Eskom	Standard	Nuclear Operating Unit

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Note

With the changes to the Eskom structure the names in documents will be inconsistent for a period of time

The terms Nuclear Division, Nuclear Operating Unit are to be seen as referring to the integrated high level description of the Koeberg Operating Unit

Content

1. Introduction

This standard specifies the radiological protection optimisation requirements for the Eskom Generation Division in terms of the Eskom Radiation Protection Policy EPL 32-227 and Standard EST 32-226. Eskom is committed to ensure that nuclear and radiation safety receives the highest priority to provide for the protection of persons and the environment against harmful ionising radiation in accordance with the safety principles and requirements addressed in the Eskom Radiation Protection Policy and Standard.

2. Supporting Clauses

2.1 Scope

2.1.1 Purpose

This standard specifies the requirements for optimisation of radiation protection in terms of Eskom Policy EPL 32-227, Eskom standard EST 32-226 and the Nuclear Division Manual 238-19 relating to radiation protection and safety of radiation sources.

2.1.2 Applicability

This procedure is applicable to Group III hazardous substances (electronic products), Group IV hazardous substances (radioactive sources), radioactive material, restricted material, special nuclear material and radioactive waste defined in the Nuclear Division Radiation Protection Manual 238-19.

2.1.3 Effective Date

2.2 Normative/Informative References

The following normative references contain provisions that, through reference in the text, constitute requirements listed in this document. Parties using this document shall apply the most recent edition of the documents listed below, unless otherwise specified in the applicable statutory and regulatory requirements:

2.2.1 Normative

[1] 32-227: Eskom Policy, Radiation Protection and safety of radiation sources.

[2] 32-226: Eskom Standard, Requirements and rules for radiation protection and the safety of radiation sources.

[3] 238-19: Nuclear Division Radiation Protection Manual.

[4] 238-35: Radiation Protection Dose and Risk Limits.

[5] 238-43: Requirements for Radiation Workers.

2.2.2 Informative

The following informative references were used during the development of this document. Although listed, the informative references are not mandatory requirements.

[1] 238-1: Nuclear Division Integrated Management System.

2.3 Definitions

2.3.1 **Alpha value:** The attribution of a monetary value or alpha value to dose saving in Eskom, is a means of defining how much money in Rand should be spend to avert one sievert.

2.3.2 **Assessment:** The process and the result, of analysing systematically the hazards associated with sources and authorised actions, and associated protection and safety measures, aimed at quantifying performance measures for comparison with criteria.

2.3.3 **Authorisation(s):** See authority and licence(s).

2.3.4 **Authorised action:** An action authorised in terms of the Nuclear Regulator Act, 1999 (Act No. 47 of 1999).

2.3.5 **Authority:** Written authority issued by the relevant regulator.

2.3.6 **Collective dose:** The total effective dose incurred by a population, being the sum of all the individual effective doses to members of the population.

2.3.7 **Defence in depth:** The application of more than a single protective measure for a given radiation or nuclear safety objective, so that the objective is achieved even if one of the protective measures fails.

2.3.8 **Dose constraint:** A prospective and source-related restriction on the individual dose arising from the predicted operation of the authorised action which serves exclusively as a bound on the optimisation of radiation protection and nuclear safety to limit the range of options considered and to restrict the doses via all pathways.

2.3.9 **Dose:** The amount of radiation received, where the use of a more specific term such as effective dose or equivalent dose is not necessary for defining the quantity of interest.

2.3.10 **Dose limit:** The value of the effective radiation dose, or the equivalent dose of radiation to individuals, from controlled practices, that shall not be exceeded.

2.3.11 **Effective dose:** The summation of the tissue equivalent doses, each multiplied by the appropriate tissue weighting factor. The effective dose is expressed in sievert.

2.3.12 **Electronic product:** Any electronic product that emits ionising electro-magnetic, particulate radiation or any sonic, infrasonic or ultrasonic wave.

2.3.13 **Eskom:** is used for Eskom Holdings Limited, its divisions and wholly owned subsidiaries.

2.3.14 **Exposure:** The act or condition of being subject to irradiation. Exposure can be either external exposure (irradiation by sources outside the body), or internal exposure (irradiation by sources inside the body). Exposure should be classified as; either normal exposure, potential exposure, occupational exposure, public exposure or emergency exposure.

2.3.15 **Group III hazardous substance:** Any electronic product that emits ionising and non-ionising radiation.

