The situation of individual dose management of the workers who engaged in emergency work in Fukushima-daiichi nuclear power station accident

Tokyo Electric Power Company,Inc.

September ,2012

Contents

1. Summary of emergency works

2. The dose of workers who engaged in emergency works
   ①Change every month
   ②Accumulated effective dose
   ③Specific workers under high radiation dose ・interim measures

3. The situation of workers of unknown contact information

4. Excess of dose limit of emergency works

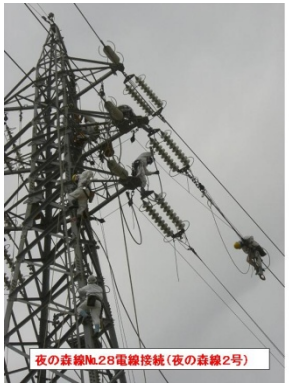
5. Excess of dose limit of women workers

6. The situation of improvement of dose management
   ①External exposure(The situation of APD deployment)
   ②Internal exposrure (The situation of WBC deployment)

7. (Reference)
   Dose exposure reduction measures for emergency works

1. Summary of emergency works

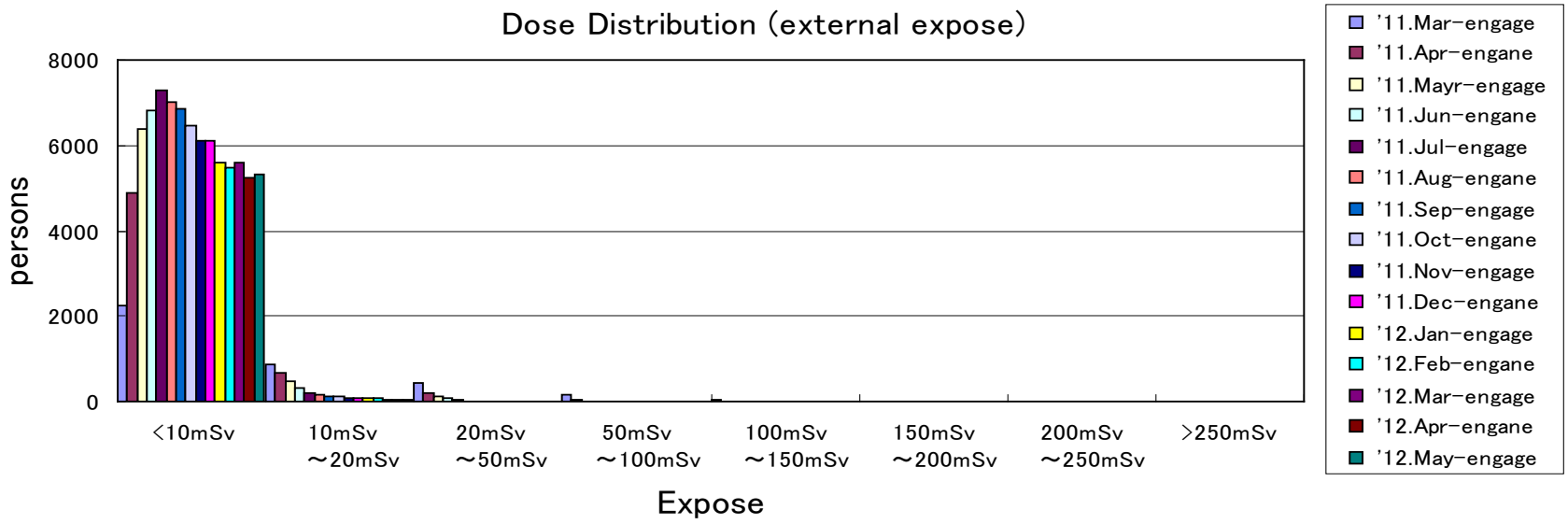
- By the earthquake and Tsunami ,we had to restore with power supply to cool fuel in the reactor pressure vessel and the spent fuel pit.
- We got cooperation of the Self-Defense Forces and the fire department.
- The concrete pieces of the reactor building roof scattered under the influence of hydrogen explosion ,and fire engines were not able to approach the reactor building.
- The Self-Defense Forces removed them using the heavy industrial machine.
- To gain the phenomenon ,continuation of the plant operation and the restoration of the instrument.
- We had a lot of works ,fuel coolant ,water treatment ,radiological release reduction and improvement of the work environment.
- We got cooperation with experience rich cooperation company and each electric company.
- Now the stable situation continues.
- At first unable to use the radiation management system and dose management was carried out by a lot of workers.



