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The Evolution of Koeberg Nuclear Power Station: *From Inception to Long Term Operation*

Content Overview

The aim of this presentation is to provide the public with an overview of the history of Koeberg Nuclear Power Station (KNPS) and the development and evolution of its Long-Term Operation (LTO) program. The topics discussed include the following:

1	Lifecycle of KNPS: Construction, commissioning, 40-years of safe operation and the future
2	International Atomic Energy Agency's (IAEAs) role in the lifecycle of KNPS
3	What Is Long Term Operation (LTO)
4	Regulatory Landscape
5	LTO Scope and Timelines
6	Safety Aspects Of Long -Term Operation (SALTO)
7	Plant Modifications for LTO
8	Periodic Safety Review (PSR)
9	LTO Safety Case
10	Nuclear Installation Licence: NIL-01 Evolution
11	LTO Status Reporting

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Lifecycle of Koeberg Nuclear Power Station:
Construction, Commissioning, and 40-years of Operation

Koeberg Nuclear Power Station
Construction, Commissioning, and 40-years of Operation

Construction Phase (1976 – 1984)

1976:

- Project initiation and site selection

1980 – 1984:

- Major construction of reactors, turbines, and infrastructure

Location:

- 30 km north of Cape Town, near Melkbosstrand

Reactor Type:

- Two 930 MWe Pressurised Water Reactors (PWRs)

Reactor Design and Supplier:

- French company Framatome (now part of EdF - Electricité de France)

Safety and Oversight:

- Early safety reviews conducted to ensure compliance with international standards.
- Framatome and EdF provided technical expertise and oversight during construction.

Commissioning Phase (1984 - 1985)

1984:

- Koeberg Unit 1 was connected to the grid and began commercial operation in July.

1985:

- Koeberg Unit 2 was connected to the grid and began commercial operation in November.

Safety and Compliance:

- The plant was commissioned under strict safety standards, with oversight from the International Atomic Energy Agency (IAEA) and local regulatory bodies.
- Initial Operational Safety Review Team (OSART) missions were conducted to ensure compliance with good global practices.
- World Association of Nuclear Operators (WANO) peer reviews were initiated to benchmark safety and operational performance.

Operation (1985 – Present)

1985 – 2005:

- 20 years of reliable operation, supplying ~5% of South Africa's electricity.

2005 – 2025:

- Mid-life plant upgrades and safety enhancements.

Safety Reviews and Upgrades:

- Regular OSART and WANO peer reviews ensure continuous safety and performance improvements.
- Periodic Safety Reviews (PSRs) align the plant with evolving international standards.
- Collaboration with EdF and EGS (EdF Group Solutions) provides technical support for upgrades and safety enhancements.
- Numerous safety upgrades and maintenance programs were implemented to ensure compliance.
- Regular inspections and refuelling outages maintain operational integrity.

Life Extension

Long-Term Operation Application:

- Extension to 2044 for Unit 1 and 2045 for Unit 2
- Life extension program includes replacing steam generators and critical components, with safety reviews for compliance
- A safety case documents all evaluations completed and justifies life extension
- A specific PSR is dedicated to life extension
- An ageing management evaluation based on IAEA guidance called Safety Aspects of Long-Term Operation (SALTO) documents international acceptance of potential equipment ageing aspects

Decommissioning:

- Plans for decommissioning are being developed, with a focus on safe dismantling and long-term waste management.

Key Achievements

1984:

- First grid connection.

2024:

- 40 years of operation milestone.

Achievements:

- Supplies ~5% of South Africa's electricity reliably since 1985.
- Outstanding safety record with no major incidents.
- Completed steam generator replacements and mid-life plant safety upgrades.
- Life extension program underway to operate until 2045.
- Zero greenhouse gas emissions, supporting climate goals.
- Developed a highly skilled workforce and supports local communities

Click here: Application to operate the Koeberg nuclear power station (KNPS) beyond the timeframe established in the nuclear installation licence No. NIL-01 (Variation 19)

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IAEA's role in the lifecycle of Koeberg Nuclear Power Station (KNPS)

IAEA's role in the lifecycle of KNPS

What is the IAEA?

- The IAEA is an international organization that promotes the peaceful use of nuclear energy and ensures it is safe, secure, and sustainable
- It was established in 1957 as part of the United Nations and its headquarters is in Vienna, Austria
- South Africa as an international member subscribes to all objectives of the IAEA.
- The IAEA publishes internationally accepted nuclear safety principles, standards and guides

IAEA's involvement in Koeberg's Construction and Operation

- The IAEA guidelines and safety standards influenced Koeberg's design and construction. The French consortium adhered to IAEA safety principles
- The IAEA technical expertise and knowledge have dictated Koeberg's design operations and safety reviews since construction, during initial operation and also for Long Term Operation

Summary of the IAEA's ongoing involvement in Koeberg's operations

Function	Impact on KNPS
Setting and promoting safety standards	Ensures KNPS meets international safety requirements.
Conducts safety reviews (OSART) and peer missions	Provides international peer reviews and recommendations for continuous safety improvement.
Supports periodic safety reviews (PSRs)	Help KNPS assess and enhance its long-term safety performance.
Provide technical cooperation and expertise	Offers training, expertise, and support for upgrades and life extension.
Facilitates international collaboration	Connects KNPS with global best practices through WANO and other organisations.
Supports life extension	Guides KNPS in safely extending its operational life.
Assist in emergency preparedness and response	Assists KNPS in developing and testing emergency response plans.
Support decommissioning and waste management	Provides guidelines for safe decommissioning and long-term waste management.
Promote nuclear security and safeguards	Ensures KNPS complies with safeguards and enhances physical protection.
Knowledge sharing	Enables KNPS to learn from and contribute to global nuclear knowledge.
Fuel oversight	Verifies that all nuclear fuel (new and used) are accounted for by physically monitoring and visually confirming all acquired Eskom fuel remains safe and is accounted for.

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What is Long Term Operation (LTO)

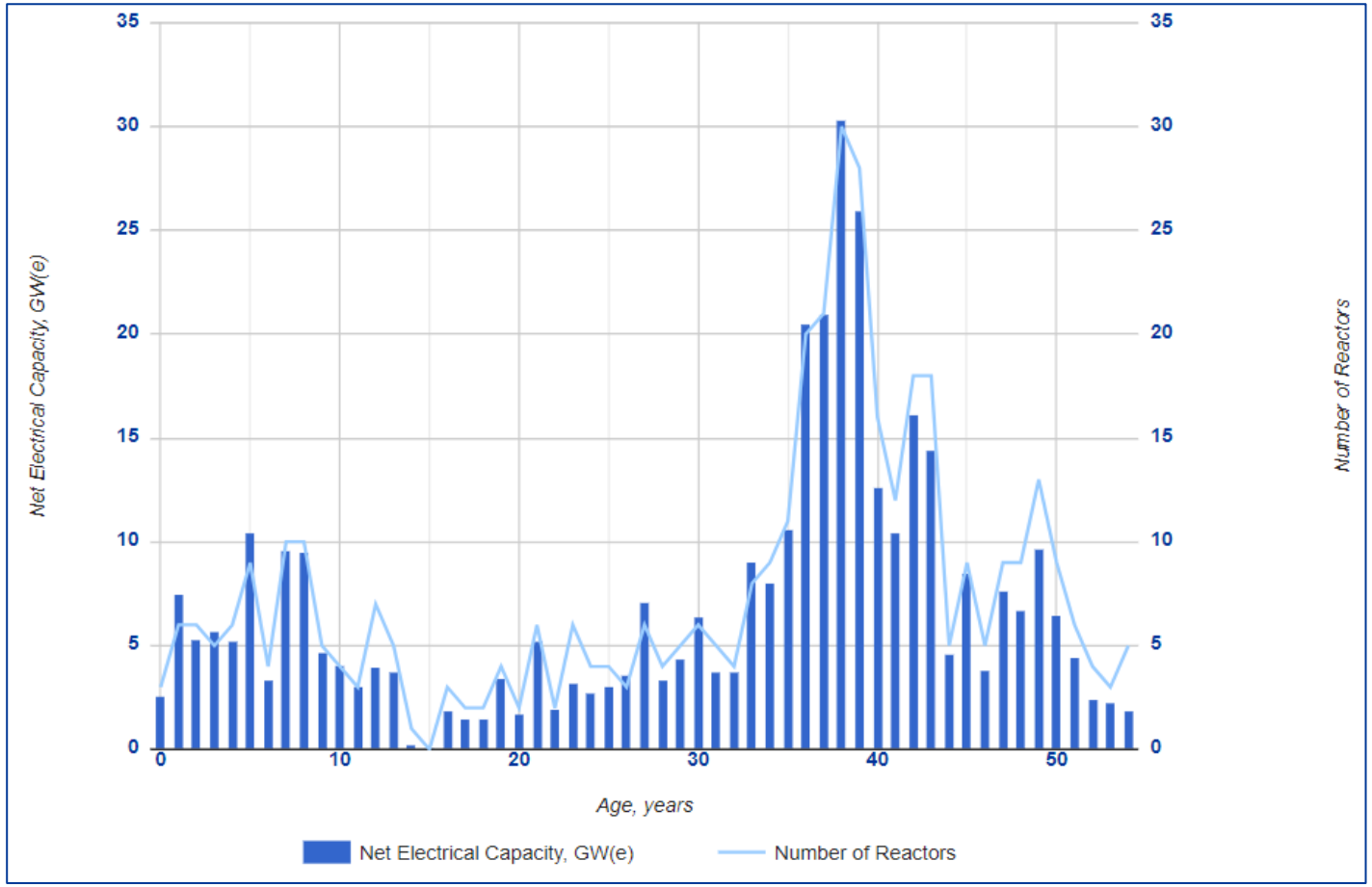
LTO describes the activities required to justify safely extending the Koeberg operational life beyond what was in the original design

