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1. Introduction

1.1 Knowledge Management

The safe, reliable and efficient operation of a nuclear power plant across all phases of its life cycle is underpinned by the provision of competent personnel who possess the necessary knowledge and skills to execute their duties correctly. If not codified and transferred effectively, critical knowledge is at risk of being lost from the organization due to workforce changes throughout its life cycle.

Knowledge Management is defined as an integrated, systematic approach to identifying, acquiring, transforming, developing, disseminating, using, sharing and preserving knowledge to help achieve an organization's objectives. The organizational knowledge required to achieve the organization's objectives resides in its employees, its business processes and in the science and technology used by the organization. Knowledge Management strongly focuses on the following fundamental components:

- People and Organization Culture – to promote the sharing and use of knowledge
- Processes – to acquire, capture and share knowledge
- Technology – to facilitate knowledge storage and accessibility

People are considered an essential component because the success of Knowledge Management depends on people's inclination to sharing and utilising knowledge and the knowledge sharing culture that is nurtured in an organization.

Some of the typical elements of a Knowledge Management Program are illustrated in Figure 1 below.

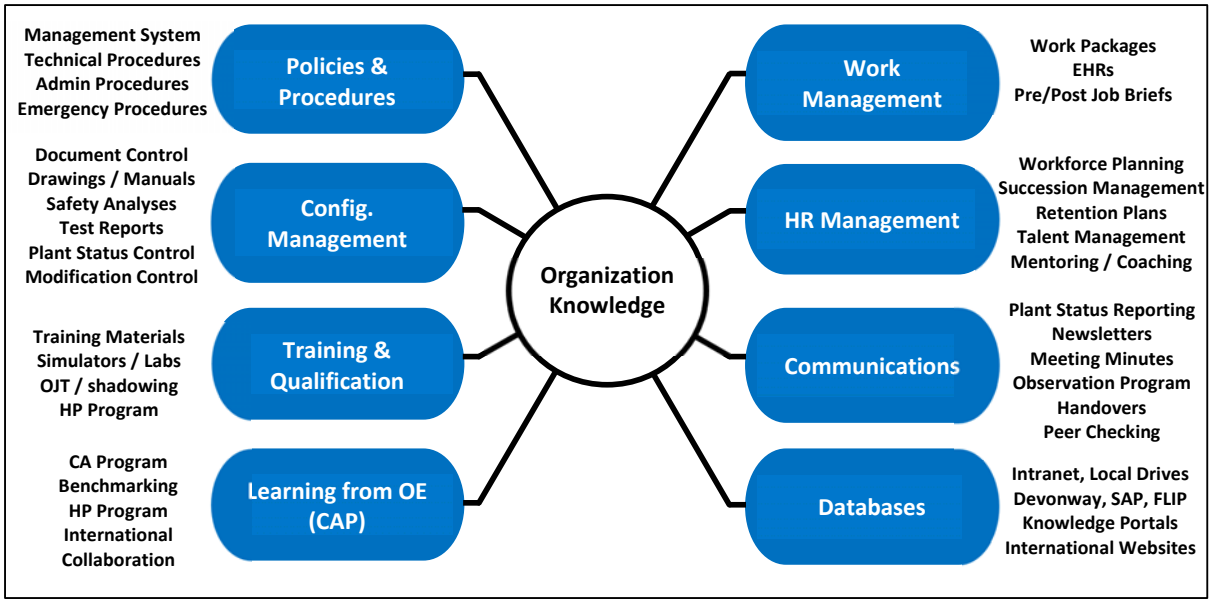

Figure 1: Typical elements and tools of a Knowledge Management Program

The Knowledge Management practices, tools and processes described in Figure 1 are already embedded within the Nuclear Operating Unit Management Systems. The effective implementation and management of all the elements in Figure 1 underpins the success of organizational knowledge management. These elements are therefore interlinked with the new Knowledge Loss Risk Management (KLRM) requirements in this standard.

1.2 Knowledge Loss Risk Management

The organizational knowledge being managed exists as either *tacit* knowledge or *explicit* knowledge and this is distinguishable by the format in which it exists and the relative ease of transfer. Knowledge Loss Risk Management focuses on tacit knowledge held by individuals and the activities that support knowledge transfer and conversion of tacit knowledge to explicit knowledge.

