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Radiological protection — Content of input data for the statistical analysis of dose records of individuals monitored for occupational exposure to ionizing radiation

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Foreword

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This document was prepared by Technical Committee ISO/TC *85 Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 2, *Radiological protection*.

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.

Introduction

Occupational exposure to ionizing radiation can occur in a range of industries, medical institutions, educational and research establishments, and nuclear fuel cycle facilities. It can also occur in workplaces with naturally occurring sources of radiation such as for underground miners to radon and aircrew to cosmic radiation. Radiation emergencies can also result in worker exposure.

The aim of an occupational radiation exposure records system is the collection and maintenance of comprehensive and accurate individual radiation exposure histories with supporting documentation. Maintaining the records in a consistent format, while considering the ease of retrieval allows for:

— evaluating the effectiveness of radiological controls;

— demonstrating that radiological controls comply with national legislative and regulatory requirements and management expectations;

— reconstructing exposure situations for medical, legal or epidemiological studies.

Recommendations of international expert bodies have been considered in the development of this document. Its application will provide the national regulatory bodies with information on recording and reporting of workers dosimetric results and will enhance the harmonization of a common and easily shared format to collect reliable and directly comparable data on individual and collective exposure in activity sectors and occupations.

Assessment of occupational exposure and evaluation of trends of these data over time is a fundamental tool for radiation protection of workers in terms of optimization of protection in line with the graded approach and dose limitation. Maintaining of life-time dose data of the occupationally exposed workers is also necessary to ensure and review radiation protection of workers, certification and other legal purposes and epidemiological studies.

Radiological protection — Content of input data for the statistical analysis of dose records of individuals monitored for occupational exposure to ionizing radiation

1 Scope

The objective of this document is to promote the harmonization of data and information reporting formats in order to provide the basis for the evaluation of occupational exposure with a view to allow for benchmarking capacity at the user level, technical review level, country level and global level (such as UNSCEAR) database or register on occupational exposure. Activity sectors and occupations (where employees are classified as occupationally exposed workers) that is included in this database or register as well as dose types and different values of interest concerning occupational exposure are described as follows.

A typical national dose register (NDR):

— contains personal, employment, and dosimetric data of occupational employment and wage statistics (OEWs) in the country.

— assists national authorities in controlling and safekeeping of the occupational doses and to allow statistical evaluations (e.g., dose trends to answer requests from regulators and others).

— assists in regulatory control by notifying regulatory authorities of overexposures within their jurisdiction and the licensee in their respective facility.

— contributes to health research and to the scientific knowledge on risks from occupational exposure to ionizing radiation.

— provides dose histories to individual workers and organizations for work planning and for compensation and litigation cases.

All information provided by the NDR, including dose histories, may be subject to confidentiality requirements.

This document is aimed at National Dose Registries but may be also applicable to dosimetry services that provide data to national dose registries.

NOTE Such a database or register on occupational radiation dose for different sectors will, among other reasons, allow to prepare the data necessary for more global surveys, such as those undertaken by the UNSCEAR and other databases such as IAEA's Information System on Occupational Exposure in Medicine, Industry and Research (ISEMIR), Information System on Occupational Exposure (ISOE) and the European Platform for Occupational Radiation Exposure (ESOREX-Platform). Presently, as the formats are different, the international description of national statistics is often incomplete or inaccurate, and in the end, the comparison of data is not established yet in many countries. This standard defines a common and easily shared format to collect reliable, traceable and directly comparable data on individual and collective exposure in activity sectors and occupations as defined in a common way.

