

Exposure Status of Workers After the Fukushima Daiichi Nuclear Power Plant Accident

February 27, 2016

Mako Oshidori

1. Status of stable iodine tablet provision/administration for emergency workers
2. Exposure doses of workers
3. Medical examination for emergency workers

☆ Reuse of radioactive waste

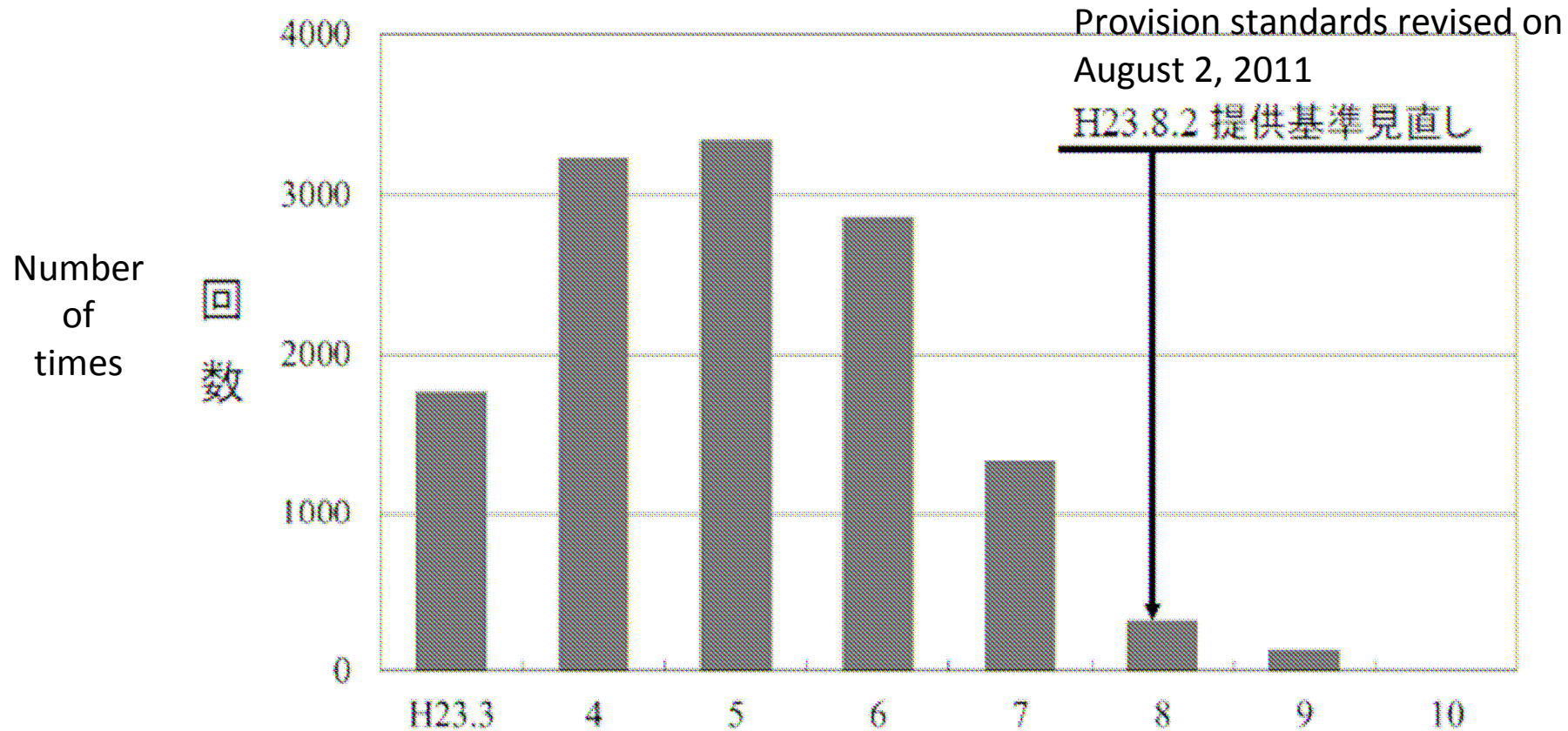
Past Record of Stable Iodine Tablet Provision at Fukushima Daiichi Nuclear Power Plant (FDNPP)

(Based on information by Dr. Hiroshi Kikuchi,
Tokyo Electric Company Occupational Physician)

- Past record of stable iodine tablet provision covers a seven-month period from March 13, 2011 to October 12, 2011.
(Beginning August 2, 2011, provision of stable iodine tablets became limited to part of workers in reactor buildings).
- Each administered dose is 1 to 2 tablets of 50mg KI (potassium iodide)
- Iodine tablets were provided free of charge.
- Very little supervision by physician after exclusion of contraindications
- About 2000 workers orally took the iodine tablets.
- Iodine tablets were administered about 13,000 times for a total of 17, 500 tablets.
- Total dose administered per person was less than 10 tablets in about 75%. Maximum was 87 tablets per person.

