Eskom	Standard	Nuclear Operating Unit

Title: **Radiation Dosimetry Requirements**

Document Identifier:	**238-42**
Alternative Reference Number:	**NSN-042**
Area of Applicability:	**Generation Division**
Functional Area:	**Radiation Protection**
Revision:	**1**
Total Pages:	**12**
Next Review Date:	**April 2024**
Disclosure Classification:	**Controlled Disclosure**

Compiled by	Functional Responsibility	Authorized by
M Maree	**KG Featherstone**	**MR Bakardien**
Corporate Specialist Radiation Protection	**Senior Manager Nuclear Strategy and Regulation**	**Chief Nuclear Officer Nuclear Operating Unit**
Date: 29.04.2022	Date: 23/05/2022	Date: 27-05-2022

Nuclear Additional Classification Information

Business Level:	**2**
Working Document:	**3 – For reference**
Importance Classification:	**Not Applicable**
NNR Approval:	**Yes, letter k28457N, NAR-2006**
Safety Committee Approval:	**Not Applicable**
ALARA Review:	**Yes**
Functional Control Area:	**Radiation protection**

CONTENTS

Page

1. INTRODUCTION 4
2. SCOPE 4
2.1 PURPOSE 4
2.2 APPLICABILITY 4
3. NORMATIVE/INFORMATIVE REFERENCES 4
3.1 NORMATIVE 4
3.2 INFORMATIVE 4
4. DEFINITIONS AND ABBREVIATIONS 5
4.1 DEFINITIONS 5
4.2 ABBREVIATIONS 7
5. REQUIREMENTS 7
5.1 REQUIREMENTS FOR INDIVIDUAL MONITORING AND EXPOSURE ASSESSMENT 7
5.2 REQUIREMENTS FOR AN EXTERNAL DOSIMETRY PROGRAMME 8
5.3 REQUIREMENTS FOR AN INTERNAL DOSIMETRY PROGRAMME 9
5.4 REQUIREMENTS FOR DOSIMETRY SERVICES 9
5.5 DOSE LIMITATION REQUIREMENTS 9
5.6 DOSE TRAINING REQUIREMENTS 9
5.7 RADIATION MONITORING REQUIREMENTS 10
5.8 REQUIREMENTS FOR ISSUANCE/COLLECTION OF RADIATION MONITORING DEVICES 10
5.9 REQUIREMENTS FOR A DOSE REGISTER 10
5.10 REQUIREMENTS FOR RADIATION WORKERS 10
6. RECORDS AND REPORTS 10
7. ACCEPTANCE: 11
8. REVISIONS 12
9. DEVELOPMENT TEAM 12
10. ACKNOWLEDGEMENTS 12

1. INTRODUCTION

This standard specifies the radiation dosimetry requirements for the Eskom Generation Division in terms of the Eskom Radiation Protection Policy, 32-227 and Standard, 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. SCOPE

2.1 PURPOSE

This standard specifies the requirements for radiation dosimetry in terms of Eskom Policy 32-227, Eskom standard 32-226 and the Generation Division Radiation Protection Manual, 238-19 relating to radiation protection and safety of radiation sources.

2.2 APPLICABILITY

This standard 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 Generation Division Radiation Protection Manual, 238-19.

3. 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:

3.1 NORMATIVE

[1] 238-19: Generation Division Radiation Protection Manual.

[2] 238-35: Radiation Protection Dose and Risk Limits.

[3] 238-36: Operational Radiation Protection Requirements.

[4] 238-43: Requirements for Radiation Workers.

[5] 32-226: Eskom Standard, Radiation Protection and safety of radiation sources.

[6] 32-227: Eskom Policy, Radiation Protection and safety of radiation sources.

3.2 INFORMATIVE

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

[7] 238-1: Nuclear Division Integrated Management System.

4. DEFINITIONS AND ABBREVIATIONS

4.1 DEFINITIONS

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

4.1.2 **Becquerel:** The unit of radioactivity in nuclear transformations or disintegrations per second.

4.1.3 **Chronic exposure:** Exposure to radon.

4.1.4 **Collective effective dose:** An expression for the total radiation dose incurred by a population, defined as the product of the number of individuals exposed to a source and their average radiation dose. The units of collective dose are termed person-sievert

4.1.5 **Committed dose:** Committed effective and/or committed equivalent dose.

4.1.6 **Committed effective dose:** Is defined as committed equivalent dose to tissue over the integration time multiplied by an appropriate tissue weighting factor. The units of committed effective dose are termed sievert and/or rem.