This document addresses:

a) a common list of activity sectors and occupations, and

b) a common and easily shared format about dose types and different values of interest concerning occupational exposure in order to collect consistent and directly comparable data on individual and collective exposure.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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/

3.1 General terms and definitions

3.1.1
occupational exposure
exposure of workers incurred in the course of their work

[SOURCE: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards - IAEA Safety Standards Series GSR Part 3, 2014]

3.1.2
monitored worker
workers routinely monitored externally, internally or in combination for radiation exposure individually or by workplace monitoring

3.1.3
measurably exposed worker
worker with doses above the minimum detectable level

3.1.4
recording level
level of dose, exposure or intake specified by the regulatory body at or above which values of dose to, exposure of or intake by workers are to be entered in their individual exposure records

[SOURCE: IAEA. IAEA safety glossary: 2018 edition. Vienna: IAEA, 2019. 278 p.]

3.1.5
sector
generic field of activity of workers

3.1.6
sub-sector
more specific designation of *sector* (3.1.5)

3.1.7
emergency exposure situation
situation of exposure that arises as a result of an accident, a malicious act or other unexpected event, and requires prompt action in order to avoid or to reduce adverse consequences

[SOURCE: IAEA. IAEA safety glossary: 2018 edition. Vienna: IAEA, 2019. 278 p]

3.1.8
planned exposure situation
situation of exposure that arises from the planned operation of a source or from a planned activity that results in an exposure due to a source

Note 1 to entry: Exposure in an emergency can include both occupational exposure and public exposure and can include unplanned exposures resulting directly in the emergency exposure situation and planned exposures to emergency workers and helpers in an emergency undertaking actions to mitigate the consequences of the emergency.

Note 2 to entry: Exposure in an emergency can be reduced only by protective actions and other response actions.

[SOURCE: IAEA. IAEA safety glossary: 2018 edition. Vienna: IAEA, 2019. 278 p]

3.1.9
existing exposure situation
situation of exposure that already exists when a decision on the need for control needs to be taken

Note 1 to entry: Existing exposure situations include exposure to natural background radiation that is amenable to control; exposure due to residual radioactive material that derives from past practices that were never subject to regulatory control; and exposure due to residual radioactive material deriving from a nuclear or radiological emergency after an emergency exposure situation has been declared ended.

[SOURCE: IAEA. IAEA safety glossary: 2018 edition. Vienna: IAEA, 2019. 278 p]

3.1.10
workplace monitoring
radiological monitoring using measurements made in the working environment

[SOURCE: ISO 12749-2:2022, 3.4.53]

3.2 Quantities

3.2.1
personal dose equivalent
$H_p(d)$
dose equivalent in soft tissue, at an appropriate depth, *d*, below a specified point on the body

Note 1 to entry: The SI unit of the personal dose equivalent is joule per kilogram ($J \cdot kg^{-1}$), known as sievert (Sv).

Note 2 to entry: The full specification of the personal dose equivalent includes the specification of the depth, d, expressed in millimetres.

Note 3 to entry: Soft tissue in this context is ICRU 4-element tissue with a density of 1 $g \cdot cm^{-3}$.

Note 4 to entry: For the estimation of the local skin dose, a depth of 0,07 mm is employed. The personal dose equivalent for this depth is then denoted by $H_p(0,07)$. The dose equivalent to an extremity (such as hand, forearm, foot and ankle) is denoted by $H_p(0,07)$. The dose equivalent at 10 mm depth is denoted with analogous notation $H_p(10)$. For the lens of the eye, a depth of 3 mm is employed with analogous notation $H_p(3)$.

Note 5 to entry: In the ICRU Report 47, ICRU has extended the definition of the personal dose equivalent to include the dose equivalent at a depth, d, in a phantom having the composition of the ICRU tissue. Then $H_p(d)$, for the calibration of personal dosimeters, is the dose equivalent at d in a phantom composed of ICRU tissue, but of the size and shape of the phantom used for the calibration.

Note 6 to entry: The personal dose equivalent rate is the dose equivalent rate in soft tissue below a specified point on the body at an appropriate depth, d. The unit is sievert per second ($Sv \cdot s^{-1}$). Other units are any quotient of the sievert or its decimal multiples and a suitable unit of time (e.g. $mSv \cdot h^{-1}$).