Long Term Operation (LTO)

- Term used for extending operation beyond its original operating licence term, typically 40 years.
- It is supported by various Safety Assessments to demonstrate that it is safe to do so.
- Involves public participation.
- Requires regulatory approval.
- There are 190 nuclear reactor units that have been in operation for 40 years or more and also extended the operational life.

Unit 1 Commences Commercial Operation (July 1984)	40-year Commercial Operation Lifespan (21 July 2024)	Life Extension – LTO (Operation until 21 July 2044)
Unit 2 Commences Commercial Operation (November 1985)	40-year Commercial Operation Lifespan (9 November 2025)	Life Extension – LTO (Operation until 9 November 2045)

Age distribution of reactor units globally



What is LTO

- The original assumed life of Koeberg was 40 years of operation
- In 2019 the National Nuclear Regulator changed the Koeberg Licence to be valid for the operation of the Koeberg Nuclear Power Station until 21 July 2024 unless, amended for subsequent licensing stages including long term operation; or varied, suspended or revoked.
- This date is 40 years after the date that Unit 1 entered commercial operation. (Unit 2 entered commercial operation on 9 November 1985, and the Unit 2 Licence is linked to this date, i.e., 9 November 2025).
- The onus is on Eskom to demonstrate to the Regulator that all aspects have been justified to allow the safe extension of the operating license for the period of Long-Term Operation requested through a formal Licence change application.

LTO - Koeberg technical life of plant overview

60 Year Life expectation

Original assumptions (40 years)

Business as Usual: Operation, Refuelling, Service/Maintenance, Ongoing Design Improvements.

LTO Period (20 years)

Future Work as part of normal plant operation

1984 — 2024 — 2025 — 2045

NNR approval

Activities required for LTO

- Understand and map out the approach/requirements for Nuclear License extension,
- Review all aging mechanisms and ensure they are acceptable for the period of Long Term Operation,
- Review Nuclear Safety against local and international regulatory requirements and identify any gaps,
- Identify the projects and activities that are needed to support the licence application

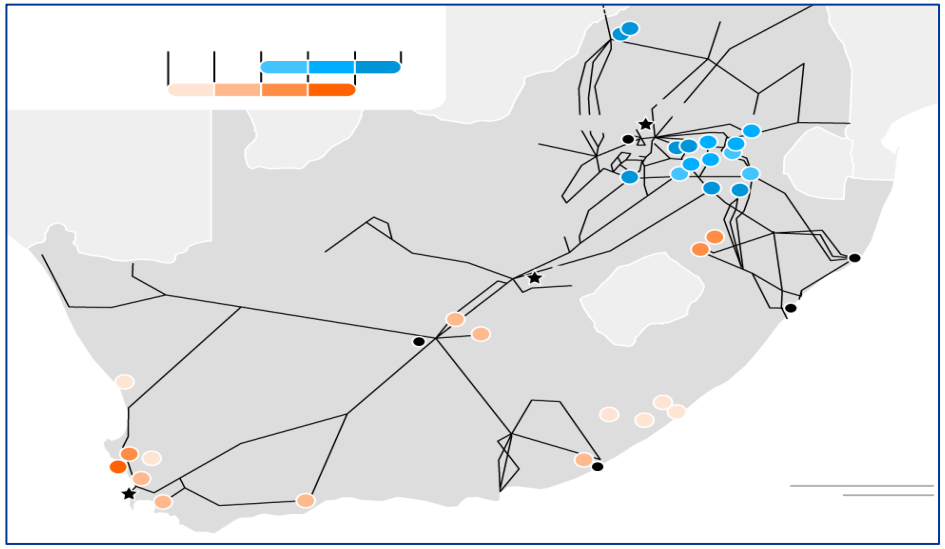
Complete the required Projects and Activities needed to enter LTO during outages x26 and x27 (2024 and 2025).

Compulsory activities after 2024/license extension based on LTO studies:

- *Updated service/maintenance plans*
- *Updated Inspection schedule,*
- *Additional safety monitoring requirements*
- *Continued plant enhancements*

Why LTO? Koeberg is an essential and the only baseload power supply in the Western Cape

- KNPS is the only base load power plant within the Western Cape, ensuring a reliable supply of electricity to the grid.
- The Western Cape grid connects to the Mpumalanga Generation pool via 400 kV and 765 kV transmission lines which is more than 1000 km away.
- If KNPS is not in service, there would be large active and reactive power losses, these losses occur when transporting power over long distances.
- KNPS is categorised as base load and the inertia of its large turbine and generators contributes to frequency stabilisation of the Southern African Power Pool.
- Koeberg helps South Africa reduce its reliance on coal-fired power plants, which are major contributors to greenhouse gas emissions and air pollution.

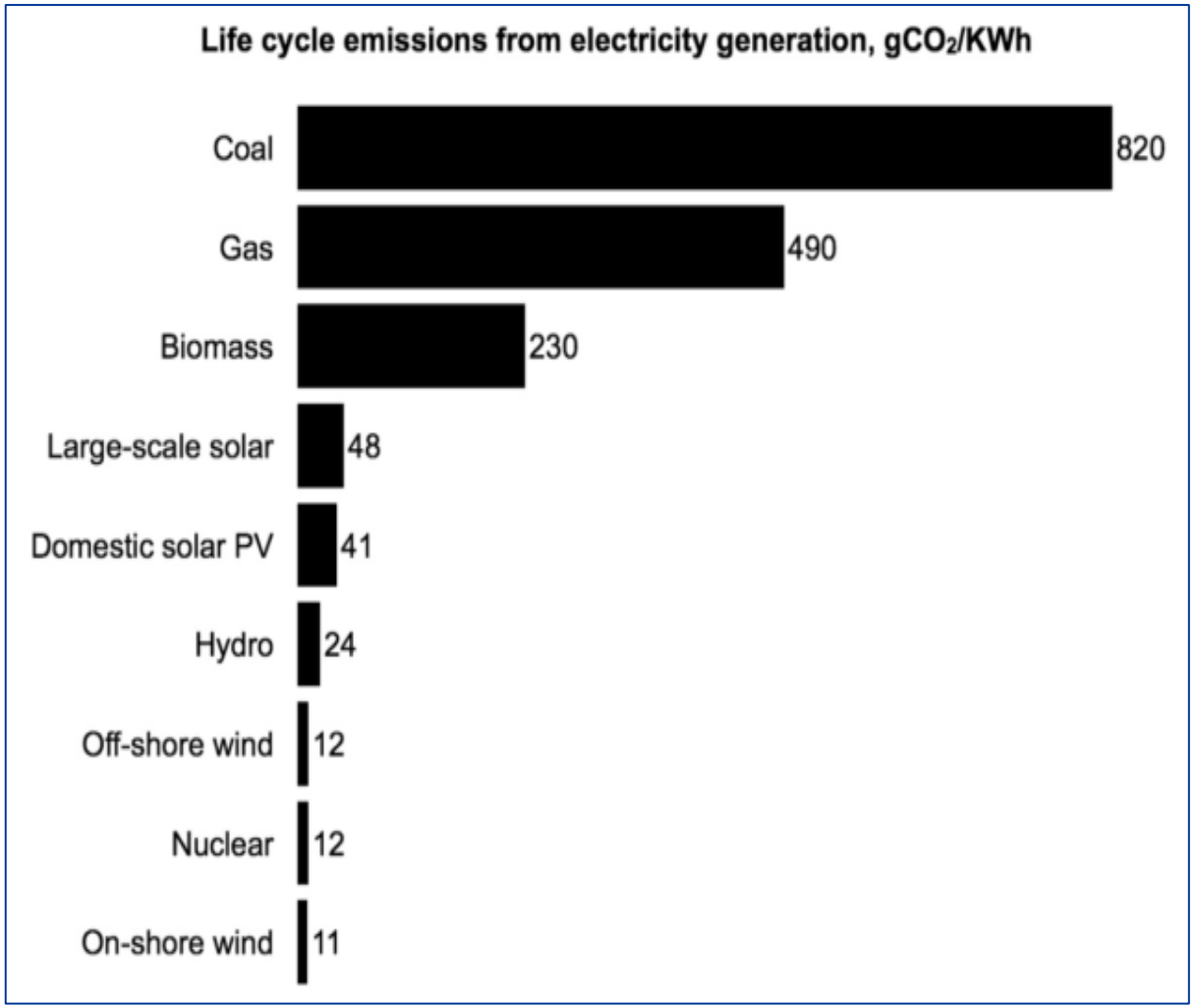


Koeberg LTO is a cost-effective option for Eskom and South Africa

- The cost of a nuclear plant LTO project is significantly cheaper than adding new onshore wind or solar photovoltaics with battery backup (baseload) according to the International Energy Agency.
- Should Koeberg LTO not continue, the plant will have to be decommissioned. This comes at a massive cost. LTO would result in the deferment of these costs by another 20 years.
- LTO will not result in a significant increase in decommissioning costs.
- Koeberg is the lowest cost and most reliable base-load plant in Eskom.

