several obsolescence strategies have been developed.

F6) N/A.

F7) N/A.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS:

4.2 – DOCUMENTS REVIEWED:

n.a.

4.3 – RESOLUTION DEGREE:

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

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

1.16– ISSUE TITLE:

Deficiencies in cable ageing management programme

1.2 – FUNDAMENTAL OVERALL PROBLEM:

Systematic cable ageing management programme with adequate technical justification is not fully in place.

2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) For cable ageing management programme (CAMP), standard document 331-127, procedure document 331-198, and three manuals specific to medium voltage cables (331-311), low voltage cables (240-98789276), and I&C cables (240-98789629) have been developed. However, the CAMP tasks/requirements have not yet been loaded on SAP for periodic and automatic download for implementation.

F2) Process to assure the consistency between ageing management matrix (AMM) and cable ageing management programme (CAMP) is defined in 331-275. However, standard level document that require the implementation of the process has not been prepared.

F3) CAMP manuals and AMM are not fully consistent. The following is missing or not appropriate:

- CAMP manuals for low voltage cables (240-98789276) and I&C cables (240-98789629) are not linked to the relevant lines in the AMM.
- AMM has not been updated to reflect the degradation mechanisms of the above CAMP manuals.

F4) Set of condition monitoring techniques are listed as requirements in manuals for medium voltage (MV) cables (331-311), low voltage (LV) cables (240-98789276), and I&C cables (240-98789629). Two condition monitoring techniques are selected for each cable category for use, however the other required condition monitoring techniques are not performed:

- 6 techniques in the list in the manual are not performed for MV cables;
- 5 techniques in the list in the manual are not performed for LV cables;
- 5 techniques in the list in the manual are not performed for I&C cables.

F5) Criteria for prioritizing and selecting condition monitoring techniques are not clearly documented.

2.2 – SAFETY CONSEQUENCE:

The lack of a systematic cable ageing management programme with adequate technical justification could increase the risk of a loss of safety function of cables in the LTO period.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider implementation of systematic cable ageing management programme with adequate technical justification.

2.4 – IAEA BASIS:

SSR 2/2 (Rev.1)

Requirement 14: Ageing management

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

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

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

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5.37. The identified ageing effects and degradation mechanisms that require ageing management should be managed using existing ageing management programmes or existing plant programmes (possibly with improvements or modifications), or new programmes should be developed. These programmes should be coordinated, implemented and periodically reviewed for improvements as indicated in Fig. 5.

5.39. Plant programmes or processes used to manage ageing effects and ageing management programmes should include one or more of four types of activity:

(a) Prevention activities, which preclude the ageing effect from occurring;

(b) Mitigation activities, which attempt to slow the ageing effects;

(c) Condition monitoring activities, including inspection and examination for the presence and extent of ageing effects, or surveillance using test samples or coupons intended to mimic the performance of the structure or component;

(d) Performance monitoring activities, which test the capability of a structure or component to perform its intended function(s).

5.40 If necessary, more than one type of activity should be implemented to ensure that ageing effects are adequately managed and that the intended function(s) of the structure or component are maintained. …

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

5.44. Whether an ageing management programme is structure or component specific or degradation mechanism specific, specific actions relating to the detection, monitoring and prevention or mitigation of ageing effects should be specified within each ageing management programme. Such specific actions may include plant programmes for maintenance, equipment qualification, in-service inspection, testing and surveillance, as well as for controlling operating conditions.

5.47. Appropriate acceptance criteria for the inspection and monitoring of ageing effects should be established for ageing management programmes and should be based on the design basis or on the technical requirements for the structure or component, and the relevant regulatory requirements, codes and standards, so that a corrective action can be implemented sufficiently before loss of the intended function(s) of the structure or component. The need for sufficient margins should be taken into account in these acceptance criteria.

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

2.5 – DOCUMENTS REVIEWED:

- 331-289, Rev. 2, Ageing of Electrical Cables, 30.01.2019;
- 331-127, Rev. 2, Cable Ageing Management Programme at Koeberg Operating Unit, 11.04.2019;

- 331-198, Rev. 1, Cable Ageing Management Programme Roles and Responsibilities at Koeberg Operating Unit, 22.09.2017;
- 331-417, Rev. 1, Visual and Tactile Inspections Guidelines for MV, LV, and I&C Cable and Cable Systems, 30.09.2016;
- 331-148, Rev. 2, Programme Engineer's Guide, 28.11.2018;
- EA-19-017, Rev. 0, Programme Health Report, 12.02.2019;
- 331-311, Rev. 1, Cable Ageing Management Manual for Medium Voltage Power Cables and Cable Systems, 14.12.2018;
- 240-98789276, Rev. 1, Cable Ageing Management Manual for Low Voltage Cables and Cable Systems, 16.10.2018;
- 240-98789629, Rev. 1, Cable Ageing Management Manual for Instrumentation and Control Cables and Cable Systems, November 15, 2017;
- 240-142894140, CAMP MV Cable Master List;
- 240-138996505, CAMP LV Cable Master List.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

F1) SAPP notifications have been raised for outages X23, X24 and X25 to implement the Cable ageing and testing. KOU is currently in the process of creating service notifications to allow for the automatic download of the CAMP activities beyond X25. This action is tracked via the programme oversight committee and the SAPP implementation plan.

F2) The high level ageing management standard (240-149139512) has been developed for the implementation of the ageing management programme at KOU which is based on RG 027 (Interim Regulatory Guide).

F3) The CAMP manuals are updated to ensure consistency between the degradations identified in COMSY and those in the CAMP and vice versa.

F4) The CAMP manuals are updated to include condition monitoring techniques to be performed at KOU.

F5) The criteria for the condition monitoring techniques are documented on the CAMP manuals.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS:

F1) n.a.

4.2 – DOCUMENTS REVIEWED:

n.a.

4.3 – RESOLUTION DEGREE:

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

J.4 Area E Issue Sheets

1. ISSUE IDENTIFICATION	**Issue Number: E - 1**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of civil SSCs	
1.17– ISSUE TITLE: Lack of adequate planning for containment impressed current cathodic protection (ICCP)	
1.18– FUNDAMENTAL OVERALL PROBLEM: Planning and implementation of ICCP including tests with a mock-up is not adequate.	
2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019
2.1 – FACTS: **F1)** The 'Life of Plant Plan for Containment' document, states that ICCP shall be performed with a completion date in 2021, but not even the contract for mock-up design is approved by the plant. **F2)** There is an incontinency in time lines for ICCP implementation between the document (LOPP for containment) and NTP (Nuclear Technical Plan). **F3)** Despite of clear and consistent conclusions about ICCP necessity from an expert panel and an IAEA seminar, these conclusions have not been translated into actual implementation of ICCP due to financial constraints. **F4)** Typical duration of a standard' technical modification at the plant is 5 years, which does not contain the period needed for testing the ICCP on a mock-up. **F5)** Neither the ICCP technical specification nor other documents contain any information about the planning of this modification including mock-up and design phases.	
2.2 – SAFETY CONSEQUENCE: Without adequate planning and implementation of ICCP, containment integrity will be impaired.	
2.3 – RECOMMENDATION/SUGGESTION: **R)** The plant should adequately plan and implement ICCP including tests with a mock-up.	
2.4 – IAEA BASIS: SSR-2/2 (Rev.1) Requirement 10: Control of plant configuration 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. 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.	

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4.49. A corrective action programme should be put in place to ensure that conditions adverse to quality, such as ageing related degradation, are identified and that corrective actions commensurate with the significance of the issue are specified and implemented [8].

