Decontamination in Living Environment

Expert Meeting on Radiological Protection of Workers Engaged in Decontamination Work

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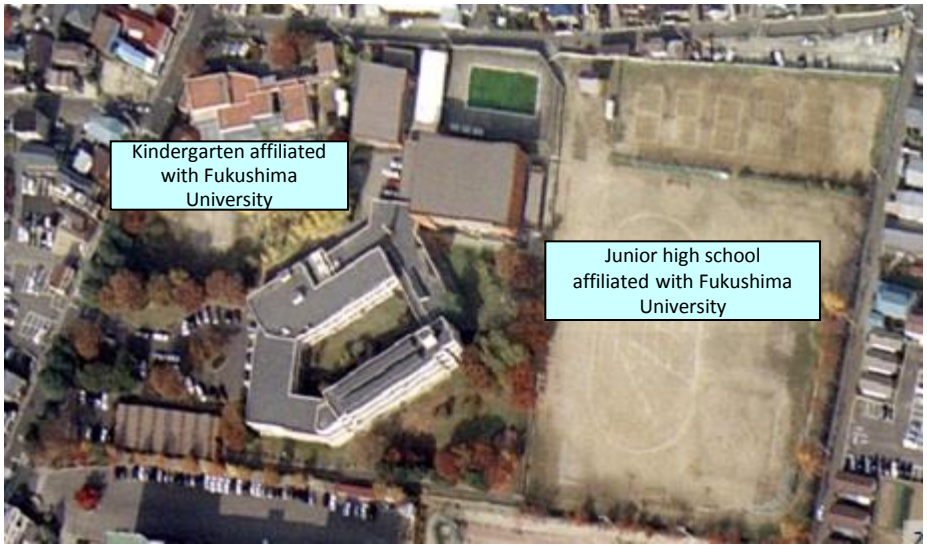
Decontamination related activities in JAEA

1. Schools
2. Swimming pool in schools
3. Houses
4. Parks
5. Communities (agricultural fields, roads, houses, forests)

Decontamination at schools (1/3) - School yards -



Comparison of dose rates between before and after decontamination

	Dose rates (μSv/h)		Reduction rate (%)
	Before decontamination	After decontamination	
Yard of junior high school			
100 cm	2.5 ± 0.3	0.15 ± 0.07	94
50 cm	2.9 ± 0.3	0.16 ± 0.06	94
1 cm	3.1 ± 0.5	0.16 ± 0.06	95
Courtyard of junior high school			
100 cm	2.4 ± 0.2	0.11 ± 0.05	95
50 cm	2.7 ± 0.2	0.11 ± 0.06	96
1 cm	3.0 ± 0.3	0.12 ± 0.07	96
Yard in kindergarten			
100 cm	1.9 ± 0.2	0.21 ± 0.06	89
50 cm	2.8 ± 0.2	0.22 ± 0.08	92
1 cm	3.1 ± 0.4	0.19 ± 0.09	94

Condition of the yards at a school and kindergarten

- Topsoil up to 5 cm in depth that contained relatively large amounts of radioactive materials removed.
- Surface of the yards covered with new soil.

Trenches for storing removed soil

- Dug in school yards.
- 1.5 m in depth.
- Water shielding sheet liner at the bottom and sides.
- Mixture of top soil from the trench mixed with new soil used as a cover soil with thickness of 50 cm.
- Temporary storage

Dose rates (D) measured at a 10 m by 10 m mesh.

- Before decontamination

  D (at 100 cm^H) < D (at 50 cm^H) < D (at l cm^H): Contribution by radioactive materials on the surface was dominant.

- After decontamination

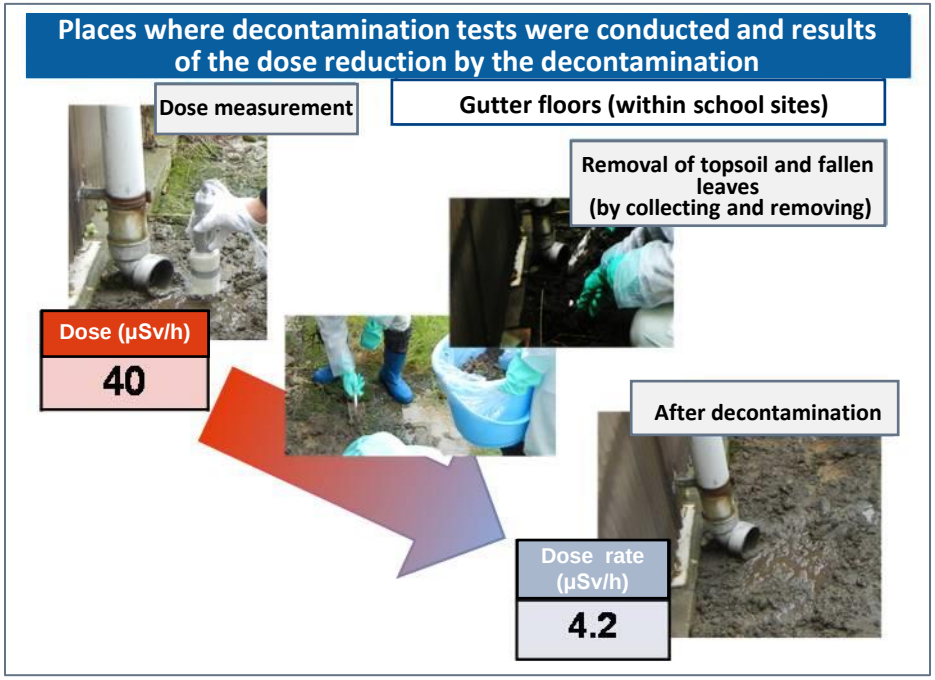
  Dose rates were significantly reduced.

