

ABATEMENT OF RADIOACTIVE FLOW BY THE PRIPYAT RIVER WATERS FROM THE CONTAMINATED TERRITORIES OF THE CHERNOBYL NPP EXCLUSION ZONE

D.I. GUDKOV¹, V.V. DEREVETS², S.I. KIREEV² and A.B. NAZAROV²

¹Institute of Hydrobiology of the National Academy of Sciences of Ukraine

²State Scientific-Production Enterprise "Chernobyl Radioecological Centre"

of the Ministry of Emergency Situation of Ukraine

.Address for correspondence: Institute of Hydrobiology,

Geroyev Stalingada Ave. 12, UA-04210 Kiev, Ukraine;

(Tel: +380-44-418-91-83, Fax: +380-44-418-22-32, e-mail: digudkov@svitonline.com)

In 1986 after the termination of aerosol emissions from destroyed unit of the Chernobyl nuclear power plant (NPP) the basic migration of radionuclides beyond the bounds of the exclusion zone occurs by a waterway. During 1986–2004 about 130 TBq (tera-becquerel) of ¹³⁷Cs (caesium-137) and 160 TBq of ⁹⁰Sr (strontium-90) flow into Kiev reservoir by Pripyat River – the main waterway of the exclusion zone. Getting into reservoir radionuclides are distributed on all cascade of Dnieper River reservoirs. The flow of radionuclides into the rivers influences increase on radiation doze of the population of Ukraine at water consumption. In this connection the necessity of the careful control behind the radionuclide contents in water, estimation of its transference into Dnieper River reservoirs, and also forecasting and prevention of such transference is obvious.

The main purposes of the submitted researches were: the analysis of results of surface waters radioecological monitoring within territory of the Chernobyl NPP exclusion zone; the definition of the basic sources of radioactive contamination of Pripyat River; the assessment of efficiency of operation mode of water-protection structures interfering of radionuclide flow into Pripyat River; the evaluation of radioactive contamination distribution beyond the bounds of the exclusion zone, as well as development and duly introduction of measures on its minimization.

The radiation monitoring of surface waters within territory of the exclusion zone covers practically all the main streams and reservoirs. As a whole under the constant control are more than 20 large and small streams, 10 closed and languid stream reservoirs in most typical ranges and points, which characterize a hydrological mode and radiation condition of water objects in places of water-protection structures location, places of work and residing of the personnel of the exclusion zone.

The greatest contribution in radionuclide contamination of Pripyat River and the formation of transference of radionuclides in Dnieper River reservoirs system brings in radionuclide migration from periodically flooded sites of Pripyat River flood-lands, with the basic inflows of the river, and also from cooling-pond of the Chernobyl NPP. To the basic sources concern also Uzh River, which flows into Pripyat River and Braginika River flowing into Kiev reservoir.

The maximal flow of radionuclides by Pripyat River was registered in 1986 – about 66 TBq of ¹³⁷Cs and 28 TBq of ⁹⁰Sr. The next years this value for ⁹⁰Sr was about 10–14 TBq (in years of average water flow) and 3–4 TBq (in years of low water flow). About 60% of ⁹⁰Sr flow by Pripyat River are formed on the part of catchment basin, which is taking place

within territory of the exclusion zone. Since 1988 the annual flow of ^{137}Cs rarely exceeded half of ^{90}Sr flow, and in separate years did not reach also a quarter. About 85–90% of general flow of ^{137}Cs by the river is formed outside of the exclusion zone.

For the postaccident period was observed some crisis situations connected to surface waters. The greatest radionuclide contamination of Pripyat River waters in the postaccident period (except for 1986 and 1987) is registered in the end of January–February 1991, when the powerful ice jams were generated, which have caused abrupt flood within Pripyat River flood-lands in the inner (10-km) exclusion zone. Thus the maximal concentration of ^{90}Sr in water of the river have amount $12 \text{ kBq}\cdot\text{m}^{-3}$. The flow of ^{90}Sr by Pripyat River for the period of greatest intensity of display of ice jams (19.01–09.02.1991) has amount about 4 TBq. Three quarters of this amount have flow into the river from the territory of left-bank, so-called, Krasnensky flood-lands. This, unprotected (on that period) from flooding by high waters, territory is characterised by the highest levels of radioactive contamination within exclusion zone.

At the end of 1992 for prevention of flooding by Pripyat River waters the most contaminated site of the left bank flood-lands (and inevitable thus wash-out of radionuclides from its territory) the complex of flood protection structures was entered into operation, which included a protecting sandy dam long 11,2 km (contiguous to an already existing dam), drainage channel, which connects the basic reservoirs in the protected territory, and also pump station for swapping surpluses of water from the channel on "old" polder. The area of the fenced territory is about 22 sq. km. After termination of construction of dam structures and specification of mode of pump station operations, the contribution of left bank flood plain in formation of the radionuclide transference has decreased twice.

The importance of a new dam was most brightly showed in February 1994 during an ice jam on Pripyat River when the level of water in the river considerably has exceeded critical marks of water spill on flood-lands and approximately was equal to mostly high levels of 1991. The maximal concentration of ^{90}Sr in Pripyat River was $6 \text{ kBq}\cdot\text{m}^{-3}$, that is was twice less, than in 1991. The flow of ^{137}Cs also was twice less.

After a number of relatively stable years, the spring of 1999 has brought new anxieties connected to a condition of surface waters. In value of the maximal charges and levels, the high water of those year was evaluated as greatest not only for the postaccident period, but also after 1979. In expectation of possible flooding of the unprotected sites of flood-lands, were building up existing dams, which block the most contaminated creeks of Pripyat River and constructed the protective embankment. Due to the carried out measures the direct flow of Pripyat River waters on the contaminated territory has not taken place. With the subsequent increase of Pripyat River level the water have flow on the territory of these sites only as filtration through a body of dams. After termination of high water and decrease of water level in the river, the return surface run-off of waters in Pripyat River and accordingly intensive radionuclide flow did not occur. By our estimations, in conditions of the described above crisis situation, the water-protection measure has prevented possible additional flow of ^{90}Sr with surface waters in amount about 17–20 TBq.