TABLE 2. GENERIC ATTRIBUTES OF AN EFFECTIVE AGEING MANAGEMENT PROGRAMME

5. Mitigation of ageing effects Operations, maintenance, repair and replacement actions to mitigate detected ageing effects and/or degradation of the structure or component

7. Corrective actions

Corrective actions if a structure or component fails to meet the acceptance criteria

9. Quality management

…Confirmation (verification) process for ensuring that preventive actions are adequate and appropriate and that all corrective actions have been completed and are effective…

2.5 – DOCUMENTS REVIEWED:

- EN-ISO 12696, Cathodic protection of steel in concrete;
- Ref 240-137447723, Technical Requirement Specification for the Design of impressed Current Cathodic Protection, 2018/06/22;
- KBA-0022-N-NEPO-LOPP 164, Plant Engineering Life of Plant Plan Containment Building, 19 March 2019;
- 240-137447723, Technical Requirement Specification for the Design of Impressed Current Cathodic Protection on the Containment Building, 22/06/2018;
- JN391-NSE-ESKB-L-7770 rev0, Assessment of Containment Unit2 Visual Inspection after outage 223 and on-line monitoring up to 4th quarter 2018;
- JN793-NSE-ESKB-L-7763, Containment Monitoring Results first quarter 2019, 06/03/2019.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

ICCP has progressed significantly with the development of a TRS, appointment of an owner's consultant and contract placed for the ICCP design. This includes the mock-up. ICCP implementation is scheduled to be completed prior to LTO.

F1 & F2: The ICCP timelines previously referenced in Containment LOPP document, LOPP KBA-0022-N-NEPO-LOPP 164, has been updated in accordance with the project implementation dates developed by the ICCP Project Team.

A Contractor has been appointed for the ICCP (and mock-up) design, in accordance with 240-137447723 *'TRS for the Design of Impressed Current Cathodic Protection on the Containment Buildings',* which is currently in process.

Alignment of the civil LOPPs and the NTP timelines, is tracked under OD 6.11/CR 121535-050 CA.

F3: The ICCP Modification (16002) was raised and approved during 2016. The initial financial challenges experienced has improved since 2019/2020 FY and funds were approved for the Design Phase of the project. This has resulted in the procurement of the ICCP Design Contract, that is currently in progress.

F4 & F5: The specification for the ICCP, 240-137447723 *'TRS for the Design of Impressed Current Cathodic Protection on the Containment Buildings', has made the following provisions, which were considered in project implementation schedule.*

- *"the Consultant proposes the way, shape and form of the mock-up to demonstrate that his ICCP design meets the Employer's requirements, i.e. whether the mock-up is a newly constructed structure, makes use of an existing structure or takes another approach or form"*

- *"The mock-up shall be monitored, operated and maintained by the Consultant for 1 year, after which the mock-up is handed over to the Employer. The intention is for the Employer to utilise the mock-up as a tool to assess the effectiveness of the full ICCP installation on the Containment Buildings and to optimise the ICCP System settings for ensuring successful corrosion protection."*

For more detail, refer to the following ODCOF's, attached.

- 08016.ODCOF.062 (OD_16.16 (OD_27.1); OD_16.16a (OD_27.1a); OD_16.17 (OD_27.2)) and
- 08016.ODCOF.133 (OD_16.15)

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS:

F1) n.a.

4.2 – DOCUMENTS REVIEWED:

n.a.

4.3 – RESOLUTION DEGREE:

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

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

1.19– ISSUE TITLE:

Risk of hydrogen embrittlement of containment tendons linked to ICCP implementation

1.20– FUNDAMENTAL OVERALL PROBLEM:

The plant does not recognize the potential risk of hydrogen embrittlement of containment tendons linked to ICCP implementation.

2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) Due to chloride ingression into the concrete of containment, the function of the pre-stressed tendons cannot be adequately demonstrated for LTO.

F2) The different campaigns of repairs of nuclear island facades based on traditional works do not address containment tendons corrosion protection regarding hydrogen embrittlement.

F3) Impressed Current Cathodic Protection (ICCP) can lead to hydrogen embrittlement for high-strength steels. This phenomenon is not explicitly addressed in the document 240-137447723, 'Technical Requirement Specification for the Design of Impressed Current Cathodic Protection' (22/06/2018).

F4) The document KBA 0022 N NEPO LOPP 164 'Plant Engineering Life of Plant of the Containment Building' specifying ageing management for the containment, states that ICCP is a relevant solution but without addressing the hydrogen embrittlement risk generated by ICCP.

F5) The passive rebars tendons of containment are electrically connected to the ICCP cannot act independently on these two categories of steels; the document 240-137447723 'Technical Requirement Specification for the Design of Impressed Current Cathodic Proection' (22/06/2018) does not specify priority between rebars and tendons.

2.2 – SAFETY CONSEQUENCE:

Without addressing the potential risk of hydrogen embrittlement of containment tendons linked to ICCP implementation, the failure of containment tendons could occur and consequently the integrity of the containment cannot be guaranteed.

2.3 – RECOMMENDATION/SUGGESTION:

R) The plant should address the potential risk of hydrogen embrittlement of containment tendons linked to ICCP implementation.

2.4 – IAEA BASIS:

SSR-2/2 (Rev.1)

Requirement 14: Ageing management

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

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

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

Requirement 16: Programme for long term operation

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

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

NS-G-1.10

4.1. The performance parameters for containment system should be established in accordance with the function to be performed in the operational states of design basis accident conditions assumed in the design pf the plant. In particular, performance in terms of structural behaviour and leaktightness should be established for the entire period of an accident, including recovery of the plant and establishment of safe shutdown conditions.

4.7 Containment systems should be designed to have high functional reliability commensurate with the importance of the safety functions to be performed.

4.39. The containment may be subjected to several ageing phenomena such as the corrosion of metallic components, the creep of tendons and the reduction of prestressing (in prestressed containment), the reduction of resilience in elastomeric seals, and the shrinkage and cracking of concrete. The detrimental effects of ageing cannot easily be identified during lifetime. all ageing

mechanisms are required to be identified and taken into account in the design. provision should be made for monitoring the ageing of the containment, for testing and inspection of components where possible, and for periodically replacing items that are susceptible to degradation through ageing (ref [1] para. 5.47)

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TABLE 2. GENERIC ATTRIBUTES OF AN EFFECTIVE AGEING MANAGEMENT PROGRAMME

2. Preventive actions to minimize and control ageing effects

Specification of preventive actions

Determination of service conditions (i.e. environmental conditions and operating conditions) to be maintained and operating practices aimed at precluding potential degradation of the structure or component

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

2.5 – DOCUMENTS REVIEWED:

- EN-ISO 12696, Cathodic protection of steel in concrete;
- 240-137447723, Technical Requirement Specification for the Design of impressed Current Cathodic Protection, 2018/06/22;
- KBA-0022-N-NEPO-LOPP 164, Plant Engineering Life of Plant Plan Containment Building, 19 March 2019;
- 240-137447723, Technical Requirement Specification for the Design of Impressed Current Cathodic Protection on the Containment Building, 22/06/2018.
- JN391-NSE-ESKB-L-7770 rev0, Assessment of Containment Unit2 Visual Inspection after outage 223 and on-line monitoring up to 4th quarter 2018
- JN793-NSE-ESKB-L-7763, Containment Monitoring Results first quarter 2019, 06/03/2019

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

Hydrogen embrittlement has been identified as a potential ICCP risk and included in the TRS and to be demonstrated via the mock-up.

F1: The initial assessment of the KNPS Containment Civil TLAA 301, is documented in report L1124-GN-RPT-019, which has confirmed that TLAA 301 Concrete Containment Tendon Pre-Stress shall be re-analysed for KNPS units 1 and 2.

The required re-analysis has been completed (*refer to Report D02-ARV-01-183-095_KOEBERG 'TLAA 301 Containment Reanalysis), which include the following concluding remarks:*

The TLAA 301 Concrete Containment Tendon Pre-Stress has been revalidated for KNPS unit 1 and 2.

> ***Concrete compression and structural integrity:*** *The lowest concrete compression has been found in the dome peak. With conservative assumption in extrapolation of monitoring results the concrete compression is consumed and low tensile strains of 0.2 MN/m2 at maximum are predicted to appear whereas the criterion is zero. However, the exceedance is marginal and the stress is still far lower than the stress limit for concrete crack. The stresses and strains of pre-stressing steel, liner and reinforcement has been verified as well to be within the limits according to the original design. It is concluded that the containment structural integrity is ensured for the planned LTO.*
>
> ***Functionality of the monitoring system*** *- the data basis for the dome monitoring is at the lower limit and leading to less reliable analysis results than the data for the cylindrical part. There is also the danger of failure of functioning strain gauges during the next 20 years in LTO. It is therefore recommended to install additional strain gauges fixed to the exterior surface of both domes. The proposed alignment is detailed in chapter 4.6.2.3. The assumed erratic*

behaviour of load cell (dynamometer) number 152 shall be observed. In case of further erratic behaviour, it is recommended to recalibrate the load cell or to exchange it, if damaged, see chapter 4.6.2.2. It is recommended to perform the outstanding repair of the 4 erratic pendulums in unit 1, see chapter 4.6.2.1. It is recommended to install the additional temperature gauges to improve the temperature monitoring, see chapter 4.6.2.6.