The Nuclear Safety and Quality Manual, 238-8, specifies that Eskom's Knowledge Management processes and practices shall ensure that information and knowledge, necessary for discharging its duties, is retained in the event of personnel changes. A Knowledge Loss Risk Assessment process is therefore necessary to determine and mitigate the potential business impact of the loss of critical knowledge due to employee attrition. This standard describes the NOU Knowledge Loss Risk Management requirements.

2. Supporting Clauses

2.1 Scope

This document covers the management of knowledge loss risks within the NOU.

2.1.1 Purpose

The purpose of this standard is to establish the Knowledge Loss Risk Management requirements to mitigate the potential risk of loss of knowledge and skills, necessary for the safe, reliable and efficient operation of the Koeberg Nuclear Power Plant throughout the remaining phases of its life cycle.

2.1.2 Applicability

Requirements are applicable to all business areas within the NOU.

2.1.3 Effective date

NOU business areas to comply with the requirements of this standard six months from the date of authorization.

2.2 Normative / Informative References

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] 238-8: Nuclear and Safety Quality Manual

[2] 240-128157536: Eskom Talent Discovery Procedure

[3] 240-128158712: Procedure for Deployment

[4] 240-128258875: Procedure for Development

[5] 240-138530260: Management Position Handover Requirements for the NOU

[6] 240-95405347: Procurement of Items and Services for the NOU

[7] IAEA Nuclear Energy Series NG-T-6.11: Knowledge Loss Risk Management in Nuclear Organizations

[8] KAA-688: The Corrective Action Process

[9] KAA-850: Koeberg Nuclear Power Station Safety Culture Enhancement Programme

[10] KAA-865: Koeberg Nuclear Power Station Human Performance Programme

[11] KSA-049: Koeberg Training Standard

2.2.2 Informative

[12] EPRI Technical Report 1012127: Capturing Undocumented Expert Knowledge

[13] EPRI Technical Report 3002003207: Nuclear Maintenance Applications Center – Video Capture Techniques for Knowledge Transfer

[14] EPRI Technical Report 3002005546: Knowledge Transfer and Retention Guideline – Guidance for Transfer and Retention of Tacit Knowledge

[15] IAEA Nuclear Energy Series NG-G-6.1: Guide to Knowledge Management Strategies and Approaches in Nuclear Energy Organizations and Facilities

[16] IAEA Nuclear Energy Series No. NG-T-6.10: Knowledge Management and its Implementation in Nuclear Organizations

[17] IAEA TECDOC No. 1510: Knowledge Management for Nuclear Industry Operating Organizations

[18] IAEA TECDOC No. 1711: The Impact of Knowledge Management Practices on NPP Organizational Performance — Results of a Global Survey

[19] IAEA TECDOC No.1399: The Nuclear Power Industry's Ageing Workforce: Transfer of Knowledge to the Next Generation

[20] IAEA TECDOC No.1884: Knowledge Management Perspectives on Outsourcing in Operating Nuclear Power Plants

[21] ISO 9001: Quality Management Systems – Requirements

[22] RG-0027: Interim Regulatory Guide on Ageing Management and Long-Term Operations of Nuclear Power Plants

2.3 Definitions

2.3.1. **Attrition Factor:** is a risk factor based on an individual's anticipated retirement date or other known attrition date.

2.3.2. **Bench Strength:** is the term used to describe staff who could, in terms of their competences, skills and readiness, step into key roles within the organization on departure of current incumbents.

2.3.3. **Codify:** the process of converting an individual's knowledge into a format that allows it to be communicated or transferred independently of the individual.

2.3.4. **Explicit knowledge**: knowledge that has been captured or codified and is easier to transfer; exists in physical formats such as procedures, training materials, databases and other electronic formats.

2.3.5. **Intellectual Property:** the result of creative endeavour that is recognised and protected by law, including Patents, Designs, Know-How, Copyright and Trade-Marks.

2.3.6. **Knowledge Management Champion:** an individual who proactively promotes and encourages knowledge management with the aim of persuading their peers of its significance and benefit to the organization.

2.3.7. **Knowledge Management:** is the integrated, systematic approach to identifying, acquiring, transforming, developing, disseminating, using, sharing and preserving knowledge to help achieve the organization's objectives.