Koeberg LTO is environmentally friendly.

- Nuclear remains one of the lowest carbon-emission sources of energy and LTO will contribute to South Africa's commitment to zero carbon by 2050 in terms of the Paris Agreement.
- Nuclear plants are among the cleanest sources of energy at 12 gCO2/kWh since nuclear plants have no direct emissions.
- Water usage is a critical issue in South Africa. To ensure low water usage, the steam cycle at KNPS is cooled by sea water and not freshwater, so the freshwater usage is low.



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LTO Regulatory Landscape

LTO Regulations

LTO Regulatory Framework

R.266 LTO Regulation

- Establishes the requirements for LTO

RG-0027 (Long-Term Operation of Nuclear Power Plants):

- Provides guidelines for demonstrating the safety of nuclear plants during extended operation.
- Focuses on ageing management, safety margins, and ensuring continued compliance with safety standards.

RG-0028 (Periodic Safety Review):

- Requires a comprehensive safety review every 10 years.
- Ensures all safety aspects (e.g., design, operation, and ageing) are reassessed and updated to align with IAEA SSG-25.

Licensing Process for Nuclear Installations

- Outlines the steps for licensing, including LTO.
- Includes submission of safety cases, regulatory reviews, and public consultation

NNR Regulations for Koeberg Nuclear Power Station

- NNR Act No 47 of 1999
- Koeberg Nuclear Installation License: NIL-01
- Regulatory Licence Documents
  - ✓ **LD-1012:** *Requirements in Respect of Proposed Modifications to KNPS*
  - ✓ **LD-1020:** *Radiation Dose Limitation of KNPS*
  - ✓ **LD-1023:** *Quality Management Requirements for KNPS*
- Regulatory Documents:
  - ✓ **RD-0014:** *Emergency Preparedness and Response Requirements for Nuclear Installations*
  - ✓ **RD-0022:** *Dose Limitations for KNPS*
  - ✓ **RD-0024:** *Requirements on Risk Assessment and Compliance with Principle Safety Criteria for Nuclear Installations*
  - ✓ **RD-0034:** *Quality and Safety Management Requirements for Nuclear Installations*
- Regulatory Guides:
  - ✓ **RG-0007:** *Management of Safety*
  - ✓ **RG-0011:** *Interim Guidance for Siting of Nuclear Facilities*
  - ✓ **RG-0019:** *Interim Guidance on Safety Assessments of Nuclear Facilities*
  - ✓ ***RG-0027:*** *Ageing Management and Long-Term Operations of Nuclear Power Plants*
  - ✓ ***RG-0028:*** *Periodic Safety Review of Nuclear Power Plants*
- Several Position Papers and Guides, e.g. *No. R388, No. 716, etc.*

For more information refer to *https://nnr.co.za/about/acts-and-regulations/*

LTO Safety Case and Approval Process

Safety Case Compilation:

- Demonstrates the plant's safety for extended operation.
- Includes ageing management, safety improvements, and compliance with RG-0027 and RG-0028.

Regulatory Submission and Review:

- Safety case and PSR outcomes submitted to the NNR.
- NNR evaluates compliance with RG-0027, RG-0028.

Public Consultation:

- Public Information Document (PID) submitted and published as part of PP-0014 requirements.

Approval:

- NNR grants LTO licence if all safety, regulatory, and public consultation requirements are met.

Click here: - Koeberg Nuclear Installation License: NIL-01 Variation 21)
- Briefing Note on Koeberg Unit 2 Long-Term Operation: Licensing Update and Public Engagement

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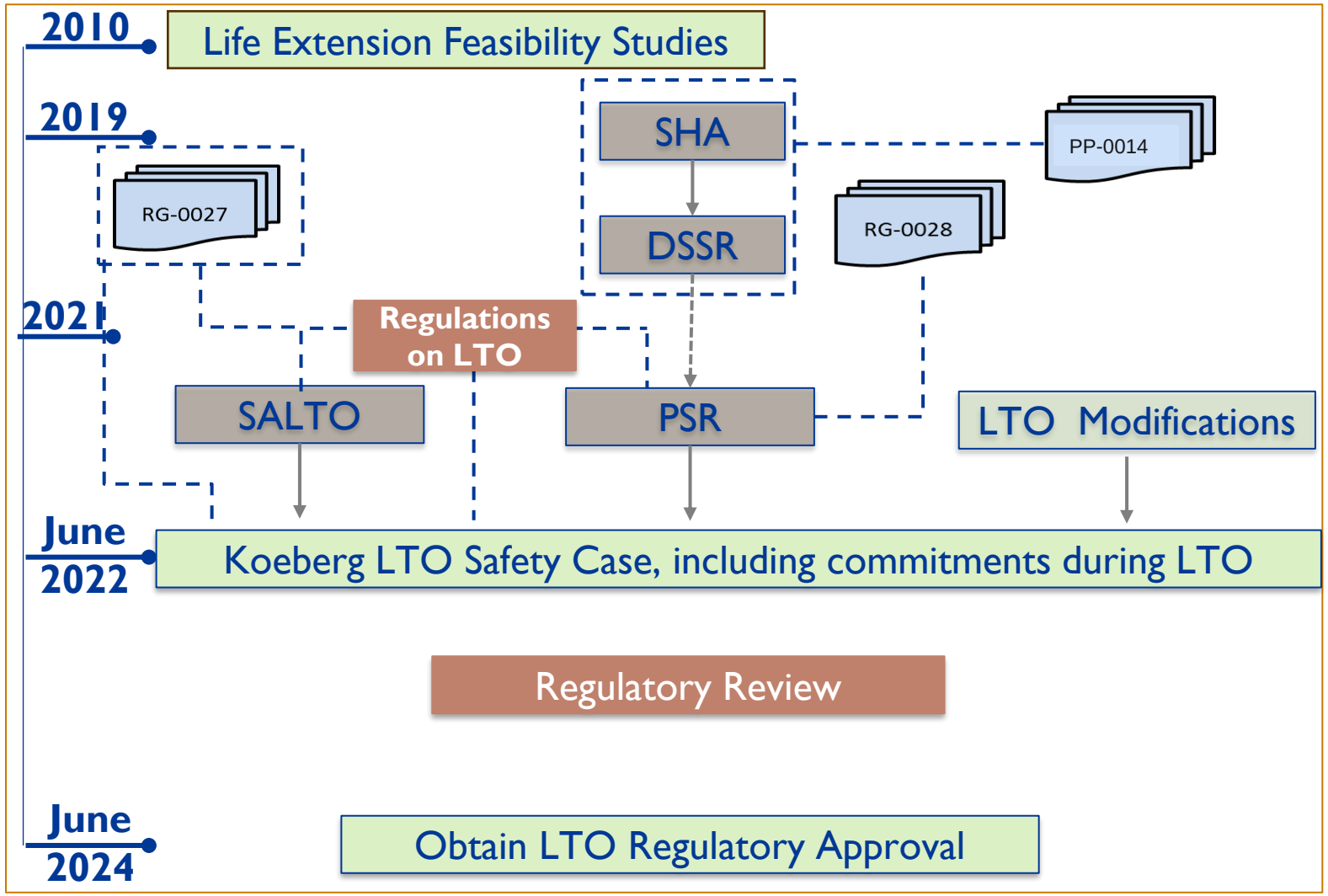
LTO Scope And Timelines