Inspections and Repair measures *- extent the containment surface repairs considerably in the following period of LTO to ensure the structural integrity of the containment structures of unit 1 and 2. The recommendations in the inspection reports shall be followed.*

The beforementioned concluding remarks, related to the Containment Tendon (TLAA-301) re-validation, will be captured and tracked as LTO commitments.

As part of the refurbishment project in recent years, a protective coating has been applied on the patch repairs and their periphery. A protective coating is being considered in areas where the surface coating has failed to restrict chloride ingress until the ICCP is operational.

Additionally, the x27 ILRT's are planned for execution during x26 outages, to confirm the integrity of the containment prior to embarking on life extension.

F2, F3, F5: 240-137447723 *'TRS for the Design of Impressed Current Cathodic Protection on the Containment Buildings' was updated to incorporate the concerns raised.* Hydrogen embrittlement is a potential consequence if the ICCP controlling parameters are incorrect. The mock-up is intended to demonstrate the adequate parameters determined theoretically via the design.

F4: KBA 0022 N NEPO LOPP 164 'Plant Engineering Life of Plant of the Containment Building' was updated to include hydrogen embrittlement as a degradation mechanism linked to ICCP system. As such, hydrogen embrittlement was considered in the 240-137447723 *'TRS for the Design of Impressed Current Cathodic Protection on the Containment Buildings'* and to be taken into account as part of the design, subsequent installation and ICCP aging management programme, which will become available as the ICCP project progresses.

For more detail, refer to the following ODCOF's, attached.

- 08016.ODCOF.062 (OD_16.16 (OD_27.1); OD_16.16a (OD_27.1a); OD_16.17 (OD_27.2)) and
- 08016.ODCOF.133 (OD_16.15)

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS:

F1) n.a.

4.2 – DOCUMENTS REVIEWED:

n.a.

4.3 – RESOLUTION DEGREE:

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

1. ISSUE IDENTIFICATION	**Issue Number: E - 3**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Ageing management of civil SSCs	
1.21– ISSUE TITLE: Inappropriate ageing management of anchorages	
1.22– FUNDAMENTAL OVERALL PROBLEM: Ageing management of anchorages is not appropriate.	
2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) The responsibility regarding ageing management of embedded anchorages and anchor bolts is not clearly defined.

F2) The responsibility regarding ageing management of embedded anchorages belonging to cable trays are not clearly addressed in the document related to boundary definition.

F3) The document related to boundary definition states that the anchorages of accumulators, valve actuators and centrifugal purifier are considered as civil structures but the guidance document for civil structures contain no information about anchorages.

F4) The document 'Anchor Bolting Programme Requirements Manual' deals only with non-embedded anchorages.

F5) The inspection procedure for building is not clear regarding anchorages, for example the document related to the nuclear auxiliary building inspection says only "check the condition of all steel components fixed to the NAB for signs of corrosion".

2.2 – SAFETY CONSEQUENCE:

Without appropriate ageing management of anchorages, the safety function of these components cannot be assured for LTO.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider improvements to ageing management of anchorages.

2.4 – IAEA BASIS:

SSR-2/2 (Rev.1)

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.

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3.20. A systematic approach (see Fig. 1) should be applied to managing the ageing and obsolescence of SSCs to ensure that required intended functions are maintained at all times during the operation stage of the nuclear power plant.

5.4. The responsibilities of the ageing management entity should include:

(a) Development of the plant's ageing management programme;

(b) Coordination of existing and new plant programmes that are relevant to ageing management;

(c) Systematic monitoring of relevant operating experience and research and development results, and evaluation of their applicability to the plant;

(d) Direction of interdisciplinary ageing management teams for managing complex ageing issues;

(e) Assessment and optimization of ageing management programmes;

(f) Dealing with external technical support organizations;

(g) Evaluation of further training needs;

(h) Performance of periodic self-assessments;

(i) Improvement of activities relating to ageing management.

5.6. Responsibilities for the implementation of ageing management programmes and for reporting on the performance of SSCs should be defined and allocated within the operating organization (e.g. operations, maintenance and engineering units).

5.18. If an SSC within the scope is directly connected to an SSC out of the scope, clear definitions of the boundaries between them should be established.

5.39. If necessary, a new programme that includes or supplements these activities should be developed. Such existing or newly developed programmes can be at different levels of detail (e.g. structure or component level, commodity group level or system level) depending on their complexity and importance to safety.

5.43 Ageing management programmes specific to ageing effects and degradation mechanisms or specific to structures and components should be developed. Existing plant programmes should be coordinated and maintained to cover the activities indicated in para.

2.5 – DOCUMENTS REVIEWED:

- L1124-GN-RPT-004, Rev. 2, L1124 SALTO Project, Boundary Definition by Bigramme Salto Assessment, draft;
- 240-138623765, Rev.1, Anchor Bolting Programme Requirements Manual (ABPRM), 2018-11-09;
- KGR-008, Rev. 1, Guide to using the criteria for analyzing and classification of defects (CACD), 2017;
- KWR-IP-CIV-011, Rev.1, Visual Inspection of the Nuclear Auxiliary Building, 2017-09-01;

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

Improvements have been made to the anchor bolting programme and one-time inspections scheduled for post-installed threaded fasteners like bolts, studs, nuts, washers, screws (without ECS code).

F1, F2: Programme Responsibility for Ageing Management of Embedded Anchors and Anchor Bolts and Fixings was addressed under OD 7.43 / CR121535-009CA, refer to 08016.ODCOF.126.

F3, F4, F5: Updates to the exiting Bolting Programme, to incorporate Ageing Management of Embedded Anchors and Anchor Bolts and Fixings, are in progress. Tracked under OD 7.44 / CR 121535-010 CA in Devonway.

One-time inspections of the post-installed threaded fasteners like bolts, studs, nuts, washers, screws (without ECS code), to check for soundness, are currently in progress, which will inform any additional action to be taken. Tracked under SAP notifications 25288918, 5288920, 25289391, 5289392, 25289393, 5289589 for I&T to perform the one-time inspections and CR 121535-004 CA (OD_7.18C) for MRG to review one-time inspection results for any additional actions to be taken from an aging management programme perspective.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS:

F1) n.a.

4.2 – DOCUMENTS REVIEWED:		
n.a.		
4.3 – RESOLUTION DEGREE:		
1.	**Insufficient progress to date**	n.a.
2.	**Satisfactory progress to date**	n.a.
3.	**Issue resolved**	n.a.

1. ISSUE IDENTIFICATION	**Issue Number: E - 4**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area:	
1.23– ISSUE TITLE:	
Inconsistent documents regarding civil structures	
1.2 – FUNDAMENTAL OVERALL PROBLEM:	
There are inconsistencies in documents regarding ageing management of civil structures.	
2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) The planned lifetime is not clearly stated in all Lifetime of Plant Plan (LOPP) documents.

F2) A link between degradation mechanisms and ISI is missing from some of the LOPP documents.

F3) In a new civil components report it is stated that the spent fuel pool liner is listed as a component but it is not described in the inspection document for the fuel building.

F4) One bigramme in the boundary list is “liner” but it is not clear if this is only including the liner of the containment or if the liner of spent fuel pool is also included.

F5) Inspection activities to be performed for the spent fuel pool liner is not included in any programme.

F6) In the inspection report of the nuclear auxiliary building done 2018 (KFU-42), for the defect number 9HNA-I-028 the photo shows also a crack beyond the threshold criteria but the explanation for absence of action does not refer to the inspection guidance and trending history.

