

Medical and Agricultural Aspects of Rehabilitation of Radioactively Contaminated Territories and Radiation Protection of Population

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25 years after the accident in the Ukraine there are more than 2.25 million people affected by the Chernobyl disaster.

This is more than 260 thousands of "liquidators" and nearly two million victims, including about 0.5 million children.

The health status of these people have been constantly monitored, the patterns of development and progress of diseases, mortality, and the effect of radiation and dose-forming nuclides on human health, risk factors for frequent diseases, acute (radiation sickness) and long-term effects of radiation have been studied.

The carried out researches showed that between the "liquidators" there is an increase of the frequency of stochastic and non-stochastic effects of radiation - leukemia, cancer, nonneoplastic diseases. Of all the forms there was the largest increase in the incidence of thyroid cancer – by 5.6 times. Pathologies of thyroid cancer are also the most common among the affected population (52%). Proportion of healthy people among the "liquidators" declined to 5%, and among the evacuees - up to 20%. The proportion of people among the "liquidators" with chronic nonneoplastic pathologies increased 7 times - up to 84%, mortality from these diseases has increased almost 6 times - up to 12%. This is especially considers people who received external radiation dose from 0.25 to 0.7 Gray. In the structure of reasons of death, the leading roles play cardiovascular diseases (80%), especially coronary heart disease. This is followed by respiratory diseases, digestive and nervous systems.

With regard to children, according to the analysis of morbidity in the long-term period it turned out that more susceptible to radiation were children of not early age, and children from 8 to 12 years old and adolescents to 16 years old. In this case, there was persistent trend to decrease the health of children and 15 years after the accident, among evacuated children, not a single child with a first group of health is left. The lowest health rate had children with the exposure dose of thyroid more than 2 Gray.

It was veraciously established that the exposure to the thyroid gland affects health of children and plays a determining role during fetal development. At a dose of more than 1 Gray it was reported that almost all children had chronic somatic pathologies.

It is radioactive iodine in the first days-weeks after the accident and existing iodine deficiency are the main reasons of pathologies that develop in the long run. The annual growth rate of endocrine diseases among liquidators is 3-5 times higher than among population in general.

Leading medical and research centers in the world have recognized that the significant increase in thyroid cancer is the main medical consequence of the Chernobyl disaster.

It follows thence the importance of timely implementation of iodine prophylaxis in case of nuclear accidents.

As for the external exposure doses, the smallest number of diseases with a statistically proven risk was recorded in the dose of sub cohort to 0.1 Gray.

As for those people who have survived acute radiation sickness (more than 200 people), then during the first 3 months after the accident, 28 people who received high doses (more than 5 Gray) died. During the 25 years 39 people more died, and the surviving fraction of people with physical abnormalities (somatic pathologies) is 100%. However, most of them have from 5 to 12 chronic diseases simultaneously.

In case of the accident at the Chernobyl NPP has been realized the most severe scenario of the consequences for agriculture of Ukraine: polluted more than 5 million hectares of land on which agricultural production was elaborated and lived more than 3 million people, lost much of the cattle.

Agricultural lands of the Chernobyl exclusion zone is completely removed from economic circulation. Other contaminated areas assigned to several categories: unconditional (obligatory) resettlement, guaranteed voluntary resettlement and enhanced radiological control.

The criteria for this division are the density of contamination and dose. Accordingly, the density of contamination of the isotopes of cesium is more than 15, from 5 to 15 and from 1 to 5 Curie per km²; strontium: more than 3, from 0.15 to 3 and from 0.02 to 0.15 Curie per km²; plutonium: more than 0.1 from 0.01 to 0.1 and from 0.005 to 0.01 Curie per km²). Furthermore, a more correct, integral criterion is equivalent absorbed dose. Accordingly, it is 5, 1 and 0.5 mSv per year.

Immediately after the accident in Ukraine was established infrastructure of scientific support of monitoring and remediation of contaminated areas.

In the ninetieth in Ukraine on the basis of scientific researches of our scientists every 2-3 years were published "Recommendations for Agriculture and Forestry in terms of radioactive contamination," the introduction of which allowed to improve the situation significantly, to reduce the level of product contamination and internal exposure dose of the population.

It was shown that the radiation consequences are largely determined not only by the density of soil contamination, but also by landscape-ecological conditions, when the concentration of radionuclides in agricultural products at the same density of pollution can vary by 2 orders of magnitude (hundreds of times).

In principle, the works on rehabilitation of radioactively contaminated land and radiation protection of population can be divided into two diametrically opposed directions:

first - is obtaining of a "clean" products on the contaminated lands by reducing the coefficients of radionuclides in the chain soil-plant-animal;

the second - is rehabilitation of radioactively contaminated lands by growing fast-growing "energy" crops, movement of radionuclides in plants and their subsequent utilization in power installations.

In the first direction a number of countermeasures has been worked out and implemented. In agriculture – is the special technologies of remediation of

contaminated lands: application of lime materials and fertilizers in non-traditional ratios and doses. Reduction of radioactivity of production in this case is 1.5-3 times. In animal breeding is achieved a high efficiency of administration in the diet of animals sorbents (ferrocens, zeolites), which leads to a decrease of radioactivity of products by 2-5 times, as well as the feeding of beef cattle in the final stages of fattening by clean fodder (radiocaesium content in muscle tissue within two to three months decreased by 5-8 times due to its high output rate ^{137}Cs from the body of animals).

In the second direction so far has been carried out only scientific researches and we approached the launch of the first pilot projects. According to its potential, it is the most promising direction for the exclusion zone. This perspective is determined by the synergetic effect:

- decreases the density of soil contamination with radionuclides due to their conversion into plants;

- the burning of these plants is obtained by thermal and electrical energy required to maintain the infrastructure of the exclusion zone;

- decreases the amount of natural gas, which is currently used in the exclusion zone to ensure heat in Chornobyl city and Chornobyl NPP;

- reduces the volume of radioactive wastes, which are to be disposed - for disposal are used only ash and filters catching radioactive substances from the smoke, not the mass of wood, which can be regarded as low active level wastes.

When these projects are implemented the business interests of private investors and environmental interests of the state coincide.

In addition, one should consider the fact that today all over the world there is competition for acreage between "energy" and food crops. In this regard, the Chornobyl exclusion zone provides clear benefits for the "energy" crops as far as to gain "clean" food products in most parts of this zone in the foreseeable future will not succeed.