The Number of Times Iodine Tablets Were Administered

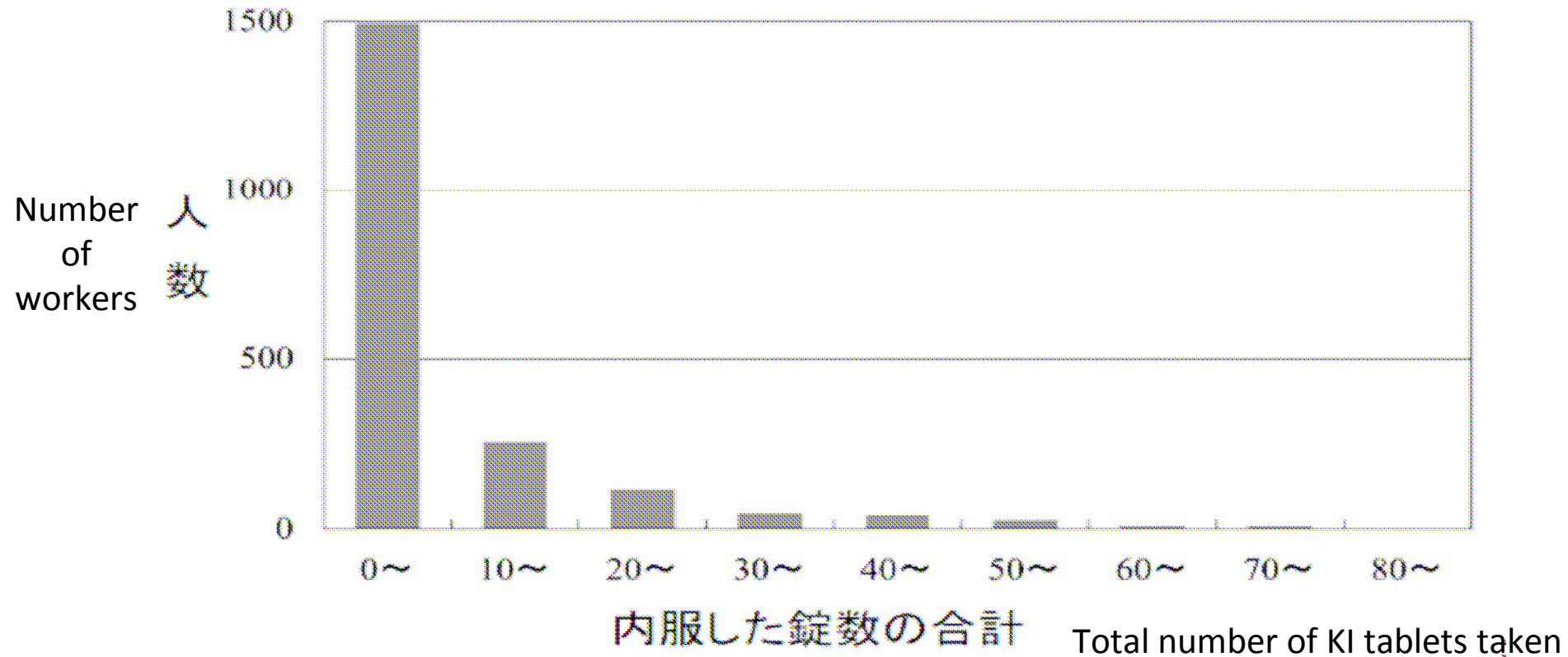
Iodine tablets were administered about 13,000 times for a total of 17,500 tablets.



Graph by Dr. Hiroshi Kikuchi (TEPCO)

The Number of Workers Taking Iodine Tablets

Total number administered per person: <10 tablets in about 75%
Maximum: 87 tablets per person



Graph by Dr. Hiroshi Kikuchi (TEPCO)

Side Effects, etc.

