Radiation Exposure Assessment for Cleanup Work in Residential Areas

In Cooperation with the Japan Atomic Energy Agency

1. Summary

The external exposure dose received by workers from radiation sources (Cs-134 and Cs-137) such as soil in culverts was calculated for various working conditions, based on the results of our verification test on decontamination. In terms of assessment, we created a model for 1) cleaning rain gutters, 2) removing weeds, 3) cleaning culverts, and 4) removing dirt from under the eaves, and implemented an assessment.

Regarding internal exposure caused by inhalation of dust, this was ruled out given that no airborne radiation was detected during the verification test. Internal exposure resulting from direct oral intake was also ruled out since worker screening during the verification test showed radiation measurements similar to background levels.

2. Parameters for gutter cleaning (Residence C)

The following are the major parameters used to calculate external exposure doses.

Item		Unit	Value	Reason for the value
Shape of radiation source		—	-	Assumes five adhesions of soil of size 10 cm (L) × 10 cm (W) × 1 cm (T), dispersed in a gutter approx. 12 m in length.
Distance from radiation source		cm	30	Calculations were carried out for points 1cm to 30 cm away from the source. The value for 30 cm is shown as an example.
Cleanup work duration		min	28	Based on measurements
Concentration of radioactive materials in the radiation source	Cs-134	Bq/kg	399,000	Based on measurements
	Cs-137		430,000	

3. Parameters for weed removal (Residence E)

The following are the major parameters used to calculate external exposure doses.

Item		Unit	Value	Reason for the value
Shape of radiation source	Weeds	—	-	Assumes a weed 15 cm in height and soil 3 cm in depth containing radioactive materials, in a 2m x 2m area
	Soil		-	
Distance from radiation source		cm	50	Calculations were carried out for points between 1cm and 100 cm above ground. The value for the distance 50 cm is shown as an example.
Cleanup work duration		min	13	Based on measurements
Concentration of radioactive material in weeds	Cs-134	Bq/kg	12,000	Based on measurements
	Cs-137		13,300	
Radioactive material concentration in soil	Cs-134		16,800	
	Cs-137		18,300	

4. Parameters for culvert cleanup (Residence C)

The following are the major parameters used to calculate external exposure doses.

Item		Unit	Value	Reason for the value
Shape of radiation source		—	-	Assumes soil adhesion of size 15 m (L) × 15 cm (W) × 10 cm (T) contaminated with radioactive material.
Distance from radiation source		cm	50	Calculations were carried out for points 1cm to 100 cm away from the source. The value for 50 cm is shown as an example.
Cleanup work duration		min	29	Based on measurements
Concentration of radioactive materials in the radiation source	Cs-134	Bq/kg	19,100	Based on measurements
	Cs-137		20,900	

5. Parameters for removal of soil from under the eaves (Residence C)

The following are the major parameters used to calculate external exposure doses.

Item		Unit	Value	Reason for the value
Shape of radiation source		—	-	This assumes soil volume of 10 m (L) × 20 cm (W) × 3 cm (T) contaminated with radioactive material.
Distance from radiation source		cm	50	Calculations were carried out for points 1cm to 100 cm away from the source. The value for 50 cm is shown as an example.
Cleanup work duration		min	8	Based on measurements
Concentration of radioactive materials in the radiation source	Cs-134	Bq/kg	119,000	Based on measurements
	Cs-137		128,000	

6. Assessment results

The following are the total exposure doses for Cs-134 and Cs-137, according to our assessment with the above parameters.

The table also lists the total exposure doses for Cs-134 and Cs-137, assuming 1 hour spent on each of these activities.

	Exposure dose	Work duration	Distance from radiation source	Exposure dose for one hour worked
(1) Gutter cleaning	0.063 µSv	28 min	30cm	0.14 µSv
(2) Weed removal	0.41 µSv	13 min	50cm	1.9 µSv
(3) Culvert cleanup	0.25 µSv	29 min	50cm	0.51 µSv
(4) Removal of soil from under the eaves	0.20 µSv	8 min	50cm	1.5 µSv
Total	0.92µSv	78 min	-	4.1 µSv

If 4 hours of work consisting of 1 hour each of #1-4 were carried out once per month for 1 year, the additional exposure dose would be approximately 49 µSv/year, well below 1 mSv/year.