Result of estimation of the released amount of radioactive materials into the ocean (in the vicinity of a port)

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Tokyo Electric Power Company

1 Estimation of the total released amount

In estimating the released amount of radioactive materials into the ocean (in the vicinity of a port), the possible paths of release are fallout in the vicinity of a port (part of the amount released into the atmosphere), direct release from the power station facilities (radioactive waste treatment facilities; units 2 and 3 pits), and influx from rainwater. Since it is impossible to calculate these separately on the basis of limited monitoring data, however, the released amount was estimated on the basis of the observed values of radioactivity concentration in the ocean (in the vicinity of the water discharge canals) (back analysis).

The calculation was performed at the Central Research Institute of Electric Power Industry using the calculation code for the simulation of dispersion of radioactive materials in the ocean developed by the Institute.

2 Estimation of the amount of radioactivity released into the ocean (in the vicinity of a port)

2.1 Overview of the calculation method (Fig. 1)

- Using a calculation code for the simulation of dispersion of radioactive materials in the ocean that the Central Research Institute of Electric Power Industry developed on the basis of the Regional Ocean Modeling System, ROMS*1, advection dispersion based on a tentative released amount was calculated to carry out back analysis of the released amount that reproduces the monitoring data (the radioactivity concentration in seawater near the water discharge canals of the Fukushima Daiichi Nuclear Power Station).
- ROMS is a model that carries out dispersion calculation on the basis of the results of a short-term weather forecasting system (the wind speed, ocean waves, atmospheric pressure, air temperature, and the like), and uses wide-area ocean reanalysis data (HYCOM) to increase its accuracy.
- To proceed with the system, a certain release rate was assumed to conduct dispersion calculation in a sea area to make back analysis of a release rate that will reproduce the monitoring data. The result was accumulated for the entire period to calculate the released amount into the ocean
- On the basis of the released amount determined, a dispersion calculation was performed, and a comparison was made between the calculated and the measured values of radioactivity concentration in seawater in the vicinity of the Fukushima Daini Nuclear Power Station (the Iwasawa seacoast, on the north side of the second floor) in order to confirm the validity of the result of the comparison.

*Reference: Central Research Institute of Electric Power Industry, Research Report, V11002 2011

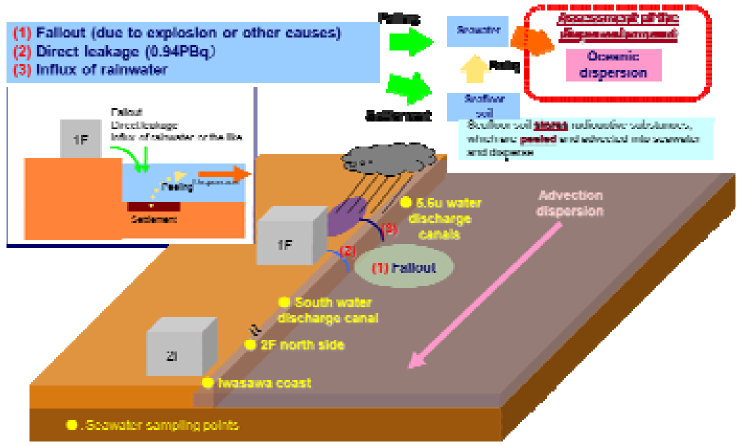

Fig. 1 Conceptual sketch of the release of radioactive materials into the ocean near a port

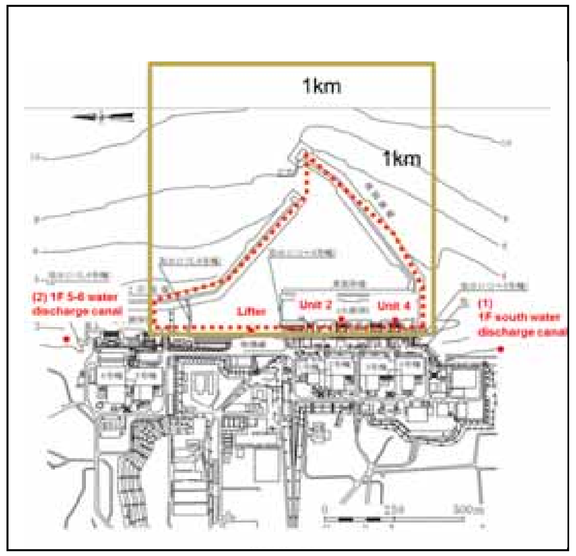

Fig.2 Source of release postulated

2.2 Area in which dispersion originates (source of release) (Fig.2)

To calculate advection dispersion, an area of sources of release that allows radioactive materials to disperse into the ocean is postulated.

Horizontal resolution: 1km×1km; vertical resolution: 20 layers (water depth down to 500m taken into consideration)

⇒To make a back analysis of a released amount that reproduces the monitoring data (the concentration of radioactive materials in seawater) by calculating the advection dispersion using a tentative released amount

3 Reproducibility of the result of monitoring in the nearby sea area (Figs. 3 and 4)

The result of calculation reproduces the change in the concentration near the water discharge canals of the Fukushima Daiichi Nuclear Power Station and near the Fukushima Daini Nuclear Power Station.