F7) The document for procedure of inspection of nuclear auxiliary building is for both steel and concrete structures. However, for steel structures the document refer to a specific CACD (criteria for analysing and classification) for steel structures that does not exist.

F8) The document KBA 0022 N NEPO NPP 217 (September 2019 draft) has a list of ageing mechanisms stating if a mechanism is applicable to the plant or not. The document is not finalized, for example for carbonation of concrete there is no clear conclusion.

F9) Inspection activities of containment liner has not been finalized for LTO.

2.2 – SAFETY CONSEQUENCE:

Without consistent ageing management documents, the condition of civil structures in LTO scope cannot be adequately maintained.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider improving ageing management documents regarding civil structures.

2.4 – IAEA BASIS:

SSR-2/2 (Rev.1)

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.

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5.47 Appropriate acceptance criteria for the inspection and monitoring of ageing effects should be established for ageing management programmes and should be based on the design basis or on the technical requirements for the structure or component, and the relevant regulatory requirements, codes and standards, so that a corrective action can be implemented sufficiently before loss of the intended function(s) of the structure or component. The need for sufficient margins should be taken into account in these acceptance criteria.

5.70. The assumptions, activities, evaluations, assessments and results of the evaluation of the plant programme for ageing management should be documented in accordance with national regulatory requirements as well as in accordance with IAEA safety standards [2, 8]. The documentation should be developed and retained in an auditable and retrievable form.

5.71. The documentation should also include the following to demonstrate that ageing effects will be managed during the planned operating period:

(a) A description of plant programmes and documentation relevant to ageing management;

(b) A list of commitments or plans for the improvement or development of plant programmes and documentation relevant to ageing management.

2.5 – DOCUMENTS REVIEWED:

- KBA-0022-N-NEPO-LOPP-164, Rev 0, NUCLEAR ENGINEERING LIFE OF PLANT Containment Building, March 2019;
- KBA-0022-N-NEPO-LOPP-169, Rev 0, NUCLEAR ENGINEERING LIFE OF PLANT Diesel Building, 2019;
- L1124-CV-RPT-001, Rev. 1, L1124 SALTO Project, New Civil Components report, draft;
- L1124-GN-RPT-004, Rev. 2, L1124 SALTO Project, Boundary Definition by Bigramme Salto Assessment, draft;
- KWB-1AA-T02, Rev. 5, 1AA-T02 Unit 1 Control Room Panel T02 Alarm Cards, 2019-03-20;
- KGR-008, Rev. 1, Guide to using the criteria for analyzing and classification of defects (CACD), 2017;
- KWR-IP-CIV-009, Rev. 1, Visual Inspection of the Fuel Buildings and PTR Tank Rooms at Koeberg Nuclear Power Station, 2017-08-28;
- KWR-IP-CIV-011, Rev. 1, Visual Inspection of the Nuclear Auxiliary Building, 2017-09-01;
- KBA-0022-N NEPO-NPP-217, Nuclear Engineering Position Paper, Reinforced Concrete Structures Degradation and Ageing Mechanisms, draft;
- KWR-VT-001, Rev. 3, Visual Examination of ISIPRM Module E.E Components, 2018-02-05;

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

Progress has been made with some documents updated and others scheduled for updates.

F1 & F2: The gaps identified in Issue Sheets E1, E2 and E4 that were specifically directed to the KBA 0022 N NEPO LOPP 164 for the Containment Structures, were addressed. Refer to 08016.ODCOF.133 (OD_16.15) attached.

The gaps directed to KBA 0022 N NEPO LOPP 164 were further reviewed for applicability and relevance to the entire civil LOPP suite. The resultant gaps identified through this evaluation are being addressed as part of OD 6.11/CR 121535-050 CA.

F3, F4 & F5: A new Aging Management Programme for the Spent Fuel Pool, Reactor Pool and Sump Liners, is under development, and tracked under OD_6.12 / CR 115457-020 CA and OD_7.47 / CR 121535-012 CA. The programme ownership/responsibility was addressed under OD_7.46 / CR 121535-011 CA refer to 08016.ODCOF.127.

F6 & F7: Updates to KGR-008 is in progress, and tracked under OD_7.45 / CR 121535-019 CA.

F8: Updates and finalisation of KBA 0022 N NEPO NPP 217 (draft) are in progress and tracked under OD_7.48 / CR 121535-020 CA.

F9: The inspection activities identified through the Civil Aging Management Assessment w.r.t Containment Liner requirements in the existing ISIPRM, include ageing of paints, vibration fatigue, thermal cracking of steel liner that should be confirmed and update of the ISIPRM (if required). Tracked under OD_6.1A – 010 / CR 115457-016 CA.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS:

F1) n.a.

4.2 – DOCUMENTS REVIEWED:

n.a.

4.3 – RESOLUTION DEGREE:

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

J.5 Area F Issue Sheets

1. ISSUE IDENTIFICATION	**Issue Number: F - 1**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Human resources competence and knowledge management for LTO	

1.1 – ISSUE TITLE:

Inadequate human resources policy and strategy for LTO

1.2 – FUNDAMENTAL OVERALL PROBLEM:

Human resources policy and strategy is inadequate for the LTO period.

2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.1 – FACTS:

F1) The human resources (HR) strategy and policy is determined and provided by Eskom headquarters. However, there is no specific HR strategy and policy reflecting LTO programme at the plant.

Human Resources (HR) is mandated to partner and empower line management to recruit, develop, and retain skilled, committed, engaged and accountable employees across Eskom. In response to the Eskom strategy to improve performance and grow sustainability, HR has defined its enabling strategy to create a high-performing culture as a desired end state. The foundation of the HR strategy is intended that people management begins with the alignment of HR objectives to business objectives. In creating the step change required to enable a high-performing culture, the Eskom HR strategy is anchored around the following five core themes that work together in order to support the execution of the overall business strategy:

- Engaged employees: to create workplace harmony and win hearts and minds
- A safe work place: to promote discipline, accountability and behaviour change for safety.
- Competent and highly skilled workforce beyond Eskom: to ensure the right mix and right quantities of skills at the right time.
- Performance-based work place: to drive collaborative methods of work that ensures a high performing organization, accompanied by appropriate reward and recognition system.
- Transformed work place: to promote value-based effective and accountable leaders driving transformation beyond compliance.

HR strategy and policies are determined by corporate HR and they are unable to support the needs of the business for LTO. This HR strategy remains unchanged for LTO. To supplement corporate procedures and policies, the NOU has developed the Human Resources Strategy on LTO 240-156938857 which elaborates how LTO will be supported using the current policies and procedures.

F2) The plant conducted a strategic workforce planning exercise in 2016. It analysed the workforce needs, identified gaps between present and the future and implemented solutions/ strategies that would enable the accomplishment of the vision and objectives of the organisation. Currently, there is no updated workforce plan beyond 2024 reflecting additional staffing needs required for LTO.

The NOU conducted a strategic workforce planning exercise in 2016. The strategic workforce planning outlines strategic alignment of human resources with the business direction of the organisation. It analyses the current workforce needs, identifies gaps between present and the future and implemented solutions/strategies that will enable the accomplishment of the vision, mission, goals, and objectives of the organisation. This exercise was performed before the SALTO assessment. It is believed that a more up-to-date workforce planning exercise that is informed by the SALTO assessment and the current business efficiency objectives will provide an improved strategic plan for LTO.

Talent management and succession planning are business as usual requirements as contained in Eskom's procedures. The business unit will not have a separate process for LTO but it will be incorporated in the talent management and succession planning discussion. A NOU workforce management plan: 240-123782330 has been developed which takes into account any additional staffing requirements uniquely associated with LTO.

F3) Human Resources does not have a representative in LTO Steering Committee.

The HR Middle Manager attends the LTO Steering Committee meetings.

F4) The plant lost 73 employees from operating, engineering and maintenance departments during last few years. Currently, there are 129 vacancies. Due to financial constraints, Eskom placed a temporary moratorium on recruitment, so the plant can only hire new engineers in training for engineering area and artisans for maintenance on the learnership contract.

Various position have been priorities and recruitment is on going.

