

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

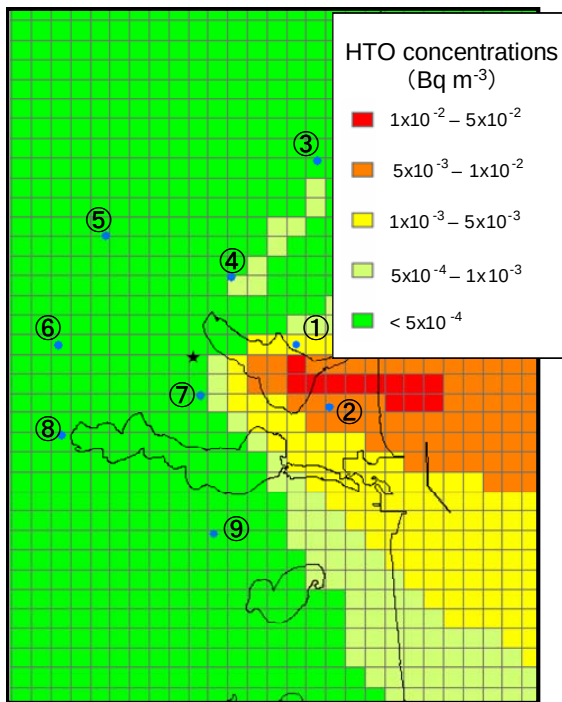
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Abstract

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 distributions of the radionuclides around the plant and the radiation dose that results from them. To validate the model using actual field data, concentrations of radionuclides (^3H , ^{14}C , and ^{129}I , etc.) in various environmental samples around the plant and the environmental γ -ray dose at IES were measured. Because no nuclear fuel rods have been sheared or dissolved at the plant since October 2008, concentration levels of the radionuclides in most environmental samples collected in FY 2009 were similar to the background ones before the plant test operation. Although radionuclide concentrations higher than the background were detected in several samples of soil, sediment and food, the validation results of ETDAM are reported here using the data obtained in FY 2006-2008 when many nuclear fuel rods were sheared and dissolved.

The monthly atmospheric HTO concentration has been continuously measured in nine locations around the plant by using a passive sampling method. Distributions of HTO concentration released from the spent nuclear fuel reprocessing plant were estimated with ETDAM, and compared with the measured values. Although the distribution patterns of the estimated HTO concentrations agreed fairly well with the measurements, the estimated concentrations tended to be larger than the measured values.

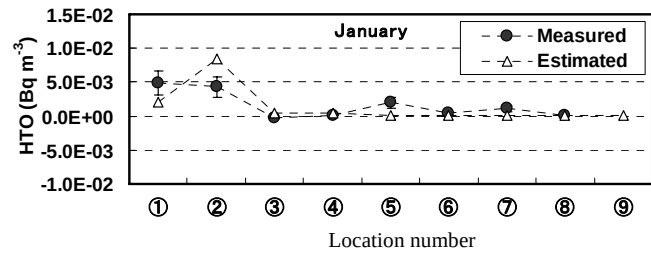
Concentrations of ^{129}I in brackish lake water samples collected from Lake Obuchi on 15 July and 20 October 2008 were higher than their background level and showed a slight increase during the period between the samplings. The concentration of ^{129}I originating from atmospheric deposition to the 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 15 July was used as the initial concentration in the model, and then the atmospheric deposition and advection-diffusion of ^{129}I were simulated until 20 October. The estimated concentrations of ^{129}I on 20 October agreed well with the observed values, suggesting that the atmospheric deposition significantly contributed to the ^{129}I concentration in the lake water.



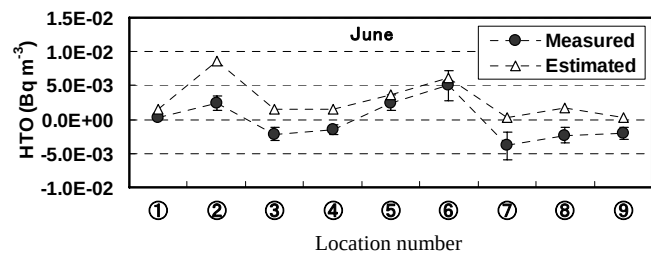
(a) Distribution of HTO concentrations estimated by ETDAM in January 2008. Calculation conditions with ETDAM: calculation area, 50 x 50 km with a grid resolution of 500 x 500 m; 1.4 km above the mean sea level with 50 m calculation interval.

①—⑨ indicate the location number.

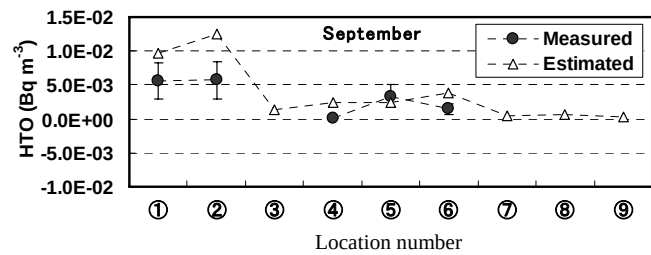
★ indicate the main stack of the nuclear fuel reprocessing plant.



(b) January 2008.



(c) June 2008.



(d) September 2008.

Fig.1 Measured monthly atmospheric HTO concentrations around the spent nuclear fuel reprocessing plant in Rokkasho and those estimated with ETDAM.

The measured concentrations were obtained by subtracting background concentrations estimated as mean ^3H concentrations in monthly precipitation before test operation using actual spent nuclear fuels (April 2001 – March 2005).