Activities for the LTO Safety Case



Legend

SHA – *Seismic Hazard Analysis Studies*

DSSR – *Duynefontyn Site Safety Report*

SALTO – *IAEA Safety Aspects for Long Term Operation*

PSR – *Periodic Safety Review*

LTO Mods – *Plant Modifications needed for LTO*

RG-0027: *Ageing management and long-term operations of NPPs*

RG-0028: *Periodic safety review of NPPs*

PP-0014: *Considerations for external events for nuclear installations*

RG – *NNR Regulatory Guide* ***PP -*** *Position Paper*

Koeberg's Long Term Operation

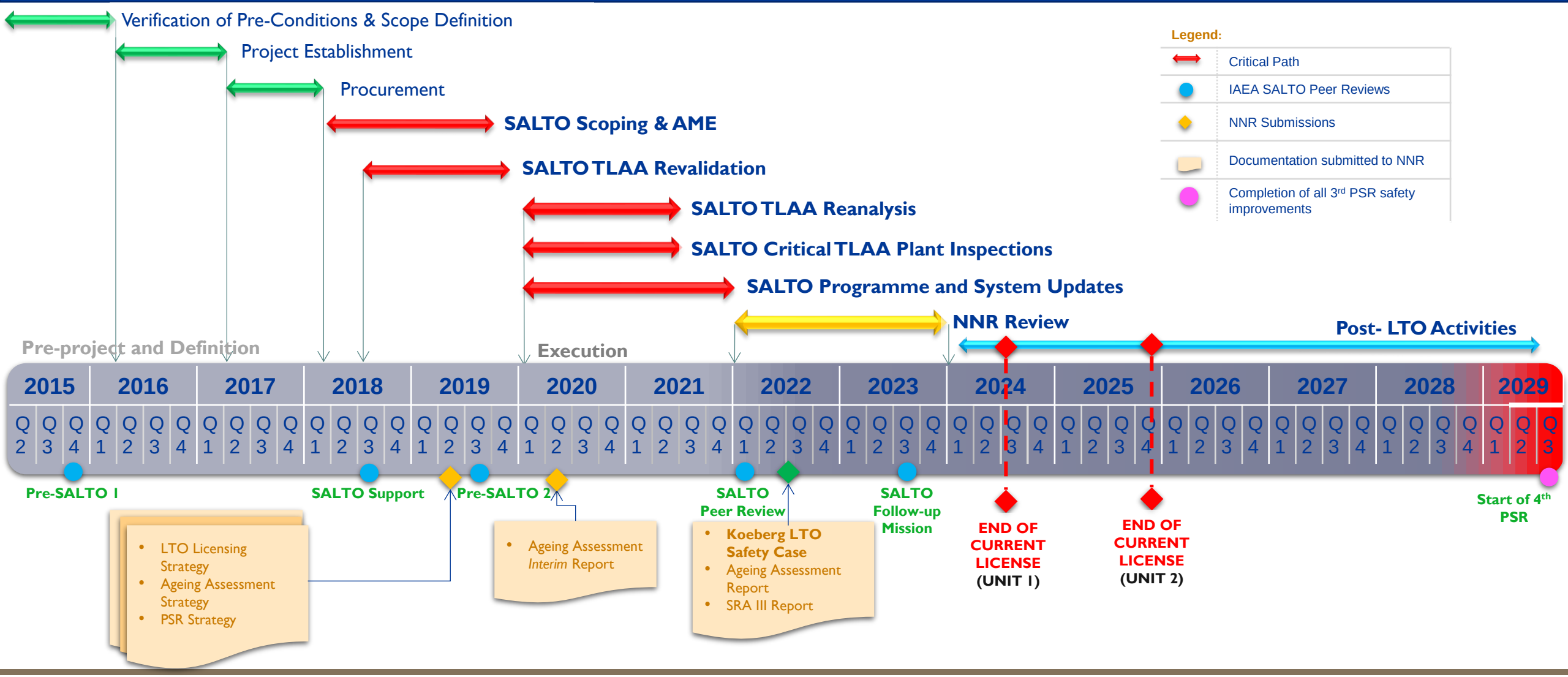
Timeline and history

- Life extension feasibility studies started in 2007 (based on IAEA-TECDOC-1503 and 1309) considering plant technical assessment, licensing issues and economic aspects.
- In **2010** Eskom Board approval of strategy and Eskom informed NNR of the planned Long Term Operation Approach.
- This gave the green light to the Steam Generator Replacement project (the replacement was seen as a prerequisite for LTO).
- In **2012** the SG replacement project contract was stopped due to legal challenges, and the process restarted. A new contract was signed in 2014 with installation planned for 2018. The implementation was moved to 2021 due to manufacturing defects and Eskom's focus on quality and nuclear safety. In 2022 the implementation was deferred to 2023 due to the lack of an agreed implementation plan and to protect the Koeberg return to service date.
- In absence of regulations, Eskom proposed a Licensing Framework for Long Term Operation (LTO) to the Nuclear Regulator in 2015.
- In **2015**, Eskom requested the IAEA assistance in implementing the IAEA-SALTO approach. (Safety Assessment for Long Term Operation) and the first IAEA assist mission was held.
- In **2019** the NNR issued variation 19 to the Koeberg Nuclear Installation License, introducing an end date by which operations must end, unless varied (June 2024).
- In **2019** the NNR published documents *RG-0027: Ageing Management and Long-Term Operations of Nuclear Power Plants and RG-0028: Periodic Safety Review of Nuclear Power Plants*, to specify nuclear regulatory requirements for extending Koeberg operational life.
- Eskom's LTO project plan and scope incorporated the above requirements.
- All evaluations and required activities completed and documented in the LTO safety case and submitted to the NNR June 2022
- NIL01 variation 21 was issued in July 2024 stipulating unit 1 LTO operation to July 2044

Click here:
- Safety Case for Long-Term Operation of Koeberg Nuclear Power Station (331-618, Revision 3)
- Evolution of the LTO safety case (331-618, Revisions 1a to 3)
- Informative References
- Normative References

Koeberg's Long Term Operation

Timeline and history (cont.)



LTO Scope (1/2)

Submission	Purpose
Safety aspects of Long-term operation (SALTO)	▪ The objective of SALTO is to assess Koeberg's ageing management processes. The results are used to identify improvements and to demonstrate that Koeberg processes are suited for LTO, ▪ The process involves identifying systems, structures and components (SSC's) that are important to plant and nuclear safety. The design life and limits of these components are evaluated through a rigorous safety analysis and confirmed to be qualified for 60 years of operation. ▪ All potential degradation of all safety related equipment are evaluated and checked for adequate management of ageing (based on internationally agreed phenomena). Improvements of maintenance strategies, monitoring programmes and testing regimes are identified and actioned in a graded manner. ▪ The entire effort has been reviewed by teams of international peers under leadership of the IAEA.
Periodic Safety Review (PSR)	▪ Provides assurance that the **plant status is acceptable against current safety requirements** (national and international). ▪ Provides assurance that the **plant is safe to continue operating until the next Periodic Safety review** (10 yr. intervals), and identifies and grades all identified deviations that are actioned with corrective actions.

Click here: SALTO Ageing Management Assessment Report (Final) 331-681, Revision 1

LTO Scope (2/2)

Activity	Purpose
Plant modifications	▪ The modifications required prior to LTO included replacement of the steam generators, unit 2 reactor vessel head and CRDM and the refuelling storage (PTR) tanks. ▪ Modifications that will improve safety have been identified and committed during LTO and include severe external event modifications and qualified equipment with limited life e.g., pressuriser heater replacement.
Duynefontyn Site Safety Report (DSSR)	▪ Assesses the magnitude & occurrence probability of external events and hazards, ▪ Assesses site security, public exposure risks & physical characteristics that could pose a significant impediment to the development and execution of emergency preparedness and response actions.
Nuclear Security review	▪ Conduct an overall security risk assessment. Assess Koeberg security provisions (physical and cyber) to confirm compliance with national regulations, and conformance to international nuclear security standards,
Public Information Document (PID)	▪ The purpose of the Public Information Document (PID) is to provide members of the public with sufficient information on safety, health and environmental aspects relating to the Eskom application for LTO.

