

Evaluation of the exposure dose of workers engaged in radiation work at
the Fukushima Daiichi Nuclear Power Station

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TEPCO has been evaluating the exposure dose of workers who engaged in radiation work at the Fukushima Daiichi Nuclear Power Station under two types, internal and external exposure to radiation, and has submitted the evaluation results to the Ministry of Health, Labour and Welfare regularly.

TEPCO today submitted to the Ministry of Health, Labour and Welfare a report on the exposure dose evaluation the data of which are those we collected until the end of May 2021. Here is part of the report: the maximum value of the external exposure dose among the workers who engaged in the work at the power station in May was 5.69 mSv, and regarding the internal exposure dose, no significant value was measured.

Exposure Dose Distribution

1. Effective Dose from External Exposure

Table 1 shows the distribution of external exposure dose of workers who were involved in radiation work at the Fukushima Daiichi Nuclear Power Station for the past three month.

Table 1. External Exposure Dose

Dose Ranges (mSv)	March 2021			April 2021			May 2021		
	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total
Above 100	0	0	0	0	0	0	0	0	0
75-100	0	0	0	0	0	0	0	0	0
50-75	0	0	0	0	0	0	0	0	0
20-50	0	0	0	0	0	0	0	0	0
10-20	0	0	0	0	0	0	0	0	0
5-10	0	55	55	0	6	6	0	6	6
1-5	40	654	694	25	366	391	24	357	381
1 or less	957	5032	5989	944	4602	5546	916	4661	5577
Total	997	5741	6738	969	4974	5943	940	5024	5964
Maximum (mSv)	3.42	8.90	8.90	2.19	6.40	6.40	2.99	5.69	5.69
Average (mSv)	0.16	0.44	0.40	0.10	0.28	0.25	0.11	0.27	0.24

• The values of the exposure dose and the number of the workers in the table above are subject to change, because there are cases that APD data are replaced with monthly dose data measured by integral dosimeters. Or dose data of workers who wore only an integral dosimeter (ex., workers who entered only the Seismic Isolation Building) need to be updated in the table after the publication of the data.

2. Sum of External and Internal Exposure Dose (Effective Dose)

Table 2 shows the distribution of cumulative exposure dose of workers who are involved in radiation work at Fukushima Daiichi for five years, starting on April 1, 2021. Table 3 shows the distribution of cumulative exposure dose in the fiscal year of 2021. Two different periods of time are shown in the Table 2: from April 1, 2021 to April 30, 2021 and from April 1, 2021 to May 31, 2021, and Table 3: from April 1, 2021 to April 30, 2021 and from April 1, 2021 to May 31, 2021 for comparison.

Table 2. Cumulative Exposure Dose for Five Years

Dose Ranges (mSv)	April 2021			April 2021 - May 2021			Difference		
	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total
Above 100	0	0	0	0	0	0	0	0	0
75-100	0	0	0	0	0	0	0	0	0
50-75	0	0	0	0	0	0	0	0	0
20-50	0	0	0	0	0	0	0	0	0
10-20	0	0	0	0	1	1	0	1	1
5-10	0	6	6	0	49	49	0	43	43
1-5	25	366	391	59	748	807	34	382	416
1 or less	944	4602	5546	963	4770	5733	19	168	187
Total	969	4974	5943	1022	5568	6590	53	594	647
Maximum (mSv)	2.19	6.40	6.40	4.44	11.02	11.02	-	-	-
Average (mSv)	0.10	0.28	0.25	0.20	0.50	0.45	-	-	-

• The values of the exposure dose and the number of the workers in the table above are subject to change, because there are cases that APD data are replaced with monthly dose data measured by integral dosimeters. Or dose data of workers who wore only an integral dosimeter (ex., workers who entered only the Seismic Isolation Building) need to be updated in the table after the publication of the data.

• No significant internal exposure has been reported since October 2011.