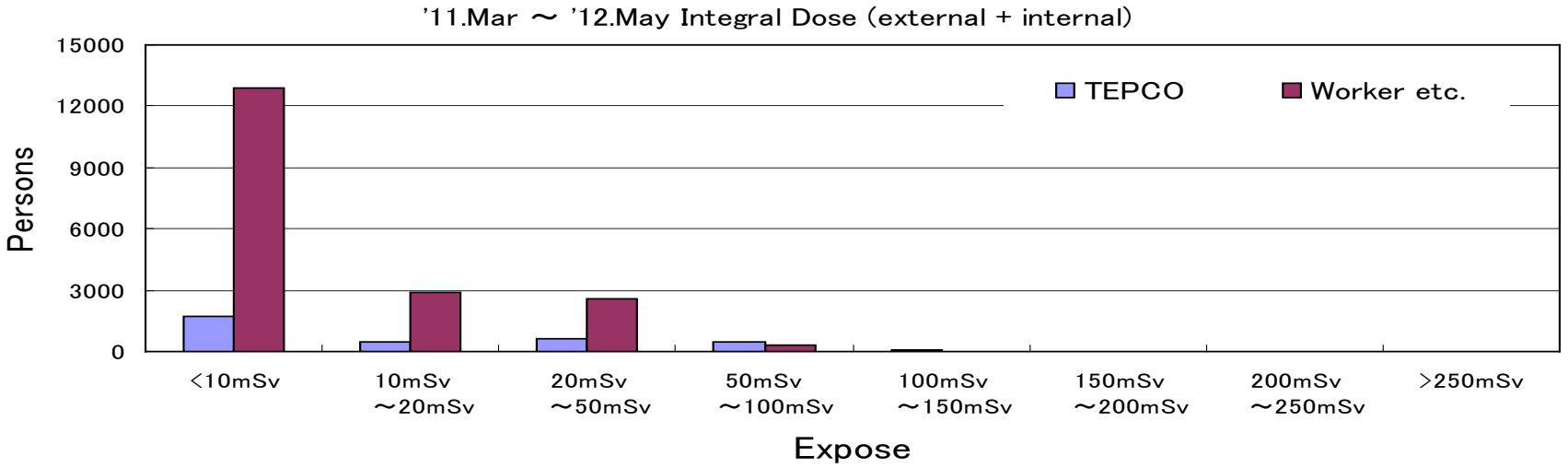
2. The dose of workers who engaged in emergency works
①Change every month

- About 22,000 workers engaged in recovery work in Fukushima daiichi nuclear power station(1F) until the end of May ,2012.(External dose decreases.)
- By effects such as work environment improvement ,there were no external exposure workers more than 50mSv from June ,2011.
- About 66% workers are under 10mSv until May ,2012(external and internal explosure)
- Workers more than 100mSv are 167 people

  (TEPCO:146 workes　Cooperation company:21 workes)



2. The dose of workers who engaged in emergency works
②Accumulated effective dose



Distribution (mSv)	'11.Mar ～ '12.Apr			'11.Mar ～ '12.May			Fluctuation		
	TEPCO	Worker etc.	Total	TEPCO	Worker etc.	Total	TEPCO	Worker etc.	Total
>250	6	0	6	6	0	6	0	0	0
200 ～ 250	1	2	3	1	2	3	0	0	0
150 ～ 200	22	2	24	22	2	24	0	0	0
100 ～ 150	117	17	134	117	17	134	0	0	0
50 ～ 100	452	326	778	460	348	808	8	22	30
20 ～ 50	612	2,473	3,085	613	2,583	3,196	1	110	111
10 ～ 20	494	2,900	3,394	490	2,925	3,415	-4	25	21
<10	1,715	12,483	14,198	1,737	12,901	14,638	22	418	440
Total	3,419	18,203	21,622	3,446	18,778	22,224	27	575	602
Maximum (mSv)	678.80	238.42	678.80	678.80	238.42	678.80	-	-	-
Mean (mSv)	24.83	9.45	11.88	24.79	9.46	11.84	-	-	-

2. The dose of workers who engaged in emergency works

③Specific workers under high radiation dose ・interim measures

○Step 2 was finished on December 16 ,2011.