2.3.16 **Group IV hazardous substance:** Any fabricated radio-isotopes.

2.3.17 **Intake:** The process of taking radioactive nuclides into the body by inhalation or ingestion or through the skin.

2.3.18 **Ionising radiation:** Radiation capable of producing ion pairs in biological material(s).

2.3.19 **Licence(s):** An authorisation granted by the relevant regulatory authority, accompanied by specific requirements and conditions, to be complied with.

2.3.20 **Monitoring:** The continuous or periodic measurement of radiological and other parameters or determination of the status of a system.

2.3.21 **Nuclear safety:** The achievement of safe operating conditions prevention of nuclear accidents or mitigation of nuclear accident consequences, resulting in the protection of workers, the public and the environment against the potential harmful effects of ionising radiation or radioactive material.

2.3.22 **Occupational exposure:** All exposures of radiation to workers incurred in the course of their work.

2.3.23 **Potential exposure:** Exposure to radiation that is not expected with certainty to be delivered, but that may result from an incident at a source, or owing to an event, or sequence of events, of a probabilistic nature, including equipment failures and operating errors.

2.3.24 **Practice:** Any human activity that introduces sources of exposure or exposure pathways, in addition to those of natural background radiation levels, or extends exposure to additional people, or modifies the network of exposure pathways from existing sources; so as to increase the exposure, or the likelihood of exposure, to people, or the number of people exposed.

2.3.25 **Prior safety assessment:** A safety assessment undertaken prior to commencement of operations.

2.3.26 **Public exposure:** Exposure incurred by members of the public from radiation sources.

2.3.27 **Radiation protection:** The protection of people from the effects of exposure to ionising radiation and the means of achieving this.

2.3.28 **Radiation:** See ionising radiation.

2.3.29 **Regulatory authority:** Authority designated by government for regulatory purposes in connection with radiological protection and occupational health and safety, i.e. the National Nuclear Regulator and the Directorate: Radiation Control, Department of Health.

2.3.30 **Risk:** The probability that an injury or damage will occur.

2.3.31 **Safety assessment:** An analysis to evaluate the performance of an overall system and its impact, where the performance measure is radiological impact or other measure.

2.3.32 **Source:** Anything that may cause radiation exposure, by emitting ionising radiation, or releasing radioactive substances, or materials.

2.4 Abbreviations

Abbreviation	Description
ALARA	As Low As Reasonably Achievable
ESKOM	Eskom Holdings SOC Limited, its divisions and wholly owned subsidiaries
NNR	National Nuclear Regulator

3. Requirements

3.1 Programme Requirements

3.1.1 The responsibilities relating to optimisation of radiation protection [keeping all exposures as low as reasonably achievable (ALARA), by taking economic and social factors into account] shall be

implemented in accordance with Eskom Policy EPL 32-227 and Eskom standard EST 32-226 relating to radiation protection and safety of radiation sources.

3.1.2 The magnitude of doses to individuals, the number of people exposed and the likelihood of incurring exposures shall be kept as low as reasonably achievable (ALARA), economic and social factors being taken into account.

3.1.3 The objectives and goals for optimisation of the radiation protection programme shall comply with requirements in 5.8.

3.1.4 The optimisation programme shall address work control aspects relating to planning, scheduling, preparation, implementation and feedback.

3.1.5 Qualitative and/or quantitative analyses should be used to demonstrate optimisation of radiation protection.

3.1.6 The optimisation process should be applied to all components of the radiation protection programme, during planning, design, modification and operation.

3.1.7 A radiation safety forum/committee should be established if appropriate, in order to advise Eskom Business Unit Management on various optimisation aspects of radiation protection.

3.2 Process Requirements

The following optimisation process should be applied:

3.2.1 Identify radiological protection issues;

3.2.2 Identify alternative protection options;

3.2.3 Apply decision-aiding techniques (quantitative or qualitative);

3.2.4 Select one option (the optimised solution).

3.3 Training Requirements

3.3.1 Eskom radiation workers shall receive initial and follow-up training, which addresses basic principles of optimisation of radiation protection.

3.3.2 The requirements for radiation workers in Eskom employment are defined in Eskom Standard, 238-43: Requirements for Radiation Workers.

3.4 Requirements for dose limitation

3.4.1 A system of dose limitation shall be applied.

3.4.2 The dose limits for radiation workers and the public are defined in Eskom Standard, 238-35: Radiation Protection Dose and Risk Limits.