Table 3. Cumulative Exposure Dose in the Fiscal Year of 2021

Dose Ranges (mSv)	April 2021			April 2021 - May 2021			Difference		
	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total
Above 100	0	0	0	0	0	0	0	0	0
75-100	0	0	0	0	0	0	0	0	0
50-75	0	0	0	0	0	0	0	0	0
20-50	0	0	0	0	0	0	0	0	0
10-20	0	0	0	0	1	1	0	1	1
5-10	0	6	6	0	49	49	0	43	43
1-5	25	366	391	59	748	807	34	382	416
1 or less	944	4602	5546	963	4770	5733	19	168	187
Total	969	4974	5943	1022	5568	6590	53	594	647
Maximum (mSv)	2.19	6.40	6.40	4.44	11.02	11.02	-	-	-
Average (mSv)	0.10	0.28	0.25	0.20	0.50	0.45	-	-	-

• The values of the exposure dose and the number of the workers in the table above are subject to change, because there are cases that APD data are replaced with monthly dose data measured by integral dosimeters. Or dose data of workers who wore only an integral dosimeter (ex., workers who entered only the Seismic Isolation Building) need to be updated in the table after the publication of the data.

3. Sum of External and Internal Exposure Dose of Workers Exposed to Especially High Radiation (Effective Dose)

Table 4 shows the distribution of cumulative exposure dose of workers exposed to especially high radiation.*¹

Table 4. Cumulative Exposure Dose (workers exposed to especially high radiation)

Dose Ranges (mSv)	March 2011 - September 2015
Above 100	1
75-100	191
50-75	233
20-50	267
10-20	186
5-10	129
1-5	145
1 or less	51
Total	1203
Maximum (mSv)	102.69
Average (mSv)	36.49

(Since October 2015, TEPCO Holdings has opted not to report to the Labour Standards Inspection Office about workers exposed to especially high radiation.)

*1. Workers exposed to especially high radiation means workers who are involved in operations in which they could be exposed to the emergency exposure dose limit (100 mSv), which is stipulated in "Ordinance on Prevention of Ionizing Radiation Hazards, Chapter 7." In more detail, they are workers engaged in the work to maintain the function of the cooling facility to cool down the reactor facility or the spent fuel tank in the reactor facility, the steam turbine and its related facilities or the surrounding area where the radiation doses exceed 0.1 mSv/h. Or they are workers who would engage in keeping running the function to control or prevent the release of a large number of radioactive materials should it be likely to occur due to malfunction or damage of the reactor facility.

So far workers who have worked as "workers exposed to especially high radiation" are all TEPCO employees.

*2. The number of “workers exposed to especially high radiation” each month is the number of the workers who reported working as such workers in a given month and were engaged in that work. The figures in the cumulative data during the period from March 2011 to September 2015 in Table 4 above include the numbers of workers who have been reported to work as “workers exposed to especially high radiation” at least once.

*3. The values of the exposure dose and the number of the workers in the table above are subject to change, because there are cases that APD data are replaced with monthly dose data measured by integral dosimeters. Or the dose data of workers who wore only an integral dosimeter (ex., workers who entered only the Seismic Isolation Building) need to be updated in the table after the publication of the data.

*4. The figure shown in the dose range, “Above 100mSv,” in the cumulative data during the period from March 2011 to September 2015 is the figure when the March 2011 data of the internal exposure dose were reevaluated in July 2013.

4. Equivalent Dose

Table 5 and Table 6 show equivalent dose to the skin and the lens of the eyes of the workers, respectively, who were involved in radiation work at the Fukushima Daiichi Nuclear Power Station for the past three months.

Table 5. Equivalent Dose to the Skin

Dose Ranges (mSv)	March 2021			April 2021			May 2021		
	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total
Above 500	0	0	0	0	0	0	0	0	0
300-500	0	0	0	0	0	0	0	0	0
250-300	0	0	0	0	0	0	0	0	0
200-250	0	0	0	0	0	0	0	0	0
150-200	0	0	0	0	0	0	0	0	0
100-150	0	0	0	0	0	0	0	0	0
75-100	0	0	0	0	0	0	0	0	0
50-75	0	0	0	0	0	0	0	0	0
20-50	0	0	0	0	0	0	0	0	0
10-20	0	10	10	0	1	1	0	0	0
5-10	0	81	81	0	26	26	1	6	7
1-5	43	727	770	26	397	423	23	382	405
1 or less	954	4923	5877	943	4550	5493	916	4636	5552
Total	997	5741	6738	969	4974	5943	940	5024	5964
Maximum (mSv)	3.42	16.30	16.30	4.00	11.40	11.40	5.96	5.69	5.96
Average (mSv)	0.17	0.54	0.48	0.12	0.33	0.30	0.12	0.28	0.26

• The values of the exposure dose and the number of the workers in the table above are subject to change, because there are cases that APD data are replaced with monthly dose data measured by integral dosimeters. Or the dose data of workers who wore only an integral dosimeter (ex., workers who entered only the Seismic Isolation Building) need to be updated in the table after the publication of the data.