4.1.7 **Committed equivalent dose:** Is defined as the equivalent dose rate at a specific time in an organ or tissue after the elapsed time following an intake of radioactive substance.

4.1.8 **Contamination:** The presence of radioactive substances in, or on a material, or the human body, or other place where they are undesirable or could be harmful.

4.1.9 **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.

4.1.10 **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.

4.1.11 **Dosemeter(s):** An instrument to detect and measure accumulated radiation exposure. Used for personal monitoring.

4.1.12 **Dosimetry:** See dosemeter.

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

4.1.14 **Employee:** A person who has entered into or works under a contract of service or of apprenticeship or learnership, with an employer, whether the contract is express or implied, oral or in writing, and whether the remuneration is calculated by time or by work done, or is in cash or in kind, and includes:

a) a casual employee employed for the purpose of the employer's business

b) a person who has entered into a contract of service or of apprenticeship or learnership with the employer

c) a person provided to Eskom by a Temporary Employment Service (Labour Broker) and who works under the control, instruction and supervision of an Eskom employee

d) a casual employee

e) a part-time worker

f) a temporary worker

g) an occasional employee

h) an unattached learner

i) a bursar

j) a sub-contractor

Note: In the event of an injury to persons in the above categories it will be regarded as arising out of and in the course of duty, if the injured person worked under the instruction and supervision of an Eskom employee.

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

4.1.16 **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.

4.1.17 **External exposure:** Irradiation by sources outside the body.

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

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

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

4.1.21 **Internal exposure:** Irradiation by sources inside the body.

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

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

4.1.24 **Occupational exposure:** All exposures of radiation to employees incurred during work.

4.1.25 **Personal dosemeter:** Dosemeter such as a TLD intended to be worn on the body.

4.1.26 **Potential exposure:** Exposure to radiation that is not expected with certainty to be delivered, but that should 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.

4.1.27 **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.

4.1.28 **Protection and safety:** The protection of people against exposure to ionising radiation or radioactive substances and the safety of radiation sources, including the means for achieving such protection and safety, such as the various procedures and devices for keeping peoples' doses and risks as low as reasonably achievable.

4.1.29 **Radiation worker:** Any person who is potentially exposed to radiation through his/her occupation to more than 1 mSv per annum.

4.1.30 **Radiation:** See ionising radiation.

4.1.31 **Registration:** The granting of a certificate of registration.

4.1.32 **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.

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

4.2 ABBREVIATIONS

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

5. REQUIREMENTS

5.1 REQUIREMENTS FOR INDIVIDUAL MONITORING AND EXPOSURE ASSESSMENT

5.1.1 Eskom shall be responsible for arranging for the assessment of the occupational exposure of Eskom employees on the basis of individual monitoring where appropriate and shall ensure that adequate arrangements are made with appropriate dosimetry services under an adequate quality assurance programme.

5.1.2 For any employee who is normally employed in a radiological controlled area, or who occasionally works in a radiological controlled area and should receive significant occupational exposure, individual monitoring shall be undertaken where appropriate, adequate and feasible. In cases where individual monitoring is inappropriate, inadequate or not feasible, the occupational exposure of the worker should be assessed on the basis of the results of monitoring of the workplace and on information on the locations and duration of exposure of the worker.

5.1.3 For any employee who is regularly employed in a radiological supervised area, or who enters a controlled radiological area only occasionally, individual monitoring should not be required but the occupational exposure of the worker shall be assessed. This assessment should be on the basis of the results of monitoring of the workplace or individual monitoring.

5.1.4 The nature, frequency and precision of individual monitoring shall be determined with consideration of the magnitude and possible fluctuations of exposure levels and the likelihood and magnitude of potential exposures.

5.1.5 Eskom shall ensure that employees who should be exposed to radioactive contamination, including employees who use protective respiratory equipment, are identified and shall arrange for appropriate monitoring to the extent necessary to demonstrate the effectiveness of the

protection provided, and to assess the intake of radioactive substances or the committed doses, as appropriate.

5.1.6 In Eskom workplaces where workers are liable to receive an (average) effective dose of 6 mSv per year averaged over five consecutive years, individual monitoring of workers shall be undertaken where appropriate, adequate and feasible.

5.1.7 For workers in Eskom workplaces for whom individual monitoring is inappropriate, inadequate or not feasible, the occupational exposure of such workers shall be assessed from the results of workplace monitoring and information on the locations and durations of the workers.

