# Validation of 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, is now undergoing its final testing using actual spent nuclear fuels. An environmental transfer and dose assessment model (ETDAM) was developed for estimating areal and temporal distribution of the radionuclides around the plant and the radiation dose that result from them. To validate the model using actual field data, we measured concentrations of radioactive nuclides ($^{3}$H, $^{14}$C, and $^{129}$I, etc.) in various environmental samples around the plant and the environmental γ-ray dose at IES. In FY 2008, we found higher levels in part of the measurement results than the background and the FY 2007 levels. The model was validated using the data obtained in FY 2007, and validation results are reported here.

Concentrations of free water tritium (FWT) in pine needle samples collected in October 2007 at Kami-iyasaka, Rokkasho were found to be higher than their background level. The concentrations of $^{3}$H in atmospheric water vapor were estimated with the model. The estimated concentrations of $^{3}$H in atmospheric water vapor were the same level as the measured FWT concentrations in the pine needle samples. This showed that the high FWT concentrations in the pine needle samples originated from the $^{3}$H released from the reprocessing plant.

Concentrations of $^{129}$I in soil samples collected at Obuchi, Rokkasho in 2007 have already been reported. The inventory of $^{129}$I in the surface soil was higher than that in 2003, before the start of testing using actual spent nuclear fuels. The measurement of $^{129}$I in soil samples collected at the same place in 2008 showed that the surface inventory of $^{129}$I further increased from that in 2007. The inventory of $^{129}$I in 2007 estimated by the model was higher than the measured one. This may be caused by the conservative deposition velocity of $^{129}$I adopted in the model.

Concentrations of $^{129}$I in brackish lake water samples collected from Lake Obuchi on 10 July and 15 October 2007 were higher than their background level and showed a slight increase during the period between the samplings. The concentration of $^{129}$I originating from atmospheric deposition to the lake surface was estimated by the model assuming $^{129}$I concentration of inflow water from a river and the Pacific Ocean as their background level. The measured $^{129}$I concentration on 10 July was used as the initial concentration in the model, and then the atmospheric deposition and advection-diffusion of $^{129}$I were simulated until 15 October. Although the estimated concentration of $^{129}$I on 15 October was approximately 2 - 3 times higher than the observed value, the atmospheric deposition was suggested to contribute significantly to $^{129}$I concentration in the lake water.

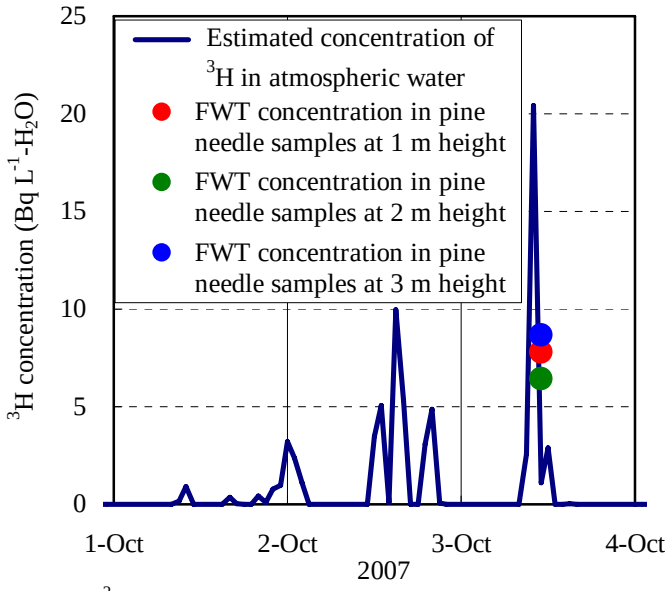


Fig. 1 $^{3}H$ concentrations in atmospheric water vapor estimated with ETDAM and measured FWT concentrations in pine needle samples collected at Kami-iyasaka, Rokkasho. Calculation conditions with ETDAM: area, 50 x 50 km; grid resolution, 500 x 500 m; height, 1.4 km above the mean sea level; 50 m interval.

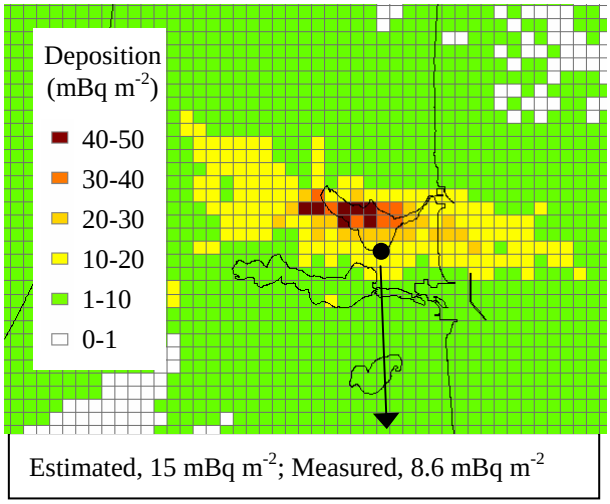


Fig. 2 Cumulative deposition of $^{129}I$ from April 2006 until August 2007 estimated with ETDAM. Calculation conditions were the same as those in Fig. 1.

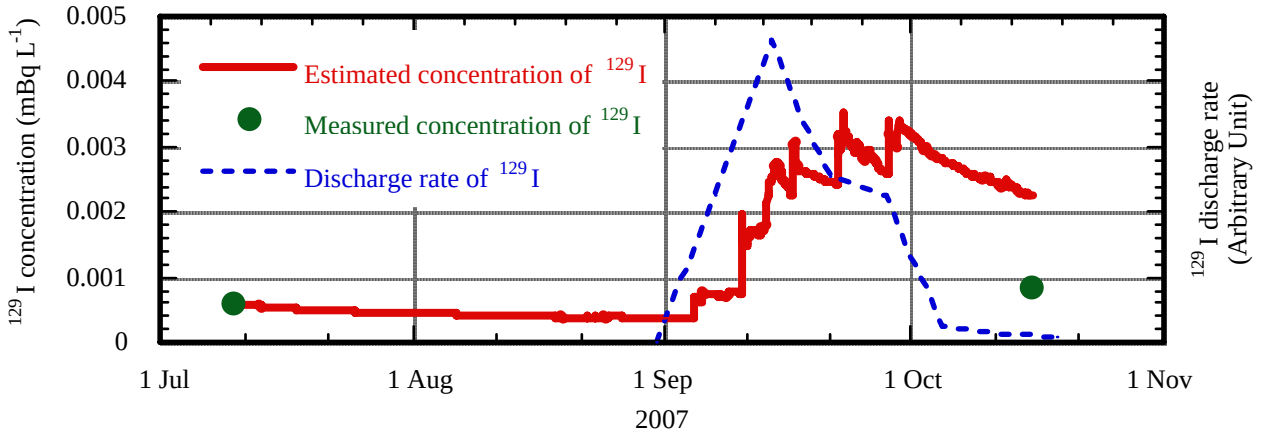


Fig. 3 Concentrations of $^{129}I$ in surface lake water at the center of Lake Obuchi estimated with ETDAM. Calculation conditions were the same as those in Fig. 1.