• Equivalent dose is a measure of the radiation dose to organs and tissues, and the equivalent dose limit to the skin is 500 mSv/year (the emergency exposure dose limit is 1 Sv).

• Equivalent dose to the skin is measured at a depth of 70 micrometers from the skin surface. When the equivalent dose is measured with a dosimeter other than the one put on around the chest and the abdomen, for example, a finger dosimeter, and the maximum measurement value is counted as the equivalent dose.

Table 6. Equivalent Dose to the Lens of the Eyes

Dose Ranges (mSv)	March 2021			April 2021			May 2021		
	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total
Above 150	0	0	0	0	0	0	0	0	0
100-150	0	0	0	0	0	0	0	0	0
75-100	0	0	0	0	0	0	0	0	0
50-75	0	0	0	0	0	0	0	0	0
20-50	0	0	0	0	0	0	0	0	0
10-20	0	1	1	0	0	0	0	0	0
5-10	0	61	61	0	8	8	1	6	7
1-5	42	659	701	26	372	398	23	382	405
1 or less	955	5020	5975	943	4594	5537	916	4636	5552
Total	997	5741	6738	969	4974	5943	940	5024	5964
Maximum (mSv)	3.42	10.50	10.50	2.19	7.30	7.30	5.96	5.69	5.96
Average (mSv)	0.16	0.46	0.42	0.11	0.29	0.26	0.12	0.28	0.26

• The values of the exposure dose and the number of the workers in the table above are subject to change, because there are cases that APD data are replaced with monthly dose data measured by integral dosimeters. Or the dose data of workers who wore only an integral dosimeter (ex., workers who entered only the Seismic Isolation Building) need to be updated in the table after the publication of the data.

• Equivalent dose is a measure of the radiation dose to organs and tissues, and the equivalent dose limit to the lens of the eye is 50 mSv/year and 100 mSv/5 years (the emergency exposure dose limit is 300 mSv). The equivalent dose limit to the lens of the eye before April 1, 2021 was 150mSv/year (the emergency exposure dose limit is 300 mSv).

• The equivalent dose to the lens of the eyes is measured at depth of 1 centimeter for neutron, 3 millimeters for X-ray, gamma ray and beta ray from the skin surface. However, as for X-ray, gamma ray and beta ray, it is measured at depth of 1 centimeter or 70 micrometer when deemed appropriate with consideration for radiation type and energy type (since April, 2021).

• The equivalent dose to the lens of the eyes was measured at an appropriate depth of 1 centimeter or 70 micrometers from the skin surface using one of the following method (until March, 2021):

- ① The case of using dosimeter put inside full face mask
- ② The case of using dosimeter put around the chest, the abdomen or the head and neck (excluding the case of ①)

5. Cumulative Equivalent Dose

Table 7 and Table 8 show the distribution of cumulative equivalent dose to the skins and the lens of the eyes of the workers, respectively, who were involved in radiation work at the Fukushima Daiichi Nuclear Power Station during two different periods of time, from April 1, 2021 to April 20, 2021 and from April 1, 2021 to May 31, 2021 for comparison.

Table 9 shows the distribution of cumulative exposure dose for five years, starting on April 1, 2021: from April 1, 2021 to April 30, 2021 and from April 1, 2021 to May 31, 2021 for comparison.

Table 7. Equivalent Dose to the Skin

Dose Ranges (mSv)	April 2021			April 2021 - May 2021			Difference		
	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total
Above 500	0	0	0	0	0	0	0	0	0
300-500	0	0	0	0	0	0	0	0	0
250-300	0	0	0	0	0	0	0	0	0
200-250	0	0	0	0	0	0	0	0	0
150-200	0	0	0	0	0	0	0	0	0
100-150	0	0	0	0	0	0	0	0	0
75-100	0	0	0	0	0	0	0	0	0
50-75	0	0	0	0	0	0	0	0	0
20-50	0	0	0	0	0	0	0	0	0
10-20	0	1	1	0	6	6	0	5	5
5-10	0	26	26	3	74	77	3	48	51
1-5	26	397	423	57	784	841	31	387	418
1 or less	943	4550	5493	962	4704	5666	19	154	173
Total	969	4974	5943	1022	5568	6590	53	594	647
Maximum (mSv)	4.00	11.40	11.40	6.51	13.50	13.50	-	-	-
Average (mSv)	0.12	0.33	0.30	0.22	0.55	0.50	-	-	-

- The values of the exposure dose and the number of the workers in the table above are subject to change, because there are cases that APD data are replaced with monthly dose data measured by integral dosimeters. Or the dose data of workers who wore only an integral dosimeter (ex., workers who entered only the Seismic Isolation Building) need to be updated in the table after the publication of the data.