→The dose limit of emergency work reduced to 100mSv.

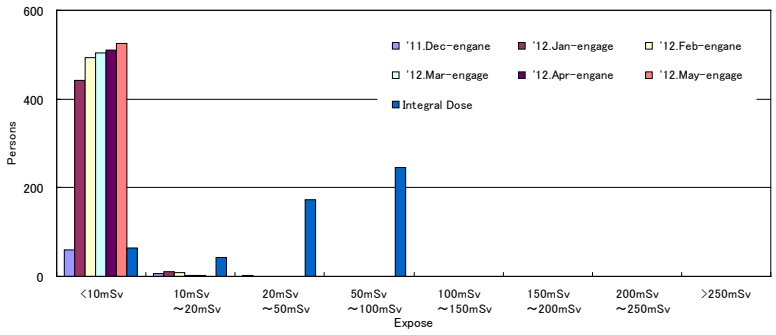
(The workers who engaged in the work to maintain the function that cooling reactor facility or spent fuel tank at the area where the radiation dose exceed 0.1 mSv /h and prevent release of huge amount radioactive material due to trouble or break of reactor facility.)

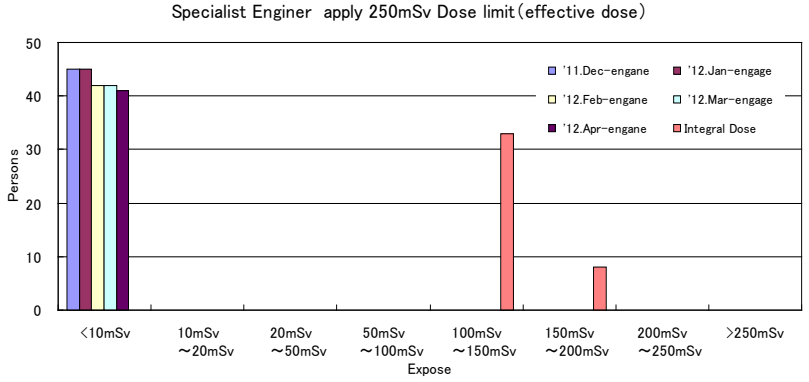
○It is necessary for the target workers to enroll in the labor standards supervision station beforehand.

○The workers with a specialized skill among workers exceeding 100mSv had to get the permission of the Minister of Health, Labour and Welfare beforehand.

→Dse limit 250mSv was applied as interim measures workers for technical tradition until 30 April ,2012.

(All interim measures workers are TEPCO. The number of workers is 45 workers. Finally 41 workers)





3. The situation of workers of unknown contact information

○We checked 3,745 workers who engaged in emergency works since March ,2011.

→There were 514 workers of unknown contact information among them.

→Most of them were the entry error to the list or false input.

