RULEBOOK

ON LIMITS OF RADIONUCLIDES CONTENT IN DRINKING WATER, FOODSTUFFS, FEEDING STUFFS, MEDICINES, GENERAL USE PRODUCTS, CONSTRUCTION MATERIALS AND OTHER GOODS THAT ARE PUT ON MARKET

("Official Gazette of Republic of Serbia", no. 86/2011 and 97/2013)

Article 1

This rulebook prescribes limits of radionuclides content in drinking water, foodstuffs, feeding stuffs, medicines, general use products, construction materials and other goods that are put on market.

Article 2

It is prohibited to intentionally add radionuclides into drinking water, foodstuffs, feeding stuffs, toys, personal hygiene products, face and body products and jewellery in production process.

It is prohibited to import and export goods under paragraph 1 of this Article that have intentionally added radionuclide.

Article 3

Certain terms used herein shall have the following meanings:

1. Activity (A): activity A of certain amount of radionuclides in a given energy state at a given point in time is defined as:

\[ A = \frac{dN}{dt} \]

where \( dN \) is the expected value of the number of spontaneous nuclear transformations of a given energy level in the time interval \( dt \). Unit for activity is becquerel [Bq];

2. Becquerel (Bq) is the name for unit of activity. One becquerel is equivalent to one decomposition per second: \( 1 \text{ Bq} = 1 \text{ s}^{-1} \);

3. Artificial sources are sources of ionizing radiation which are not of natural origin;
4. The annual limit of intake (GGU), for a given individual is radionuclides activity that would by body intake produce the expected dose equal to prescribed dose limits;

5. Gray (Gy) is the name for the unit of absorbed dose. One gray is equivalent to one joule per kilogram: 1 Gy = 1 J kg⁻¹;

6. The derived concentrations of radionuclides in the living environment are limit values of environmental contamination that are based on standardised models derived from primary or secondary limits, use of which provides that prescribed limits are not exceeded;

7. Natural sources of radiation are sources of ionizing radiation of natural earth or cosmogenic origin;

8. Foodstuff is any substance or product, whether processed, partially processed or unprocessed and intended for human consumption, or can reasonably be expected to be used for human consumption, except feeding stuffs for animals that are not used for foodstuffs production, livestock, if they are not prepared to be put on market for human consumption, plants prior harvesting, picking or harvesting fruits, medical products, cosmetic products, tobacco and tobacco products, narcotic or psychotropic substances, remains (residues) and contaminants. Foodstuff is also a drink, chewing gum and any substance intentionally added to foodstuffs during preparation, processing or production;

9. General use products in terms of this rulebook are:
   1) dishes, utensils, facilities, devices and wrapping material for foodstuffs;
   2) children's toys;
   3) personal hygiene products, face and body products and packaging for these items;
   4) cleaning products;
   5) tobacco, tobacco products and smoking accessories;
   6) the specific items that with use come into direct contact with skin or mucous tissues.

10. Sievert is the unit for equivalent or effective dose. One sievert is equivalent to one joule per kilogram: 1 Sv = 1 J kg⁻¹.

**Article 4**

The limits of the radionuclides content in drinking water, foodstuffs, feeding stuffs, medicines, construction materials and other goods that are put on market are constrained by limits of annual intake of radionuclides in the human body by breathing (inhalation - GGU吸入) and nutrition (ingestion - GGU摄) as well with derived concentrations of radionuclides in the environment (IK), according to Rulebook on the limits of radioactive contamination of persons, work and living environment and methods of decontamination.

**Article 5**
The derived concentrations of radionuclides in drinking water, $IK_v$, for population are calculated as follows:

$$IK_v = GD \cdot e(g)_{\text{mg,n}} \cdot V_v$$

where:

GD – is the limit value of effective dose for individual from the population. For the calculation of derived concentration of radionuclides in drinking water, the value of 0.1 mSv/year is taken as GD value;

$V [l]$ – is the average annual intake of drinking water per habitant (730 l).

