Radiation-Hygienic Situation Along the Ukrainian Territory Due to the Chernobyl Accident

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As a result of the Chernobyl accident, all Ukrainian regions have been practically contaminated; 12 regions (from 27) have been heavily contaminated, with an urgent need of providing the special actions. We've determined the values of density of soil contamination by Cs-137 and Sr-90 in the different regions and the parameters presenting the degree of radionuclide transfer (i.e., coefficient of accumulation, Ca) in plants and the value of radionuclide quantity in soil in the state of dessorbtion for plants (i.e., coefficient of dessorbtion, Cd) along the so-called "Western and Southern traces". From these data we may see that the contamination along the Ukrainian territory has the so-called "spot nature" and the values of contamination density obtained in the different regions are considerably differed. The degree of radionuclide transfer into plants is defined by their state in soil that has been depended upon radionuclide chemical forms in releases. Due to inhomogeneous physico-chemical releases, the parameters of radionuclide transfer into plants are various in the different regions of Ukraine. The radiation situation in Ukraine is much depended on the radionuclide contamination of the Dnieper, which is the main and in some regions the only source of drinking water supply for the Ukrainian public. There were determined the values of mean individual and population internal exposure doses due to Cs-137 and Sr-90 intake with drinking water in the different regions since 1986. The contamination situation in the Ukrainian regions is rather complicated, inhomogeneous and unique as pertinent to the factors affecting on it and creating a number of problems for predicting the prognoses of its future development.

The Chernobyl accident has a number of ecological and radiation-hygienic peculiarities; as pertinent to these peculiarities it is very difficult to give the assessments of radiation-ecological consequences, to estimate the doses for different segments of population suffered as a result of this accident, and to evaluate the risk of possible delayed medical consequences. According to all these difficulties it is not easy to develop the strategy of scientific investigations and the system of protection actions.

The Chernobyl accidental fallouts have a long-term nature and a wide spectrum of radioactive isotopes, due to which together with unfavorable meteoconditions, large territories have been contaminated, but the contamination densities are recorded to be quite different. The segments of population living in the contaminated regions are also varying (depending on character, type, kind and doses of irradiation).

So as a result of the Chernobyl accident all Ukrainian regions have been practically contaminated; moreover, 12 regions (from 27) have been heavily contaminated (Table 1). The

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contamination along the Ukrainian territory has the so-called "spot nature" and the values of contamination density obtained in the different regions are considerably different.

Table 1 - The levels of contamination of Ukrainian soils

THE LEVELS OF CONTAMINATION OF UKRAINIAN SOILS (only according to caesium-137)				
density	37-185 kBq/m^2	(1-5 Ci/km^2)	-	40 300 km^2
	185-555 kBq/m^2	(5-15 Ci/km^2)	-	3 100 km^2
	555-1480 kBq/m^2	(15-40 Ci/km^2)	-	1 100 km^2
	1480 kBq/m^2	(40 Ci/km^2)	-	800 km^2
Different levels of radiation contamination are registered in more than 1.5 thousands of settlements of Kiev, Zhitomir, Chernigov, Rovno, Volyn, Cherkassi, Chernovitsi, Vinnitsa, Ivano-Frankovsk, Sumi, Kirovograd, Ternopol oblasts.				

It is well-known that the Chernobyl accident has an unique nature as pertinent to the complex spectrum of physico-chemical peculiarities of radioactive releases changed in wide-spread ranges depending on the direction and distance from the accidental Unit. Due to this fact we may register the variations in transport intensity of radionuclides from soil into plants in the regions located far from the accidental reactor. We have determined the values of density of soil contamination by Cs-137 and Sr-90 in the different regions, the parameters presenting the degree of radionuclide transfer (i.e., coefficient of accumulation, Ca) in plants, and the value of radionuclide quantity in soil in the state of desorbtion for plants (i.e., coefficient of desorbtion, Cd) along the so-called "Western and Southern traces". According to these data we may say, that the degree of radionuclide transfer into plants is defined by their state in soil that has been dependent upon radionuclide chemical forms in releases.

During the first years after Chernobyl accident, more than 50% of strontium-90 and caesium-137 have been found in soil in the non-changeable forms. Later on, the soluble form of strontium-90 in soil has been transformed into the changeable state, but the soluble fractions of caesium-137 have been only slightly transformed into the changeable state (less than 5% from its total content in soil). After the Chernobyl accident the forest fires have influenced much on the intensity of migration processes in soil. Due to the burning of forest soil upper layer, it is registered more intensive radionuclide migration into mineral layer of soil, (i.e., these places of forest are more radiologically dangerous as compared with the places more heavily contaminated).