- No report of side effects due to orally administered stable iodine tablets, including shock from iodine sensitivity.
- Side effects of iodine tablets excluded from reported illnesses of workers at FDNPP
- Health checkup for workers who took stable iodine tablets
 - ① Those who took stable iodine tablets longer than 14 days
 - ② Those who took a total of 20 tablets or more
- Transient hypothyroidism suspected in 3 out of 229 workers (10% of the eligible workers never underwent the health checkup).

Committed Effective Dose to Thyroid and Past Record of Stable Iodine Tablet Intake

Thyroid committed doses were estimated to exceed 100 mSv in 178 workers.

	Stable Iodine Intake		Total
	Yes	No	
Age < 40	76	25	101
Age ≥ 40	25	52	77
Total	101	77	178

Cumulative dose distribution for March-December 2011 (Compiled from TEPCO handouts by Oshidori Mako)

	TEPCO employees	Contractors	Total
≤ 1 mSv	687	4237	4924
> 1 and ≤ 5 mSv	557	4298	4955
> 5 and ≤ 10 mSv	354	2430	2784
> 10 and ≤ 20 mSv	487	2717	3204
> 20 and ≤ 50 mSv	647	2172	2819
> 50 and ≤ 75 mSv	240	238	478
> 75 and ≤ 100 mSv	161	62	223
> 100 and ≤ 150 mSv	116	20	136
> 150 and ≤ 200 mSv	26	2	28
> 200 and ≤ 250 mSv	1	2 (Maximum 238.42 mSv)	3
> 250 mSv	6 (Maximum 678.80 mSv)	0	6
Total	3282	16278	19560

Details of 6 Workers Exceeding 250 mSv

6 TEPCO employees: main control room operators and electric/instrumentation maintenance workers. (2 in 20s, 1 in 30s, 2 in 40s and 1 in 50s)
Engaged in operating/monitoring and repair of monitoring devices in the main control room, etc. for several days beginning March 11.
Internal bodily contamination by radionuclides occurred due to the entry of contaminated air into the main control room through emergency doors damaged by the hydrogen explosion of the reactor building. (Diesel generator electric cables had been put through the emergency doors in the evening of March 11 in order to supply power to the main control room). In addition, a rapid development of the events complicated accurate protective measures such as appropriate selection, fitting and placement of masks: a gap between a mask and eye glasses or drinking water and eating food with the mask off where the mask was mandatory.

Operator (30s)	678.80 mSv	(internal: 590 mSv) (Took 2 KI [potassium iodide] tablets but no record of dates)
Operator (40s)	645.54 mSv	(internal: 540 mSv) (Took 10 KI tablets total on March 14, May 2, 3, 12, 20, and 21)
Operator	353.12 mSv	(internal: 241.81 mSv)
Maintenance crew	310.97 mSv	(internal: 259.66 mSv)
Maintenance crew	477.01 mSv	(internal: 433.05 mSv)
Maintenance crew	360.85 mSv	(internal: 327.90 mSv)

(Table compiled by Mako Oshidori from TEPCO handouts)

Cumulative dose distribution for March-December 2011 (Compiled from TEPCO handouts by Mako Oshidori)

	TEPCO employees	Contractors	Total
1 mSv以下	687	4237	4924
> 1 and ≤ 5 mSv	557	4298	4955
> 5 and ≤ 10 mSv	354	2430	2784
> 10 and ≤ 20 mSv	487	2717	3204
> 20 and ≤ 50 mSv	647	2172	2819
> 50 and ≤ 75 mSv	240	238	478
> 75 and ≤ 100 mSv	161	62	223
> 100 and ≤ 150 mSv	116	20	136
> 150 and ≤ 200 mSv	26	2	28
> 200 and ≤ 250 mSv	1	2 (Maximum 238.42 mSv)	3
> 250 mSv	6 (Maximum 678.80 mSv)	0	6
合計人数	3282	16278	19560

Cumulative dose distribution for March 2011-December 2015 (Compiled from TEPCO handouts by Mako Oshidori)

	TEPCO employees	Contractors	Total
$\leq 1\text{mSv}$	1259	12565	13824
> 1 and ≤ 5 mSv	879	9551	10430
> 5 and ≤ 10 mSv	495	5360	5855
> 10 and ≤ 20 mSv	620	5665	6285
> 20 and ≤ 50 mSv	633	6350	6983
> 50 and ≤ 75 mSv	329	1717	2046
> 75 and ≤ 100 mSv	314	270	584
> 100 and ≤ 150 mSv	117	20	137
> 150 and ≤ 200 mSv	26	2	28
> 200 and ≤ 250 mSv	1	2 (Maximum: 238.42mSv)	3
> 250 mSv	6 (Maximum: 678.80mSv)	0	6
Total	4679	41502	46181

Exposure dose distribution for the most recent three months

About 7,000 workers per day
Third month data is preliminary.