  D (at 100 cm^H) ~ D (at 50 cm^H) ~ D (at l cm^H): Contribution of radioactive materials of the surrounding area was dominant.

→ The applied technology and approach were effective.

Decontamination at schools (2/3) - School building -

- Technical supports including measurement of radiation exposure doses and evaluation of decontamination effect were provided for the demonstration project to develop measures for reducing radiation exposure doses at schools such as Fukushima Daiichi Municipal Elementary School in Fukushima City (25 June to 2 July). Assistance was also provided to the prefectural office to develop guidance for formulating radiation exposure dose reduction measures.



Decontamination at schools (3/3)

Reported by Nuclear Energy Group, Disaster Management Department, Fukushima Prefectural Government

[Examples of places where radiation dose is high]

(1) Within school sites

Places with high dose rate	Ambient dose rate (μSv/h)		
	1 cm[H] from the ground surface	50 cm[H] from the ground surface	100 cm[H] from the ground surface
Gutter floor (Fukushima Daiichi Elementary School)	47	4.7	2.0
Rooftop drainage (Fukushima Daiichi Elementary School)	35	11	3.3
Gutter ditch (Kanayagawa Elementary School))	>30	2.3	1.2
Drainage under eye-washing equipment at swimming pool (Kitasawamata Elementary School)	12	4.0	2.0

(2) School commuting routes

Places with high dose rate	Ambient dose rate (μSv/h)		
	1cm from the ground surface	50cm from the ground surface	100cm from the ground surface
Puddles underneath electric poles (Kitasawamata Elementary School)	>30	2.5	1.6
Sidewalks where sediment is accumulated and/or weeds are overgrown. (Kanayagawa Elementary School))	25	3.2	1.6
Road ditch (Kitasawamata Elementary School)	13	1.4	1.1
Road ditch (Fukushima Daiichi Elementary School)	12	4.5	3.3

[Examples of decontamination effect]

(Unit:μSv/h)

Decontaminated place	Before decontamination	After decontamination	Decontamination method
Rooftop drainage outlet (Fukushima Daiichi Elementary School)	35	1.9	Removal of gravels and fallen leaves, scrubbing with brushes, and high pressure washing
Gutter floor (Kitasawamata Elementary School)	40	4.2 3.7	Removing sediment and moss, plus water washing
Sidewalks where sediment is accumulated and/or weeds are overgrown. (Kanayagawa Elementary School)	25	3.8 1.2	Removing sediment, weeding plus high-pressure washing
Road ditch (Kitasawamata Elementary School)	13	1.6	Weeding and removing sediment

(Measured at surface: 1 cm from the surface.)

[Radiation dose at places where waste was temporarily stored after decontamination]

Methods for temporary storage

○[Case where sediment removed at ditches was temporarily stored in approximately 200 sand bags (approx. 6 m^3) and covered with a blue vinyl sheet]

Surface 1 cm above	Distance 1 m	Distance 5 m	Distance 10 m	Distance 20 m
50	6.4 ~ 7.4	2.4 ~ 2.8	2.1 ~ 2.6	1.5 ~ 2.3

(Unit:μSv/h)

Methods for shielding

○[Case where sandbags containing sediment from ditches were shielded by U-shaped concrete ditches (6 cm in thickness)]

1 cm from the sandbags	1 cm from the shield of U-shaped ditch
15	2.9 ~ 3.2

(Unit:μSv/h)

Decontamination at swimming pools (1/6)

- **Water in an outdoor swimming pool contained cesium.**
- **Coagulation and precipitation process applied to purify water.**
- **Swimming pool water after purification discharged and then pool decontaminated.**

<u>Coagulation and precipitation process</u>

1) Add zeolite (100 g) and coagulant (150 ml) into pool water (1 ton).
2) Mature for 15 - 30 minutes after mixing well.
3) Coagulate cesium-adsorbed zeolite along with soil particles and green algae.
4) Discharge filtered water.
5) Cover the precipitated matter packed in jute bags with water shielding sheet and piled sandbags for radiation shielding purpose.

