Improvement 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

In FY 2020, four approaches were used to improve the advanced environmental transfer and dose assessment model (AdvETDAM) for radionuclides released from the nuclear fuel reprocessing plant in Rokkasho: 1) validating functions for probabilistic evaluations with uncertainty of simulation results; 2) introducing temporal variation to the coefficient of Cs transfer from soil to pasture grass; 3) evaluation of the model improvement during 10 years; and 4) comparing results of the model calculations and observations for 2020. For approach 1), these functions had been developed in FY 2019 with reference of the level 3 probabilistic risk assessment for nuclear power plants, and they were validated in FY 2020, assuming cases of abnormal and normal discharges of radionuclides from the reprocessing plant. Approach 2) was based on previous studies at IES. A program module to calculate Cs concentration in pasture grass using a temporal variation coefficient was developed, then this was installed as a part of AdvETDAM. Approach 3) was conducted for the plant operation test using actual spent fuel (April 2006 to October 2008) and assuming the same source rates as in the safety review. The results of the simulation using the improved AdvETDAM were closer to the observed γ-ray radiation dose rates due to discharged ^{85}Kr from the reprocessing plant than results obtained using the earlier version of AdvETDAM. For approach 4), the calculation results of excess ^{3}H concentrations in the atmosphere for 2020 were confirmed to correspond to observation results.
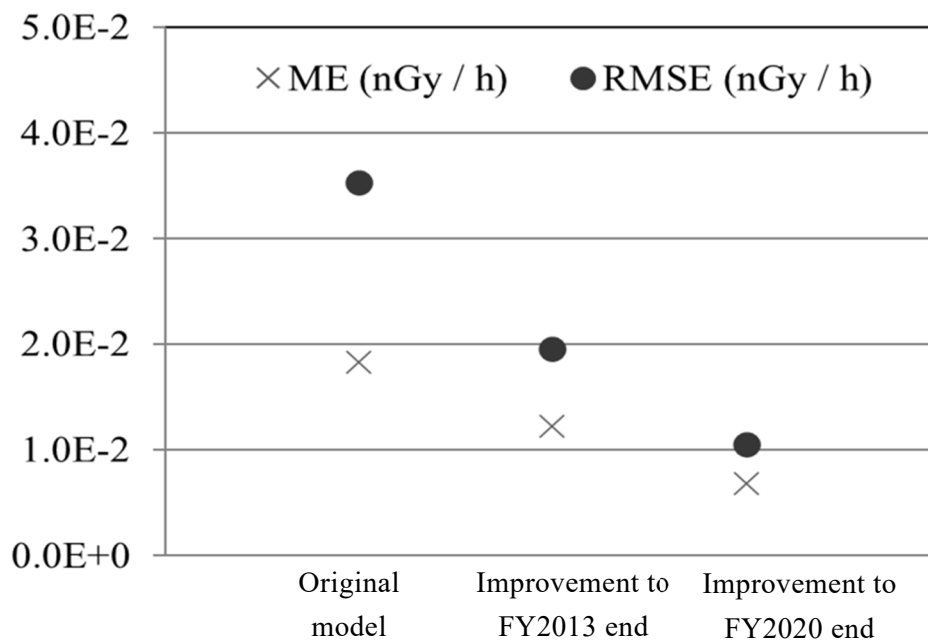
Fig. 1 Mean error (ME) and root mean square error (RMSE) of the simulation results for monthly γ-ray radiation dose rates due to discharged [85]Kr from the spent nuclear fuel reprocessing plant of Japan Nuclear Fuel Ltd. during the operation test using actual spent fuel (April 2006 to October 2008) at the main site of the Institute for Environmental Sciences (IES). Observed dose rates of γ-rays from [85]Kr at the IES were used as the references for the evaluations. MEs represent bias of the simulation results from the observation results, and RMSEs represent total error. As improvements of the model during 10 years, its accuracy was improved.
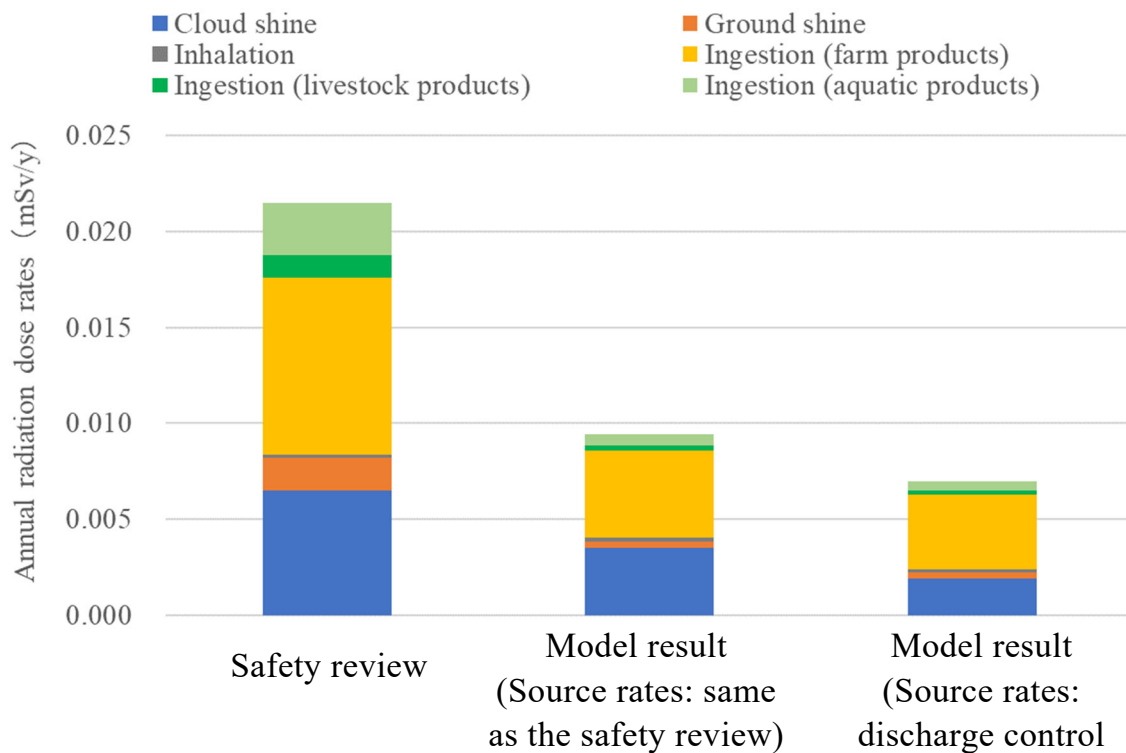

Fig. 2 Annual radiation dose rates calculation results obtained using the newest improved AdvETDAM compared to the values for the safety review of the reprocessing plant. The source rates using the safety review evaluation were assumed for reprocessing spent nuclear fuel after keeping it 4 years at the site; however discharge control targets were assumed for reprocessing after keeping it for 15 years. Results for both models were smaller than those of the safety review.