区分(mSv)	H27.10月			H27.11月			H27.12月		
	東電社員	協力企業	計	東電社員	協力企業	計	東電社員	協力企業	計
100超え	0	0	0	0	0	0	0	0	0
75超え～100以下	0	0	0	0	0	0	0	0	0
50超え～75以下	0	0	0	0	0	0	0	0	0
20超え～50以下	0	0	0	0	0	0	0	0	0
10超え～20以下	0	9	9	0	7	7	0	4	4
5超え～10以下	0	145	145	0	110	110	0	66	66
1超え～5以下	52	1699	1751	48	1447	1495	43	1256	1299
1以下	1130	7864	8994	1119	7924	9043	1014	7989	9003
計	1182	9717	10899	1167	9488	10655	1057	9315	10372
最大(mSv)	3.20	14.42	14.42	4.96	13.88	13.88	2.59	13.27	13.27
平均(mSv)	0.22	0.70	0.64	0.22	0.61	0.57	0.18	0.51	0.47

from TEPCO's handouts

- Average exposure dose for each month tends to be lower, but the number of workers whose exposure doses exceed 5 mSv is about the same and the total exposure dose of all workers tend to be high.
- Preliminary data in the third month are updated at a later time when doses from other dosimeters become available.

区分(mSv)	H27.9月			H27.10月			H27.11月		
	東電社員	協力企業	計	東電社員	協力企業	計	東電社員	協力企業	計
100超え	0	0	0	0	0	0	0	0	0
75超え～100以下	0	0	0	0	0	0	0	0	0
50超え～75以下	0	0	0	0	0	0	0	0	0
20超え～50以下	0	0	0	0	0	0	0	0	0
10超え～20以下	0	16	16	0	9	9	0	7	7
5超え～10以下	1	140	141	0	145	145	0	76	76
1超え～5以下	51	1590	1641	52	1699	1751	44	1399	1443
1以下	1144	8034	9178	1130	7864	8994	998	7852	8850
計	1196	9780	10976	1182	9717	10899	1042	9334	10376
最大(mSv)	5.60	15.30	15.30	3.20	14.42	14.42	4.96	13.88	13.88
平均(mSv)	0.24	0.67	0.63	0.22	0.70	0.64	0.20	0.55	0.52

from TEPCO's handouts

Medical examination for emergency workers (by the government)

- The exposure limit was temporarily raised to 250 mSv for about 20,000 emergency workers.
- Medical examination governed by ordinance for all emergency workers
- (General medical examination, Ionizing Radiation Medical Examination, mental health care)
- For emergency workers exceeding 50 mSv:
 - Eye examination for cataract added to the above
- For emergency workers exceeding 100 mSv:
 - Thyroid examination and cancer screening (stomach, lungs and colon) added to the above
 - 174 workers
- 50 mSv and 100 mSv represent effective doses of radiation received while engaged in emergency work.

Non-occupational exposure doses are not added to the worker doses

- Fukushima Health Management Survey includes Basic Survey which estimates external exposure doses from activity record questionnaire for the four month period between March 11, 2011 and July 11, 2011.
- Highest dose is 66 mSv.
- But Basic Survey does not include occupational exposure doses that might be received if a Fukushima resident is also a FDNPP worker.
- No assessment so far has combined the exposure doses received while working within the FDNPP property with non-occupational doses from daily life.

Epidemiological study by Ministry of Health, Labour and Welfare (MHLW)

- The MHLW epidemiological study was just started last year.
- Targets 20,000 emergency workers. Study period is lifetime of workers (until death).
- Basic aim is to study health effects of cumulative exposure doses.
- Furthermore, subpopulations are to be established within the target population in order to study health effects from “exposure in a short period” or “exposure doses by organ.”
- Prospective research study (a study method that follows the target population for lifetime).
- Results are to be released regardless of whether the analysis revealed statistical significance.