5.2 REQUIREMENTS FOR AN EXTERNAL DOSIMETRY PROGRAMME

5.2.1 Eskom shall estimate all potential doses of ionising radiation to which an employee or any other person, who enters Eskom's premises where ionising radiation is present.

5.2.2 Eskom shall issue a personal dosemeter to every registered radiation worker in Eskom's employment and shall include in the internal rules, instructions concerning the wearing of such dosemeters on the radiation worker's person.

5.2.3 Any person to whom a personal dosemeter has been issued shall be obliged to wear it on his/her person at all times, while working in a controlled zone or handling a source.

5.2.4 Eskom shall ensure that dosemeters are replaced for evaluation:

5.2.4.1 at regular intervals, or

5.2.4.2 when an unplanned exposure larger than 2 mSv has, or is suspected to have, occurred. Investigations shall be made into all circumstances whenever this limit is exceeded.

5.2.5 In any case where a dosemeter has been lost or destroyed, or where it is not possible to assess the dose received by an employee, Eskom shall investigate the circumstances of the case for the purpose of assessing the dose received by the employee during that period. Eskom shall perform a special entry in the dose record of that employee.

5.2.6 Where Eskom has reason to believe that the dose that should have been received by an employee differs from the dose record, the circumstances of the exposure of that employee to ionising radiation shall be investigated.

5.2.7 Eskom shall keep such dose records for the period specified by the relevant regulatory authority.

5.2.8 Local rules and procedures shall specify administrative dose limits.

5.2.9 Eskom shall, in addition to a personal dosemeter, also issue a direct-reading dosemeter and/or special dosimetric devices i.e. extremity dosemeters as and when required.

5.2.10 Any person to whom a direct-reading dosemeter has been issued shall be obliged to wear that meter on his/her person at all times, while working in a controlled zone or handling a source.

5.2.11 Direct-reading dosemeters shall be read at least once a day or shift, or at frequencies specified in local rules and procedures during use; and accurate records of the radiation doses shall be recorded. The dosemeters shall be calibrated at intervals prescribed by the relevant regulatory authority by persons approved to do so.

5.2.12 Only dosimetric devices used for legal dosimetry as approved by the relevant regulatory authority shall be used for measuring external radiation exposures.

5.3 REQUIREMENTS FOR AN INTERNAL DOSIMETRY PROGRAMME

5.3.1 Eskom shall provide for an internal dosimetry programme as required by the relevant regulatory authority.

5.3.2 Eskom radiation workers shall be assessed routinely through an internal dosimetry programme as required by the relevant regulatory authority.

5.3.3 Baseline internal dosimetry monitoring shall be conducted on Eskom radiation workers, if appropriate, in areas where radioactive contamination is present. The method of determining the internal contamination or uptake shall consider the nature of the radioactivity present.

5.3.4 Following an accidental or suspected ingestion or inhalation of radioactive material, internal dosimetric assessment shall be performed.

5.3.5 In the event of an injury contaminated by radioactivity, internal dosimetry assessment shall be performed.

5.3.6 Routine follow-up measurements shall be performed following an intake.

5.3.7 In-vivo assessment(s) shall be performed on radiation workers who have been subjected to contamination, or potential airborne contamination upon termination of employment as a radiation worker. The sensitivity of the in vivo counter shall be such that it will be capable of detecting activities of at least 1 % of the Annual Limit of Intake.

5.4 REQUIREMENTS FOR DOSIMETRY SERVICES

5.4.1 An Eskom dosimetry service approved by the relevant regulatory authority shall:

5.4.1.1 supply personal dosemeters for use by Eskom radiation employees;

5.4.1.2 keep dose records in respect of each Eskom radiation worker, and destroy those dose records only with the written permission of the relevant regulatory authority;

5.4.1.3 issue copies of Eskom dose records routinely as specified by the relevant regulatory authority;

5.4.1.4 when requested to do so, furnish copies of the dose records relating to any Eskom employee as should be required;

5.4.1.5 immediately send, to the relevant regulatory authority, details of any employee dose records as required.

5.5 DOSE LIMITATION REQUIREMENTS

The dose limits specified in 238-35: Radiation Protection Dose and Risk Limits shall be complied with.