- Equivalent dose is a measure of the radiation dose to organs and tissues, and the equivalent dose limit to the skin is 500 mSv/year (the emergency exposure dose limit is 1 Sv).

- Equivalent dose to the skin is measured at a depth of 70 micrometers from the skin surface. When the equivalent dose is measured with a dosimeter other than the one put on around the chest and the abdomen, for example, a finger dosimeter, and the maximum measurement value is counted as the equivalent dose.

Table 8. Equivalent Dose to the Lens of the Eyes

Dose Ranges (mSv)	April 2021			April 2021 - May 2021			Difference		
	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total
Above 150	0	0	0	0	0	0	0	0	0
100-150	0	0	0	0	0	0	0	0	0
75-100	0	0	0	0	0	0	0	0	0
50-75	0	0	0	0	0	0	0	0	0
20-50	0	0	0	0	0	0	0	0	0
10-20	0	0	0	0	1	1	0	1	1
5-10	0	8	8	1	54	55	1	46	47
1-5	26	372	398	59	772	831	33	400	433
1 or less	943	4594	5537	962	4741	5703	19	147	166
Total	969	4974	5943	1022	5568	6590	53	594	647
Maximum (mSv)	2.19	7.30	7.30	6.41	10.47	10.47	-	-	-
Average (mSv)	0.11	0.29	0.26	0.21	0.52	0.47	-	-	-

- The values of the exposure dose and the number of the workers in the table above are subject to change, because there are cases that APD data are replaced with monthly dose data measured by integral dosimeters. Or the dose data of workers who wore only an integral dosimeter (ex., workers who entered only the Seismic Isolation Building) need to be updated in the table after the publication of the data.
- Equivalent dose is a measure of the radiation dose to organs and tissues, and the equivalent dose limit to the lens of the eye is 50 mSv/year and 100 mSv/5 years (the emergency exposure dose limit is 300 mSv).
- The equivalent dose to the lens of the eyes is measured at depth of 1 centimeter for neutron, 3 millimeters for X-ray, gamma ray and beta ray from the skin surface. However, as for X-ray, gamma ray and beta ray, it is measured at depth of 1 centimeter or 70 micrometer when deemed appropriate with consideration for radiation type and energy type.

Table 9. Equivalent Dose to the Lens of the Eyes: Cumulative Exposure Dose for Five Years

Dose Ranges (mSv)	April 2021			April 2021 - May 2021			Difference		
	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total	TEPCO Employees	Contractors	Total
Above 100	0	0	0	0	0	0	0	0	0
75-100	0	0	0	0	0	0	0	0	0
50-75	0	0	0	0	0	0	0	0	0
20-50	0	0	0	0	0	0	0	0	0
10-20	0	0	0	0	1	1	0	1	1
5-10	0	8	8	1	54	55	1	46	47
1-5	26	372	398	59	772	831	33	400	433
1 or less	943	4594	5537	962	4741	5703	19	147	166
Total	969	4974	5943	1022	5568	6590	53	594	647
Maximum (mSv)	2.19	7.30	7.30	6.41	10.47	10.47	-	-	-
Average (mSv)	0.11	0.29	0.26	0.21	0.52	0.47	-	-	-

- The values of the exposure dose and the number of the workers in the table above are subject to change, because there are cases that APD data are replaced with monthly dose data measured by integral dosimeters. Or the dose data of workers who wore only an integral dosimeter (ex., workers who entered only the Seismic Isolation Building) need to be updated in the table after the publication of the data.
- Equivalent dose is a measure of the radiation dose to organs and tissues, and the equivalent dose limit to the lens of the eye is 50 mSv/year and 100 mSv/5 years (the emergency exposure dose limit is 300 mSv).
- The equivalent dose to the lens of the eyes is measured at depth of 1 centimeter for neutron, 3 millimeters for X-ray, gamma ray and beta ray from the skin surface. However, as for X-ray, gamma ray and beta ray, it is measured at depth of 1 centimeter or 70 micrometer when deemed appropriate with consideration for radiation type and energy type.