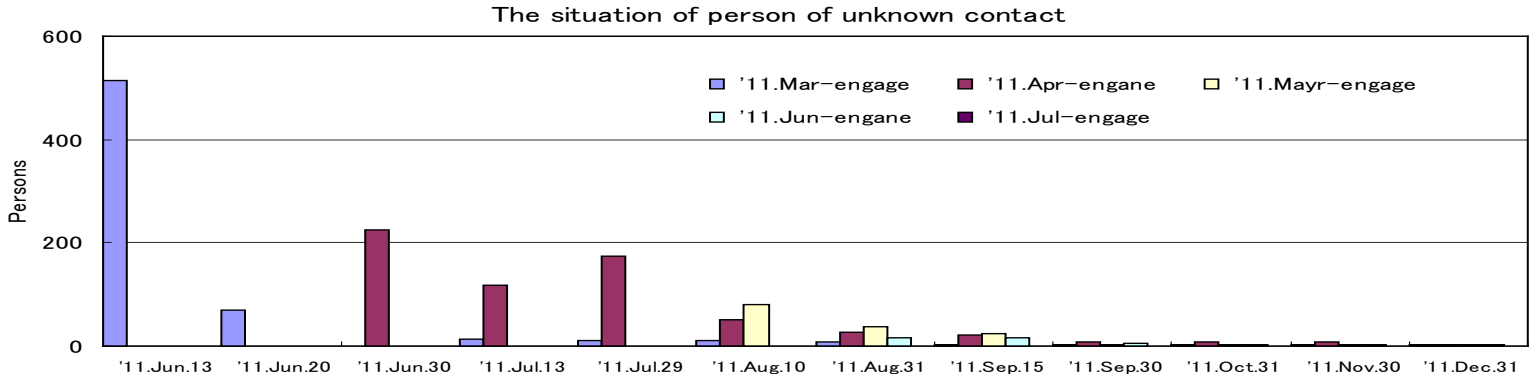
→As a result of the data inspection , workers of unknown contact information reduced from 514 to 16 people 30 November ,2011.

○We couldn't confirm existence of 10 workers. And 6 workers retired and didn't communicate but after that we could contact 3 workers.

→We made public the name of 13 workers 16 December ,2011 and we could contact 3 workers.

→Now there are 10 workers of unknown contact information.

○Workers of unknown contact information don't occur since July ,2011.



3. The situation of workers of unknown contact information (A cause and measures)

【Cause】

○When we lent worker APD ,we managed handwritten account book.

→ Most of them were the entry error to the list or false input.

【Measures】

○Now pubrication of a card by each worker and intoroduce individual discrimination system(bar codes) .

→Workers of unknown contact information don't occur since July ,2011.

(Changed a card with photgraph since 6 Feburary ,2012)

【Action】

○Offer cooporation company workers of unknown information contact list.

○Setting of the communication window.

○Hearing investigation to the worker who carried out same activity.

○The use of the homepage.

4. Excess of dose limit of emergency works

○We comfirmed that 6 workers exceeded 250mSv of dose limit of emergency works.

○They had a physical checkup in National Institute of Radiological Sciences.

→We comfirmed that their health including acute obstacle didn't have influence.

○To check their health condition , they undergo a medical examination regularly

Object	Section	Internal expose	external expose	Effective Dose
A	Operator(unit 3,4)	590mSv	88.08mSv	678.08mSv
B	Operator(unit 3,4)	540mSv	105.56mSv	645.56mSv
C	Operator(unit 3,4)	241.81mSv	110.27mSv	352.08mSv
D	Maintenance(unit 1,2)	259.7mSv	49.23mSv	308.93mSv
E	Maintenance(unit 1,2)	433.1mSv	42.4mSv	475.5mSv
F	Maintenance(unit 1,2)	327.9mSv	31.39mSv	359.29mSv

4. Excess of dose limit of emergency works

【Cause】

○They were more likely to take in radioactive material in the main control room.
→The heating ventilating system of main control room didn't function by power supply loss.

○Operator and the member of maintenance division were busy with restoration of facilities.
→They made as hard as possible efforts about the radiation protection.

○As a result ,we estimated that they took in radioactive material by following factors inside.
→①It was great difficult that they put on radioprotection equipment precisely because of the situation progressed rapidly.
②By long time work ,they had to eat and drink in the main control room.
③There was a gap in the temple of glasses at the time of mask wearing.
④They worked near emergency door of main control room.It was the situation that they couldn't support immediately including the hydrogen hydrogen explosion of No.1 unit reactor building roof.
⑤Short time ,they made a gap into their mask and their face at the time of work.