[SOURCE: ICRU Report 51]

3.2.2
personal dose equivalent at 10 mm depth
$H_p(10)$
dose equivalent in soft tissue at a depth of 10 mm below a specified point where the dosimeter is worn/mounted, i.e., on the human body or a calibration phantom

[SOURCE: ICRP 103:2007]

3.2.3
ambient dose equivalent at 10 mm depth
$H^*(10)$
dose equivalent at a point in a radiation field, that would be produced by the corresponding expanded and aligned field, in the ICRU sphere at 10 mm depth on the radius opposing the direction of the aligned field

[SOURCE: ISO 20785-4:2019, 3.16, modified — "at 10 mm depth" has been added in the term.]

3.2.4
collective effective dose
total radiation dose incurred by a specified group of persons (e.g. a population summation of "effective dose")

Note 1 to entry: The value of this quantity is equal to the product of the number of individuals exposed to a radiation source and their average radiation dose.

Note 2 to entry: The collective dose is expressed in person-sievert.

Note 3 to entry: This entry was numbered 393-19-08 in IEC 60050-393:2003.

3.2.5
average dose monitored
collective effective dose (3.2.4) divided by the total number of workers routinely monitored for radiation exposure, in units of mSv

3.2.6
average dose above recording level
collective effective dose (3.2.4) divided by the number of workers with doses above the recording level, in units of mSv

3.2.7
internal dose
dose from internal emitters calculated with biokinetic and dosimetric models, in units of mSv

Note 1 to entry: dose caused by contamination of the skin is considered an internal or external dose

3.2.8
external dose
dose from penetrating external radiation fields

EXAMPLE photons and neutrons

Note 1 to entry: expressed using the personal dose equivalent $H_p(10)$

3.2.9
effective dose
summation of doses from internal emitters and external radiation fields estimated using personal dose equivalent at 10 mm depth, $H_p(10)$ (3.2.1) or ambient dose equivalent at 10 mm depth, $H^*(10)$ (3.2.3), or from internal emitters only, to provide a single numerical value, in units of mSv

3.2.10
equivalent dose
absorbed dose to an organ or tissue T, adjusted to account for the effectiveness of the type of radiation, in units of mSv

Note 1 to entry: equivalent dose to the skin and an extremity is estimated using personal dose equivalent $H_p(0,07)$, in units of mSv

Note 2 to entry: equivalent dose to the lens of the eye is estimated using personal dose equivalent, $H_p(3)$, but also $H_p(0,07)$ or $H_p(10)$ according to ISO 15382, in units of mSv

Note 3 to entry: equivalent dose to a tissue is estimated using personal dose equivalent (H_T), in units of mSv

3.2.11
committed effective dose
time integral of the equivalent dose rate over an integration period, which, in the context of this International Standard, is 50 years following any intake

4 Description of the nature of the exposure and classification list of activity sectors

The concept is to include non-exclusive classification identifiers for workers in order to characterise the nature of their exposure and the sectors/occupations associated with it (see Annex A).

Firstly, the data field describes the nature of the exposure and the method of its determination. It designates the exposure situation, the method used for the determination of a given record, the dose type and the exposure pathway. The type of radiation (alpha, photon, neutron etc.) is optional information that could be also provided.

Next, the classification list of activity sectors proposed is based on a three-level coding system.

The 1st level identifies the sector of activity concerned. Six sectors are defined:

— medical;

— nuclear;

— industrial;

— workplaces with natural radiation sources;

— military activities;

— others.

The 2nd level provides increasingly detailed information on the sub-sectors.

The 3rd level provides occupation for each of the five sectors (see Annex B).

If a worker works in several sub-sectors or performs several tasks or occupations, it shall be classified preferentially in the most dosing sub-sector or the most dosing occupation. Only annual dose for each worker should be supplied (see Annex C for an example of a dose record for a worker).

5 Description of dose types

The database or national dose registry report:

a) the doses for radiological protection purposes:

   — effective dose;