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Item 1657

REGULATION OF THE COUNCIL OF MINISTERS

of 11 August 2021

on indicators enabling the determination of ionizing radiation doses used when assessing exposure to ionizing radiation[1]

Pursuant to Art. 25 Item 1 of the Act of 29 November 2000—Atomic Law (Dz. U. 2021 items 623 and 784), it is ordered as follows:

§ 1. The regulation shall lay down indicators enabling the determination of ionizing radiation doses used when assessing exposure, as well as the manner and frequency of making exposure assessments for:

1) workers;

2) members of the public.

§ 2. 1. The exposure of workers and members of the public shall be assessed by determining effective doses and equivalent doses, taking into account the magnitude and values of indicators enabling the determination of ionizing radiation doses used when assessing exposure to ionizing radiation.

2. The magnitudes and values of indicators enabling the determination of ionizing radiation doses used when assessing exposure to ionizing radiation shall be laid down in an appendix to the regulation.

3. When the effective doses and equivalent doses mentioned in Section 1 are established, they shall be reduced by ionizing radiation doses resulting from natural background ionizing radiation present in a given area, taking into account the actual time of exposure to ionizing radiation. If natural background ionizing radiation is unknown, its value shall be assumed as 2.4 mSv for the effective dose during a calendar year.

4. The determination of ionizing radiation doses for workers shall be performed based on dosimetric measurements.

5. The determination of ionizing radiation doses for members of the public shall include:

1) an estimate of ionizing radiation doses related to external irradiation, taking into account the type and energy of ionizing radiation;

[1]Within the scope of its regulation, the present regulation implements Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionizing radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom (Official Journal of the EU L 13 of 17 January 2014, p. 1, Official Journal of the EU L 72 of 17 March 2016, p. 69, Official Journal of the EU L 152 of 11 June 2019, p. 128, and Official Journal of the EU L 324 of 13 December 2019, p. 80).

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2) an estimate of penetration of radioactive substances into the body, taking into account the type of isotopes, their activity and concentration, and—where necessary—their physical and chemical state.

6. In the case of activities which can lead to releases of radioactive substances into the environment, ionizing radiation doses shall be established for groups of members of the public, whose exposure from a source of ionizing radiation related to an activity using artificial or natural sources of ionizing radiation may be deemed representative for a population which is the most exposed to this source of ionizing radiation, hereinafter: the ‘reference groups’.

7. When determining ionizing radiation doses for a reference group, behaviors typical for the people from this group shall be taken into account.

8. When laying down criteria for choosing the reference groups, the characteristic features of these groups, and the frequency of establishing ionizing radiation doses for reference groups, the predicted magnitude of ionizing radiation doses for people from the reference groups shall be taken into account along with their exposure pathways.

9. When making an exposure assessment, as mentioned in Art. 24 of the Act of 29 November 2000—Atomic Law, the assessment results for ionizing radiation doses shall be recorded for reference groups along with the criteria for choosing the reference groups and the characteristic features of these groups, as mentioned in Section 8.

§ 3. 1. The assessments of exposure of workers to ionizing radiation shall be made for each calendar year by establishing ionizing radiation doses based on dosimetric measurements, as mentioned in § 2 Section 4, performed in periods no longer than three months, and if the period of employment under the conditions of exposure is shorter than three months—after the end of this period.

2. The assessments of exposure of members of the public to ionizing radiation shall be made once per year.

3. Under the conditions of a radiation emergency, an assessment of the exposure of workers and members of the public to ionizing radiation shall be made with a frequency enabling the determination of measures and actions which are necessary for health protection.

§ 4. The regulation shall enter into force 14 days after its promulgation.[2]

Prime Minister: *M. Morawiecki*

[2]The present regulation was preceded by Regulation of the Council of Ministers of 18 January 2005 on ionizing radiation dose limits (Dz. U. item 168), which in accordance with Art. 37 Section 1 Item 2 of the Act of 13 June 2019 amending the Act - Atomic Law and the Act on Fire Protection (Dz. U. item 1593, and 2020 item 284) shall become repealed on the day when the present regulation enters into force.

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Appendix to Regulation of the Council of Ministers
of 11 August 2021 (item 1657)

THE MAGNITUDES AND VALUES OF INDICATORS ENABLING THE DETERMINATION OF IONIZING RADIATION DOSES USED WHEN ASSESSING EXPOSURE TO IONIZING RADIATION

1. The effective dose E, expressed in sieverts (Sv), is determined by the formula:

$$E = \sum_T w_T \sum_R w_R D_{T,R}$$

where:

$D_{T,R}$—stands for the absorbed dose, expressed in grays (Gy), in a tissue or an organ T, delivered by radiation type R,

w_R—stands for the radiation weighting factor R (table 1); in the case when the type of radiation or its energy are not specified in table 1 or are unknown, the approximated value of the radiation weighting factor w_R can be assumed as the averaged value of the radiation quality factor Q at a depth of 10 mm in the ICRU sphere[3], determined by the formula:

$$Q = \frac{1}{D} \int_{L=0}^{\infty} Q(L) D_L dL$$

where:

D—stands for the absorbed dose, expressed in grays (Gy), at the point of averaging the values of Q,

L—stands for unrestricted linear energy transfer per one micrometer of a charged particle path in water, expressed in kiloelectron volts per micrometer (keV/µm),

$D_L dL$—stands for the absorbed dose at the examined point with unrestricted linear energy transfer between L and $L + dL$,

$Q(L)$—stands for the radiation quality factor at the examined point, dependent on the value of L:

$Q(L) = 1$ if $L < 10$ keV/µm,

$Q(L) = 0.32L - 2.2$ if 10 keV/µm $\leq L \leq 100$ keV/µm,

$Q(L) = 300\sqrt{L}$ if $L > 100$ keV/µm,

w_T—stands for the weighting factor of a tissue or an organ T (table 2).