Concentrations of cesium in pool water

- Before decontamination: > 200 Bq/L
- After decontamination: Below the detection threshold

The precipitated matter can be stored safely.

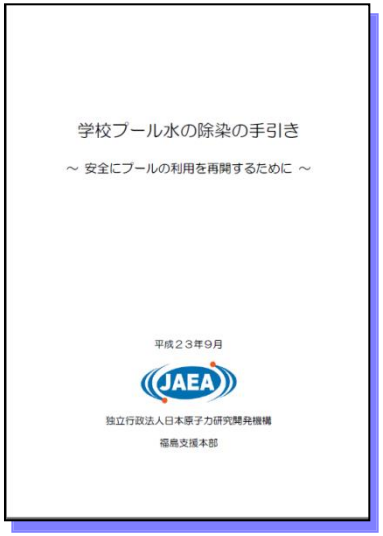
<u>Ambient dose rate (mSv/h)</u>

- BG: 0.7 - 0.9
- After packing in jute bags: 13 - 21
- After sandbags are piled: 1.0 - 1.2

-> The applied decontamination technologies and approach were effective

Decontamination at swimming pools (2/6)

- Guidance was prepared based on the demonstration test results ("Guidance for Decontaminating Swimming Pool Water in Schools") and released on JAEA's website at:
  http://www.iaea.go.ip/02/press1.shtml



Guidance

- Progress Review Meeting (7 September 2011): Announced at regular press conference of Fukushima University.

- Interactive communication and trust in relationship established with local residents (in Fukushima City and Date City) and school personnel through decontamination activities.


Decontamination staff members for schools in Date City: Project "Kizuna"

Decontamination at swimming pools (3/6)

- Workers' exposure (1/4)

– Source: JAEA website (Japanese)

		Worker A	Worker B	Worker C	Worker D	Worker E
	Working period	22-28, July	22-28, July	27-28, July	22-27, July	22-27, July
	Working days	7	7	2	6	6
Details (μSv/ day)	22 July	1	1		1	1
	23 July	6	6		6	6
	24 July	7	7		8	8
	25 July	8	8		8	8
	26 July	11	14		17	12
	27 July	17	20	7 (Work in the afternoon)	16	15
	28 July	22	29	18		
	Total dose (μSv)	72	85	25	56	50
	Daily average(μSv/ day)	10	12	13	9	8

Red: Filtering of sludge with sheets

Green: Decontamination of drainage outlets at the bottom of swimming pools

Radiation exposure dose increased in process (6) (26th to 28th) where filtering of sludge with sheets (dose rate on sludge surface: about 150 μSv/h) and removing of gravel (about 5,000Bq/L) in drainage outlets at the bottom of swimming pools were performed.

Decontamination at swimming pools (4/6)
- Workers' exposure (Hashirazawa Elementary School)

– Source: JAEA website (Japanese)

Cumulative exposure dose of JAEA staff

(Unit: μSv)

Staff	2 August	3 August	4 August	5 August	Total
A	5	15 (9)	24 (19)		24
B	4	15 (9)	24 (19)		24
C	4	14 (7)	21 (17)		21
D	2	7 (5)	18 (17)		18
E	4	13 (8)	23 (17)	32 (26)	32
F	4	15 (8)	23 (18)		23

The numerical values in parentheses are those when the activity started.

Workers' exposure dose and others

Workers' Identification Number	Exposure Dose (μSv)				Responsible as/for	Remarks
	2 Aug	3 Aug	4 Aug	5 Aug		
1	-	-	-	-	Administrator	Acquired how to measure pH.
2	-	-	-	-	Pump	Acquired drainage technology using pumps.
3	4	-	-	-	Pump	Acquired drainage technology using pumps.
4	3	4	7	4	Pump	Acquired drainage technology using pumps.
5	-	-	-	-	Pump	Acquired drainage technology using pumps.
6	-	0	-	-	Measurement	Acquired how to use radioactivity measurement instrument.
7	0	-	-	-	Measurement	Acquired how to use radioactivity measurement instrument.
8	-	-	-	-	Measurement	Acquired how to use radioactivity measurement instrument.
9	1		0		Measurement	Acquired how to use radioactivity measurement instrument.
10	4	4	5	3	Staff	Acquired how to measure pH.
11	4	4	4	6	Staff	Acquired techniques for temporary storage in sandbags.
12	-	-	-	-	Staff	Acquired techniques for temporary storage in sandbags.
13	-	-	-	3	Cleaning	Acquired how to measure pH.
14	-	-	-	-	Cleaning	Acquired technology for sampling pool water.
15	-	-	-	-	Cleaning	Acquired technology for sampling pool water.
16	-	-	-	-	Cleaning	Acquired technology for washing contaminated objects?
17	3	5	4		Cleaning	Acquired technology for washing contaminated objects?
18	-	-	-	-	Cleaning	Acquired techniques for washing contaminated objects?
19	-	5	4	6	Cleaning	Acquired technology for sampling pool water.