F5) Currently the plant is dealing with the recruitment policy (Talent Discovery Procedure) elaborated and authorised by Eskom (240-128157536). Based on this procedure the plant is elaborating its recruitment plan. LTO aspect is not included in the document.

The roles and responsibilities for all functional areas of the NOU are detailed in the Nuclear Operating Unit organisational structure document 240-64602879 (KOU Organisational Structures) which has been updated to incorporate support Long Term Operations objectives and initiatives.

F6) Succession and talent process is comprehensive and follows high standards. However, it covers only one year period. The plan is reviewed regularly every year but does not fully incorporate LTO period.

Eskom has a talent management process for MPGS bands which aims to provide for a pool of talented individuals to be recruited into key positions and become successors for critical and core skills categories.

F7) The plant has not implemented the LTO plan related to workforce and assignment of LTO responsibilities and accountabilities. The sufficiency of resources for life extension is not demonstrated.

A NOU workforce management plan: 240-123782330 has been developed which takes into account any additional staffing requirements uniquely associated with LTO.

2.2 – SAFETY CONSEQUENCE:

Without adequate human resources policy and strategy, the plant cannot ensure sufficient qualified and competent human resources throughout the LTO period.

2.3 – RECOMMENDATION/SUGGESTION:

R) The plant should implement an adequate human resources policy and strategy for LTO.

2.4 – IAEA BASIS:

GSR-Part 2

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.

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.

4.27. The knowledge and the information of the organization shall be managed as a resource.

SSR 2/2 (Rev.1)

Requirement 4: Staffing of the operating organization

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.

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5.1. For the implementation of the plant programme for ageing management, the policy and objectives of the programme should be established, and the necessary resources (e.g. human resources, financial resources, tools and equipment, and external resources) should be identified and allocated. The organizational arrangements, such as the organizational structure and the policies of the operating organization should meet national requirements and IAEA safety standards [2, 8, 18–20], and should be in accordance with national practices.

7.4. In addition to the existing obligations associated with ageing management, the operating organization should clearly define the additional responsibilities and authorities associated with the preparation for, and implementation of, long term

operation, after considering all the regulatory requirements relevant to long term operation. The operating organization should ensure that appropriate resources are available to support these assigned responsibilities and accountabilities.

2.5 – DOCUMENTS REVIEWED:

- 32 - 83, Rev. 4, Eskom Nuclear Management Policy, 2018;
- 32-1066, Rev. 4, Remuneration & Benefits Policy, 2019;
- 32-1073, Rev. 5, Remuneration and Benefits Practices Manual, 2015;
- 238-186, Rev. 2, Nuclear Support Benchmarking Program, 2013;
- 240-128157536, Rev. 3, Talent Discovery Procedure, 2018;
- KAA-501, Rev. 10, Process for Modifications at Koeberg, 2010;
- Power Point presentation on Succession Planning and Talent Management.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

F1) Human Resources (HR) is mandated to partner and empower line management to recruit, develop, and retain skilled, committed, engaged and accountable employees across Eskom. In response to the Eskom strategy to improve performance and grow sustainability, HR has defined its enabling strategy to create a high-performing culture as a desired end state. The foundation of the HR strategy is intended that people management begins with the alignment of HR objectives to business objectives. In creating the step change required to enable a high-performing culture, the Eskom HR strategy is anchored around the following five core themes that work together in order to support the execution of the overall business strategy:

- Engaged employees: to create workplace harmony and win hearts and minds
- A safe work place: to promote discipline, accountability and behaviour change for safety.
- Competent and highly skilled workforce beyond Eskom: to ensure the right mix and right quantities of skills at the right time.
- Performance-based work place: to drive collaborative methods of work that ensures a high performing organization, accompanied by appropriate reward and recognition system.
- Transformed work place: to promote value-based effective and accountable leaders driving transformation beyond compliance.

HR strategy and policies are determined by corporate HR and they are unable to support the needs of the business for LTO. This HR strategy remains unchanged for LTO. To supplement corporate procedures and policies, the NOU has developed the Human Resources Strategy on LTO 240-156938857 which elaborates how LTO will be supported using the current policies and procedures.

F2) The NOU conducted a strategic workforce planning exercise in 2016. The strategic workforce planning outlines strategic alignment of human resources with the business direction of the organisation. It analyses the current workforce needs, identifies gaps between present and the future and implemented solutions/strategies that will enable the accomplishment of the vision, mission, goals, and objectives of the organisation. This exercise was performed before the SALTO assessment. It is believed that a more up-to-date workforce planning exercise that is informed by the SALTO assessment and the current business efficiency objectives will provide an improved strategic plan for LTO.

Talent management and succession planning are business as usual requirements as contained in Eskom's procedures. The business unit will not have a separate process for LTO but it will be incorporated in the talent management and succession planning discussion. A NOU workforce management plan: 240-123782330 has been developed which takes into account any additional staffing requirements uniquely associated with LTO.

F3) The HR Middle Manager attends the LTO Steering Committee meetings.

F4) Various position have been priorities and recruitment has been progressing with a lot of vacancies filled.

F5) The roles and responsibilities for all functional areas of the NOU are detailed in the Nuclear Operating Unit organisational structure document 240-64602879 (KOU Organisational Structures) which has been updated to incorporate support Long Term Operations objectives and initiatives.

F6) Eskom has a talent management process for MPGS bands which aims to provide for a pool of talented individuals to be recruited into key positions and become successors for critical and core skills categories.

F7) A NOU workforce management plan: 240-123782330 has been developed which takes into account any additional staffing requirements uniquely associated with LTO.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS:

F1) n.a.

4.2 – DOCUMENTS REVIEWED:

n.a.

4.3 – RESOLUTION DEGREE:

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

1. ISSUE IDENTIFICATION	**Issue Number: F - 2**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Human resources competence and knowledge management for LTO	

1.2 – ISSUE TITLE:

Inconsistent competence management for LTO

1.2 – FUNDAMENTAL OVERALL PROBLEM:

Competence management procedures are inconsistent for LTO.

2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.2 – FACTS:

F1) Training Department does not have a representative in the LTO Steering Committee.

Section 1.1.3 of the LTO Steering Committee constitution (240-161561906), the committee provides a support, guidance and oversight of the progress related to the LTO programme. Preparation for LTO requires significant effort from all departments with the Nuclear Operating Unit (NOU), all groups with the NOU require a thorough understanding of what the effort requires, what impact it could have on resources and how their inputs to prepare for LTO and output enable LTO are integrated into the overall LTO programme.

Furthermore, the senior managers of all groups are permanent members of the committee and training group is directly reporting to General Manager (Koeberg Power Station). Therefore, should there be a requirement for training to provide any feedback/information, they may be called up on by the committee as required.

F2) The plant organizes every 4 years the Task DIF (Difficulty, Importance and Frequency), exercise related to training and competence management (last one took place in 2017 for engineering). However, the results of this assessment do not provide estimate of skills and competences required for the LTO period.

As part of the training development and competency index management, Nuclear Engineering groups have initiated the process of developing training programme in accordance with SAT process. These groups include, Material Reliability Group (MRG), Probability Safety Assessment Group (PSA), Nuclear Site Studies (NSS), Safety Case Group (SCG), Design Engineering (DE) and Integrated Plant Design (IPDK). As the station is currently embarking on LTO, some of the NE groups have included tasks that are related to LTO in their training programme, while other tasks may not being specific to LTO, however, the intention is for ensuring that the continues operation of the plants, however, they intended to ensure long term operation of the plant.

F3) Job descriptions exist for all positions and detail the key performance indicators and job outputs associated with each position. Additional roles and responsibilities are not defined and job descriptions required for LTO are not in place yet.

All job descriptions are graded at corporate level. The corporate grading committee was established to grade jobs that are generic across Eskom businesses (i.e. Engineering). All jobs across disciplines throughout Eskom are evaluated using the TASK factor i.e. complexity, knowledge, influence and pressure of the job. All jobs need to be reflected on the organisational structure. Generic job descriptions are utilised to ensure consistency across Eskom. The competence and the minimum education requirements in the job descriptions are utilised in the advertisement and selection purpose during the recruitment process. Recruitment and selection occurs as a standard process governed by Eskom's recruitment and selection procedure. In many respects Koeberg is already managing the effects of ageing and LTO as Task will not change due to LTO. The competencies to manage these effectively have been identified. The Authorisation Index is utilised to track and monitor required staff competencies within the NOU and is the driving force for new competencies.