2. The effective dose E received within the specified time is determined by summarizing the effective dose from external exposure E_z received during that time and the committed effective doses caused by penetration of radioactive isotopes into the body, received over the same time. The effective dose E, expressed in sieverts (Sv), for a person in an age group g, is determined by the formula:

$$E = E_z + \sum_j e(g)_{j,p} J_{j,p} + \sum_j e(g)_{j,o} J_{j,o}$$

where:

$e(g)_{j,p}$ and $e(g)_{j,o}$—stand for the committed effective dose for workers or members of the public with unit penetration of their body by a radioactive isotope j by ingestion or inhalation, respectively (tables 3–7), depending on the manner in which the isotope penetrates into the digestive tract, and from the

[3]A sphere made of a tissue equivalent material, with a diameter of 30 cm and a density of 1 g/cm3, whose mass composition is: 76.2% oxygen, 11.1% carbon, 10.1% hydrogen, and 2.6% nitrogen.

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digestive tract into body fluids, determined by the value of the f_i factor (tables 8–9), and on the type of absorption of the isotope by the lungs (V—very fast, F—fast, M—moderate, S—slow absorption rate),

$J_{j,\,p}$ and $J_{j,\,o}$—stand for the activity of a radioactive isotope j which has penetrated the body by ingestion or inhalation, respectively.

3. If noble gases, except radon present in the air, constitute the source of exposure, the value of the effective dose, expressed in sieverts (Sv), is determined as a product of the relevant conversion factor (table 10), the time-averaged activity concentration of the isotope, expressed in becquerels per cubic meter (Bq/m^3), and the time of staying in the gas cloud, expressed in days (d).

4. If radon and its progeny present in the air constitute the source of internal exposure, the committed effective dose is determined by measuring or calculating potential alpha energy as the total energy of alpha particles emitted during decay of the radon progeny Rn-222 in the decay chain up to lead Pb-210 (excluding this isotope), and the decay of the thoron progeny Rn-220 in the decay chain up to lead Pb-208, expressed in joules (J). The value of the committed effective dose, expressed in sieverts (Sv), is determined as a product of the concentration of potential alpha energy, expressed in joules per cubic meter (J m^{-3}), the time of exposure, expressed in hours (h), and a proper conversion factor:

radon in a residential house	1.1 Sv/J h m^{-3},
radon at a workstation	1.4 Sv/J h m^{-3},
thoron at a workstation	0.5 Sv/J h m^{-3}.

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TABLE 1. VALUES OF THE RADIATION WEIGHTING FACTOR (w_R)

Type of radiation (R)	Radiation weighting factor (w_R)[1)]
Photons	1
Electrons and muons	1
Protons and charged pions	2
Alpha particles, fission fragments, heavy ions	20
Neutrons, $E_n < 1$ MeV	$2{,}5 + 18{,}2e^{-[\ln(E_n)]^2/6}$
Neutrons, 1 MeV $\leq E_n \leq$ 50 MeV	$5{,}0 + 17{,}0e^{-[\ln(2E_n)]^2/6}$
Neutrons, $E_n >$ 50 MeV	$2{,}5 + 3{,}25e^{-[\ln(0{,}04E_n)]^2/6}$

[1)] All the values are applicable to the case of irradiation of the body by external ionizing radiation, or radiation emitted by radioactive isotopes inside the body. When determining the values of the neutron radiation weighting factor, the energy E_n should be expressed in megaelectron volts (MeV).

TABLE 2. VALUES OF THE WEIGHTING FACTOR OF A TISSUE OR AN ORGAN (w_T)

Tissue or organ (T)	The weighting factor of a tissue or an organ (w_T)
Mammary glands	0.12
Lungs	0.12
Colon	0.12
Other tissues[2)]	0.12
Bone marrow (red)	0.12
Stomach	0.12
Gonads	0.08
Bladder	0.04
Esophagus	0.04
Thyroid	0.04
Liver	0.04
Salivary glands	0.01
Brain	0.01
Bone surface	0.01
Skin	0.01

[2)]The remaining tissues are: the adrenal glands, the area of the upper respiratory tract, the gallbladder, the heart, the kidneys, the lymph nodes, the muscles, the oral mucosa, the pancreas, the prostate (men), the small intestine, the spleen, the thymus, and the uterus/cervix (women). The value $W_T = 0.12$ is used for an arithmetic mean of doses for the 13 tissues and organs listed above for each gender.