5.6 DOSE TRAINING REQUIREMENTS

5.6.1 Eskom radiation workers shall receive training relating to radiation dosimetry. This training should include:

5.6.1.1 An overview of the dosimetry programme used by the Eskom installation;

5.6.1.2 device issuance criteria;

5.6.1.3 descriptions of standard and special dosimetry devices for extremity, neutron and high radiation area monitoring;

5.6.1.4 proper wearing and utilization of devices;

5.6.1.5 reporting requirements if loss, damage or abnormal performances occur.

5.7 RADIATION MONITORING REQUIREMENTS

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

5.7.2 Radiation workers engaging in radiological activities shall be issued with personal dosemeters (TLDs) and direct-reading dosemeters.

5.7.3 Direct reading dosemeters shall be used.

5.7.4 Personal dosemeters and direct-reading dosemeters shall be calibrated routinely in accordance with the requirements prescribed by the relevant regulator.

5.8 REQUIREMENTS FOR ISSUANCE/COLLECTION OF RADIATION MONITORING DEVICES

5.8.1 Arrangements shall be made for the issue and collection of dosimetric devices.

5.8.2 Prior to the initial issue of dosimetric devices, employees shall have successfully completed the appropriate radiation protection training and medical evaluation(s).

5.8.3 The exposure history of the worker shall have been reviewed to ensure compliance with the dose limitation in paragraph 5.5.

5.8.4 Controls shall be established to ensure that employees are in possession of dosemeters when entering radiologically controlled areas.

5.9 REQUIREMENTS FOR A DOSE REGISTER

5.9.1 The requirements for a radiation dose register specified in 238-43: Requirements for Radiation Workers shall be complied with.

5.10 REQUIREMENTS FOR RADIATION WORKERS

5.10.1 The requirements for radiation workers specified in 238-36: Operational Radiation Protection Requirements shall be complied with.

6. RECORDS AND REPORTS

6.1 Records and reports relating to radiation dosimetry shall be established, implemented, retained, maintained and made available for reference.

6.2 Records and reports relating to radiation dosimetry shall be submitted to the relevant regulator at predetermined periods as required.

6.3 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 radiation dosimetry.

6.4 Radiation exposures in excess of the dose limitation shall be investigated, recorded and reported to the relevant regulator.

6.5 A person terminating work as a radiation worker shall be provided with a summary of the applicable dosimetry information contained in the dose register.

7. ACCEPTANCE:

This following people were informed of the request submitted to the National Nuclear Regulator (NNR) via letter K-28414-E and the NNR response via letter k28414N relating to implementation of administrative changes to this document.

Name	Designation
Anari van Greuning	Hendrina Acting Power Station Manager
Avi Singh	Peaking Cluster General Manager
Bonga Mashazi	Kusile Power Station Manager
Douglas Woodhall	Corporate Consultant
Jurie Pieterse	Komati Acting Power Station Manager
Justice Bore	Camden Power Station Manager
Londi Mthembu	Majuba Power Station Manager
Lourence Chauke	Duvha Power Station Manager
Lukhanyo Ndube	Kendal Power Station Manager
Marcus Nemadodzi	Arnot Power Station Manager
Maserati Lesolang	Matla Power Station Manager
Morongwe Raphasha	Kriel Power Station Manager
Nomawethu Mtwebana	Koeberg Nuclear Power Station Manager (Acting)
Obakeng Mabotja	Matimba Power Station Manager
Refilwe Langa	Koeberg Nuclear Power Station Radiation Protection Manager
Riedewaan Bakardien	Nuclear Cluster Chief Nuclear officer
Sello Mametja	Tutuka Power Station Manager
Solly (Yangaphe) Ngcashi	Lethabo Power Station Manager
Tertius Karsten	Chief Physicist
Tshepiso Temo	Grootvlei Power Station Manager
Zweli Witbooi	Medupi Acting Power Station Manager

8. REVISIONS

Date	Rev.	Compiler	Remarks
March 2022	1	M Maree	Administrative changes implemented in accordance with letter k28414N dated, 22 March 2022.
December 2019	0B	M Maree	NNR approval via letter k26060N dated 6 December 2019 for extension of review date from October 2019 to May 2020.
September 2018	0A	M Maree	NNR approval via letter k24608N dated, 4 September 2018 for implementation of administrative changes.
March 2012	0	M Maree	NNR approval via letter k20275N dated, 12 March 2012 for implementation of Radiation Protection Standards.

9. DEVELOPMENT TEAM

This document has been developed by Marc Maree.

10. ACKNOWLEDGEMENTS

- E Flanagan
- K Featherstone
- MV Moduka