2.3.8. **Position Factor:** approximates the difficulty or level of effort required to replace an individual in their specific organizational role. It is based on the uniqueness and criticality of an individual's skills and knowledge

2.3.9. **Tacit knowledge:** knowledge that resides in the mind of the individual only and has not been captured or transferred; is acquired through practice and experience and is based on intuition and individual skill. This knowledge is not easily codified and is difficult to transfer.

2.3.10. **Total Risk Factor:** is an overall assessment of knowledge loss risks due to attrition. It is a product of the Position Factor and Attrition Factor and is used to identify individuals that have the most significant potential for knowledge loss from the organization so that these risks can be mitigated.

2.3.11. **Undocumented Knowledge:** knowledge that resides in an organization that has not been documented in such a manner that ensures it is accessible to other personnel that may need it.

2.3.12. **User Requirement Specification:** a written statement of the requirements to be fulfilled by a proposed product, process, service or plant modification, inclusive of a set of approved, measurable customer wants and needs.

2.4 Abbreviations

Abbreviation	Explanation
CA	Corrective Action
EHR	Equipment History Records
EPRI	Electric Power Research Institute

Abbreviation	Explanation
FLIP	Operating Logs Repository
HP	Human Performance
HR	Human Resources
IAEA	International Atomic Energy Agency
IDP	Individual Development Plan
KLRA	Knowledge Loss Risk Assessment
KLRM	Knowledge Loss Risk Management
KM	Knowledge Management
NEXCO	Nuclear Executive Committee
NNR	National Nuclear Regulator
NOU	Nuclear Operating Unit
NPP	Nuclear Power Plant
OE	Operating Experience
OJT	On-Job Training
SAP	Systems, Applications and Products (in Data Processing)
SAT	Systematic Approach to Training
TRS	Technical Requirement Specification
URS	User Requirements Specification

2.5 Roles and Responsibilities

2.5.1 Department Line Management

- Promote a knowledge sharing culture within the department and NOU.
- Identify, manage and mitigate knowledge loss risks in their respective areas.
- Create awareness of the knowledge loss risk management requirements in their respective areas.
- Identify a KM Champion for their department to actively promote Knowledge Management processes and practices and to facilitate / support the implementation of the requirements in this document.
- Conduct knowledge loss risk assessments and assign a Total Risk Factor to all personnel in their respective areas.
- Conduct knowledge elicitation interviews, where required, with support from the department KM Champion (refer to Appendix B for further guidance).
- Develop, implement and monitor the effectiveness of knowledge loss risk mitigation action plans.
- Revise their department KM Risk Register on an annual basis and ensure it is stored in an appropriate access-controlled electronic repository.
- Utilise the department KM Risk Register as a tool for business planning and performance monitoring activities.

2.5.2 KM Champion

- Proactively promotes Knowledge Management processes and practices within the NOU.
- Supports their Line Manager with the implementation of the Knowledge Loss Risk Management requirements of this document.
- Facilitates the annual review of the department KM Risk Register and performs the necessary updates to the KM register to keep it current (action updates, risk factor updates, etc.).
- Attends the periodic KM Champion meetings, when scheduled.

2.5.3 Power Station General Manager

- Maintain and define the requirements for Knowledge Loss Risk Management as described in this document.

2.5.4 Leadership Steering Committee Members and Chairperson

- Monitor adherence to the requirements of this standard and provide oversight on Knowledge Loss Risk Management activities.

2.6 Process for Monitoring

Compliance to this standard shall be monitored in accordance with Eskom's applicable monitoring processes which includes, but is not limited to, self-assessments and quality assurance audits. In addition, oversight of the implementation and adherence to this standard shall periodically be provided via the Leadership Steering Committee. Periodic meetings shall also be conducted with the designated KM Champions to ensure alignment with the requirements in this standard.

2.7 Related/Supporting Documents

240-162970311: Department KM Risk Register Template

335-85: Leadership Steering Committee Terms of Reference

3. Knowledge Loss Risk Assessment Requirements

3.1 Knowledge Loss Risk Management Overview

The IAEA have issued numerous publications on the subject of Nuclear Knowledge Management. The methodologies described in the IAEA Technical Report, *NG-T-6.11: Knowledge Loss Risk Management in Nuclear Organizations*, has been considered in the development of the NOU Knowledge Loss Risk Assessment (KLRA) process described in this NOU standard.