In addition, NE has identified key managerial positions for LTO and thy are documented in 240-161561906, LTO Steering Committee. The key positions identified for LTO are Chemistry, Operating, Engineering, Maintenance and Radiation Protection (RP). These groups may be called upon to the committee as required even though business area senior managers responsible for these respective functional groups are permanent members of the steering committee.

Due to the discussions that were held with several stakeholders such as HR and the SALTO team, it was realised that the request for a written appointment for managers will not be a sustainable process. As incumbents filling these positions, their roles and responsibility related to their functions does not differ because of LTO, there is a clear defined process through the appointment letter or delegations of authority (DOAs).

F4) The authorization index (competence index) is utilized to track and monitor required staff competences within the plant. The proficiency is monitored by the whole team/ department, however, there is no information about the competence proficiency for each employee.

Base on the authorisation indicator for Systems Engineering, both overall group and individual competency is included in the authorisation index. Furthermore, NE training programme authorisation indicator will display the same level of information to ensure consistency within all engineering groups in NOU.

F5) There is no competence index utilized for middle management.

The plant managers are selected and appointed by adhering to the job specification for each position, which states the qualifications, skills, and requisite experience required for a position. The qualification, skills, and experience requirements as listed in job descriptions are informed by the job position requirements. This is further assessed by undergoing interviews and psychometric testing. Two programmes prepare the managers: MMTP (middle management talent programme) and supervisors SDP (supervisory development programme) in terms of the required leadership, supervisory, and management skills to effectively conduct plant operations and oversight.

In the event of organisational changes being necessary, the control of organisational structures procedure (KAA-844) facilitates the changes and review thereof. This process will determine what changes to management training are required. The curriculum steering committee meeting provides oversight of supervisory and management leadership for action and implementation according to the systematic approach to training (SAT) process.

The Human Resource Department periodically reviews the leadership needs of the business and updates the changes, content, and programmes as required.

F6) Neither the pool of successors nor the pool of critical knowledge holders is linked with the competence matrix.

A Nuclear Engineering knowledge management standard, 240-14668659, was developed to address the issue of critical skill los necessary for safe operation. This document outlines the process of identifying critical skills and knowledge. Furthermore, once the skill has been identified, an action plan must be developed by liaising with Training and HR department or consult the following relevant procedures as stipulated in the standard.

2.2 – SAFETY CONSEQUENCE:

Without consistent competence management procedures, the plant cannot ensure appropriate competence for safe LTO.

2.3 – RECOMMENDATION/SUGGESTION:

S) The plant should consider ensuring consistent competence management procedures for LTO.

Competent management is determined by utilising a graded approach, which further informs the implementation of the systematic approach to training (SAT) for training programmes at Koeberg. This graded approach is determined in accordance with KGT-006. If the need arises to update or revise the training programme or training material to achieve a certain objective like LTO, a need analysis is performed and TCR is documented and the SAT process is followed if the training need is required.

Therefore, the current process is dynamic, and it accommodate changes for the betterment of Koeberg training.

2.4 – IAEA BASIS:

GSR Part 2

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.

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.

4.25. Senior management shall ensure that individuals at all levels, including managers and workers:

(a) Are competent to perform their assigned tasks and to work safely and effectively;

(b) Understand the standards that they are expected to apply in completing their tasks.

2.5 – DOCUMENTS REVIEWED:

- KAA-501, Rev. 10, Process for Modifications at Koeberg, 2010;
- KAA-780, Rev. 8a, Systematic Approach to Training Procedure suite, 2018;
- KAA-781, Rev. 5, Systematic Approach to Training Procedure suite, 2018;
- KAA-782, Rev. 5, Systematic Approach to Training Procedure suite, 2016;
- KAA-783, Rev. 5, Systematic Approach to Training Procedure suite, 2018;
- KAA-784, Rev. 12, Systematic Approach to Training Procedure suite, 2018;
- KAD-025, Rev. 1, Processing of Operating Experience, 2014;
- KGA-035, Rev. 4, Processing of Operating Feedback received through the EDF Cooperation, 2019;

- KGA-051, Rev. 1, Benchmarking Guide at Koeberg Nuclear Power Station, 2009;
- KGT-054, Rev. 7, Chemistry Training Programme Guide, 2019;
- KGT-055, Rev. 3, General Radiation Protection Training Programme Guide, 2019;
- KGT-070, Rev. 6, Education, Training and Development Practitioner Training Programme, 2019;
- KGT-071, Rev. 8, Plant Engineering Training Programme Guide, 2016;
- KGT-072, Rev. 7, Nuclear Engineer's Programme Guide, 2016;
- KSA-049, Rev. 9, Station Training Standard, 2019.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

F1) Section 1.1.3 of the LTO Steering Committee constitution (240-161561906), the committee provides a support, guidance and oversight of the progress related to the LTO programme. Preparation for LTO requires significant effort from all departments with the Nuclear Operating Unit (NOU), all groups with the NOU require a thorough understanding of what the effort requires, what impact it could have on resources and how their inputs to prepare for LTO and output enable LTO are integrated into the overall LTO programme.

Furthermore, the senior managers of all groups are permanent members of the committee and training group is directly reporting to General Manager (Koeberg Power Station). Therefore, should there be a requirement for training to provide any feedback/information, they may be called up on by the committee as required.

F2) As part of the training development and competency index management, Nuclear Engineering groups have initiated the process of developing training programme in accordance with SAT process. These groups include, Material Reliability Group (MRG), Probability Safety Assessment Group (PSA), Nuclear Site Studies (NSS), Safety Case Group (SCG), Design Engineering (DE) and Integrated Plant Design (IPDK). As the station is currently embarking on LTO, some of the NE groups have included tasks that are related to LTO in their training programme, while other tasks may not being specific to LTO, however, the intention is for ensuring that the continues operation of the plants, however, they intended to ensure long term operation of the plant.

F3) All job descriptions are graded at corporate level. The corporate grading committee was established to grade jobs that are generic across Eskom businesses (i.e. Engineering). All jobs across disciplines throughout Eskom are evaluated using the TASK factor i.e. complexity, knowledge, influence and pressure of the job. All jobs need to be reflected on the organisational structure. Generic job descriptions are utilised to ensure consistency across Eskom. The competence and the minimum education requirements in the job descriptions are utilised in the advertisement and selection purpose during the recruitment process. Recruitment and selection occurs as a standard process governed by Eskom's recruitment and selection procedure. In many respects Koeberg is already managing the effects of ageing and LTO as Task will not change due to LTO. The competencies to manage these effectively have been identified. The Authorisation Index is utilised to track and monitor required staff competencies within the NOU and is the driving force for new competencies.

In addition, NE has identified key managerial positions for LTO and they are documented in 240-161561906, LTO Steering Committee. The key positions identified for LTO are Chemistry, Operating, Engineering, Maintenance and Radiation Protection (RP). These groups may be called upon to the committee as required even though business area senior managers responsible for these respective functional groups are permanent members of the steering committee.

Due to the discussions that were held with several stakeholders such as HR and the SALTO team, it was realised that the request for a written appointment for managers will not be a sustainable process. As incumbents filling these positions, their roles and responsibility related to their functions does not differ because of LTO, there is a clear defined process through the appointment letter or delegations of authority (DOAs).

F4) Base on the authorisation indicator for Systems Engineering, both overall group and individual competency is included in the authorisation index. Furthermore, NE training programme authorisation indicator will display the same level of information to ensure consistency within all engineering groups in NOU.

F5) The plant managers are selected and appointed by adhering to the job specification for each position, which states the qualifications, skills, and requisite experience required for a position. The qualification, skills, and experience requirements as listed in job descriptions are informed by the job position requirements. This is further assessed by undergoing interviews and psychometric testing. Two programmes prepare the managers: MMTP (middle management talent programme) and supervisors SDP (supervisory development programme) in terms of the required leadership, supervisory, and management skills to effectively conduct plant operations and oversight.

