International Standard

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Radiological protection — Procedures for monitoring the dose to the lens of the eye, the skin and the extremities

Radioprotection — Procédures pour la surveillance des doses au cristallin, à la peau et aux extrémités

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 2, *Radiological protection*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 430, *Nuclear energy, nuclear technologies, and radiological protection,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 15382:2015), which has been technically revised.

The main changes are as follows:

— addition of neutron radiation;

— reference to up-to-date standards on reference radiation fields;

— clarification and extension of several procedures;

— extension of dosimetry procedures at nuclear power plants including indirect eye lens dosimetry.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The human body shall be protected from harmful effects of exposure to ionizing radiation, internally and externally. Effective dose limits keep the occurrence of stochastic effects to an “acceptable” level, while protection from tissue reactions (i.e. deterministic effects) is provided by dose limits for specific organs. The human skin shall be protected from external tissue reactions, such as erythema and ulceration. For the lens of the eye, there is the risk of radiation induced cataract at elevated exposures. To protect the skin of the whole body, the extremities, and the lens of the eye, separate dose limits are recommended by the International Commission on Radiological Protection (ICRP). These separate dose limits are needed because, in case of localized exposures, the equivalent doses to the skin and the lens of the eye could exceed these limits even if the effective doses were lower than the limit. Specific dosimetry is needed to monitor these doses and to assess compliance with applicable limits.

There are some situations where the correct assessment of the exposure of the skin, extremities, and lens of the eye can be challenging. In the nuclear sector, there can be exposure due to weakly penetrating radiation caused by unshielded unsealed radioactive sources, or by working in glove boxes. These types of exposure can occur, in particular in connection with contamination. Exposure to weakly penetrating radiation from radioactive noble gases in room air also shall be considered. In the medical field, doses to extremities and doses to the lens of the eye could occur during interventional procedures and in nuclear medicine.

Monitoring the extremities and the lens of the eye is not always straightforward, and many practical problems can arise for the application of monitoring in the workplace, due to issues such as geometry, resulting in an unsuitable monitoring situation. This document provides guidance on how and when this monitoring should be done, for all the different types of workplace fields. This document is directed to all who are involved in the dosimetry of the skin, extremities, and the lens of the eye; for example: radiation protection officers, regulators, workers, dosimetry services, etc.

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Radiological protection — Procedures for monitoring the dose to the lens of the eye, the skin and the extremities

1 Scope

This document provides procedures for monitoring the dose to the skin, the extremities, and the lens of the eye. It gives guidance on how to decide if such dosemeters are needed and to ensure that individual monitoring is appropriate to the nature of the exposure, taking practical considerations into account.

This document specifies procedures for individual monitoring of radiation exposure of the skin of the body, extremities (skin of the hands, fingers, wrists, forearms including elbow, lower leg including patella, feet and ankles), and lens of the eye in planned exposure situations. It covers practices which involve a risk of exposure to photons in the range of 8 keV to 10 MeV, electrons and positrons in the range of 0,07 MeV to 1,2 MeV mean beta energies being equivalent to 0,22 MeV and 3,6 MeV beta maximum energy - in accordance to the ISO 6980 series, and neutrons in the range of thermal to 20 MeV.

This document gives guidance for the design of a monitoring programme to ensure compliance with legal individual dose limits. It refers to the appropriate operational dose quantities, and it gives guidance on the type and frequency of individual monitoring and the type and positioning of the dosemeter. Finally, different approaches to assess and analyse skin, extremity, and lens of the eye doses are given.

It is not in the scope of this document to consider exposure due to alpha radiation fields.

NOTE 1 The requirements for the monitoring of the occupational exposure may be given in national regulations.

NOTE 2 Dose to the lens of the eye due to intake of tritium is not in the scope of this document. Moreover, the situation of the workers that work in contaminated atmosphere and can have alpha and/or radon eye lens dose is also not in the scope.

2 Normative references

The following documents are referred to in the text in such a way that some or all their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 18090-1, *Radiological protection — Characteristics of reference pulsed radiation — Part 1: Photon radiation*

IEC 62387, *Radiation protection instrumentation — Dosimetry systems with integrating passive detectors for individual, workplace and environmental monitoring of photon and beta radiation*

IEC 60846-1, *Radiation protection instrumentation — Ambient and/or directional dose equivalent (rate) meters and/or monitors for beta, X and gamma radiation — Part 1: Portable workplace and environmental meters and monitors*

IEC 61526, *Radiation protection instrumentation - Measurement of personal dose equivalents for X, gamma, neutron and beta radiations - Active personal dosemeters*

ISO 14146, *Radiological protection — Criteria and performance limits for the periodic evaluation of dosimetry services for external radiation*

IEC 61331-3, *Protective devices against diagnostic medical X-radiation — Part 3: Protective clothing, eyewear and protective patient shields*

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ISO 4037-1, *Radiological protection — X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy — Part 1: Radiation characteristics and production methods*

ISO 4037-2, *Radiological protection — X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy — Part 2: Dosimetry for radiation protection over the energy ranges from 8 keV to 1,3 MeV and 4 MeV to 9 MeV*

ISO 4037-3, *Radiological protection — X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy — Part 3: Calibration of area and personal dosemeters and the measurement of their response as a function of energy and angle of incidence*

ISO 4037-4, *Radiological protection — X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy — Part 4: Calibration of area and personal dosemeters in low energy X reference radiation fields*

ISO 6980-1, *Nuclear energy — Reference beta-particle radiation — Part 1: Methods of production*

ISO 6980-2, *Nuclear energy — Reference beta-particle radiation — Part 2: Calibration fundamentals related to basic quantities characterizing the radiation field*

ISO 6980-3, *Nuclear energy — Reference beta-particle radiation — Part 3: Calibration of area and personal dosemeters and the determination of their response as a function of beta radiation energy and angle of incidence*

ISO 8529-1, *Neutron reference radiations fields — Part 1: Characteristics and methods of production*

ISO 8529-2, *Reference neutron radiations — Part 2: Calibration fundamentals of radiation protection devices related to the basic quantities characterizing the radiation field*

ISO 8529-3, *Neutron reference radiation fields — Part 3: Calibration of area and personal dosemeters and determination of their response as a function of neutron energy and angle of incidence*

IEC 61005, *Radiation protection instrumentation — Neutron ambient dose equivalent (rate) meters*

ISO 21909-1, *Passive neutron dosimetry systems — Part 1: Performance and test requirements for personal dosimetry*

ISO 21909-2, *Passive neutron dosimetry systems — Part 2: Methodology and criteria for the qualification of personal dosimetry systems in workplaces*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Individual monitoring

4.1 Quantities

Skin and extremities monitoring involves the measurement of $H_p(0,07)$, the estimator of the equivalent dose to the skin.

Based on the International Commission on Radiation Units and Measurements (ICRU) definitions, lens of the eye monitoring involves the measurement of $H_p(3)$, the estimator of the equivalent dose to the lens of the eye. If the radiation field is well known, $H_p(3)$ can be estimated by the use of dosemeters type tested and calibrated in terms of other quantities, i.e., $H_p(0,07)$ and $H_p(10)$ (this latest being the estimator of the

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