KLRA is a risk-based approach to assessing the potential business impact of the loss of critical knowledge due to employee attrition. Critical knowledge is knowledge that is considered essential / key for business activities directly linked to the safe and reliable operation of the plant and is knowledge that is at risk of being lost. This concept is illustrated in Figure 2 below.

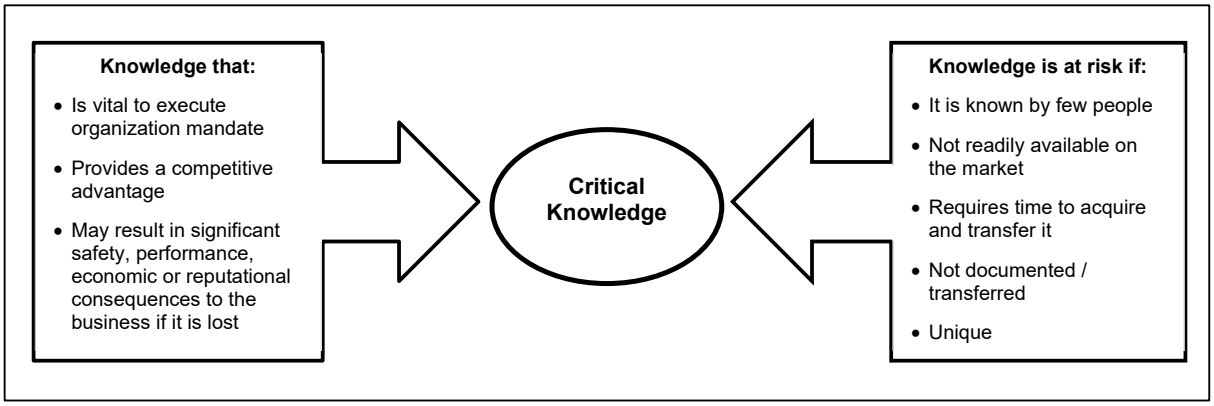

Figure 2: Critical Knowledge

The KLRA process is a 3-step process which is used to:

- Identify personnel that hold critical knowledge and skills (as defined in Figure 2).
- Assess the knowledge loss risk based on 2 two factors: attrition risk and criticality of the knowledge and position held by the individual.
- Develop and implement mitigation plans to appropriately address potential knowledge loss threats through knowledge preservation / transfer and conversion of tacit knowledge to explicit knowledge.
- Continuously monitor and evaluate the efficacy of the knowledge loss mitigation plans.

This KLRA focuses on the individual-level knowledge loss risks and may be used to complement other ESKOM-wide organization-level competence and skills management processes (e.g., skills audits and workplace skills planning as described in the Procedure for Deployment, 240-128158712). The KLRA process requirements are summarized in Figure 3 below.

Figure 3: Knowledge Loss Risk Assessment process requirements overview

3.2 Knowledge Loss Risk Assessment

The risk assessment is required so that individuals with the most significant and imminent knowledge loss potential can be identified.

3.2.1. All personnel shall be assigned an Attrition Factor, Position Factor and Total Risk Factor based on the risk matrix and guidelines in Appendix A.

3.2.2. The Total Risk Factor informs the level of effort and urgency required to effectively manage the knowledge loss risks.

3.2.3. Knowledge loss risks, for all personnel that have been assigned a Total Risk Factor of ≥ 11 OR a Position Factor of ≥ 3, shall be mitigated.

3.3 Knowledge Loss Risk Mitigation

3.3.1. All personnel that have been assigned a Total Risk Factor of ≥ 11 OR a Position Factor of ≥ 3 shall undergo a knowledge elicitation interview to identify potential critical knowledge loss areas. The knowledge elicitation interview questionnaire detailed in Appendix B may be used as a prompt to guide the interviewer to identify the critical or unique knowledge and skills held by the interviewee.

3.3.2. The knowledge and information shared by personnel during the elicitation interview shall be captured and preserved in a manner such that its future use and transfer to other personnel can be assured.

3.3.3. It is recommended that the information and knowledge shared during the elicitation interview be captured in the form of a report, however, other appropriate formats may also be used for this purpose.

