

Evaluation of the exposure dose of workers at the Fukushima Daiichi Nuclear Power Station

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TEPCO has been evaluating the exposure dose of workers 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 February 2019. Here is part of the report: the maximum value of the exposure dose among the workers who engaged in the work at the power station in February was 10.87mSv, 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)	December 2018			January 2019			February 2019		
	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	4	4	0	0	0	0	2	2
5-10	0	55	55	0	37	37	1	56	57
1-5	21	621	642	16	511	527	28	677	705
1 or less	981	5562	6543	944	5569	6513	933	5567	6500
Total	1002	6242	7244	960	6117	7077	962	6302	7264
Maximum (mSv)	4.52	14.10	14.10	2.32	7.81	7.81	5.38	10.87	10.87
Average (mSv)	0.13	0.42	0.38	0.10	0.36	0.32	0.15	0.42	0.39

• The values of the exposure dose and the number of the workers in the table above are subject to change, because there are times when 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 Main Anti-earthquake 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, 2016. Table 3 shows the distribution of cumulative exposure dose in the fiscal year of 2018. Two different periods of time are shown in the Table 2: from April 1, 2016 to January 31, 2019 and from April 1, 2016 to February 28, 2019, and Table 3: from April 1, 2018 to January 31, 2019 and from April 1, 2018 to February 28, 2019 for comparison.

Table 2. Cumulative Exposure Dose for Five Years

Dose Ranges (mSv)	April 2016 - January 2019			April 2016 - February 2019			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	5	5	0	5	5	0	0	0
50-75	0	65	65	0	71	71	0	6	6
20-50	29	1310	1339	33	1344	1377	4	34	38
10-20	118	1977	2095	123	2045	2168	5	68	73
5-10	174	2164	2338	172	2157	2329	-2	-7	-9
1-5	527	4428	4955	534	4440	4974	7	12	19
1 or less	1251	8467	9718	1244	8494	9738	-7	27	20
Total	2099	18416	20515	2106	18556	20662	7	140	147
Maximum (mSv)	34.11	77.27	77.27	34.23	79.73	79.73	-	-	-
Average (mSv)	2.42	5.46	5.15	2.48	5.56	5.25	-	-	-

• The values of the exposure dose and the number of the workers in the table above are subject to change, because there are times when 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 Main Anti-earthquake 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 2018

Dose Ranges (mSv)	April 2018 - January 2019			April 2018 - January 2019			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	6	615	621	12	751	763	6	136	142
5-10	56	753	809	64	824	888	8	71	79
1-5	245	2557	2802	246	2686	2932	1	129	130
1 or less	1117	5527	6644	1116	5410	6526	-1	-117	-118
Total	1424	9452	10876	1438	9671	11109	14	219	233
Maximum (mSv)	11.66	19.90	19.90	13.41	19.90	19.90	-	-	-
Average (mSv)	0.84	2.22	2.04	0.94	2.44	2.25	-	-	-

• The values of the exposure dose and the number of the workers in the table above are subject to change, because there are times when 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 Main Anti-earthquake 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 (100mSv), 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 0.1mSv/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 times when 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 Main Anti-earthquake 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)	December 2018			January 2019			February 2019		
	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	13	13	0	7	7	0	2	2
5-10	1	100	101	0	76	76	1	66	67
1-5	20	703	723	16	614	630	30	803	833
1 or less	981	5426	6407	944	5420	6364	931	5431	6362
Total	1002	6242	7244	960	6117	7077	962	6302	7264
Maximum (mSv)	5.20	15.80	15.80	2.32	14.80	14.80	5.38	11.97	11.97
Average (mSv)	0.13	0.53	0.47	0.11	0.47	0.42	0.16	0.48	0.44

• The values of the exposure dose and the number of the workers in the table above are subject to change, because there are times when 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 Main Anti-earthquake 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 500mSv/year (the emergency exposure dose limit is 1Sv).

• 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, the maximum measurement value is counted as the equivalent dose.

Table 6. Equivalent Dose to the Lens of the Eyes (Including inside of full-face mask)

Dose Ranges (mSv)	December 2018			January 2019			February 2019		
	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	6	6	0	0	0	0	2	2
5-10	0	71	71	0	51	51	1	66	67
1-5	21	640	661	16	542	558	30	803	833
1 or less	981	5525	6506	944	5524	6468	931	5431	6362
Total	1002	6242	7244	960	6117	7077	962	6302	7264
Maximum (mSv)	4.52	14.10	14.10	2.32	9.40	9.40	5.38	11.97	11.97
Average (mSv)	0.13	0.46	0.41	0.10	0.39	0.35	0.16	0.48	0.44

• The values of the exposure dose and the number of the workers in the table above are subject to change, because there are times when 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 Main Anti-earthquake 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 150mSv/year (the emergency exposure dose limit is 300mSv).

• The equivalent dose to the lens of the eyes is measured at an appropriate depth of 1 centimeter or 70 micrometers from the skin surface using one of the following method:

- 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, 2018 to January 31, 2019 and from April 1, 2018 to February 28, 2019 for comparison.

Table 7. Equivalent Dose to the Skin

Dose Ranges (mSv)	April 2018 - January 2019			April 2018 - February 2019			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	182	182	0	216	216	0	34	34
10-20	9	767	776	16	885	901	7	118	125
5-10	58	870	928	70	918	988	12	48	60
1-5	247	2471	2718	244	2569	2813	-3	98	95
1 or less	1110	5162	6272	1108	5083	6191	-2	-79	-81
Total	1424	9452	10876	1438	9671	11109	14	219	233
Maximum (mSv)	11.91	45.20	45.20	13.87	46.54	46.54	-	-	-
Average (mSv)	0.89	3.03	2.75	0.99	3.28	2.98	-	-	-

• The values of the exposure dose and the number of the workers in the table above are subject to change, because there are times when 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 Main Anti-earthquake 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 500mSv/year (the emergency exposure dose limit is 1Sv).

• 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, the maximum measurement value is counted as the equivalent dose.

Table 8. Equivalent Dose to the Lens of the Eyes (Including inside of full-face mask)

Dose Ranges (mSv)	April 2018 - January 2019			April 2018 - February 2019			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	17	17	0	22	22	0	5	5
10-20	8	666	674	14	813	827	6	147	153
5-10	55	837	892	67	915	982	12	78	90
1-5	249	2586	2835	248	2692	2940	-1	106	105
1 or less	1112	5346	6458	1109	5229	6338	-3	-117	-120
Total	1424	9452	10876	1438	9671	11109	14	219	233
Maximum (mSv)	11.89	23.20	23.20	13.85	23.56	23.56	-	-	-
Average (mSv)	0.87	2.43	2.23	0.96	2.69	2.46	-	-	-

• The values of the exposure dose and the number of the workers in the table above are subject to change, because there are times when 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 Main Anti-earthquake 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 eyes is 150mSv/year (the emergency exposure dose limit is 300mSv).

• The equivalent dose to the lens of the eyes is measured at an appropriate depth of 1 centimeter or 70 micrometers from the skin surface using one of the following method:

- 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)