The level of radiation contamination of soil is an important index, but not full enough. It is well known that depending on the soil, nature it is possible to have food stuffs contaminated greater that allowable levels from the areas with radiation density 1-2 Ci/km^2 and v.v. the "pure" foodstuffs - from more contaminated territories. Comparing the data presented, the values of density of soil contamination by Cs-137 and Sr-90 in the different Ukrainian regions and the values of Cs-137 and Sr-90 concentrations in milk and potato as pertinent to the same territories, we may say that the high levels of radionuclide contamination of food stuffs are not always associated with high levels of radioactive contamination of soil. This phenomenon is related to the forms of radionuclide fall-outs, as well as the soil peculiarities of the Ukrainian regions.

Besides, the radiation situation in Ukraine is very dependent on the radionuclide contamination of the Dnieper, which is the main and in some regions the only source, of drinking water supply for the Ukrainian public. There were determined the values of mean individual and population internal exposure doses due to Cs-137 and Sr-90 intake with drinking water in the different regions since 1986. It should be noted here that the Dnieper serves as one of the best recreation areas in the Ukraine and people spending time in this area also contributes to forming the irradiation dose. Cs-137 and Sr-90 concentrations in the Dnieper water is especially important for people living in the Southern regions where the levels of radionuclide concentrations registered in agricultural foodstuffs from irrigation areas are also associated with radioactive contamination of the Dnieper. Thus, at present radionuclide contamination of the Dnieper is the main factor of dose forming for the Southern region of Ukraine. Moreover, the Dnieper biota, due to its ecological peculiarities, is a long-term source of radionuclide transport into the human food chain.

At the same, time the Ukrainian population is exposed to other sources of ionizing artificial and natural radiation. It should be noted here, that the central regions of Ukraine (30-35% of all Ukrainian territory) are situated on the crystal massif with high concentrations of natural radionuclides; due to this fact, the irradiation doses may be considerable. Figure 1 presents the comparative assessments of collective radiation doses of Ukrainian population associated with all sources of ionizing radiation. The predicted value of population dose due to the Chernobyl accident (for 70 years after the accident) is 1.2 % of total population dose. The main dose-forming factors are natural radioactivity (78%) and radiodiagnosis procedures (17%); the main radiation protection actions for decreasing the total collective doses associated with these two factors should be carried out. So the criteria of radiation risk for people living in the contaminated regions should be the values of total dose of human irradiation associated with all sources of radiation.

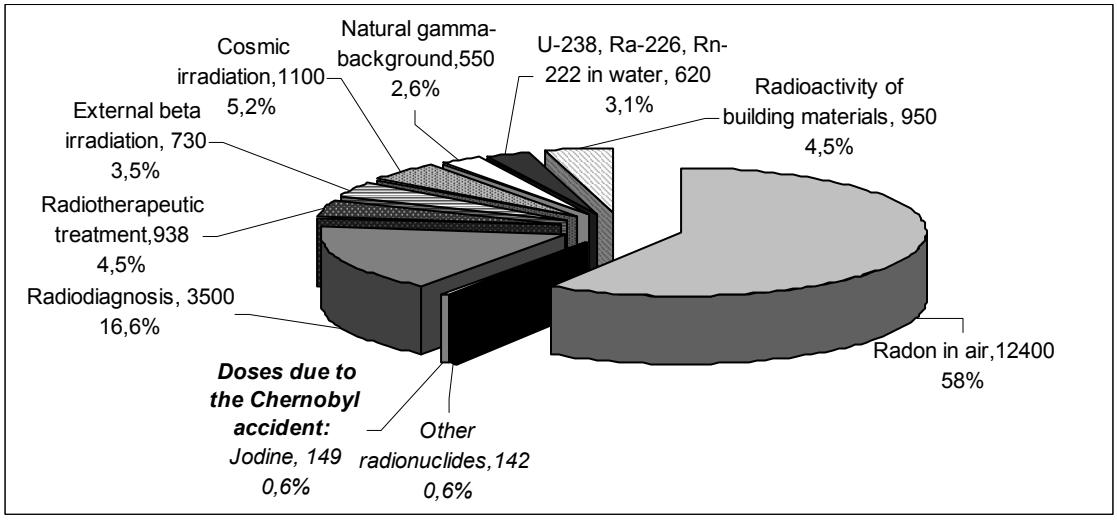

Figure 1 - The assessment of collective radiation doses of Ukrainian population due to the main radiation natural and artificial factors after the Chernobyl accident (for 70 years), thousand men∗Sv