4. Excess of dose limit of emergency work（Measures）

【 Measures① 】
- Information communization
- Deployment and use of radioprotection equipment

【 Measures② 】
- Prohibition of eating and drinking at limit area of meal

【 Measures③⑤ 】
- Education of radiation protection equipment
- Wearing of a steady mask
- Adoption of a new mask

【 Measures④ 】
- Survey before work
- Wearing of a steady mask

5. Excess of dose limit of female workers

○We comfirmed that 2 female workers(A/B) exceeded dose limit(5mSv/3 months).
(Management dose limit of female worker at TEPCO:4mSv/3months)

○2 non-radiation females workers(C/D) who waited in anti-earthquake building exceeded dose limit 1mSv/year.

○We comfirmed that their health including acute obstacle didn't have influence.

Object	Section	Internal expose	external expose	Effective Dose	note
A	Security Group	13.6mSv	3.95mSv	17.55mSv	
B	Medical Group	6.71mSv	0.78mSv	7.49mSv	
C	General Group	2.81mSv	0.61mSv	3.42mSv	Non-radiation worker
D	Welfare Group	2.59mSv	0.78mSv	3.37mSv	Non-radiation worker

5. Excess of dose limit of women workers (A cause and measures)

【Cause】

○As a result of investigation ,it was very probable that they took in radioactive material at anti-earthquake building.

○Setting of the buffering area which didn't bring in radioactive material was delay.

○The entrance door of anti-earthquake building was not airtight structure and doors were warped under the influence of a hydrogen explosion(Unit 1 and 3)

→It was difficult to completely prevent an Inflow radioactive material.

【Measures】

○Use not to let female workers work at 1F since 23 March ,2011.

○Change to the tile which is hard to attach and deproyment of the local exhauster.

→Reduction of radioactive matter concentration in air in the anti-earthquake building.

6. The situation of improvement of dose management
①External exposure(The situation of APD deployment)

○Unable to use about 5,000 APDs and their chargers for the tsunami.

○Gathered 320 available APDs.

→All workers couldn't have APD.

→A representative of the work carried a APD.(necessary condition:same work ,same work place .etc)

○Newly purchase of 100 APDs 1 April ,2011 and brought 640 APDs from Kashiwazaki Kariwa Nuclear Power Station(1,060 APDs in total)

→It went back up for the use that all workers could have APD(Now about 6,300APDs in total).

○Started operating the individual discrimination system(bar codes) at 1F 1 April ,2011 and J-Village 8 June ,2011.

→Sure of radiation management

○Started to notify individual dose by receipts 6 August ,2011.

APD lending place
at anti-earthquake building

Printed form of
APDs measured value

6. The situation of improvement of dose management
Internal exposrure (The situation of WBC deployment)

○4 Whole body counter(WBC) at 1F.
→All WBCs were unavailable because of loss of power ,radioactive contamination of WBCs and high back ground.

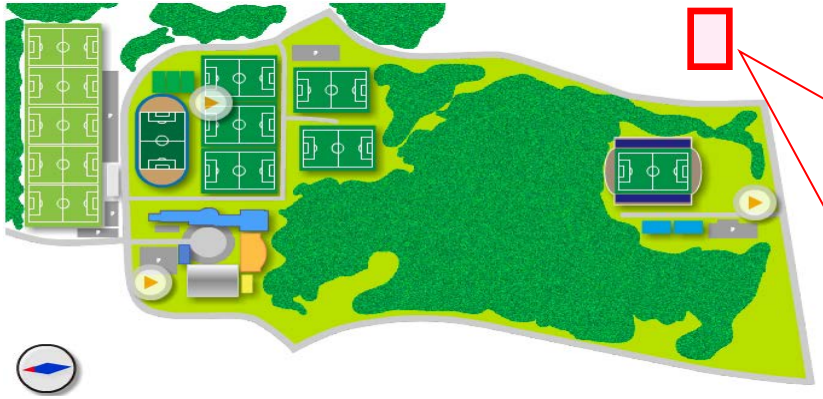
○Installation of movable WBC , borrowed from Japan Atomic Energy Agency(JAEA) ,at Onahama coal center since 22 March ,2011.

○4 WBCs at Fukushima daiini Nuclear Power Station(2F).
→All WBCs were unavailable because of radioactive contamination and high back ground.
→2 WBCs were able to use by extension of the measurement time since 11 April ,2011.

