

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 August 2018. 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 August 2018 was 6.35mSv, 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)	June 2018			July 2018			August 2018		
	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	4	4	0	21	21	0	8	8
1-5	29	488	517	27	597	624	24	435	459
1 or less	939	5795	6734	867	5665	6532	924	5793	6717
Total	968	6287	7255	894	6283	7177	948	6236	7184
Maximum (mSv)	2.68	7.37	7.37	2.72	9.70	9.70	2.16	6.35	6.35
Average (mSv)	0.14	0.30	0.28	0.13	0.34	0.32	0.13	0.26	0.25

• 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.

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 July 31, 2018 and from April 1, 2016 to August 31, 2018, and Table 3: from April 1, 2018 to July 31, 2018 and from April 1, 2018 to August 31, 2018 for comparison.

Table 2. Cumulative Exposure Dose for Five Years

Dose Ranges (mSv)	April 2016 - July 2018			April 2016 - August 2018			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	1	1	0	1	1	0	0	0
50-75	0	39	39	0	44	44	0	5	5
20-50	11	1104	1115	14	1138	1152	3	34	37
10-20	110	1784	1894	112	1805	1917	2	21	23
5-10	147	2008	2155	147	2015	2162	0	7	7
1-5	502	4442	4944	516	4463	4979	14	21	35
1 or less	1211	8214	9425	1256	8247	9503	45	33	78
Total	1981	17592	19573	2045	17713	19758	64	121	185
Maximum (mSv)	26.71	75.27	75.27	27.48	75.50	75.50	-	-	-
Average (mSv)	2.20	4.98	4.70	2.19	5.04	4.74	-	-	-

• 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 - July 2018			April 2018 - August 2018			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	68	68	0	114	114	0	46	46
5-10	5	352	357	8	427	435	3	75	78
1-5	155	1509	1664	200	1770	1970	45	261	306
1 or less	1066	5939	7005	1103	5834	6937	37	-105	-68
Total	1226	7868	9094	1311	8145	9456	85	277	362
Maximum (mSv)	8.04	17.11	17.11	8.37	17.20	17.20	-	-	-
Average (mSv)	0.39	1.02	0.93	0.46	1.19	1.09	-	-	-

• 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)	June 2018			July 2018			August 2018		
	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	1	1	0	0	0	0	0	0
10-20	0	8	8	0	5	5	0	0	0
5-10	0	27	27	0	55	55	0	16	16
1-5	32	678	710	31	791	822	26	535	561
1 or less	936	5573	6509	863	5432	6295	922	5685	6607
Total	968	6287	7255	894	6283	7177	948	6236	7184
Maximum (mSv)	3.40	20.20	20.20	3.40	16.00	16.00	2.58	6.65	6.65
Average (mSv)	0.15	0.43	0.39	0.15	0.48	0.43	0.14	0.31	0.29

• 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

Dose Ranges (mSv)	June 2018			July 2018			August 2018		
	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	0	0	0	0	0
5-10	0	9	9	0	22	22	0	16	16
1-5	31	545	576	31	656	687	26	535	561
1 or less	937	5733	6670	863	5605	6468	922	5685	6607
Total	968	6287	7255	894	6283	7177	948	6236	7184
Maximum (mSv)	2.68	9.40	9.40	3.32	9.70	9.70	2.58	6.65	6.65
Average (mSv)	0.15	0.33	0.31	0.14	0.37	0.34	0.14	0.31	0.29

• 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 a depth of 70 micrometers from the skin surface using a dosimeter put on around the chest or the abdomen, and thus the shielding effect of face masks is not taken into consideration.

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 July 31, 2018 and from April 1, 2018 to August 31, 2018 for comparison.

Table 7. Equivalent Dose to the Skin

Dose Ranges (mSv)	April 2018 - July 2018			April 2018 - August 2018			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	40	40	0	55	55	0	15	15
10-20	0	187	187	0	223	223	0	36	36
5-10	7	425	432	11	515	526	4	90	94
1-5	166	1798	1964	203	2038	2241	37	240	277
1 or less	1053	5418	6471	1097	5314	6411	44	-104	-60
Total	1226	7868	9094	1311	8145	9456	85	277	362
Maximum (mSv)	8.04	37.90	37.90	8.37	37.93	37.93	-	-	-
Average (mSv)	0.42	1.51	1.36	0.49	1.70	1.53	-	-	-

• 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.

Table 8. Equivalent Dose to the Lens of the Eyes

Dose Ranges (mSv)	April 2018 - July 2018			April 2018 - August 2018			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	4	4	0	4	4	0	0	0
10-20	0	79	79	0	137	137	0	58	58
5-10	7	401	408	10	486	496	3	85	88
1-5	161	1715	1876	202	2010	2212	41	295	336
1 or less	1058	5669	6727	1099	5508	6607	41	-161	-120
Total	1226	7868	9094	1311	8145	9456	85	277	362
Maximum (mSv)	8.04	22.50	22.50	8.37	22.50	22.50	-	-	-
Average (mSv)	0.41	1.14	1.05	0.48	1.34	1.22	-	-	-

• 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.