Decontamination at swimming pools (5/6)
- Workers' exposure (Tsukidate Elementary School)

– Source: JAEA website (Japanese)

Cumulative exposure dose of JAEA staff (Unit:μSv)

Staff	23 August	24 August	25 August	26 August	Total
A	3	(5) 9	(11) 14	(16) 19	19
B	2	(4) 7	(9) 13	(14) 16	16
C	3	(5) 8	(9) 13	(15) 18	18
D	5	(9) 16	(22) 24	(29) 33	33

The numerical values in parentheses are those when the activity started.

Workers' exposure dose, etc.

Workers' Identification Number	Exposure Dose (μSv)				Responsible as/for
	2 Aug	3 Aug	4 Aug	5 Aug	
1	-	-	-	-	Administrator
2	-	-	-	-	Pump
3	-	-	-	-	Pump
4	3	3	3	2	Pump
5	-	-	-	-	Pump
6	-	-	-	-	Measurement
7	-	-	-	-	Measurement
8	1	1	-	2	Measurement
9	-	-	-	-	Measurement
10	-	-	-	-	Staff
11	2	3	4	0	Staff
12	-	-	3	-	Staff
13	-	-	3	-	Cleaning
14	-	-	-	-	Cleaning
15	2	3	-	1	Cleaning
16	-	-	-	-	Cleaning
17	2	3	5	1	Cleaning

Decontamination at swimming pools (6/6)
- Workers' exposure (Hobara Elementary School)

– Source: JAEA website (Japanese)

Cumulative exposure dose of JAEA staff (Unit: μSv)

Staff	30 August	31 August	1 September	2 September	Total
A	3	(5) 8	(10) 15	(17) 20	20
B	5	(6) 8	(8) 12	(15) 20	20
C	3	(5) 9	(11) 14	(15) 19	19
D	4	(6) 9	(11) 14	(16) 20	20

The numerical values in parentheses are those when the activity started.

Workers' exposure dose and others

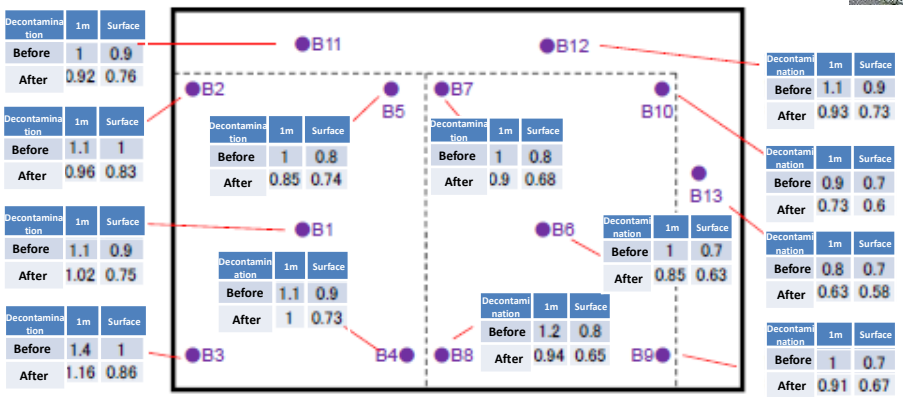
Workers' Identification Number	Exposure Dose (μSv)				Responsible as/for
	30 Aug	31 Aug	1 Sep	2 Sep	
1	-	-	-	3	Administrator
2	-	-	-	-	Pump
3	-	-	3	-	Pump
4	4	2	-	-	Pump
5	-	-	-	-	Pump
6	-	-	-	-	Measurement
7	1	2	3	-	Measurement
8	-	-	-	2	Measurement
9	-	-	-	-	Staff
10	3	2	4	5	Staff
11	-	-	3	-	Staff
12	-	-	3	-	Cleaning
13	-	-	-	-	Cleaning
14	3	4	3	3	Cleaning
15	-	-	-	-	Cleaning
16	0	4	4	3	Cleaning

See below

Decontamination at houses

Supports were also provided for decontamination in the decontamination demonstration project (22 - 24 July) by Date city for three residential houses in the specified evacuation recommended areas. JAEA was also involved in measurement of radiation exposure dose rates before and after decontamination and evaluation of the project.

2nd Floor



Example of dose changes in a house by decontamination