

Validation of the Advanced Environmental Transfer and Dose Assessment Model for Radionuclides Released from the Nuclear Fuel Reprocessing Plant in Rokkasho

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Abstract

The first commercial nuclear fuel reprocessing plant in Japan, located in Rokkasho, Aomori Prefecture finished its final testing using actual spent nuclear fuels and is now undergoing safety assessment by the Nuclear Regulation Authority. The advanced environmental transfer and dose assessment model (AdvETDAM) was developed for estimating areal and temporal distributions of the radionuclides around the plant and the radiation doses resulting from these radionuclides. To validate the model using actual field data, we measured the concentrations of radionuclides (^3H , ^{14}C , ^{129}I , etc.) in environmental, agricultural, and livestock samples collected at points around the plant and the environmental γ -ray dose rates at IES.

Because no nuclear fuel rods have been sheared or dissolved at the plant since October 2008, we found concentration levels of the radionuclides in most environmental samples collected in FY 2018 were similar to the background ones before the plant test operation, excluding several samples. Iodine-129 deposited on soil and lake sediment surfaces around the plant has still remained at a higher level than each background level. The excess ^{129}I inventory in surface soil collected around the reprocessing plant has been obtained by subtracting the global fallout-derived ^{129}I inventory from the total ^{129}I inventory of soil, and it has been compared with estimated ^{129}I deposition density using AdvETDAM. The geographical distribution pattern of estimated ^{129}I deposition density agreed relatively well with measured excess ^{129}I inventory in soil, except the north area of the reprocessing plant site which AdvETDAM evaluated to be the maximum ^{129}I deposition area.

To improve the accuracy of the model prediction in AdvETDAM, we investigated the distributions and transfer of radionuclides in a terrestrial environment in Fukushima Prefecture after the accident at the Fukushima Dai-ichi Nuclear Power Plant. In FY 2018, we continuously studied the following subjects: 1) the re-suspension rate of radiocesium and 2) the discharge rate of radiocesium via rivers. The atmospheric concentrations and fluxes of ^{137}Cs gradually decreased during FYs 2012 to 2015 with different effective half-lives, however, both values after 2015 have become nearly constant. The clear seasonality with high atmospheric ^{137}Cs concentration in summer and low concentration in winter was found the same as in our previous observations. We measured concentrations of ^{137}Cs and ^{129}I in suspended load samples collected in two small rivers in Iitate during 2018 and found that both concentrations correlated with those of organic materials in the samples.