In the event of organisational changes being necessary, the control of organisational structures procedure (KAA-844) facilitates the changes and review thereof. This process will determine what changes to management training are required. The Leadership Steering Committee provides oversight of supervisory and management leadership for action and implementation according to the graded approach to the systematic approach to training (SAT) process.

The Human Resource Department periodically reviews the leadership needs of the business and updates the changes, content, and programmes as required.

F6) A Nuclear Engineering knowledge management standard, 240-14668659, was developed to address the issue of critical skill los necessary for safe operation. This document outlines the process of identifying critical skills and knowledge. Furthermore, once the skill has been identified, an action plan must be developed by liaising with Training and HR department or consult the following relevant procedures as stipulated in the standard.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3
4.1 – FACTS: **F1)** n.a.	
4.2 – DOCUMENTS REVIEWED: n.a.	
4.3 – RESOLUTION DEGREE:	

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

n.a.: not applicable for the present mission.

1. ISSUE IDENTIFICATION	**Issue Number: F - 3**
NPP: Koeberg	**Unit: 1 and 2**
Reviewed Area: Human resources competence and knowledge management for LTO	
1.1 - ISSUE TITLE: Lack of a knowledge management programme	
1.2 – FUNDAMENTAL OVERALL PROBLEM: A knowledge management programme has not been developed.	
2. ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** 11/09/2019

2.3 – FACTS:

F1) There is no clear ownership of knowledge management (KM) processes in the plant.

The NOU has elements of KM principles embedded in its routine business practices, and are owned by a various functional owner's according to their mandates. The processes in the organisation give life to the principles and practices required by the organisation to ensure KM is functioning correctly. KM is viewed as being similar to configuration management where there are a multitude of processes that collectively entrench the principles and practices in the NOU and are shared by all departments.

The aim of the newly created KM standard document is to bring KM elements together under the banner of KM and to focus on making it part of routine activities in the NOU. Those principles include:

- identifying knowledge gaps and addressing them;
- placing an importance on the value of knowledge in the organisation through investment in information systems;
- embarking on identifying where and how tacit knowledge can be converted to explicit knowledge to ensure long-term sustainability;
- creating new sources of knowledge or ways at making it available to the organisation in its quest to improve both operational and safety performance;
- striving for continual learning through programmes that encourage the promotion and sharing of experiences both positive and negative; and
- Setting up ways to engage and connect aging and new workers so that knowledge can be transferred, shared, and retained.

F2) Knowledge Management Programme is not a binding regulatory license requirement.

Knowledge Management is a binding regulatory license requirement due the introduction of RG 027 which is the INTERIM REGULATORY GUIDE that is called Ageing Management and Long Term Operation of Nuclear Power Plants date March 2019.

F3) There are some segments of KM techniques and aspects implemented in the plant and described in the draft document 240-146686589 Koeberg Operating Unit KM Framework). However, they are not standardized, used and evaluated systematically throughout all plant processes/ units. Every unit/ line manager uses different and not measurable methods and approaches.

Eskom should have processes in place for ensuring that any information and knowledge necessary for discharging the duties is not lost in the event of personnel changes.

The importance of accurate and valid information in making sound technical and business decisions has been identified in the NOU as an element of the business that will allow for sustainability into the foreseeable future. Operational and strategic information is validated before it is used to ensure safe and reliable operation of the units.

The summary report so far that have been developed provide a perspective on a Risk Factor which is based on possible attrition and critical skills that the individual possesses. The risk factor outcome is used to determine the urgency at which the manager needs to implement actions to minimize the risks of loss of critical knowledge necessary for safe operations of the power plant and achievement of the NOU's main business objectives.

The recommendations and outcome of the interviews have resulted in handover on required engineering processes due to forthcoming retirements, identifying job shadowing opportunities to obtain requisite knowledge and skills, coaching opportunities to close gaps, and civil engineering training program gaps.

The plan is to implement this process throughout the NOU.

F4) The draft document 240-146686589 (Koeberg Operating Unit KM Framework) dated July 2019 maps the plant's position on KM taking into consideration the current requirements for LTO. The document is not authorized nor published. There is no other procedure, standard or policy on KM available at the plant.

The NOU has elements of KM principles embedded in its integrated management system, On the 12th October 2020, NEXCO endorsed the implementation of KM. The Chief Nuclear Officer (CNO) and Nuclear Engineering Manager (NEM) agreed to use Nuclear Engineering (NE) as a pilot for KM. The owner of the pilot is Nuclear Engineering and the experience from the pilot will be available for when KM is roll out to the rest organisation. This permitted the Nuclear Engineering Manager to authorise the 240- 146686589 KM standard for use in NE. The standard has been developed by benchmarking with IAEA workshops and International Nuclear Power Stations (NPS). The standard has been developed and authorised.

F5) The plant does not have a process for knowledge-loss risk assessment and mitigation for retiring employees or critical knowledge holders (experts).

A project plan with all the activities has been developed and consist of the following activities; · Revise Nuclear Policy, 32-83. Submit Nuclear policy mark ups to Nuclear Support · Present to NEXCO the mandate to Incorporate Knowledge Management as function in the NE FOS under Engineering Support. · Update the NE org structure using complete the change management form, 238-187. · Update 238-8 to incorporate Knowledge Management. · Recruit and acquire Knowledge Manager. · Identify critical skills. In addition a document to be developed to cover the following clarifying ownership of KM, KM processes for collecting and using OE KM Processes detailing the following: · A process for knowledge-loss risk assessment and mitigation for suppliers, TSO and outside service providers.

Plant processes for knowledge transfer, information and data to/ from vendor, critical equipment/component suppliers, outsourced services and TSOs. · IT/IS processes support managing information and records and their availability. · The plant retains records of traceability, rationale and assumptions of why and how operations, maintenance and design changes (corporate memory) have been made.

The implementation of the Knowledge management is accordance to 240-146686589 KM standard, is assigned on the Devonway for the line manager to address and could be implemented through various processes such as consulting the following procedures when creating action plans or liaise with Training department and Human Resource department about guidance on appropriate actions that will be suitable

- KAA-688 The Corrective Action Process
- 240-128158712 Procedure for Deployment
- KSA-049 Koeberg Training Standard
- 240-128157536 Eskom Talent Discovery Procedure
- 240-128258875 Procedure for Development
- 240-138530260 Management Position Handover Requirements for the NOU
- 240–162195089 Knowledge Management Interview Report
- 240-162970311 Knowledge management Total Risk Factor

The Nuclear Operating Unit (NOU) process for dealing with knowledge loss is documented in 238-105 (*Supplier Qualification and Audit Manual*). Procurement Quality Engineering (PQE) performs supplier capability assessments to check for technical competency of an organisation before it is qualified as a supplier to the NOU.

F6) The plant does not have a process for knowledge-loss risk assessment and mitigation for suppliers, TSOs and outside service providers.

A project plan with all the activities has been developed and consist of the following activities; · Revise Nuclear Policy, 32-83. Submit Nuclear policy mark ups to Nuclear Support · Present to NEXCO the mandate to Incorporate Knowledge Management as function in the NE FOS under Engineering Support. Update the NE org structure using complete the change management form, 238-187. Update 238-8 to incorporate Knowledge Management. · Recruit and acquire Knowledge Manager. Identify critical skills. In addition a document to be developed to cover the following clarifying ownership of KM, KM processes for collecting and using OE KM Processes detailing the following: A process for knowledge-loss risk assessment and mitigation for suppliers, TSO and outside service providers.

Plant processes for knowledge transfer, information and data to/ from vendor, critical equipment/component suppliers, outsourced services and TSOs. · IT/IS processes support managing information and records and their availability. · The plant retains records of traceability, rationale and assumptions of why and how operations, maintenance and design changes (corporate memory) have been made.

F7) The plant does not have a consistent, integrated and comprehensive processes for transferring knowledge, information and data to/from the vendor, critical equipment/ component suppliers, outsources services and TSOs. Each manager does it in his/her own way.