○4 WBCs at Kashiwazaki Kriwa Nuclear Power Station(KK)
→KK stay away from 1F ,so there was little use.

○The foundation of WBC center in Hirono football stadium (11 units are available now.)
→The movement of 3 WBCs from 1F and 1 WBC from 2F.
→Newly purchase of 7units

Whole Body Counter(WBC) Center



■The exterior of WBC center

■The inside of WBC center

■*WBC of installation type*

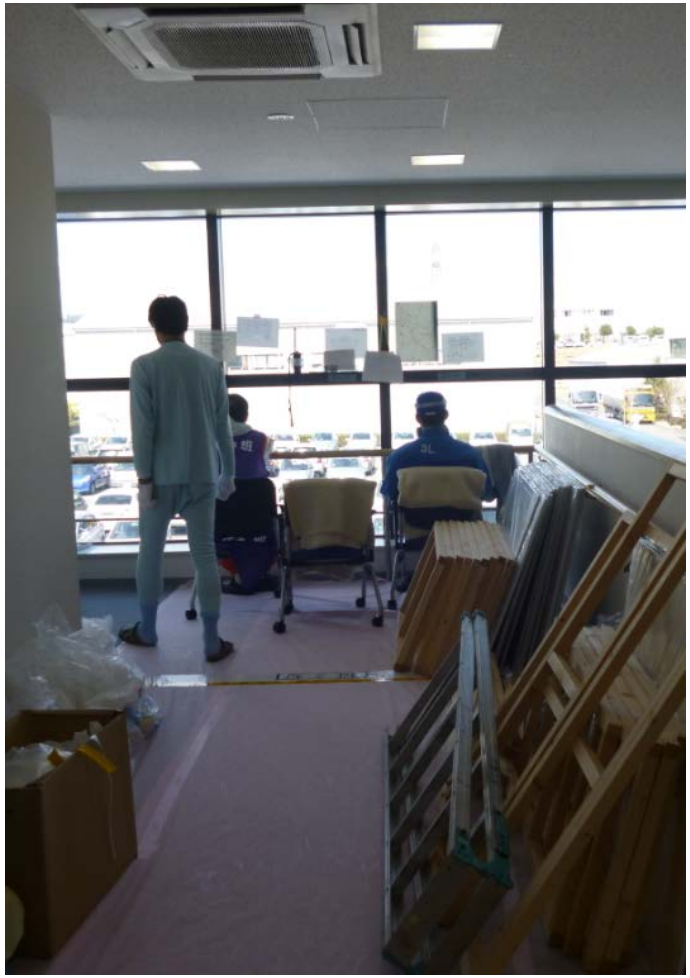
【source】
Fuji Electric Co.,Ltd. HP

■Movable WBC

【source】
Japan Atomic Emergency Agency HP

【source】
Canberra Japan KK HP

7. (Reference)Dose exposure reduction measures for emergency work (1)



