

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 October 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 October 2018 was 8.59mSv, 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)	August 2018			September 2018			October 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	9	9	0	8	8	0	16	16
1-5	25	453	478	17	469	486	26	548	574
1 or less	947	5784	6731	985	5684	6669	935	5592	6527
Total	972	6246	7218	1002	6161	7163	961	6156	7117
Maximum (mSv)	2.30	6.30	6.30	1.90	8.00	8.00	4.17	8.59	8.59
Average (mSv)	0.13	0.29	0.27	0.11	0.28	0.26	0.15	0.32	0.30

• 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 September 30, 2018 and from April 1, 2016 to October 31, 2018, and Table 3: from April 1, 2018 to September 30, 2018 and from April 1, 2018 to October 31, 2018 for comparison.

Table 2. Cumulative Exposure Dose for Five Years

Dose Ranges (mSv)	April 2016 - September 2018			April 2016 - October 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	48	48	0	53	53	0	5	5
20-50	14	1166	1180	20	1195	1215	6	29	35
10-20	117	1844	1961	117	1869	1986	0	25	25
5-10	156	2043	2199	159	2067	2226	3	24	27
1-5	503	4453	4956	513	4479	4992	10	26	36
1 or less	1273	8287	9560	1260	8346	9606	-13	59	46
Total	2063	17842	19905	2069	18010	20079	6	168	174
Maximum (mSv)	28.48	75.50	75.50	30.54	75.50	75.50	-	-	-
Average (mSv)	2.23	5.11	4.81	2.29	5.17	4.87	-	-	-

• 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 - September 2018			April 2018 - October 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	172	172	0	245	245	0	73	73
5-10	11	502	513	24	582	606	13	80	93
1-5	219	1975	2194	232	2200	2432	13	225	238
1 or less	1115	5753	6868	1114	5688	6802	-1	-65	-66
Total	1345	8402	9747	1370	8715	10085	25	313	338
Maximum (mSv)	8.70	17.50	17.50	9.27	17.50	17.50	-	-	-
Average (mSv)	0.53	1.38	1.26	0.63	1.55	1.43	-	-	-

• 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)	August 2018			September 2018			October 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	0	0	0	0	0	0	0	0
10-20	0	4	4	0	0	0	0	0	0
5-10	0	19	19	0	19	19	0	23	23
1-5	27	577	604	19	661	680	26	675	701
1 or less	945	5646	6591	983	5481	6464	935	5458	6393
Total	972	6246	7218	1002	6161	7163	961	6156	7117
Maximum (mSv)	3.10	15.70	15.70	2.00	9.60	9.60	4.17	8.59	8.59
Average (mSv)	0.14	0.37	0.34	0.12	0.37	0.34	0.16	0.38	0.35

• 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)	August 2018			September 2018			October 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	8	8	0	11	11	0	23	23
1-5	26	483	509	19	511	530	26	675	701
1 or less	946	5755	6701	983	5639	6622	935	5458	6393
Total	972	6246	7218	1002	6161	7163	961	6156	7117
Maximum (mSv)	3.01	6.30	6.30	1.90	8.00	8.00	4.17	8.59	8.59
Average (mSv)	0.13	0.30	0.28	0.11	0.31	0.28	0.16	0.38	0.35

• 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 September 30, 2018 and from April 1, 2018 to October 31, 2018 for comparison.

Table 7. Equivalent Dose to the Skin

Dose Ranges (mSv)	April 2018 - September 2018			April 2018 - October 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	73	73	0	79	79	0	6	6
10-20	0	286	286	0	369	369	0	83	83
5-10	16	620	636	28	712	740	12	92	104
1-5	223	2189	2412	237	2341	2578	14	152	166
1 or less	1106	5234	6340	1105	5214	6319	-1	-20	-21
Total	1345	8402	9747	1370	8715	10085	25	313	338
Maximum (mSv)	8.70	38.10	38.10	9.27	38.48	38.48	-	-	-
Average (mSv)	0.57	1.97	1.77	0.67	2.16	1.96	-	-	-

• 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 - September 2018			April 2018 - October 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	189	189	0	270	270	0	81	81
5-10	15	567	582	27	672	699	12	105	117
1-5	219	2180	2399	233	2374	2607	14	194	208
1 or less	1111	5462	6573	1110	5395	6505	-1	-67	-68
Total	1345	8402	9747	1370	8715	10085	25	313	338
Maximum (mSv)	8.70	22.50	22.50	9.27	22.50	22.50	-	-	-
Average (mSv)	0.55	1.52	1.39	0.65	1.73	1.59	-	-	-

• 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.