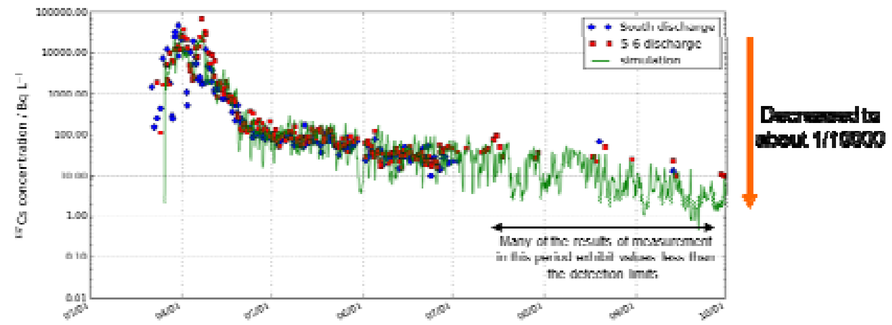

Fig.3 Concentration of radioactive materials in seawater near the water discharge canals of the Fukushima Daiichi Nuclear Power Station

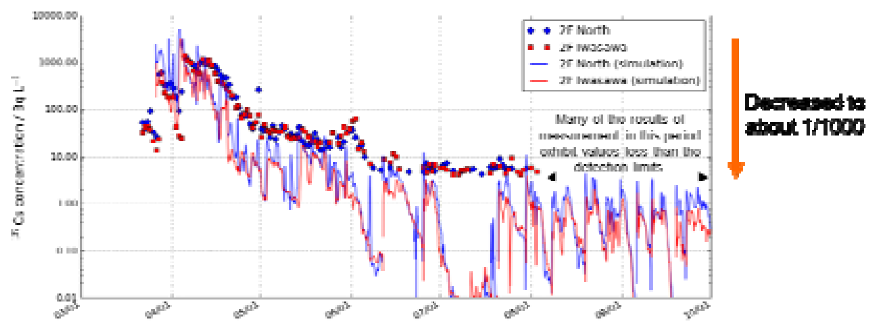

Fig.4 Concentration of radioactive materials in seawater near the Fukushima Daini Nuclear Power Station

4 Result of estimation of the released amount of radioactive materials from the vicinity of the port near Fukushima Daiichi Nuclear Power Station (Fig. 5, Tables 1 and 2)

It appears that, in March and April, not only direct leakage from the power station facilities but also fallout from the atmosphere and rainwater influx have caused radioactive materials to flow out into the ocean. Beginning in May, the amount of dispersion decreased greatly but not to zero. This is thought due to the dispersion of radioactive materials due to lifting of seafloor soil, influx accompanying rainwater, and other causes.

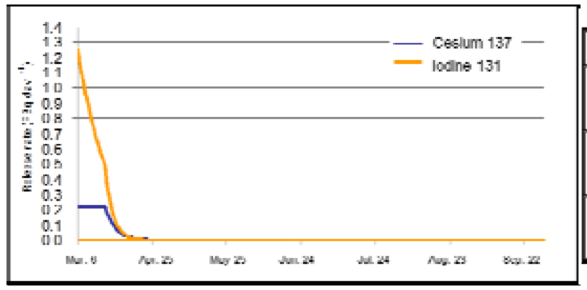

Fig. 5 Change in the amount of dispersion after March 26 (in Bq/day)

Table 1 Result of calculation of amount of dispersion (released amount) (in PBq)

Nuclide	Total amount	March 26 - 31	April 1-June 30	July 1-Sept.30	Remarks
^{131}I	11	6.1	4.9	0.0000057	Including direct leak (2.6) (April 1-6, April 4-10, May10-11)
^{134}Cs	3.5	1.3	2.2 (1.26+0.94)	0.019	Including direct leak (0.94) (April 1-6, April 4-10, May10-11)
^{137}Cs	3.6	1.3	2.2 (1.26+0.94)	0.022	Including direct leak (0.94) (April1-6, April 4-10, May10-11)

Table 2 Comparison of the results obtained by different organizations

	Period of assessment	Released amount in PBq		
		I-131	Cs-134	Cs-137
Our company (Central Research Institute of Electric Power Industry)	March 26-September 30 (Note1)	11	3.5	3.6
Japan Atomic Energy Agency	March 21-April 30 (Note2)	11.4	–	3.6
IRSN (Institut de Radioprotection et de Sûreté Nucléaire)	March 21-mid-July	–	–	27

(Note 1) A tentative calculation gives a released amount of 0.1 PBq for ^{137}Cs from March 21 when sampling started to March 25; the ratio of I-131 and Cs-137 suggests the predominance of release into the atmosphere.

(Note 2) Includes the release into the atmosphere