

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

We have developed the advanced environmental transfer and dose assessment model (AdvETDAM) for radionuclides released from the first Japanese commercial nuclear fuel reprocessing plant located in Rokkasho. The computer code system was developed on personal computers to describe atmospheric dispersion, terrestrial and aquatic transfers, and dose calculations for the released radionuclides. AdvETDAM consists of an atmospheric dispersion model with a meteorological model (MM5), a terrestrial transfer model, an aquatic transfer model for Lake Obuchi, which is a brackish lake neighboring the reprocessing plant, and its catchment area, and a coastal marine model for the Rokkasho coast.

In FY 2015, to describe radionuclide transfer in Lake Takahoko, which is another brackish lake near the reprocessing plant, and its catchment area, radionuclide transfer models were coupled with the hydrological models in the lake and the catchment area, followed by their integrating with AdvETDAM as its sub-models. In order to check operation of AdvETDAM including those sub-models, a test calculation was conducted for the period when higher ^3H concentration than background level was detected in the lake water. AdvETDAM fairly well simulated the flow of ^3H , which was released into the Pacific Ocean from the plant, through the channel to the lake and retention there.

To check the contributions of each parameter to variation of dose rate to human beings, a sensitivity analysis module with uncertainty propagation analysis were installed to AdvETDAM. In addition, the atmospheric dispersion sub-model was modified to improve accuracy of simulated atmospheric concentration and deposition of ^{129}I .

To validate the atmospheric dispersion and terrestrial transfer sub-models, the outputs of these sub-models were compared with those of ATRENO/TERFOC-N, which has the logic used for the safety review of the reprocessing plant. Although the maximum concentrations and depositions of radionuclides were comparable between the ATRENO/TERFOC-N model and AdvETDAM, the locations of the maximum values were different between the two. Further study for the radionuclide distribution around the reprocessing plant is required to validate AdvETDAM.

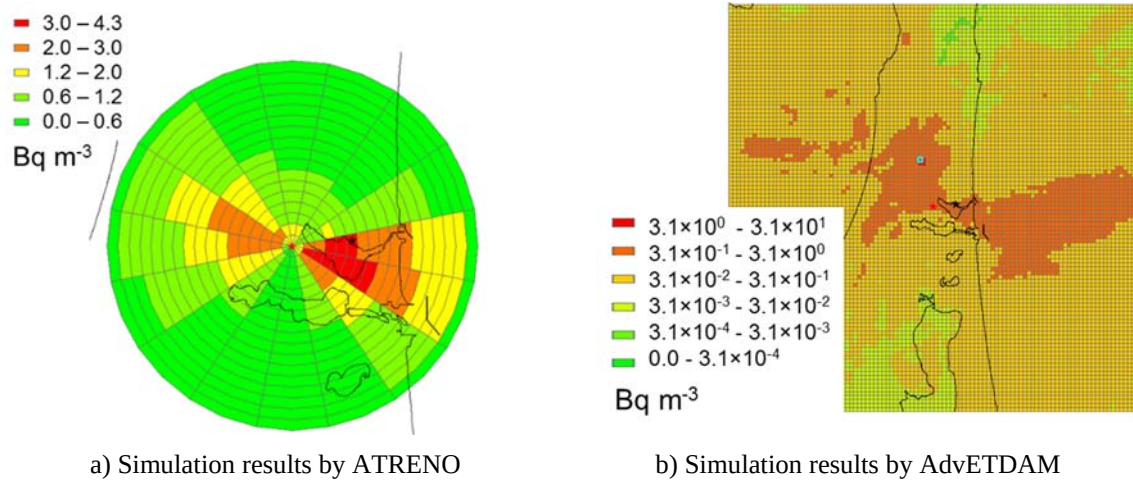


Fig. 1 Distribution of cumulative atmospheric ^3H concentration simulated using the source term in the safety review of the reprocessing plant in Rokkasho and meteorological conditions in 2007. a) and b) are simulation results by AdvETDAM and ATRENO, respectively.

Table 1 Maximum annual dose to public simulated using the source term in the safety review of the reprocessing plant in Rokkasho and meteorological conditions in 2007 by AdvETDAM and ATRENO/TERFOC-N.

Radionuclides	Maximum annual dose (mSv)		
	AdvETDAM	ATRENO/TERFOC-N	Safety review *
^{85}Kr	6.0E-03	5.7E-03	5.3E-03
^3H	1.9E-03	3.9E-03	2.8E-03
^{14}C	3.6E-03	2.4E-02	7.7E-03
^{129}I	8.3E-05	9.8E-04	6.7E-04
^{90}Sr	2.3E-05	2.7E-05	4.5E-05
^{106}Ru	3.0E-04	2.2E-04	5.7E-04
^{137}Cs	1.9E-05	6.1E-05	1.4E-04
Sum	1.2E-02	3.6E-02	1.7E-02

* The dose in the safety assessment using meteorological conditions during December 1985-November 1986.