3.3.4. Knowledge loss risk mitigation action plans shall be developed, for all individuals with a Total Risk Factor of ≥ 11 OR a Position Factor of ≥ 3, by taking into consideration business needs and the most appropriate methods to capture and transfer the identified critical knowledge.

3.3.5. Knowledge loss risk mitigation actions are not mandatory for personnel with a Total Risk Factor of ≤ 10 however, the Line Manager may deem it necessary to develop actions for the transfer and preservation of knowledge, as required.

3.3.6. Knowledge loss risk mitigation actions shall be assigned to a specific action owner with an appropriate implementation due date that is commensurate with the associated knowledge loss risk. Although not mandatory, it is suggested that the knowledge loss mitigation actions be raised on the Koeberg Devonway database for the purpose of tracking its implementation and close-out.

3.3.7. Existing NOU Training, Human Resources and other processes and procedures shall be considered during the development of the knowledge loss risk mitigation actions. Additional guidelines for consideration are detailed in Appendix C.

3.4 Documenting Knowledge Loss Risks

3.4.1. The outcomes of the knowledge loss risk assessment and mitigation steps (section 3.2 and 3.3) shall be captured on a departmental Knowledge Management (KM) Risk Register (all staff shall be included on this register).

3.4.2. Personnel information (name, unique number, department, job title, job grade and time to retirement), Position Factor, Attrition Factor, Total Risk Factor, and knowledge loss risk

mitigation actions (where required in accordance with section 3.3.4 and 3.3.5), shall be captured on the departmental KM Risk Register for all personnel. The status of the mitigation actions shall also be reflected on this register.

3.4.3. KM Risk Register serves as an inventory of critical skills and knowledge loss risks within the department and may be used as a tool in support of business planning and department performance monitoring activities.

3.4.4. The departmental KM Risk Register and the knowledge captured during the elicitation interview shall be stored in an appropriate electronic repository within each department, where this information will be accessible to the relevant department management team. Access to these departmental KLRM repositories should be controlled. The use of department-specific local network drives (G drive) or Sharepoint sites are recommended.

3.5 Monitor and Evaluate Knowledge Loss Risks

3.5.1. Department KM Risk Registers shall be reviewed and updated annually. The KM Risk Register revision number shall be updated with each annual review and the register shall be authorised by the responsible Head of department.

3.5.2. Knowledge loss risks and risk factors, mitigation action effectiveness, action implementation status, projected attrition dates and personnel changes within the department shall be reviewed to identify and address new risks or gaps that need to be reassessed during the annual review.

3.5.3. KM Risk Registers shall be updated during the annual review to reflect new staff or existing staff changes (resignations, retirements, transfers, etc.) as well as any changes to the individual risk ratings and mitigation actions.

3.6 External Supplier Knowledge Loss Risk Management

The approach for knowledge loss risk identification and mitigation outlined in this standard is applicable to external service providers to the NOU. Proprietary information, contractual and intellectual property limitations shall be duly considered by the NOU Line Manager during the development of the appropriate knowledge loss risk mitigation actions for external service providers.

The knowledge transfer and preservation requirements necessary to manage the knowledge loss risks associated with external suppliers and service providers should be identified and clearly specified in the requisite User / Technical Requirement Specifications (URS / TRS) for NOU Procurement / Commercial activities.

4. Acceptance

This document has been seen and accepted by:

Name	Designation
A Stephanus	Middle Manager Nuclear Services
B Naicker	Middle Manager Nuclear Engineering
E Viljoen	Senior Manager Nuclear Oversight (Acting)

Name	Designation
G Julius	Middle Manager Work Management
G Smith	Middle Manager Plant Training
G Wood	Middle Manager Nuclear Project Management Office
H Hall	Senior Advisor Nuclear Commercial
H Kesonk	Senior Manager Nuclear Fuel (Acting)
M Vuba	Middle Manager Operating
N Mabumbulu	Middle Manager ISED
N van Eeden	Middle Manager Radiation Protection (Acting)
S Fisa	Middle Manager Maintenance
S Mabika	Middle Manager Human Resources
V Moduka	Middle Manager Nuclear Strategy and Regulation

5. Revisions

Date	Rev.	Compiler	Remarks
August 2023	2	M Bennett	Nuclear Engineering KM Standard revised in its entirety as the document is applicable to the NOU. Document changed to level 2 Standard as agreed at NEXCO on 16 May 2023. Knowledge Loss Risk Assessment process was clarified and the document was re-worded for ease of use and application. Scope and title of the Standard changed to reflect the Knowledge Loss Risk Management requirements and not the general requirements for Knowledge Management.
May 2021	1	L Lukwe	New KM process developed for Nuclear Engineering.