Contribution to the effective dose that comes from the input of tritium $^3$H, potassium $^{40}$K, radon $^{222}$Rn and toron $^{220}$Rn and radon progenies in drinking water is not included in the limit value of effective dose of 0.1 mSv / year.

Limit value of $^3$H activity in drinking water is 100 Bq/l. Limit value of total activity of alpha-emitting unstable radionuclides is 0.5 Bq/l. Limit value of the total activity of beta-emitting unstable radionuclides is 1 Bq/l.

If the measured value of the total alpha activity or the total beta activity in drinking water is above the values specified in paragraph 3 of this Article, the identification and determination of content of individual radionuclides should be done. Drinking water may not be prohibited for use on the basis of measured values of total alpha or total beta activities, if the content of individual radionuclides is not determined.

The derived concentrations of individual radionuclides in drinking water are set forth in Table 1, which comes with this rulebook as its integral part.

**Article 6**

Derived concentration of radionuclides in foodstuffs, $IK_n$, for the population is calculated as follows:

$$IK_n = GD \cdot e(g)_{\text{mg,n}} \cdot m$$

where:

GD – is the limit value of effective dose per individual from the population. For the calculation of derived concentration of radionuclides in foodstuffs that is represented at the highest percentage in nutrition (vegetables, fruits, grains, meat and meat products, eggs, milk and dairy
products, lard, oil, sugar, coffee, confectionery, alcoholic and non-alcoholic drinks) for GD the value of 0.1 mSv/year is taken;

m [kg] – is the amount of foodstuffs that an inhabitant takes in one year.

**Article 7**

The limit of the $^{137}$Cs content in milk and dairy products, baby food, vegetables, fruits, grains, meat and meat products, eggs and other foodstuffs such as lard, oil, sugar, coffee, confectionery, alcoholic and non-alcoholic drinks is 15 Bq/kg, that is 15 Bq/l.

The limit of the $^{137}$Cs content in milk powder, forest fruits (fresh blueberries, cranberries), wildlife, fish, seafood, medicinal herbs and teas and mushrooms (fresh mushrooms and mushroom products) is 150 Bq/kg, that is 150 Bq/l.

The limit of the $^{137}$Cs content in dry mushrooms, aromas, spices and other ingredients that are used less than 2 kg per inhabitant a year is 600 Bq/kg, that is 600 Bq/l.

**Article 8**

The limits of the radionuclide content in water for animals are the same limits that are prescribed for drinking water.

The limits of the radionuclide content in feeding stuffs are equal to the prescribed limits of the radionuclide content in foodstuffs.

**Article 9**

The limits of the radionuclide content in medicines are the same as the prescribed limits of contamination in drinking water. For medicines in solid state, limits of contamination are equal to prescribed limits of contamination in drinking water, expressed in Bq/kg, where volume of 1 litre of drinking water is replaced with mass of 1 kg.

The provisions of paragraph 1 of this Article shall not apply to radiopharmaceutical products.

**Article 10**

The limits of the radionuclide content in products for personal hygiene, face and body products and children’s toys are the same limits prescribed for drinking water.

**Article 11**

Limits content of total activity of alpha unstable radionuclides in dried tobacco and tobacco-processed products is 37 Bq/kg.

**Article 11a**

Limiting content of natural radionuclides in mineral phosphate fertilizers is:
1) to uranium (238U)
   - 1600 Bq/kg, for mineral fertilizers containing macronutrient element phosphorus, which as such is placed on the market and applied,
   - 3200 Bq/kg, and the raw materials for the production of mineral fertilizers containing phosphorus macronutrient element;
2) the radium (226Ra) 1000 Bq/kg, and the mineral fertilizers containing macronutrient element phosphorus, which is placed as such on the market and are applied, as well as the raw materials for their production;
3) of potassium (40K): 27000 Bq/kg, and the mineral fertilizers containing macronutrients elements potassium and/or phosphorus, which is placed as such on the market and are applied, as well as the raw materials for their production.