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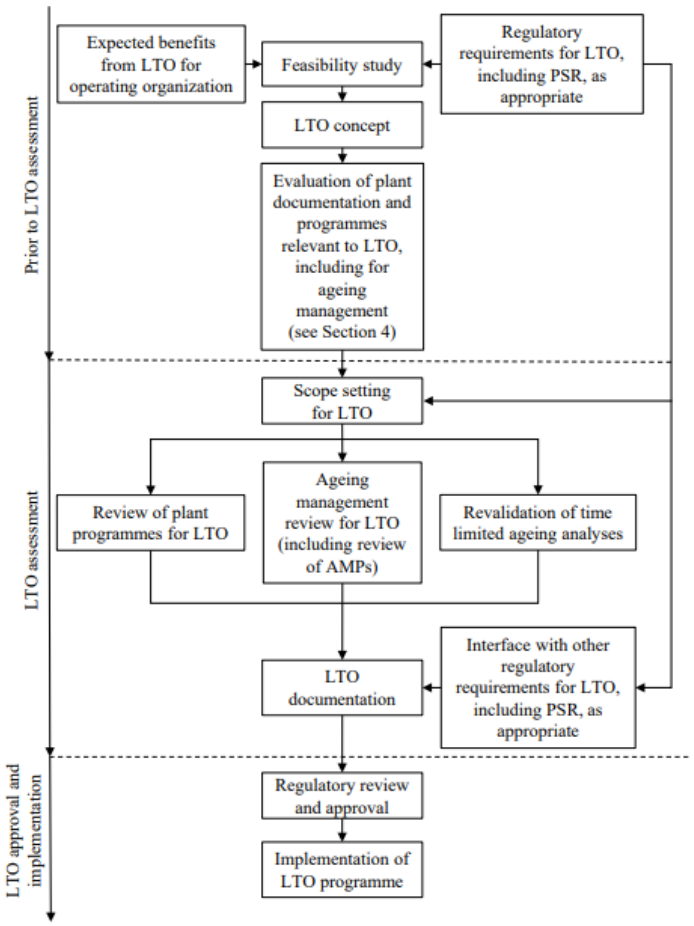
Safety Aspects Of Long Term Operation (SALTO)

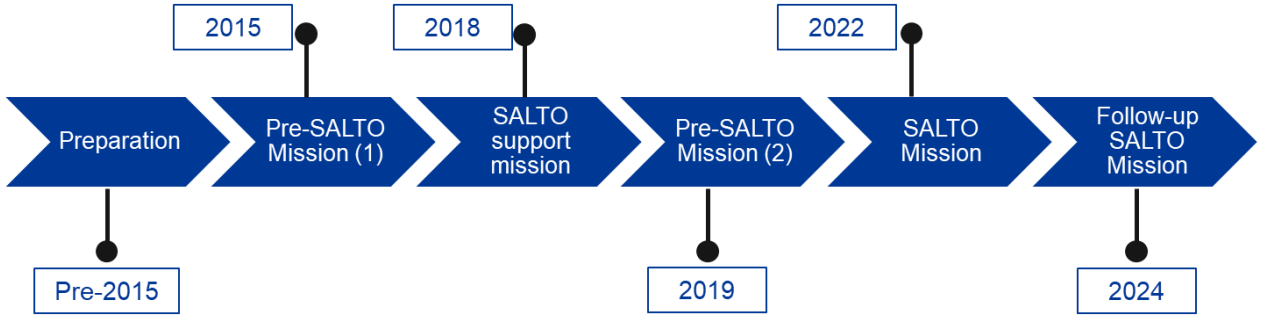
SALTO Process - overview



Note: AMP — ageing management programme; LTO — long term operation; PSR — periodic safety review.

FIG. 8. Major steps in a programme for long term operation.

- The IAEA framework was used for assessing nuclear preparedness for Long-Term Operation (LTO) in line with IAEA SSG-48: *Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants* and involves a systematic review of safety, technical, and organizational aspects to ensure the plant's capability to operate safely and efficiently beyond its original design life. Later compliance with RG 0027 was incorporated.
- The focus was on evaluating systems, structures and components (SSCs) whose failure could impact nuclear safety through rigorous monitoring, maintenance, and mitigation strategies to ensure continued safe and reliable operation.



SALTO – IAEA SSG 48 and NNR RG 0027

The SALTO process involves the following major steps:

- **Scoping** – to establish all equipment that is safety related and the environments they are exposed to. Eskom identified more than 84,000 (more than the average of 50,000 at other utilities) items that were considered important to safety.
- **Ageing management evaluation** – to review all items for potential degradation. The review was carried out and used the IAEA SRS 82 (International Generic Ageing Lessons Learnt (IGALL)) to identify all potential degradation phenomena. The potential degradation effects were then checked to verify if the Eskom management methods are sufficient to manage the potential degradation and ensure the plant equipment provides the required intent. The institutional programmes, such as maintenance, monitoring, testing, and refurbishments, were confirmed. Improvements and additional activities were identified and actioned.
- **TLAA revalidation** – to review and confirm all limits as used in the original design, to support the LTO period. Eskom identified 111 TLAAs for Koeberg. The steam generator replacement project reviewed and updated 100 TLAAs due to a larger steam generator being installed in the primary circuit. The other TLAAs were reviewed and either validated for LTO or actioned for further evaluation and justification. All updated and justified TLAAs have been documented in the Koeberg Safety Analysis Report.
- **The IAEA SALTO peer review** – During the preparation, development, and execution of the SALTO ageing assessment project, the IAEA performed reviews. These peer reviews involved IAEA leaders and international ageing management specialists. The pre-SALTO peer reviews were completed in 2015 and 2019, the final SALTO in 2022, and a follow-up SALTO in 2024.

Click here: SALTO and SALTO Follow-Up Mission to Koeberg Nuclear Power Plants Units 1 and 2

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Plant Modifications for LTO

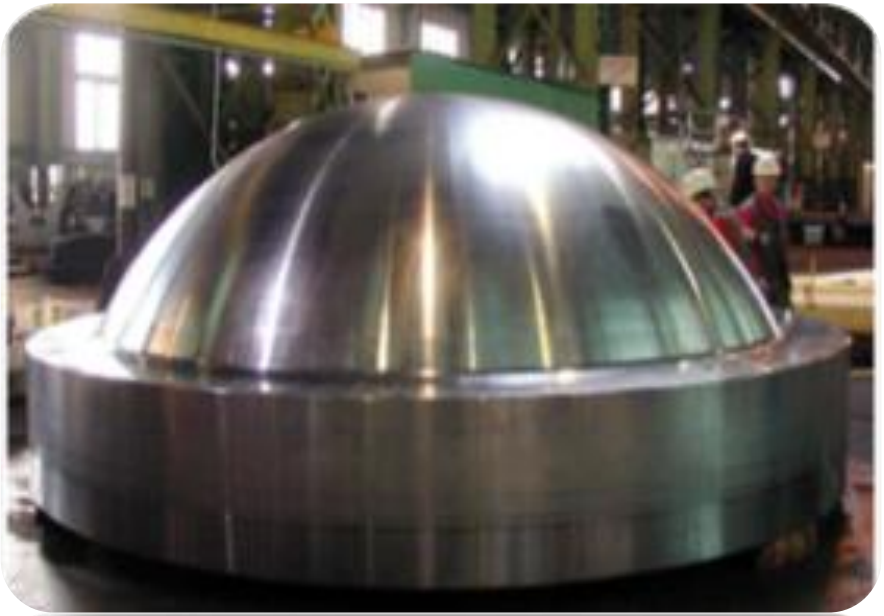
Plant Modifications for LTO

- Aligned to many other nuclear utilities, Koeberg has since commissioning been upgraded and modified to respond to international safety improvements, concerns, obsolescence, efficiency improvements and lessons learnt.
- The Eskom plant life extension initiative started in 2007, with formal approval of the strategy in 2010. The need to replace steam generators, due to stress corrosion cracking, was so well managed that Koeberg operated the steam generators longer than any other utility. It was however clear that LTO could not be achieved without steam generator replacement (SGR). Before sanctioning SGR, it was required to identify what other significant changes would be required for LTO.
- The hardware changes identified for LTO were identified and completed. These were SGR, unit 2 reactor vessel head and refueling water storage tank replacements (To accommodate the new larger steam generators some non-nuclear, secondary system changes were also required).
- In line with the Long Term Asset Management strategy, Koeberg has already replaced Turbines and Generator Transformers to facilitate plant life extension.
- A number of plant safety improvements have been identified to be implemented during LTO. These include some post-Fukushima improvements, impressed current cathodic protection of containment and replacement of equipment with limited guaranteed life (e.g. pressuriser heaters and containment electrical penetrations)
- When benchmarked against comparable utilities, no other prohibitive technical challenges have been identified that preclude Koeberg life extension up to 60 years.