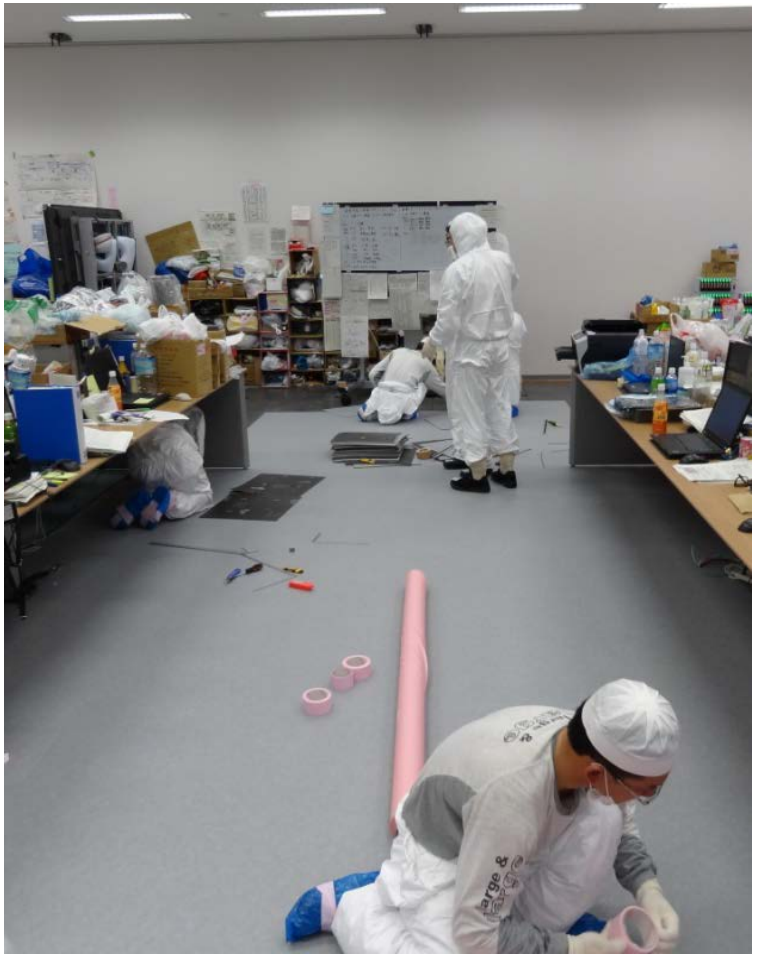
Before construction

After construction

The dose exposure reduction measures of seismic isolated building (Setting of the lead boad to the window)

7 . (Reference)Dose exposure reduction measures for emergency work (2)

Under construction



After construction

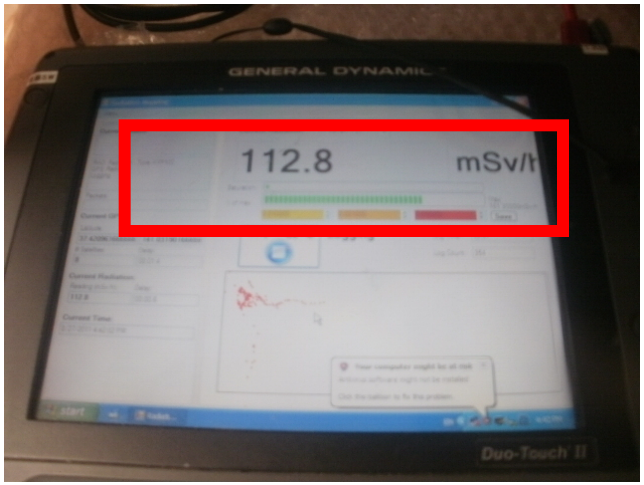
The dose exposure reduction measures of seismic isolated building (Setting P-tile on the floor)

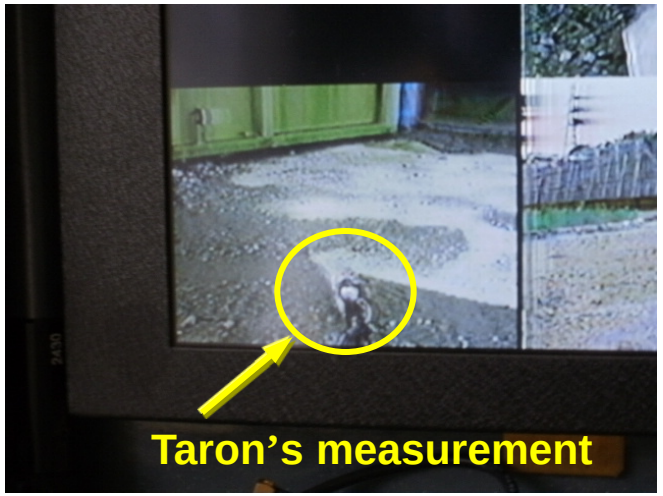
7．(Reference)Dose exposure reduction measures for emergency work (3)

Setting of the local exhauster

7．(Reference)Dose exposure reduction measures for emergency work (4)

Robot for measurement of dose rate(Taron)





Make sure of picture and measurement result by parked operation vehicle in low dose area.

7．(Reference)Dose exposure reduction measures for emergency work (5)

The tungsten best

7．(Reference)Dose exposure reduction measures for emergency work (6)