Article 12
If goods that are put on market contain two or more known radionuclides, the limit of radionuclides content have to satisfy the following condition:

$$\sum K_n I_k \leq 1$$

Where are:

$K_n$ [Bq/l, Bq/kg] – concentration of radionuclide $n$ in goods that are put on market;

$IK_n$ [Bq/l, Bq/kg] – derived concentration of radionuclide $n$ in goods that are put on market.

Article 13
The limits of radionuclide content in construction material that is used in high construction for interior are:

for radium ($^{226}$Ra): $3 \cdot 10^2$ Bq/kg;

for thorium ($^{232}$Th): $2 \cdot 10^2$ Bq/kg;

for potassium ($^{40}$K): $3 \cdot 10^3$ Bq/kg.

Gamma index for construction materials in paragraph 1 of this Article, has to be less than 1, and is calculated as follows:
\[
I = \frac{C_{Ra}}{300} + \frac{C_{Th}}{200} + \frac{C_{K}}{3000}
\]

Where are:

\(C_{Ra}\) – concentration of radium (\(^{226}\)Ra) in Bq/kg;

\(C_{Th}\) – concentration of thorium (\(^{232}\)Th) in Bq/kg;

\(C_{K}\) – concentration of potassium (\(^{40}\)K) in Bq/kg.

**Article 14**

The limits of the radionuclide content in construction materials that are used in high construction for exterior are:

for radium (\(^{226}\)Ra): \(4 \times 10^2\) Bq/kg;

for thorium (\(^{232}\)Th): \(3 \times 10^2\) Bq/kg;

for potassium (\(^{40}\)K): \(5 \times 10^3\) Bq/kg.

Gamma index for construction materials from paragraph 1 of this Article cannot be greater than 1, and is calculated as follows:

\[
I = \frac{C_{Ra}}{400} + \frac{C_{Th}}{300} + \frac{C_{K}}{5000}
\]

Where are:

\(C_{Ra}\) – concentration of radium (\(^{226}\)Ra) u Bq/kg;

\(C_{Th}\) – concentration of thorium (\(^{232}\)Th) u Bq/kg;

\(C_{K}\) – concentration of potassium (\(^{40}\)K) u Bq/kg.

**Article 15**

Limits of the radionuclide content in construction materials that is used in civil engineering construction as a base for roads, playgrounds and other civil engineering construction (under the overlay layer) so that does not increase the intensity of the absorbed dose of gamma radiation in the air are:

for radium (\(^{226}\)Ra): \(7 \times 10^2\) Bq/kg;
for thorium \(^{232}\text{Th}\): \(5 \times 10^2\) Bq/kg;

for potassium \(^{40}\text{K}\): \(8 \times 10^3\) Bq/kg.

Gamma index for building materials from paragraph 1 of this Article cannot be greater than 1, and is calculated as follows:

\[
I = \frac{C_{\text{Ra}}}{700} + \frac{C_{\text{Th}}}{500} + \frac{C_{\text{K}}}{8000}
\]

Where are:

\(C_{\text{Ra}}\) – concentration of radium \(^{226}\text{Ra}\) in Bq/kg;

\(C_{\text{Th}}\) - concentration of thorium \(^{232}\text{Th}\) in Bq/kg;

\(C_{\text{K}}\) - concentration of potassium \(^{40}\text{K}\) in Bq/kg.

**Article 16**

Limits of the radionuclides content, whose half-life is longer than 60 days, in powder or liquid substances intended for general use and for which limit values are not set by the Rulebook on registration and notification of sources of ionizing radiation, are equal to the values that are ten times greater than the limits of radionuclide content in drinking water. Volume of 1 l of drinking water is replaced by a mass of 1 kg.