The station has a designated OE function to analyse and co-ordinate all aspects of operating experience (internal and external). Operating experience from WANO SOERs, EDF Affaire Parc, and Eskom events are reviewed for applicability to Koeberg prior to being distributed to the relevant staff. The corrective action processes (KAA-688 and 331-4) are administrative procedures that describe the process and responsibilities for problem identification, reporting, investigating, and trending occurrences, events, and near misses at the NOU. This process also aims to ensure that OE information is effectively identified, screened, classified, investigated, distributed, and tracked in order to improve nuclear and conventional safety, health and the environment, and the recurrence of events. Operating experience and all other events are captured on DevonWay.

Currently collaboration exists between the NOU and EDF to share operating experience including the LTO initiatives. The process for screening the OE for applicability and significance is documented in 331-23 and 331-24. The projects that are applicable to Koeberg are presented at Engineering Technical Management Meeting (ETMM), and actions tracked on DevonWay. Knowledge Management is also driven through the Top Ten Priorities as defined by the E3C of the EDF collaboration agreement. As stipulated in Eskom's Nuclear Management policy, 32-83; and all the documents derived from these, the Long Term Strategy does cater for knowledge management.

F8) HR procedures, like exit interviews related to leaving employees do not assure the preservation of critical knowledge.

The introduction of the Knowledge Management (240-146686589) will fulfil the closure of the requirement.

F9) There are neither records, nor other evidence that the critical knowledge of leaving employees has been captured or transferred.

NOU has managed to develop processes and guidelines that support the sharing and transferring of knowledge, information, and data to and/or from a vendor. Currently, the following processes and guides exist to ensure optimal transfer of knowledge:

331-23 (Processing of Industry Operating Experience in Nuclear Engineering);

331-24 (Screening of Operating Experience for Applicability and Significance); and

KGA-035 (Processing of Experience Feedback received through the EDF Co-Operation Agreement).

These documents provide guidance on how to evaluate the applicability of events that happened in other utilities to improve plant safety and reliability. KGA-035 elaborates on the roles and responsibilities of the current dedicated Koeberg integrated team (KIT). The Koeberg Event Group (KEG) is responsible for evaluating the applicability of events and communicating them to relevant departments. The OE programme allows optimal information and data sharing and also provides the NOU with the opportunity to align with other utilities.

2.2 – SAFETY CONSEQUENCE:

Without a knowledge management programme, the plant cannot retain necessary knowledge for safe LTO.

2.3 – RECOMMENDATION/SUGGESTION:

R) The plant should develop and implement a knowledge management programme.

2.4 – IAEA BASIS:

GSR Part 2

Requirement 9: Provision of resources

4.27. The knowledge and the information of the organization shall be managed as a resource.

SSR 2/2 (Rev.1)

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:

- 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;

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.

2.5 – DOCUMENTS REVIEWED:

- 240-146686589, Koeberg Operating Unit Knowledge Management Framework – DRAFT, 2019;
- E3C, Nuclear Engineering Sub-Committee, Eskom and EDF meeting, 2018.

3. COUNTERPART ACTIONS TO RESOLVE ISSUE	**Date:** 12/11/2021

F1) The NOU has elements of KM principles embedded in its routine business practices, and are owned by a various functional owner's according to their mandates. The processes in the organisation give life to the principles and practices required by the organisation to ensure KM is functioning correctly. KM is viewed as being similar to configuration management where there are a multitude of processes that collectively entrench the principles and practices in the NOU and are shared by all departments.

The aim of the newly created KM standard document is to bring KM elements together under the banner of KM and to focus on making it part of routine activities in the NOU.

The owner of the pilot is Nuclear Engineering and the experience from the pilot will be available for when KM is roll out to the rest organisation. This permitted the Nuclear Engineering Manager to authorise the 240- 146686589 KM standard for use in NE. The standard has been developed by benchmarking with IAEA workshops and International Nuclear Power Stations (NPS). The standard has been developed and authorised.

F2) Knowledge Management is a binding regulatory license requirement due the introduction of RG 027 which is the INTERIM REGULATORY GUIDE that is called Ageing Management and Long Term Operation of Nuclear Power Plants date March 2019.

F3) NOU has elemeents of KM principles, through the corrective action process, document management process, SAP, IQReview and CURA risk, these platfoms are used to ensure information and Knowle for discharging the duties is not lost in the event of personnel changes. Through the established process the information is validated before it is used to ensure safe and reliable operation of the units.

F4) The document 240-146686589 – Nuclear Engineering Knowledge Mangement procedure has been authorised.

F5) The produre 240-146686589 – Nuclear Engineering Knowledge Mangement is used for retiring employees to understand the gaps within the department and to recommend action that's must be taken by the line manager.

F6) Plant processes for knowledge transfer, information and data to/ from vendor, critical equipment/component suppliers, outsourced services and TSOs. Is managed through the user/technical requirement specification that the requirement will be put upfront before we go to the market such as training to be provided to operating. Maintenance or NOU wants to be involved is some of the inspection.

F7) Refer to F6.

The implementation of the Knowledge management is accordance to 240-146686589 KM standard, is assigned on the Devonway for the line manager to address and could be implemented through various processes such as consulting the following procedures when creating action plans or liaise with Training department and Human Resource department about guidance on appropriate actions that will be suitable

KAA-688 The Corrective Action Process

240-128158712 Procedure for Deployment

KSA-049 Koeberg Training Standard

240-128157536 Eskom Talent Discovery Procedure

240-128258875 Procedure for Development

240-138530260 Management Position Handover Requirements for the NOU

240–162195089 Knowledge Management Interview Report

240-162970311 Knowledge management Total Risk Factor

The Nuclear Operating Unit (NOU) process for dealing with knowledge loss is documented in 238-105 (Supplier Qualification and Audit Manual). Procurement Quality Engineering (PQE) performs supplier capability assessments to check for technical competency of an organisation before it is qualified as a supplier to the NOU.

F6) The station has a designated OE function to analyse and co-ordinate all aspects of operating experience (internal and external). Operating experience from WANO SOERs, EDF Affaire Parc, and Eskom events are reviewed for applicability to Koeberg prior to being distributed to the relevant staff. The corrective action processes (KAA-688 and 331-4) are administrative procedures that describe the process and responsibilities for problem identification, reporting, investigating, and trending occurrences, events, and near misses at the NOU. This process also aims to ensure that OE information is effectively identified, screened, classified, investigated, distributed, and tracked in order to improve nuclear and conventional safety, health and the environment, and the recurrence of events. Operating experience and all other events are captured on DevonWay.

Currently collaboration exists between the NOU and EDF to share operating experience including the LTO initiatives. The process for screening the OE for applicability and significance is documented in 331-23 and 331-24. The projects that are applicable to Koeberg are presented at Engineering Technical Management Meeting (ETMM), and actions tracked on DevonWay. Knowledge Management is also driven through the Top Ten Priorities as defined by the E3C of the EDF collaboration agreement. As stipulated in Eskom's Nuclear Management policy, 32-83; and all the documents derived from these, the Long Term Strategy does cater for knowledge management.

F8) The introduction of the Knowledge Management (240-146686589) will fulfil the closure of the requirement.

F9) Records are available for all the interviews that have been conducted.

In addition the objective is to have MRG determine what the increased Ageing Management work scope will mean in terms of human resources and training. MRG is required to assess if additional resources will be required due to the introduction of new and updated Ageing Management Programmes.

4. FOLLOW-UP ASSESSMENT BY THE IAEA REVIEW TEAM	**Date:** D3/M3/ YYY3

4.1 – FACTS:

F1) n.a.

4.2 – DOCUMENTS REVIEWED:

n.a.

4.3 – RESOLUTION DEGREE:

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

APPENDIX K
MISSION TEAM MEMBER SUMMARY SHEET

IAEA Team Lead	**Mr. Gabor Petofi** IAEA, NSNI – OSS, Austria (T) [redacted] (C) [redacted] Email: [redacted]	**Eskom Host Plant Peer**	**Mr. Anton Kotze** SALTO Host Counterpart (T) +27 21 550 4745 (C) [redacted] Email: KotzeAM@eskom.co.za
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	IAEA Reviewer	IAEA Observer	Eskom Counterpart
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Redacted information provides personal information.