Appendix A – Knowledge Loss Risk Matrix

A.1 Position Factor

The Position Factor criteria is based on the uniqueness and criticality of the individual's skills and knowledge as well as the significance of the position held within the organization (e.g., positions of key decision makers or roles with significant reliability and safety impacts). It also relates to the knowledge and expertise required to fulfil the specific role. It approximates the difficulty or level of effort required to replace the individual in their specific organizational role.

	KNOWLEDGE UNIQUENESS					
KNOWLEDGE CRITICALITY		**A** General Knowledge, external recruits readily available and minimal training required	**B** Documented and held by more than one resource, clear and current procedures exist, training program in place and can be done in less than 1 year	**C** Some documented and held by other resources on site or in department, recruits are generally available and can be trained in 1-2 years	**D** Some documented and held by others in department. Can be found in industry or other sites, requires 2-4 years of focused training / experience	**E** Not documented, held by single resource, site-specific knowledge, requires 3-5 years of training / experience, ready replacements not available
	I Common Knowledge / Skills	**1**	**1**	**1**	**1**	**1**
	II Non-Mission Critical Knowledge / Skills	**1**	**1**	**1**	**1**	**2**
	III Important Knowledge / Skills	**1**	**1**	**1**	**2**	**2**
	IV Very significant Knowledge / Skills	**1**	**1**	**2**	**3**	**4**
	V Mission-critical Knowledge / Skills	**1**	**2**	**2**	**4**	**4**

A.2 Attrition Factor

The Attrition Factor is based on an individual's projected time to retirement or other known attrition date (e.g., resignation, transfer, etc.).

# of years remaining	Attrition Factor
≤ 2	**5**
≤ 3	**4**
≤ 4	**3**
≤ 5	**2**
> 5	**1**

A.3 Individual Total Risk Factor

The Total Risk Factor of an individual provides an overall assessment of knowledge loss risk due to attrition. It is computed by multiplying the Attrition Factor by the Position Factor.

$$Total\ Risk\ Factor = Attrition\ Factor\ X\ Position\ Factor$$

Total Risk Factor	Action required
16-20	**Critical**. Immediately develop action plans with due dates, showing how you will retain and transfer the critical and unique knowledge; for example, determine specific training required or set up on-the-job training/shadowing with the knowledge holder.
11-15	**Business Important.** Establish staffing plans to address the method and timing of knowledge replacement, training others or job shadowing with the current knowledge holder.
4-10	**Limited Bench Strength.** Think about potential impacts to your organization if you were to lose this knowledge from your department. Consider tertiary institution recruiting, training programs and/or process improvements. Ask yourself, if you lost a few of these individuals, would the risk level increase? If so, develop actions plans to mitigate that risk.
1-3	**Acceptable.** No action is required for low-risk positions.

Appendix B – Knowledge Elicitation Interview Questionnaire

B.1 General Questionnaire Example

The generic interview questionnaire is intended to assist the interviewer and interviewee to identify areas where unique or critical knowledge may exist. Questions may be relevant to facts or information about people, vendors, projects, problem solving, how tasks are done and unique pattern recognition skills. The interview questionnaire is a guide and may be modified as required by adding other questions or re-wording it based on specific interview needs.