Thyroid examination

- Osaka University researcher (Professor Tomotaka Sobue) is the principal researcher.
- Targets emergency workers whose thyroid equivalent doses exceeded 100 mSv (the exposed group) and a comparable control group (thyroid equivalent dose of 100 mSv or lower).
- The study suggested no clear relationship between nodules and thyroid equivalent doses. In regards to cysts, the study suggested a relatively higher rate of large cysts in the higher dose group.
- Proportion of those who were recommended or required to have secondary examination was not different between the exposed and the control groups. It was also unrelated to the thyroid equivalent dose.

Cataract study (Kanazawa Medical University)

- Studied a relationship between the cumulative dose in 3 to 5 years after exposure and lens opacity in emergency workers.
- Study conducted in Fiscal Years 2013 and 2014. (Results released in June 2015)
- At 4 years after exposure, there were very few cases of radiation cataract affecting visual function, but findings of early cataract rapidly increased in the fifth year. A potential future increase in cases of cataract affecting visual function cannot be ruled out.

Problem: Was dosimetry during the immediate post-accident period accurate?

- Insufficient availability of dosimeters immediately after the accident. Sometimes only representative members of the team wore dosimeter rather than obtaining individual doses.
- In some cases doses were intentionally lowered by placing lead shield on dosimeters.

Problem: What about radiation exposure in non-emergency workers?

- A case with the exposure dose of 80 mSv that was urgently taken to a hospital for dissecting aortic aneurysm.
- How about cardiovascular diseases?
- How about workers that have been exposed to almost 100 mSv since 2012?
- Workers who have been working at FDNPP since 2012 or who alternate decontamination work with NPP work are not considered “emergency workers.” They are not included in any study of health effects or eligible for special medical examination including cancer screening.

Problem: Post-accident exposure status

- After the accident, workers new to FDNPP increased.
- This leads to exposure from insufficient education of workers (such as inserting hands inside mask while in the reactor building).
- Lack of sense of danger due to knowing only high post-accident doses.

Problem: Harsh work environment not limited to radiation exposure

個人情報詳細表示 - 原子力入籍者管理システム - Microsoft Internet Explorer

個人情報詳細表示 - いま福島第一原子力発電所の仕事をしています | やり直し | 戻る | メニュー |

利用者: 染森 信也 サイト: 本店福島第一安定化センターJヴィレッジ運営部医療支援グループ

個人番号	GN管理番号	中央登録番号	顔写真	
氏名(漢字)	染森 信也			
氏名(カナ)	ソメモリ シンヤ			
生年月日		性別		男
日本人・外国人区分	日本人	国籍		JPN: 日本
現住所(住民票)				
現住所(居住地)				
企業系列	東京電力株式会社			
企業/組	本店福島第一安定化センターJヴィレッジ運営部医療支援グループ			
主管/作業主管グループ	本店福島第一安定化センターJヴィレッジ運営部医療支援グループ			
社員番号				
登録区分	構内	指定施設	福島第一原子力発電所	
入所区分	防護区域を除く発電所構内	従事者区分	従事者(規制法)	
カード区分	作業者証	許可証有効期限日	2018/03/31	
電健健康	実施済・良: 2012/02/21			
防護教育	a教育	実施	2012/02/10 (平成24年2月10日)	
		免除・省略区分	-	

本人確認書類
- 未登録 -

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スタート | TEPCOイントラページ | 個人情報詳細表示 | Microsoft Excel - 原子...

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Current status of radioactive waste

litate Village, Fukushima Prefecture. September 2015.



Recycling radioactive waste

- Policy to increase recycling in order to reduce the final disposal amount.
- Plan to use in the underground of residential areas, roads and playgrounds (additional annual exposure of $10 \mu\text{ Sv}$ considered permissible for children).
- Recycling promoted in public work projects by municipalities nationwide.
- A model project is currently underway as a base to spread recycling.
- Pre-accident, the standard for safe recycling was up to 100 Bq/kg according to the domestic law (Nuclear Reactor Regulation Law).
- Post-accident, radioactive waste below 8000 Bq/kg is disposed as regular waste according to the special measures law. It is actually recycled in some cases.
- Currently, soil up to 10000 Bq/kg is being considered for recycling.

- Various standards become loose after the nuclear power plant accident.
- Radioactive waste, including contaminated water and soil, is diluted and dispersed in the environment.

Even in normally operating NPPs, protection of contract workers is inadequate and lax.

Isn't nuclear power the type of energy that exploits human life?