EFFICIENT COUNTERMEASURES: THE BASIS OF POST-CHERNOBYL REMEDIATION AND SUSTAINABLE DEVELOPMENT OF THE AFFECTED TERRITORIES OF THE REPUBLIC OF BELARUS

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Плотность загрязнения территории $^{137}$Cs в Беларуси

Ожидается сокращение загрязненной территории к 2016 году в 1.5 раза, а к 2046 году в 2.4 раза по сравнению с 1986 годом.
**Priority Areas of the Program Activities**

1. **Social protection**, medical maintenance and regular **health improvement** provided to the affected population.

2. **Radiation protection** and direct target-oriented implementation of protective measures.

3. Design and implementation of specific **projects** to facilitate **modernization** and efficient utilization of production capacities, natural, primary and labour recourses, **social development**, human capacity building.

4. **Improvement of public outreach policy** on the problems related to mitigation of the Chernobyl accident consequences, including outreach to the population, information sharing and dissemination etc.
In the framework of radiation protection and target-oriented implementation of protective measures

Two categories of population should be distinguished when choosing the most appropriate strategy of protective measures for reducing the internal dose *in the long term*.

**Category 1**: Residents of contaminated areas who consume foodstuffs of local production

**Objective**: Reduction of individual effective doses received through the consumption of local contaminated foodstuffs

**Category 2**: People who live in clean areas, but may consume foodstuffs produced in contaminated areas

**Objective**: Reduction of the collective radiation dose associated with export of foodstuffs produced in contaminated areas
Radiation Control System

is developed and implemented in order to:

- Assess the radiation situation and determine the levels of ionizing radiation exposure
- Exclude production and storage of foodstuffs and raw materials with radionuclide concentration levels above the specified limits
- Evaluate the effectiveness of protective measures, provide their optimal and targeted implementation
- Develop a sound strategy of recovery actions
Why Radiation Control?

PROTECTIVE MEASURES

Vegetables & Fruits

Meat & Milk

Seafood

Gifts of Forest

Radiation Control

Consumption

Disposal/Recovery

Public information

Public information
Gradual Revision (reduction) of Permissible Levels for $^{137}\text{Cs}$ Content in Food, Bq/kg

TPLs – Temporary Permissible Levels
RPLs – Republican Permissible Levels (RPLs-99 is a current national standard for $^{137}\text{Cs}$)
Internal Radiation Doses of the population of Belarus depending on particular RPLs, mZv/year

TPLs – Temporary Permissible Levels
RPLs – Republican Permissible Levels (RPLs-99 is a current national standard for $^{137}$Cs)
<table>
<thead>
<tr>
<th>Soil Treatment (real tillage, deep tillage)</th>
<th>During the first 5 years</th>
<th>After the first 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lime Treatment (lime rate: 1,5 Hr)</td>
<td>4,0</td>
<td>2,0</td>
</tr>
<tr>
<td>Application of organic fertilizers</td>
<td>2,5</td>
<td>2,0</td>
</tr>
<tr>
<td>Application of phosphate fertilizers</td>
<td>1,5</td>
<td>0,5</td>
</tr>
<tr>
<td>Application of potassium fertilizers</td>
<td>3,5</td>
<td>3,0</td>
</tr>
<tr>
<td>Optimization of nitrogen fertilization rates</td>
<td>2,5</td>
<td>1,5</td>
</tr>
<tr>
<td>Selection of crop types with minimal uptake ability</td>
<td>30</td>
<td>5,0</td>
</tr>
</tbody>
</table>

| Root improvement                          | 6,0                      | 3,0                     |
| Surface improvement                        | 3,0                      | 1,5                     |
| Selection of grass mixtures               | 3,0                      | 2,0                     |
The Effects of Milk Processing on $^{137}\text{Cs}$ and $^{90}\text{Sr}$ Concentrations in End Products

**Cream, 20% fat**
- $T_f^{^{137}\text{Cs}} = 0.6$
- $T_f^{^{90}\text{Sr}} = 0.78$

**Cottage cheese**
- $T_f^{^{137}\text{Cs}} = 0.8$
- $T_f^{^{90}\text{Sr}} = 0.7$

**Butter**
- $T_f^{^{137}\text{Cs}} = 0.12$
- $T_f^{^{90}\text{Sr}} = 0.09$

**Melted butter**
- $T_f^{^{137}\text{Cs}} = 0.01$
- $T_f^{^{90}\text{Sr}} = 0$

**Soft cheese**
- $T_f^{^{137}\text{Cs}} = 0.7$
- $T_f^{^{90}\text{Sr}} = 4$

**Cheese**
- $T_f^{^{137}\text{Cs}} = 0.5$
- $T_f^{^{90}\text{Sr}} = 5.8$

$T_f$ – ratio of radionuclide concentration in end product to radionuclide concentration in milk (Bq/kg)
Reduction of Collective $^{137}$Cs/$^{90}$Sr Doses via Changing Milk to Meat Production (given: the soil contains 20 kBq/m$^2$ $^{90}$Sr and 1000 kBq/m$^2$ $^{137}$Cs)

**FORAGE:**
- $^{137}$Cs – 847 MBq
- $^{90}$Sr – 193 MBq

**MILK,** 400 t
- $^{137}$Cs – 67.6 MBq
- $^{90}$Sr – 2.9 MBq

**MEAT,** 37.3 t
- $^{137}$Cs – 847 MBq
- $^{90}$Sr – 193 MBq

**Collective doses, mZv**
- $^{137}$Cs – 880 mZv
- $^{90}$Sr – 232 mZv

Collective doses, mZv
- $^{137}$Cs – 36.9 mZv
- $^{90}$Sr – 3 mZv

Collective doses, mZv
- $^{137}$Cs – 36.9 mZv
- $^{90}$Sr – 3 mZv
Collective Radiation Doses after Alternative Use of Contaminated Grain Crops

Grain crops 500 t

- 137Cs – 40 MBq
- 90Sr – 22 MBq

- 137Cs – 40 MBq
- 90Sr – 22 MBq

- 137Cs – 40 MBq
- 90Sr – 22 MBq

- 137Cs – 40 MBq
- 90Sr – 22 MBq

Bread

- 137Cs – 40 MBq
- 90Sr – 22 MBq

Chicken, 161 t

- 137Cs – 2,33 MBq
- 90Sr – 0,017 MBq

Beef, 37,3 t

- 137Cs – 2,16 MBq
- 90Sr – 0,019 MBq

Pork, 81,8 t

- 137Cs – 1,68 MBq
- 90Sr – 0,004 MBq

Collective doses, mZv

- 137Cs – 260
- 90Sr – 440
- 700

- 137Cs – 30,3
- 90Sr – 1,3
- 31,6

- 137Cs – 28
- 90Sr – 1,5
- 29,5

- 137Cs – 21,8
- 90Sr – 0,3
- 22,1
Thank you for your kind attention!