1.	**General information**
1.1.	What do you consider to be the most valuable and/or unique knowledge that you hold in your current role?
1.2.	What knowledge do you hold that you consider hard to replace or that no one else in the organization has or that has not been captured or documented?
1.3.	What do you consider to be your biggest achievements in your career?
1.4.	How did you learn the things you know? (training courses, on-job experience, previous job)
1.5.	What is the main thing your colleagues are going to notice when you are gone?
1.6.	Do you have a current job description? Does it encompass the relevant aspects of your job?
2.	**Key Operational Information**
2.1.	If you break down the activities of your daily job which ones requires specific skills that other, less experienced individuals might not have?
2.2.	What have been the most useful tools, documents, websites, resources, etc. that you have used in your role?
2.3.	Which codes, standards and regulations are most frequently applicable to your role?
2.4.	What requests do you get most regularly and how do you handle them?
2.5.	What are the things that are most likely to go wrong and how do you usually handle them?
2.6.	What shortcuts/workarounds might be useful for others to know about?
2.7.	Are there any immediate issues specific to your role that in your view need to be urgently resolved?
2.8.	Are there any dormant / latent issues to your role that in your view need to be resolved in the longer term?
2.9.	Are there other roles you perform in the organisation (officially/unofficially)?
2.10.	Can you share insights of your interactions with the NNR and other external regulatory or oversight bodies?
2.11.	Are you involved with the development or maintaining of any internal databases or repositories?
3.	**Interpersonal Skills and Interactions**
3.1.	Who are the people you operationally interact with most frequently and for whom you are the main or only point of contact in your team?
3.2.	Who are the key contacts for things like expert advice, decisions, getting something processed? Are these known about and used by other members of staff on your team? Do you have key contacts that you consult outside of Koeberg that may be useful to share with other team members?
3.3.	Are there any people skills you want to mention that help you to get your job done and resolve problems?
3.4.	What has helped you deal effectively with your Customers/Directors/Peers/Staff?

3.5.	Who needs to know what you know (apart from your successor)?
3.6.	What mistakes do you typically notice your younger colleagues make and what do you think should be done about it?
4.	**Lessons Learned / OE**
4.1.	Tell us about your successes and what you have learned?
4.2.	What mistakes do you think have been made in the past that you think could be avoided in the future?
4.3.	What would be your top 3 pieces of advice to the rest of the team moving forward?
4.4.	What advice would you give your successor?
4.5.	If you could design an ideal induction for your job what would you include?
4.6.	What do you wish you had known when you started the job?
4.7.	Are there any unexploited ideas or potential improvements/innovations that you want to mention?
4.8.	Are you aware of any relevant OE (local or international) that is not widely known or documented?
4.9.	Have you attended or participated in any relevant Working Groups, Owners Groups, conferences, seminars, webinars, etc., and are there any insights you can share?
5.	**Outage Participation Information (If applicable)**
5.1.	What outage role did you perform in the last outage?
5.2.	What are crucial items that you think are only known by you and no one else as it relates to outage performance?
6.	**Contract Management and External Suppliers**
6.1.	Do you manage any contracts? Are you involved in the contracts process or tender evaluations and what have been your experiences or lessons learnt?
6.2.	Is there any specific insights you may have on vendors or external suppliers to Koeberg that is not widely known?
7.	**Miscellaneous**
7.1.	Please elaborate on the meetings that you attend and your role in the meetings?

Appendix C – Knowledge Loss Risk Mitigation Action Considerations

C.1 Options to mitigate knowledge loss

Numerous activities and actions may be considered to mitigate knowledge loss risks. The list below is not exhaustive and existing NOU HR, Training and other processes, procedures and policies should be applied when developing knowledge loss mitigation actions. Further guidelines are provided in the IAEA and EPRI literature included in the references of this standard.

Staffing and Resourcing	**Education & Coaching**
• Recruitment • Succession planning • Staff transfers • Enhancing bench strength • Staff rotation • Multi-skilling or Cross-training • Outsourcing skills and services • Re-hiring retirees	• Classroom, simulator & on-job training • Computer-based training • Informal knowledge sharing / storytelling • Coaching, shadowing and mentoring • Specific work or task assignments • Apprenticeships • Systematic Approach to Training (SAT) • Individual Development Plans (IDPs)
Knowledge Transfer / Preservation	**Process Re-engineering**
• Knowledge codification or documentation • Revise documents and procedures • Develop training materials • Video or Audio recording of tasks / instructions • Concept / knowledge maps • Photographic records / catalogues • Shared folders, intranet, wiki and local drives • Informal how-to guides • Position handover checklists • Exit interviews • Pre-job and post-job briefs • Coaching & Observations • Communities of practice • Cross-functional / multi-disciplinary activities • Improved on-boarding • Knowledge portals • Search engines and databases	• Improving processes • Smart tools and technology • Updating equipment