The limits of the radionuclide content, whose half-life is not longer than 60 days, in powder or liquid substances intended for general use, are equal to the values that are a hundred times greater than the limits of the radionuclide content in drinking water.

The limits of the radionuclide content in solid compact general use products are equal to the values that are a thousand times greater than the limits of the radionuclide content in drinking water, with the ambient dose rate equivalent of radiation arising from the examined product less than 1 μSv/h at a distance of 10 cm from its surface. At a distance of 1 m from the product surface the limit value of the ambient dose rate equivalent of radiation arising from the examined product is equal to the value that is for 0.1 μSv/h above than the background radiation value.

Regardless to the provisions of paragraph 1 and paragraph 2 of this Article, for the limits of naturally occurring radionuclides content the paragraph of the preceding Article applies.

**Article 17**

If the Serbian Radiation Protection and Nuclear Safety Agency has official information on accidents or other emergency radiological events, which indicate the possibility of contamination of foodstuffs by radionuclides, and if the circumstances request so, the limits apply to the
radionuclide content in foodstuffs listed in Table 2 and limits of radionuclide content in feeding stuffs listed in Table 4.

Period of application of the limits specified in Table 2 and Table 4 is as short as possible and as long as the conditions in paragraph 1 of this Article last for.

**Article 18**

Foodstuffs or feeding stuffs that are not in compliance with the limits of the radionuclide content listed in Table 2 and Table 4, during the time when these limits are in place, cannot be put on market.

**Article 19**

This Regulation shall enter into force on the eighth day of its publication in the "Official Gazette of the Republic of Serbia".

Table 1. Derived concentration of individual radionuclides in drinking water

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Derived Concentration (Bq/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-14</td>
<td>2,3E+02</td>
</tr>
<tr>
<td>Co-60</td>
<td>4,0E+01</td>
</tr>
<tr>
<td>Sr-90</td>
<td>4,9E+00</td>
</tr>
<tr>
<td>I-131</td>
<td>6,2E+00</td>
</tr>
<tr>
<td>Cs-134</td>
<td>7,2E+00</td>
</tr>
<tr>
<td>Cs-137</td>
<td>1,0E+01</td>
</tr>
<tr>
<td>Pb-210</td>
<td>2,0E-01</td>
</tr>
<tr>
<td>Ra-224</td>
<td>2,1E-01</td>
</tr>
<tr>
<td>Ra-226</td>
<td>4,9E-01</td>
</tr>
<tr>
<td>Ra-228</td>
<td>2,0E-01</td>
</tr>
<tr>
<td>Th-232</td>
<td>5,9E-01</td>
</tr>
<tr>
<td>U-235</td>
<td>2,9E+00</td>
</tr>
<tr>
<td>U-238</td>
<td>3,0E+00</td>
</tr>
<tr>
<td>Pu-239</td>
<td>5,5E-01</td>
</tr>
<tr>
<td>Am-241</td>
<td>6,8E-01</td>
</tr>
</tbody>
</table>

Table 2. Limits of radionuclides content in foodstuffs after a nuclear accident or in the case of other radiological emergency (Bq/kg or Bq/l)

<table>
<thead>
<tr>
<th>Isotopes of strontium, particularly 90Sr</th>
<th>Milk and dairy products</th>
<th>Foodstuffs, except less commonly used foodstuffs</th>
<th>Less commonly used foodstuffs (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Isotopes of iodine, $^{131}\text{I}$

| Alfa unstable isotopes of plutonium, transplutonium elements, particularly $^{239}\text{Pu}$, $^{241}\text{Am}$ | 500 | 2000 | 20000 |
| All other nuclides with a half-life above than 10 days, especially $^{134}\text{Cs}$, $^{137}\text{Cs}$ (excluding $^{14}\text{C}$ i $^{3}\text{H}$) | 1000 | 1250 | 12500 |

(1) Less commonly used foodstuffs are listed in Table 3.