Plant Modifications Required for LTO

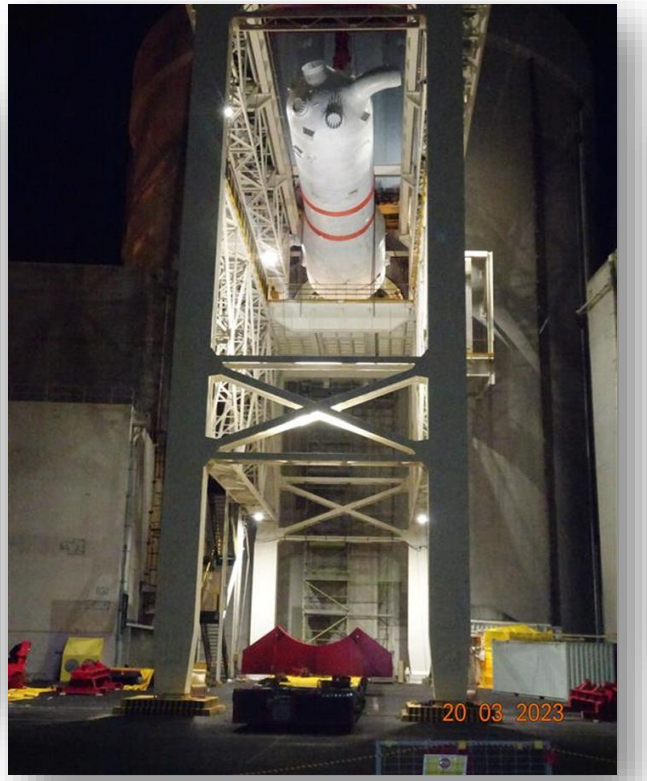
Refuelling Water Storage Tanks have been replaced in new material

The Unit 2 Reactor Pressure vessel head and control rod drive mechanisms have been replaced with improved material



Plant Modifications Required for LTO

SGR - Offloading and storage of the old steam generators



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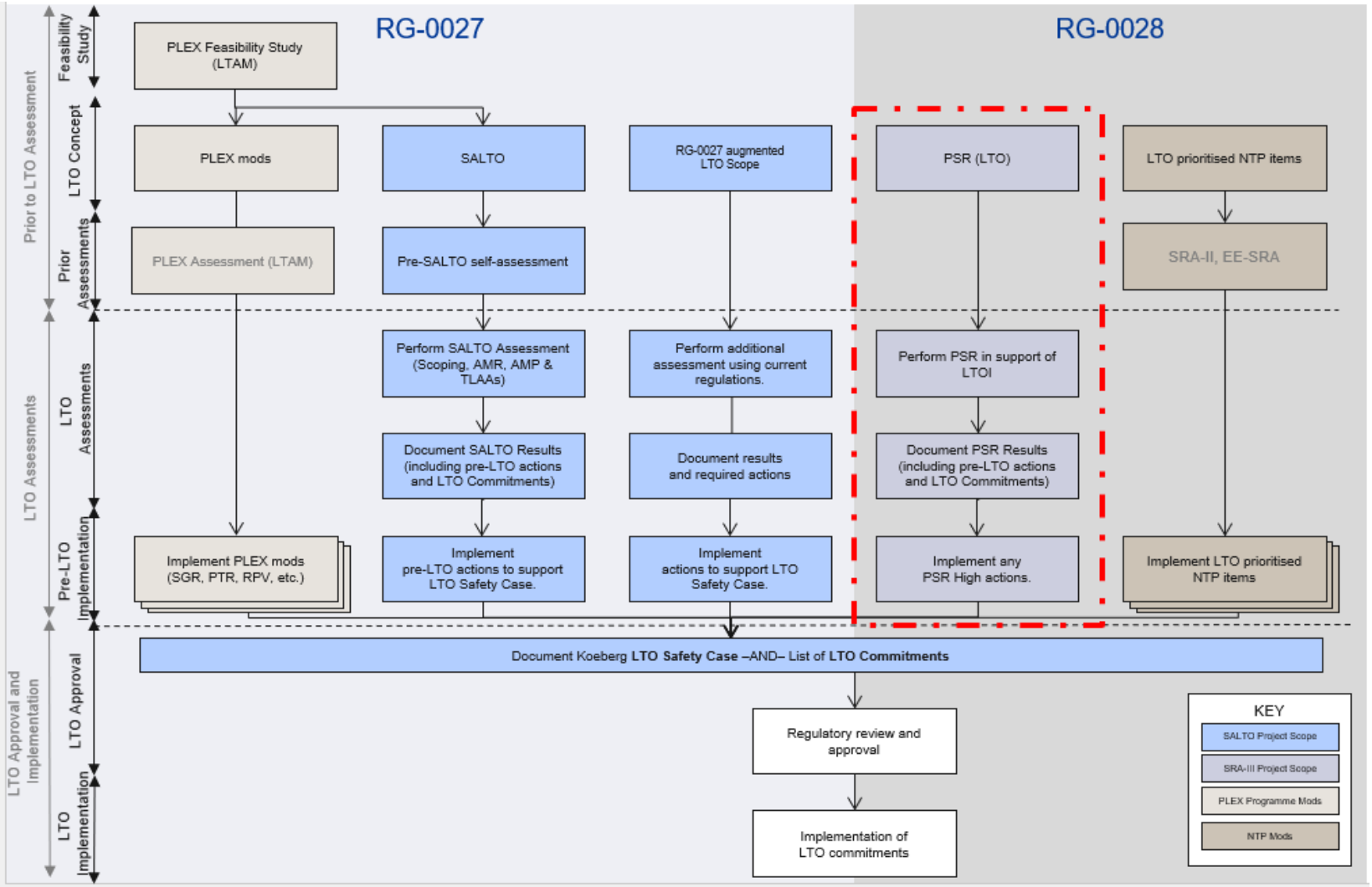
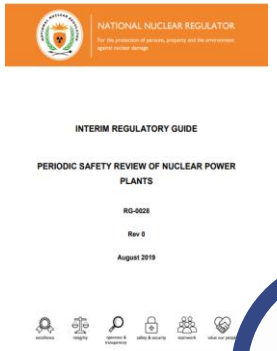
Periodic Safety Review (PSR)

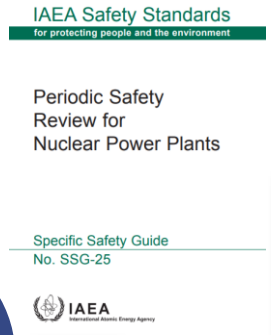
PSR – LTO context



PSR methodology and scope followed the NNR Guide RG-0028 (2019)

Periodic Safety Review (PSR)





Background

- KNPS conducted the 3rd PSR (2019–2021) to meet 10-year regulatory requirements.
- **Aim:** Ensure high safety levels and support Koeberg's application to extend its operating life by 20 years.
- PSR methodology and scope followed National Regulatory Guide RG-0028 (2019), aligned with IAEA SSG-25.

Scope

- The PSR scope reviewed 14 safety factors covering all key nuclear safety aspects for continued operations, including the 20-year LTO period.
- Each factor assessed for gaps (deviations) or strengths (positive findings).
- Global assessment: Evaluated safety outcomes, cumulative deviations, and impact of strengths.
- Safety improvements included in an Integrated Implementation Plan (IIP).
- IIP ensures all improvements are addressed before KNPS fourth PSR begins.

Subject area	Safety factor	
Plant	SF-1	Plant design
	SF-2	Actual condition of SSCs
	SF-3	Equipment qualification
	SF-4	Ageing
Safety analysis	SF-5	Deterministic safety analysis
	SF-6	Probabilistic safety assessment
	SF-7	Hazard analysis
Performance and OE feedback	SF-8	Safety performance
	SF-9	Use of experience from other plant and research findings
Management	SF-10	Organisation, the management systems, and safety culture
	SF-11	Procedures
	SF-12	Human factors
	SF-13	Emergency planning
Environment	SF-14	Radiological impact on the environment

PSR Summary

- The PSR methodology and review reports were reviewed and verified by an IAEA Technical Support Review team, which identified good alignment with the IAEA safety standards.
- **Systematic and rigorous analyses were conducted, including:**
  - 14 Safety factor reviews
  - Global assessment review, and
  - Detailed technical and process reviews.
- **Outcome of the third KNPS PSR:**
  - The continued safe operation of KNPS, including LTO, is supported.
  - Safety improvements identified in the PSR IIP.

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LTO Safety Case

Koeberg LTO safety case demonstrates that it is safe to extend the operating life

LTO Safety Case

- Considers the impact of LTO on health, safety, and the environment.
- Provides documented evidence and arguments that demonstrate that there is no undue risk to safety, health, or the environment.
- Demonstrates that regulatory requirements are met.
- Draws on safety assessments, most notably SALTO, PSR, security, and emergency plan.
- Documents all completed evaluations, justifications, and commitments for ongoing safety improvements during LTO.
- Contents:
  - LTO Requirements Framework
  - Scope of LTO assessments
  - Description of LTO activities
  - LTO safety case methodology
  - Justification for safe LTO
  - Why it is Safe to Continue Operation (Overall Assessment for an Additional 20 Years)
  - Safety Analysis Report
  - Adopted Long-Term Operation Programme
  - Long-Term Operation-Related Documents
  - Long-Term Operation Integrated Implementation Plan
  - Conclusions

Koeberg LTO safety case demonstrates that it is safe to extend the operating life (cont.)