3.4.3 Where applicable, technical and/or administrative measures shall be applied to limit exposure.

3.4.4 Where applicable, technical measures such as temporary shielding, physical barriers, protective clothing, respiratory protection and glove boxes shall be used to limit exposure.

3.4.5 Administrative measures such as written procedures, access controls, work controls, classification of areas and warning signs shall be used to limit exposure.

3.4.6 Dose constraints shall be applied to limit exposure.

3.4.7 Investigation levels shall be applied to limit exposure.

3.5 Requirements for surveillance programmes

3.5.1 The ALARA programme shall include appropriate surveillance effectiveness review.

3.5.2 An individual dose and/or intake-monitoring programme shall be implemented as appropriate. The programme shall include assessment and recording of individual exposures.

3.5.3 An area-monitoring programme shall be implemented. Procedures shall be established for systematic monitoring of work areas.

3.5.4 A record and data programme shall be implemented. Appropriate records and data of all monitoring should be preserved.

3.6 Requirements for control of public exposure

3.6.1 Public exposure shall be minimised.

3.6.2 Radioactive material released to the environment shall be monitored and minimised.

3.7 Dose reduction requirements

3.7.1 Dose reduction techniques shall be identified; evaluated and cost-effective dose reduction techniques should be implemented.

3.7.2 An alpha-value of R13 000 per person-mSv should be applied to as one of the economic tools for aiding management decisions relating to dose reduction initiated initiatives (Footnote 1).

3.8 ALARA objectives and targets

3.8.1 The average annual risk to plant personnel shall be controlled by the application of the ALARA principle. The Eskom ALARA target is less than 4mSv for the annual average individual dose for the exposed work-force.

3.8.2 The ALARA objectives for individuals are that over the individual's assumed fifty year occupational exposure period, the total effective dose received by individuals, should not exceed 500 mSv, and in any particular year, the individual's dose should be minimised to the extent practicable, taking collective dose considerations into account.

3.9 Prior safety assessment

3.9.1 Measures to control the risk of nuclear damage to individuals shall be determined on the basis of a prior safety assessment which is suitable and sufficient to identify all significant radiation hazards and to evaluate the nature and expected magnitude of the associated risks, with due regard to the dose limits and dose constraint defined in Eskom Standard, 238-35: Radiation Protection Dose and Risk Limits.

3.10 Operational safety assessment

3.10.1 Operational safety assessments shall be made and submitted to the relevant regulator at intervals specified and which shall commensurate with the nature of the operation and the radiation risks involved.

3.10.2 Operational safety assessments shall be of sufficient scope and shall be conducted and maintained in order to demonstrate continuing compliance with the dose, risk, limits and other relevant conditions.

3.10.3 Operational safety assessments shall be established for the basis for all the operational safety related programmes, limitations and design requirements.

3.11 Defence in depth

3.11.1 A multilayer (defence in depth) system of provisions for radiation protection and nuclear safety commensurate with the magnitude and likelihood of the potential exposures involved shall be applied to sources such that a failure at one layer is compensated for or corrected by subsequent layers, for the purposes of:

3.11.1.1 preventing nuclear and radiological accidents;

3.11.1.2 mitigating the consequences of any such accidents; and

3.11.1.3 restoring sources to safe conditions after any such accident.

3.12 Records and reports

3.12.1 Records and reports relating to optimisation of radiation protection shall be established, implemented, retained, maintained and made available for reference.

3.12.2 Records and reports relating to optimisation of radiation protection shall be submitted to the relevant regulator at predetermined periods as required.

3.12.3 A reporting mechanism shall be established, implemented and maintained for recording incident and accidents of any events that the relevant regulator should specify relating to optimisation of radiation protection.

3.13 Quality management

3.13.1 A quality management programme shall be established, implemented and maintained in order to ensure on-going compliance with this standard.[1]

[1]The alpha value of R13 000 per person-mSv was derived in 2003 and is based on the average alpha value applied internationally. The value should be adjusted to account for inflation and to ensure parity with the value of the rand in 2003.

4. Acceptance:

This document was seen and accepted by:

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5. Revision

Date	Rev.	Compiler	Remarks
May 2017	0B	M Maree	
September 2015	0A	M Maree	
May 2012	0	M Maree	This radiation protection standard was compiled in accordance with the Nuclear Division Radiation Protection Manual, 238-19 and supersedes Eskom Standard ESKASACB8 and Generation Standard GGS 1302.

6. Development team

This document has been developed on behalf of the Eskom Generation Division by Marc Maree.