

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 January 2019. 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 January 2019 was 7.81mSv, 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)	November 2018			December 2018			January 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	0	0	0	4	4	0	0	0
5-10	0	42	42	0	55	55	0	28	28
1-5	13	626	639	21	621	642	16	521	537
1 or less	1009	5556	6565	981	5562	6543	903	5542	6445
Total	1022	6224	7246	1002	6242	7244	919	6091	7010
Maximum (mSv)	2.95	9.88	9.88	4.52	14.10	14.10	2.32	7.81	7.81
Average (mSv)	0.11	0.39	0.35	0.13	0.42	0.38	0.11	0.35	0.31

• 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 December 31, 2018 and from April 1, 2016 to January 31, 2019, and Table 3: from April 1, 2018 to December 31, 2018 and from April 1, 2018 to January 31, 2019 for comparison.

**Table 2. Cumulative Exposure Dose for Five Years**

Dose Ranges (mSv)	April 2016 - December 2018			April 2016 - 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	4	4	0	5	5	0	1	1
50-75	0	64	64	0	66	66	0	2	2
20-50	26	1273	1299	29	1308	1337	3	35	38
10-20	118	1931	2049	118	1977	2095	0	46	46
5-10	171	2144	2315	174	2164	2338	3	20	23
1-5	521	4448	4969	529	4434	4963	8	-14	-6
1 or less	1253	8443	9696	1249	8462	9711	-4	19	15
Total	2089	18307	20396	2099	18416	20515	10	109	119
Maximum (mSv)	32.48	75.68	75.68	34.11	77.13	77.13	-	-	-
Average (mSv)	2.38	5.37	5.06	2.42	5.45	5.14	-	-	-

• 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 - December 2018			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	3	472	475	6	616	622	3	144	147
5-10	49	746	795	56	747	803	7	1	8
1-5	237	2432	2669	246	2553	2799	9	121	130
1 or less	1118	5606	6724	1115	5536	6651	-3	-70	-73
Total	1407	9256	10663	1423	9452	10875	16	196	212
Maximum (mSv)	10.55	19.90	19.90	11.66	19.90	19.90	-	-	-
Average (mSv)	0.78	2.03	1.86	0.84	2.21	2.03	-	-	-

• 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.\*<sup>1</sup>

**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)	November 2018			December 2018			January 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	1	1	0	0	0	0	0	0
10-20	0	3	3	0	13	13	0	0	0
5-10	0	60	60	1	100	101	0	36	36
1-5	14	756	770	20	703	723	16	591	607
1 or less	1008	5404	6412	981	5426	6407	903	5464	6367
Total	1022	6224	7246	1002	6242	7244	919	6091	7010
Maximum (mSv)	2.95	20.50	20.50	5.20	15.80	15.80	2.32	9.51	9.51
Average (mSv)	0.11	0.49	0.44	0.13	0.53	0.47	0.11	0.39	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 (Including inside of full-face mask)**

Dose Ranges (mSv)	November 2018			December 2018			January 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	4	4	0	6	6	0	0	0
5-10	0	44	44	0	71	71	0	36	36
1-5	14	643	657	21	640	661	16	591	607
1 or less	1008	5533	6541	981	5525	6506	903	5464	6367
Total	1022	6224	7246	1002	6242	7244	919	6091	7010
Maximum (mSv)	2.95	11.20	11.20	4.52	14.10	14.10	2.32	9.51	9.51
Average (mSv)	0.11	0.42	0.38	0.13	0.46	0.41	0.11	0.39	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 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 December 31, 2018 and from April 1, 2018 to January 31, 2019 for comparison.

**Table 7. Equivalent Dose to the Skin**

Dose Ranges (mSv)	April 2018 - December 2018			April 2018 - January 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	141	141	0	165	165	0	24	24
10-20	6	661	667	9	767	776	3	106	109
5-10	50	845	895	58	860	918	8	15	23
1-5	242	2410	2652	248	2480	2728	6	70	76
1 or less	1109	5199	6308	1108	5180	6288	-1	-19	-20
Total	1407	9256	10663	1423	9452	10875	16	196	212
Maximum (mSv)	11.02	40.00	40.00	11.91	44.63	44.63	-	-	-
Average (mSv)	0.83	2.79	2.53	0.90	2.98	2.71	-	-	-

- 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 - December 2018			April 2018 - January 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	15	15	0	17	17	0	2	2
10-20	4	532	536	8	664	672	4	132	136
5-10	50	806	856	55	852	907	5	46	51
1-5	240	2510	2750	250	2583	2833	10	73	83
1 or less	1113	5393	6506	1110	5336	6446	-3	-57	-60
Total	1407	9256	10663	1423	9452	10875	16	196	212
Maximum (mSv)	11.00	22.50	22.50	11.89	23.08	23.08	-	-	-
Average (mSv)	0.81	2.22	2.04	0.87	2.43	2.22	-	-	-

- 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.
- 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 )