LTO Safety Case

Conclusions

Eskom has conducted comprehensive assessments and studies to assure the Regulator of Eskom's commitment to meeting the national LTO requirements, the national safety criteria, national and international safety standards and codes, for the period of LTO. The safety case provides documented arguments and evidence of Koeberg's suitability for LTO. Elements of the safety case, as argued in this document, include:

- robustness of the plant design for the intended period of operations;
- effectiveness of the ageing management of SSCs important to safety;
- implementation of ageing management programmes;
- implementation of the Defence in Depth in the design and operation of the nuclear installation;
- adequacy of emergency planning, radiation protection, and waste management programmes;
- provisions to ensure continued compliance with occupational, public, and environmental safety requirements;
- adequacy of organisational arrangements for safe LTO, including knowledge management, human, and financial resource arrangements, with an emphasis on ageing management; and
- adequate use of OE for continuous improvement.

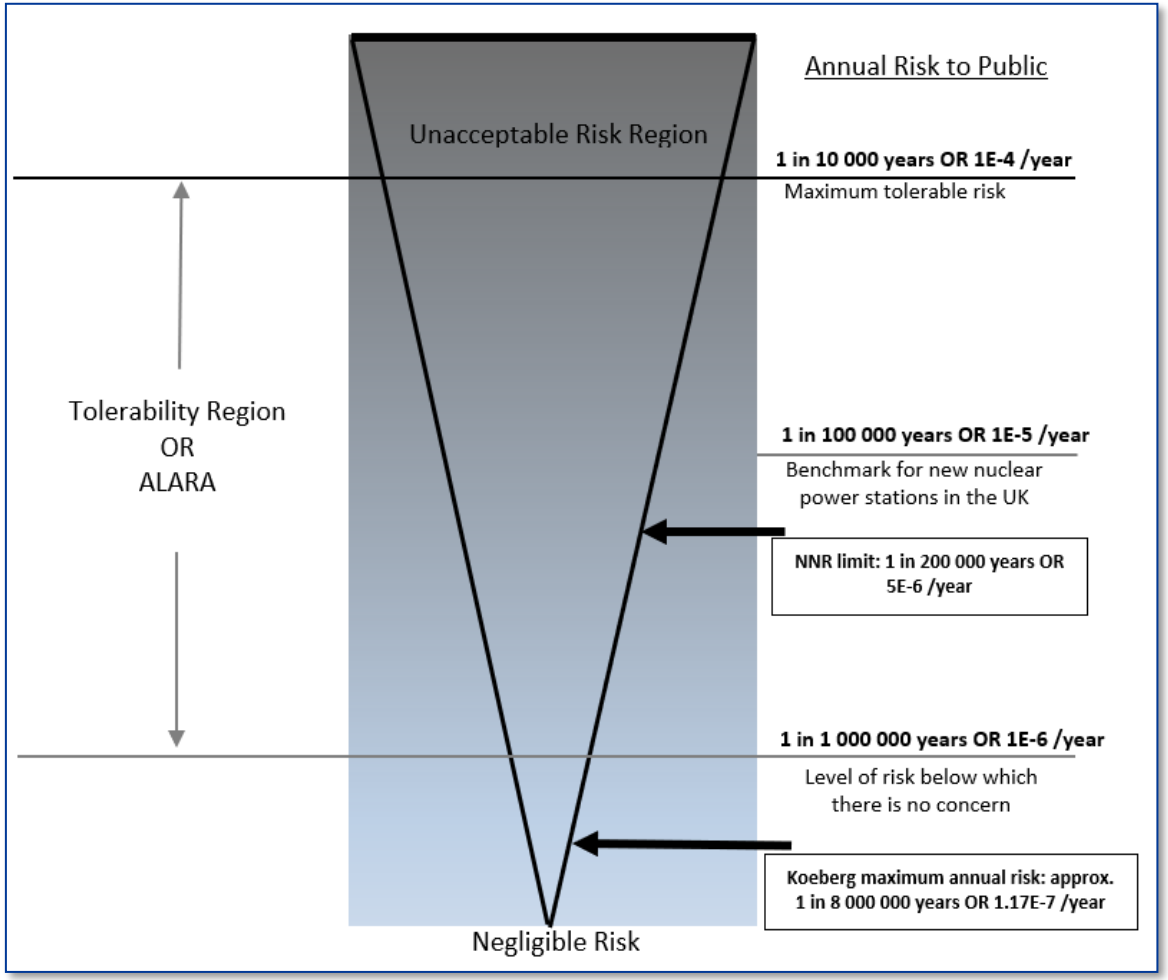
Click here:
- Safety Case for Long-Term Operation of Koeberg Nuclear Power Station (331-618, Revision 3)
- Evolution of the LTO safety case (331-618, Revisions 1a to 3)
- Informative References
- Normative References

The Risk Limits set in the Regulation for Safety Standards and Radiation Practices (R388) are met.

Safety – quantifiable risk limits

- Nuclear Power Operations should not significantly increase risk to life and health of individuals.
- Principal safety criteria have been set (risk limits) in R388.
- NNR, RD-0024 provide requirements to comply with the principal safety criteria.
- Eskom has a Regulatory approved method of determining the risk – aligned to international standards.
- Peak Public risk < 3% of the principal safety criteria.
- Peak Risk to workers < 20% of the principal safety criteria.
- Risk has reduced over time through implementation of safety improvements and modifications.

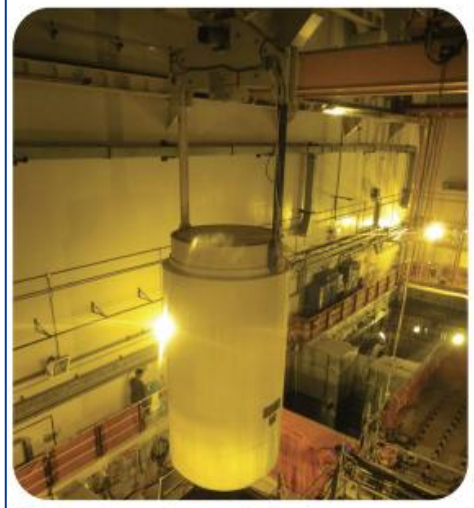
As Low as reasonably achievable (ALARA) - Risk



Major investments to improve the safety and reliability of Koeberg

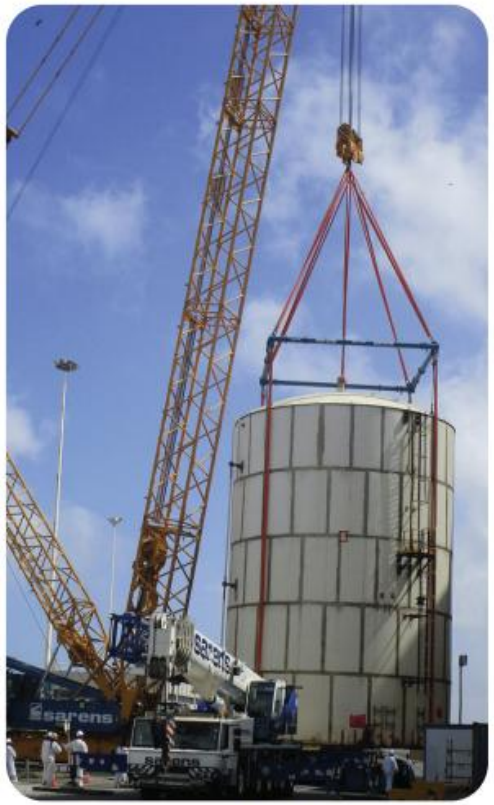
Some major activities for LTO

- Steam generator replacements.
- Replacement of refuelling water storage tanks.
- Replacement of the reactor vessel heads.
- Concrete repairs of the reactor building.
- Upgrade of obsolete analogue monitoring and control systems.
- Implementation of additional ageing management programmes.
- Inspection and testing of equipment important to safety (e.g., containment building integrated leak rate test).
- Updated assessment of all aspects of Koeberg site characteristics (seismic, tsunami, tornadoes, etc.).
- Transient interim storage facility for used nuclear fuel.



Loading of spent fuel casks.

The storage facility housing the replacement steam generators.



Reactor Cavity and Spent Fuel Pool Cooling System tank.

Arrival of the Reactor Pressure Vessel Head and Control Rod Drive Mechanisms at Koeberg.

