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Role of Reservoirs in Radionuclide Transport in the River Systems: Comparative Analyses for the Rivers of the Chernobyl and Fukushima Fallout Zones

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The 1986 accident at the Chernobyl Nuclear Power Plant (ChNPP), Ukraine, caused a significant radioactive contamination of the Dnieper River basin, and, in particular, the Pripyat River watershed. The ChNPP is situated approximately 30 km from the confluence of the Pripyat River with the Kiev Reservoir of the Dnieper river. The watersheds and floodplain territory in the vicinity of the ChNPP and the surrounding watersheds (including those in Russia and Belarus) are heavy contaminated by 137Cs and 90Sr. From these contaminated areas, radionuclides migrate into the Kiev Reservoir, and, consequently, downstream along the cascade of six Dnieper reservoirs toward the Black Sea. Spring flood events, generated by snow melting, and periodic rainfall floods in the Pripyat River watershed lead to elevated levels of radioactive contamination of the water supply sources for the Ukrainian population consuming the Dnieper River water downstream from Kiev.

The 2011 accident at the Fukushima Daiichi NPP, Japan caused 137Cs contamination of the watersheds of Abukuma River - the largest river of the fallout area, and the number of the rivers crossing the heavy contaminated "no exit" territories and flowing to the populated areas of the Fukushima Prefecture. There are deep reservoirs on some of these rivers at Mano Dam - Manogawa River, at Yokokawa Dam - Otagawa River, Takanakura Dam - Mizunashi Gawa River. In both cases - after Chernobyl accident and after Fukushima accident the reservoirs play a role of the "traps" for the contaminated sediments. However the potential risks of the secondary remobilization of 137Cs during the extreme events - the highest floods of in a cases of the dam breaks should be studied as a part of the post accidental radiation safety analyses.

The objective of this presentation is to provide an overview of the results of the monitoring of radionuclide fate in the rivers and reservoirs of the Dnieper River basin in comparison with the data for the rivers and reservoirs of the Fukushima fallout zone, including the spatial and temporal distribution and of 137Cs in water and suspended and bottom sediments, with the emphases on physical–chemical behavior of these radionuclides. The presentation is based on the consideration of published monitoring data for all considered water bodies, monitoring results of Fukushima University for Abukuma River and preliminary results of the modeling of some Japanese reservoirs in comparison with early modeling studies of the Dnieper reservoirs.

The main conclusion for the compared watersheds is that the elevated precipitation and steeper slopes of the watersheds in Fukushima area as compared to the Chernobyl zone are the reasons for the higher radiocesium wash-off from the catchments but dilution in higher runoff keeps activity concentrations of radiocesium in river water of Fukushima area relatively small. The deeper reservoirs of the Fukushima Prefecture store larger part of the fluxes of the particulated radiocesium than the Dnieper reservoirs with the lower risks for its remobilization.