Table 3. Less commonly used foodstuffs

| Garlic |
| Truffles (tartufo) |
| Capers |
| Capers (temporarily preserved, but unsuitable for immediate consumption) |
| Truffles (dried, whole, cut into pieces or ground, but not further prepared) |
| Manioc, arrowroot, salep, Jerusalem artichokes, sweet potatoes and similar roots and tubers with high starch or inulin content, fresh, chilled, frozen or dried, whole, sliced or in the form of pellets; marrow sago tree |
| Peel of citrus fruit or watermelons and melons, fresh, frozen, dried or provisionally preserved in brine, in sulphurous water or in other preservative solutions |
| Yerba mate tea |
| Pepper of the genus *Piper*, dried, crushed or ground paprika of the genus *Capsicum* or of the genus *Pimenta* |
| Vanilla |
| Cinnamon and cinnamon-tree flowers |
| Cloves (whole fruit, cloves and stems) |
| Nutmeg, mace and cardamoms |
| Seeds of anise, badian, fennel, coriander, cumin or caraway; juniper berries |
| Ginger, saffron, turmeric, thyme, bay leaves, curry and other spices |
| Flour, meal and powder of sago or of roots or tubers of cassava, arrowroot, salep, Jerusalem artichokes, sweet potatoes and similar roots and tubers with high starch or inulin content, fresh, chilled, frozen or dried, whole, cut, or in the form of pellets; marrow sago tree |
| Cassava starch |
| Hop cones, fresh or dried, ground, powdered or in the form of pellets; lupulin |
| Herbs and parts of plants (including seeds and fruits), fresh or dried, cut or whole, crushed or ground, of a kind used primarily in perfumery, in pharmacy or for insecticidal, fungicidal or similar purposes |
| Lac, natural gums, resins, gum-resins and oleoresins (for example balsams) |
| Herb juices and extracts; pectin substances, pectinates and pectates, agar-agar and other mucilages and thickeners, derived from herb products, whether or not modified |
| Fats and oils and their fractions, of fish or sea mammals, whether or not refined, but not chemically modified |
| Caviar and caviar substitutes |
| Cocoa beans, whole or ground, raw or roasted |
Shells, husks, skins and other cocoa waste  
Cocoa paste, whether or not defatted  
Truffles (tartufo), prepared or preserved otherwise than by vinegar or acetic acid  
Vegetables, fruit, nuts, fruit-peel and other parts of plants, preserved by sugar (dry, glacé or crystallised)  
Yeast (active or inactive); other single-cell micro-organisms, dead (but not including vaccines of heading 3002); prepared baking powders  
Pro-vitamins and vitamins, natural or reproduced by synthesis (including natural concentrates), derivatives thereof used primarily as vitamins, and co-compost products, including those in any solvent  
Essential oils (terpeneless or not), including concretes and absolutes; resinoids, extracted oleoresins, concentrates of essential oils in fats, in fixed oils, in waxes or the like, obtained by extraction of essential oils with grease or maceration; terpenic by-products of the deterpenation of essential oils, aqueous distillates and aqueous solutions of essential oils

Table 4. Limiting content of $^{134}\text{Cs}$ i $^{137}\text{Cs}$ in total in feeding stuffs after a nuclear accident or other radiological emergency event.

<table>
<thead>
<tr>
<th>Animal</th>
<th>Bq/kg (1, 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs</td>
<td>1250</td>
</tr>
<tr>
<td>Poultry, lambs, calves</td>
<td>2500</td>
</tr>
<tr>
<td>Other</td>
<td>5000</td>
</tr>
</tbody>
</table>

(1) Monitoring of radionuclide content in foodstuffs of animal origin is needed when the radionuclides content in the feeding stuffs is below the limit values of $^{134}\text{Cs}$ and $^{137}\text{Cs}$ listed in Table 3.

(2) These levels are related to ready-for-use feeding stuffs.