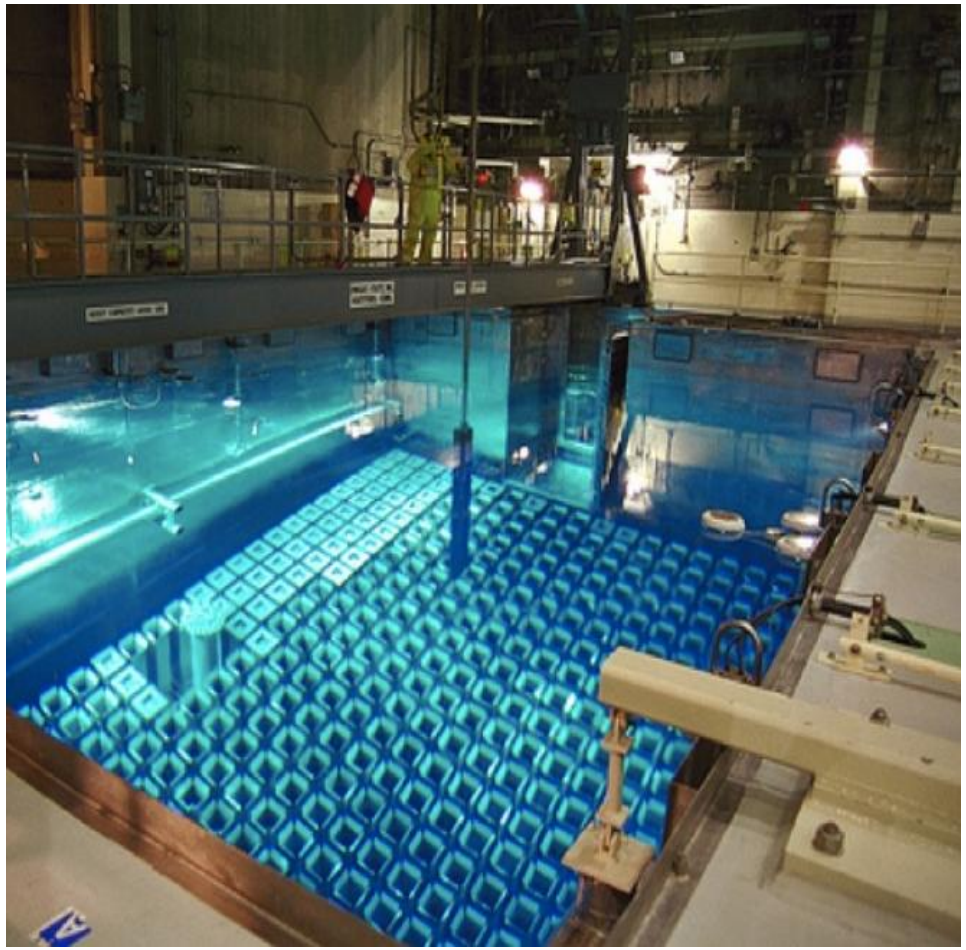
The arrival of one of the six replacement steam generators.

Sufficient safe storage for used nuclear fuel

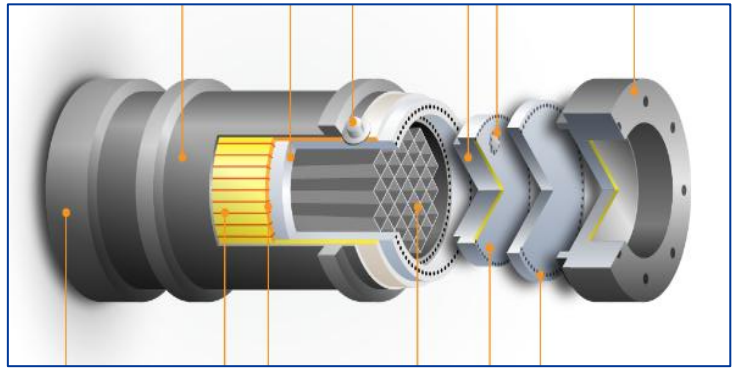
High-level waste strategy

- Spent fuel is stored in spent fuel pools on-site and dry storage casks.
- Provision for additional fuel storage casks.
- Spent fuel pools and dry storage casks are a safe and reliable means to store used fuel.
- Approach is widely used and aligned with international practices.
- A centralised interim storage facility is being developed by the National Radioactive Waste Disposal Institute and will provide the next phase of storage.

Spent Fuel Pool



Dry cask for Nuclear Fuel storage



Sufficient safe storage for radioactive waste exist

Low and Intermediate level radioactive waste (LILW)

- Low and intermediate level waste is packaged in concrete or steel waste drums.
- Packages comply with stringent acceptance criteria to ensure waste is properly contained and safely stored.
- Waste is disposed of at Vaalputs national waste disposal facility in a carefully selected site in the Northern Cape.
- The facility is managed by the National Radioactive Waste Disposal Institute (NRWDI).
- Approximately 1% of available space has been used so far.

Radioactive waste in steel drums stored at Vaalputs national waste disposal facility

Radioactive waste in concrete waste drums stored at Vaalputs national waste disposal facility

LTO safety case
Overview

- **40 Years of Safe Operation:** Koeberg has provided clean, reliable power for over 40 years.
- **LTO Application:** The LTO safety case supports extending operations for 20 more years (Unit 1: 2024–2044 (Approved by the NNR); Unit 2: 2024–2045 (Pending NNR approval).
- **Regulatory Framework:** Compliance with the NNR Act, LTO regulations, and safety criteria is required for LTO approval.
- **Key Requirements:** The safety case must address ageing management, safety analyses, resource availability, and necessary upgrades to ensure continued safe operation. Requirements under LTO regulations (R.266, RG-0027, and NIL-01 Variation 19) have been fully satisfied.
- **Safety Improvements:** Refurbishment, modifications, and engineering justifications are included to maintain the licensing basis during LTO. Necessary upgrades and improvements have been identified and aligned with regulatory standards.
- **No Safety Concerns:** Assessments found no issues preventing LTO, and the Periodic Safety Review (PSR) confirms Koeberg is safe to operate into LTO.
- **Overall Safety Assessment:** The safety case confirms Koeberg meets all regulatory requirements for LTO, ensuring safe operation beyond the current licence. The LTO safety case, 331-618 Revision 3 has been publicly released.
- **Future Safety Assurance:** Nuclear safety will be maintained through timely implementation of the LTO Integrated Implementation Plan (IIP), adhering to international best practices.

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Nuclear Installation Licence: NIL-01 Evolution

Nuclear Installation Licence: NIL-01 Evolution
Overview

What is NIL-01?

- NIL-01 is the **Koeberg Nuclear Installation Licence** that provides a framework for the licensing and regulation of nuclear installations in South Africa, ensuring compliance with national and international standards.
- The scope of NIL-01 covers the entire lifecycle of nuclear installations, including site location, design, construction, operation, decommissioning, and waste management.

Early development (Pre – 2000s): Focused on establishing basic safety and operational guidelines for Koeberg.

2000s: Formalisation of NIL-01, introducing a structured licensing process and aligning with IAEA standards.

2010s: Modernisation post-Fukushima, with emphasis on PSRs, decommissioning, and waste management.

2020 – 2025: Strengthened safety culture and preparation for Koeberg's life extension.

NIL-01 (Variations 19 to 21)

Evolution of NNR NIL-01: Variations 19 to 21 for KNPS

Variation 19:

- Initial update to align with regulatory and safety requirements.
- **Key Change:** Stipulate end of operational licence – July 2024 for both units.

Variation 20:

- Incorporation of additional safety enhancements and operational feedback
- **Key Change:** Split end of operational dates for unit 1 (Jul 2024) and unit 2 (Nov 2025).

Variation 21:

- This variation authorises the operation of KNPS Unit 1 until 21 July 2044 and Unit 2 until 9 November 2025
- **Key Change:** Updated to reflect the new expiry date of Unit 1 and Unit 2 and the addition of new specific directive requirements.

LTO NNR Directive

NNR Directive:

- Granted LTO licence for unit 1, extending operation until 21 July 2044.
- Instructs post-LTO safety case commitments (Appendix A.2 of Safety Case for LTO, 331-618 Rev 3).
- Instructs post-LTO PSR safety improvements (Appendix 1 of 3rd PSR Global Assessment Report, 331-608 Rev 2).
- Stipulates specific NNR requirements including regular reporting to the NNR and the public.

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LTO Status Reporting

LTO Status Reporting

Prior to LTO:

- The NNR was kept informed on the status of all required activities by means of workshops and formal submissions – often required prior to progressing of activities.
- The LTO safety case, including the commitment implementation plan was submitted to the NNR in July 2022. The safety case included the SALTO and PSR deliverables as well as all required justifications to support the request for LTO.
- The LTO safety case, public information documents (PID in three languages) and other related documentation were placed on the Eskom website for public information.
- The NNR organised a number of public participation sessions.

Post LTO:

- The NNR requested 6-monthly progress reports on post-LTO commitment activities. The first report was submitted to the NNR in November 2024 (6 months after the issuing of NIL-01 variation 21).
- Correspondence between Eskom and the NNR continues as normal and cover all comments and concerns raised by the NNR on current activities or submitted documentation.
- Informal workshops with the NNR continue to ensure the NNR is informed on strategies, intentions, objectives and progress of activities in progress.
- Public reporting is done at the Koberg Public Safety Information Forum as well as reporting on the Eskom website.

Click here:
- Public Safety Information Forum (PSIF) Presentation – March 2025
- Public Information Summary as Shared at Public Safety Information Forum – March 2025
- LTO Progress Report

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Thank you